A NATURAL HERITAGE INVENTORY OF THE ROANOKE RIVER FLOODPLAIN, NORTH CAROLINA

Harry E. LeGrand, Jr. and Stephen P. Hall

North Carolina Natural Heritage Program
Office of Land and Water Stewardship
Department of Environment and Natural Resources
Raleigh, N.C.

Funding provided by the North Carolina Natural Heritage Trust Fund
and the Albemarle-Pamlico National Estuary Partnership

February, 2014

Cover photo: Aerial photo of the Roanoke River floodplain forest taken by Merrill Lynch

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ABSTRACT

The floodplain of the Lower Roanoke River – from the Fall Line at Roanoke Rapids to the Albemarle Sound – contains some of the finest examples of brownwater forest ecosystems in the state. A large number of high quality natural communities exist within this area, including mature stands of Brownwater Levee Forests, Bottomland Hardwoods, and Cypress-Gum Swamps in the floodplain itself and Basic Mesic Forests on the adjoining slopes and bluffs. For each of these habitats, landscape integrity is also very high, with each community type occupying well-connected units covering large expanses of the floodplain. Due to the combined ecological integrity of the floodplain, rare species, such as the Cerulean Warbler, are found there that are now rare-to-absent over most of the rest of the Coastal Plain. For the same reasons, many species typical of floodplains more generally reach their greatest abundance along the Lower Roanoke River.

This inventory, funded by the North Carolina Natural Heritage Trust Fund and by the Albemarle-Pamlico National Estuary Partnership, focused particularly on the rich alluvial habitats located in the upper part of the floodplain. In addition to updating previous North Carolina Natural Heritage Program inventories conducted in this area, this survey also covered species that have been poorly represented in past inventories, especially animals (mainly insects) associated with brownwater habitats. A landscape-focused component was also included. This component complements our traditional approach centered on individual sites and Natural Heritage Elements, focusing more on the interconnections between sites and how well species are able to move freely about large areas in the entire floodplain of the Lower Roanoke.

Part I identifies and briefly describes 31 of the most significant natural areas in the floodplain with emphasis placed on sites that are not included within the boundaries of existing natural areas. This section also documents all natural communities and rare species of plants and animals – Natural Heritage Elements – associated with the floodplain. The individual sites are rated based on these Elements, both in terms of their contribution to protecting individual Elements within the state, and in terms of the combined conservation value represented by all Elements found within a given site.

Part II describes the results of the landscape assessment. Again, specific areas are described and evaluated in terms of their conservation significance, but in this section relative to their landscape integrity, i.e., how well they are functioning to support species' movements. As in Part I, the presence of individual species recorded during the inventory is used in this evaluation. A total of 12 landscape units were evaluated, representing 11 different habitat types.

Both parts of this inventory are intended to provide guidance for land use decisions by county governments, conservation and land management organizations, and private landowners. Conservation measures that include both individual sites as well as natural connections between sites would enhance the protection of the rich biodiversity of the Lower Roanoke River Floodplain.

ACKNOWLEDGMENTS

A number of individuals and agencies contributed to the planning, progress, and completion of this inventory. Jame Amoroso of the N.C. Natural Heritage Program contacted landowners for permission to survey their lands, prior to the visitation of the private tracts for the inventory. The Program's John Finnegan assisted with production of maps for this report. Janine Nicholson, Linda Rudd, Jame Amoroso, and Misty Buchanan reviewed the draft report and maps and assisted in the production of the final copy. Buchanan also assisted with some field work, as did Laura Gadd Robinson and Judy Ratcliffe, also with the Program. James Hawhee, of the Albemarle-Pamlico National Estuary Partnership, assisted on one field visit and provided the Program with a number of photographs.

Several staff members of the N.C. Wildlife Resources Commission were helpful in the project. Andrew Mynatt, a wildlife forester based at the Tillery Depot, assisted with many of the field visits, including providing and piloting a boat on several water-based site visits. Dale Davis at the Williamston office provided critical access to several of the Wildlife tracts in the lower part of the floodplain.

Chuck Peoples, the director of The Nature Conservancy's Roanoke River office, was helpful in many ways. He provided shapefiles of that organization's landholdings, plus their target areas for protection. He assisted with access to several sites, and he piloted a boat along the river that assisted identification of important tracts along the upper quarter of the floodplain. Jean Richter, Superintendent of the Roanoke River National Wildlife Refuge, assisted LeGrand with access information about several of the tracts on the refuge.

Dr. J. Bolling Sullivan, a consulting entomologist, joined us on several of the moth sampling trips and contributed greatly to the list of species we recorded, adding several species that had not been previously recorded in the Coastal Plain of North Carolina. J. Merrill Lynch, Parker Backstrom, and Jeff Lepore also assisted on one of the moth sampling trips. Lynch provided lodging for that visit and Lepore provided his mercury vapor set-ups for that evening's field work. For snail identifications, we wish to thank Amy Van Devender, particularly for her help in identifying a rare species of *Succinea* we found in Bertie County.

The inventory could not have been conducted without the assistance of the many landowners who allowed access to visit their lands in the floodplain. The region's natural heritage would not have been adequately or accurately portrayed in this document without inclusion of numerous private lands that were allowed visitation.

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PART I. INVENTORY OF SIGNIFICANT NATURAL HERITAGE AREAS

Harry E. LeGrand, Jr.

Photo: Sessile-flowered trillium (*Trillium sessile*), taken by James Hawhee at the Camassia Slopes Preserve, Northampton County

INTRODUCTION

The primary objective of a natural area inventory is to identify the most significant natural habitats and locations of rare plants and animals in a particular region. A Significant Natural Heritage Area (SNHA) is an area of land or water identified as having special importance for the preservation of the natural biodiversity of North Carolina. Biodiversity is generally recognized in the scientific community to refer to the diversity, not only of species, but also of natural communities and ecosystems, as well as genetically distinct populations below the species level. Each SNHA contains one or more occurrences of a rare plant or animal, or a rare or high quality natural community. An inventory may lead to conservation of these important resources through recommendations for management and protection of the sites and the rare species locations.

Most inventories of natural areas conducted by the North Carolina Natural Heritage Program (NCNHP) have focused on a single county. Almost all counties in North Carolina, especially in the Piedmont and Coastal Plain, have had inventories conducted at the county level. This is the first full-scale biological inventory of the Roanoke River floodplain since J. Merrill Lynch conducted considerable field work in the 1970s and early 1980s, publishing the Roanoke River Preserve Design Project in 1981. Since then, several phases of the Albemarle-Pamlico Estuarine Study in the late 1980s and early 1990s surveyed natural areas in each of the counties where the floodplain is located. However, these publications (Frost et al. 1990; Smith et al. 1993) reported about each county in a separate chapter, so that the sites in the Roanoke River floodplain were scattered with no summary or ecological synthesis for the floodplain.

The Natural Heritage Program's objectives are to identify and document the location and condition of North Carolina's best examples of natural ecosystems and to facilitate their protection. This Program is responsible for an ongoing statewide biological inventory of natural areas and rare plants and animals. Because of the need to conduct up-to-date and thorough natural area inventories in all counties of the state, the North Carolina Natural Heritage Program (a state agency within the Department of Environment and Natural Resources) periodically seeks and obtains funding from the N.C. Natural Heritage Trust Fund for such inventory work. Essentially all of the counties in the eastern half of the state have completed county inventories, many of which were completed 15-20 years ago. Inventory work is beginning to focus on regional inventories, such as floodplains, river basins, or natural communities. The Roanoke River and its floodplain are a key component of the Albemarle-Pamlico National Estuary Partnership (APNEP) focus area, and some additional funding for this project came from APNEP.

This report provides a framework from which conservation of the biological diversity of the Roanoke River floodplain can be effected. Conservation initiatives – involving the cooperation of the many landowners in the region, the various local and county governments, local and state land trusts, and state and Federal agencies – need to be grounded in the best and most current scientific data available. This report not only provides information on areas not previously inventoried, particularly in the rich levee and bottomland forests in the upper section of the floodplain, but also provides an update to previously visited or protected areas. Given the dynamic nature of river floodplains, as well as new challenges faced by its native species, both types of data are needed to make informed conservation decisions.

METHODS

Inventory Preparation and Landowner Contact

The methods employed in this inventory follow the guidelines established by the North Carolina Natural Heritage Program (NCNHP), in the Office of Land and Water Stewardship within the Department of Environment and Natural Resources. The NCNHP maintains the state's primary database for rare plants and animals, high-quality natural communities, and outstanding natural areas. The focus of this inventory was the identification and description of outstanding natural areas, based on the identification of high-quality natural communities, and to a lesser extent, based on the locations of rare plants and animals. A secondary focus was the identification of important areas for additional protection efforts, including areas needing field work before such protection efforts can begin.

In preparation for the field work, Dr. Harry LeGrand, zoologist at the NCNHP, collected and analyzed existing biological and physical information for the Roanoke River floodplain. This included the maps, files, references/publications, and computerized database maintained at NCNHP, as well as data provided by Chuck Peoples from the N.C. Chapter of The Nature Conservancy. Next, LeGrand identified areas with good potential for biological significance and digitized these potential sites onto an ArcView database at NCNHP. Then, LeGrand held several meetings with the other NCNHP staff and several persons familiar with the natural resources of the counties. Key contacts were Chuck Peoples, the Roanoke River project director of The Nature Conservancy, and Andrew Mynatt, forester with the N.C. Wildlife Resources Commission (hereafter, NCWRC). Additional key contacts were Dale Davis of NCWRC and Jean Richter of the U.S. Fish and Wildlife Service (hereafter, USFWS) at the Roanoke River National Wildlife Refuge.

LeGrand and Jame Amoroso (NCNHP staff) contacted the landowners to ask for permission to survey each of the known or potentially significant natural areas identified as high priority inventory areas. Several tracts were visited with the assistance of other persons making the necessary arrangements.

Field Surveys

During the 2012 field season (generally late March to early October), LeGrand conducted biological surveys. Steve Hall accompanied LeGrand on many of the trips; in addition, Hall conducted additional field work for moth surveys, usually with Bo Sullivan. Other NCNHP staff and conservation partners assisted on several trips.

Nearly all of the above trips were land-based. However, three surveys were conducted from boats on the river with the assistance of Chuck Peoples and Andrew Mynatt.

Because herbaceous plants growing on rich slopes and natural levees are often spring ephemeral species, field work from late March to mid-May was concentrated in the upper portion of the floodplain, south to the Pollocks Ferry Natural Area. Field work after mid-May was spread out

over the remainder of the floodplain. Much of the lower portion of the floodplain exists in large protected areas administered by the U.S. Fish and Wildlife Service (i.e., at the Roanoke River National Wildlife Refuge), the N.C. Wildlife Resources Commission (Roanoke River Wetlands Game Land), and The Nature Conservancy (Devil's Gut and several other tracts). More survey effort was spent in the central third of the floodplain, particularly on unprotected lands.

Due to time and funding constraints, the decision was made to concentrate field work at lands not already in conservation ownership, as well as protected areas poorly surveyed but with the potential for notable discoveries of rare plants and animals. Thus, larger protected areas with an abundance of swampland – difficult to access and likely to harbor few if any rare species – were often not surveyed. Some natural areas were not surveyed because landowners declined to allow access.

The primary information collected in the surveys included the quality, composition, and location of natural community types; population size, threats, and locations of rare plant populations and rare animal populations; and Significant Natural Heritage Area boundaries and integrity. Surveys were done in a walk-through fashion, taking notes on most of the plant species and all of the animal species noted. Surveys of small sites were done in a few hours, whereas several sites were so large (over 500 acres) that the field work required several days. Rare plant and rare animal records were entered into the NCNHP database system; records for Watch List species were entered into Excel files for each species. Significant natural community examples were also entered into the NCNHP database. A detailed Site Survey Report was completed for each site considered significant enough to be included in the final inventory report. Less detailed notes were completed for other site visits, such as for tracts not significant enough for inclusion in a natural area, or for trips made by boating along the river.

Evaluation of Site Significance

The standard Natural Heritage methodology is designed to address both species and natural communities, referred to collectively as "elements" of biodiversity. This standard methodology is used to define the rarity of particular Natural Heritage Elements and to delineate individual occurrences of these elements across the landscape. In assigning priorities for conservation, NCNHP gives special emphasis to natural areas that support populations of rare species, or rare or high quality natural communities. A natural area that has special importance for the preservation of the natural biodiversity of North Carolina is identified as a Significant Natural Heritage Area (SNHA) (also called "SNHA," "site," or "natural area" in this report).

The significance of each SNHA was evaluated using a standard system employed by NCNHP, which takes into account the quality, rarity, and number of occurrences of natural heritage Elements. The evaluation also considers the degree of imperilment for each Element at both the global level (G-Rank) and just within North Carolina (S-Rank).

Each SNHA receives two significance ratings, which measure different values:

1. Element Representational Value rates each SNHA on its importance in protecting the best occurrences of individual elements.

2. Element Collective Value rates each SNHA on the basis of the number and rarity of the elements it contains.

Each site is assigned two values, a Representational Rating (from R1-R5) which reflects the biodiversity of the state, and a Collective Value Rating (from C1-C5) which reflects the overall biodiversity of each SNHA. The two ratings measure different and complementary qualities of each site.

Element Representational Value

NCNHP uses Element Occurrence ranks to determine the SNHAs containing the best extant and natural occurrences of each element. The relative importance rank for each occurrence is assigned using the categories listed in the table below.

Collectively, these SNHAs make up a portfolio representing the best sites for each element tracked by NCNHP. Each of the SNHAs is rated according to the importance of the element occurrences contained within the site.

Table 1. Representational Value Rating Categories for SNHAs Based on Element Occurrences

Representational Value Rating	**Definition**	**Defining EO Importance**	
		G1-G2	**G3-G5**
R1 (Exceptional)	Site contains one of the best two examples of G1 or G2 Elements.	1st or 2nd	--
R2 (Very High)	Site contains the 3rd or 4th best examples in the state of G1-G2 Elements, and/or one of the best two examples of other Elements.	3rd or 4th	1st or 2nd
R3 (High)	Site contains the 5th to 8th best examples in the state of G1-G2 Elements and/or the 3rd to 6th best occurrences of any G3-G5 Element within it.	5th to 8th	3rd to 6th
R4 (Moderate)	Site contains the 9th to12th best examples in the state of G1-G2 Elements within it and/or the 7th to 10th best occurrences of any G3-G5 Element within it;	9th to 12th	7th to 10th
R5 (General)	Site contains one of the 30 best examples in the state of Elements within it, that do not qualify for categories R1-R4.	13th to 30th	11th to 30th

To determine Representational Value Scores, the NCNHP database is queried for occurrences (EOs) for each element. After EOs are sorted and ranked for each element, SNHAs are rated on the basis of the quality of the EOs they contain. The highest element importance in the site determines the SNHA significance rating. For example, a site that contains 3 element occurrences may have one that is the 8th best example of a G4 element (yielding an R4 element importance), one that is the 5th best of a G2 element (yielding an R3 element importance), and one that is the 2nd best example of a G5 element (yielding an R2 element importance). The overall Representational Value rating of the site is R2 (Very High), based on the highest element importance score of any of the elements; this element is often called the "defining element" for the SNHA.

Element Collective Value

The Element Collective Value Rating for each site sums the number of elements at a given site, and the rarity of those elements, weighted by their degree of imperilment at both the global level (G-Rank) and just within North Carolina (S-Rank).

The imperilment scores are assigned to each extant element occurrence on a 10-point scale, based on their combination of G-Ranks and S-Ranks as shown in the table below. The highest scores are given to elements that are considered imperiled at both the global (G1) and state (S1) levels, with successively smaller scores given to elements that are considered more secure (G5S5 being considered secure at both the global and state levels).

Table 2. Collective Value Point Scoring for Each G-Rank and S-Rank Combination.

G-Rank	**S-Rank**	**Element Score**
G1	S1	10
G2	S1	9
G2	S2	8
G3	S1	7
G3	S2	6
G3	S3	5
G4/G5	S1	4
G4/G5	S2	3
G4/G5	S3	2
G4/G5	S4/S5	1

For each site, the scores for occurrences of each element are added to give the final "Collective Value Score" for the site. (For example, if a site has four elements: a G2S2, a G3S1, a G5S1, and a G5S3, it scores: 8 + 7 + 4 + 2 = 21 points.) The total scores are divided into 5 Categories of "site significance": Exceptional (C1 rating), Very High (C2 rating), High (C3 rating), Moderate (C4 rating), and General (C5 rating). From Table 3 (below), a site that scores 21 points, as in the example above, is given a Moderate (C4) Collective Value rating.

Table 3. Collective Value Ratings

Collective Value Rating	Cumulative Element Score	Minimum Number of Elements
C1 (Exceptional)	91 and above	10
C2 (Very High)	61-90	7
C3 (High)	31-60	4
C4 (Moderate)	11-30	2
C5 (General)	2-10	1

DESCRIPTION OF THE STUDY AREA

General Overview

The study area for this inventory includes the floodplain of the Roanoke River located between the Roanoke Rapids Lake dam and Albemarle Sound. This section of the river lies completely within the Coastal Plain of North Carolina and is generally referred to as the Lower Roanoke (e.g., Lynch et al., 1994). The study area does not include tributary streams or creeks that extend beyond the width of the Roanoke's floodplain, nor does it include the Cashie River system, which merges with the Roanoke River at the Albemarle Sound. However, it does include the valley walls adjoining the floodplain in addition to the floodplain itself. Overall, the survey area encompasses about 130 river miles and approximately 150,000 acres (235 square miles) of the river's floodplain (Lynch 1981).

The study area covers much of four counties, and a small portion of a fifth (see Figure 1). The upper half of the study area includes the northern portion of Halifax County and the southern portion of Northampton County. The lower half of the study area contains the northern portion of Martin County and the southern portion of Bertie County. At the lowest end of the study area, the northwestern corner of Washington County is included.

This portion of North Carolina lost population between the 2000 and the 2010 censuses, based on U.S. Census Bureau data. Populations of the counties, and their trends from the 2000 census, are: Halifax 54,691 (-4.7%), Northampton 22,099 (+0.1%), Martin 24,505 (-4.3%), Bertie 21,282 (+7.6%), and Washington 13,228 (-3.6%). Towns and other human settlements are rather sparsely distributed along the margin of the river's floodplain (i.e., on terraces above the floodplain). There are only seven towns located on the river banks; these towns (and their 2010 census data) are Roanoke Rapids (15,754), Weldon (1,655), Halifax (234), Hamilton (408), Williamston (5,511), Jamesville (491), and Plymouth (3,878).

This portion of the Roanoke River contains no reservoirs and dams. Relatively few roads cross the river; at the extreme upper end, at Roanoke Rapids and Weldon, I-95 and US 158/301, along with a railroad trestle, cross high above the river. Several dozen miles down-river, US 258 crosses the Roanoke in Halifax and Northampton counties, but a former railroad trestle about 8 miles farther down the river is being removed. In Martin and Bertie counties, NC 11/42 crosses the river, as does US 13/17 at Williamston. Lastly, near the mouth of the river is a high bridge span for NC 45/308. The only other major human features along the river are two extensive clearings for prison farms -- the Odom Prison Farm in Northampton County and the Tillery Prison Farm across the river in Halifax County – and a paper mill just west of Plymouth.

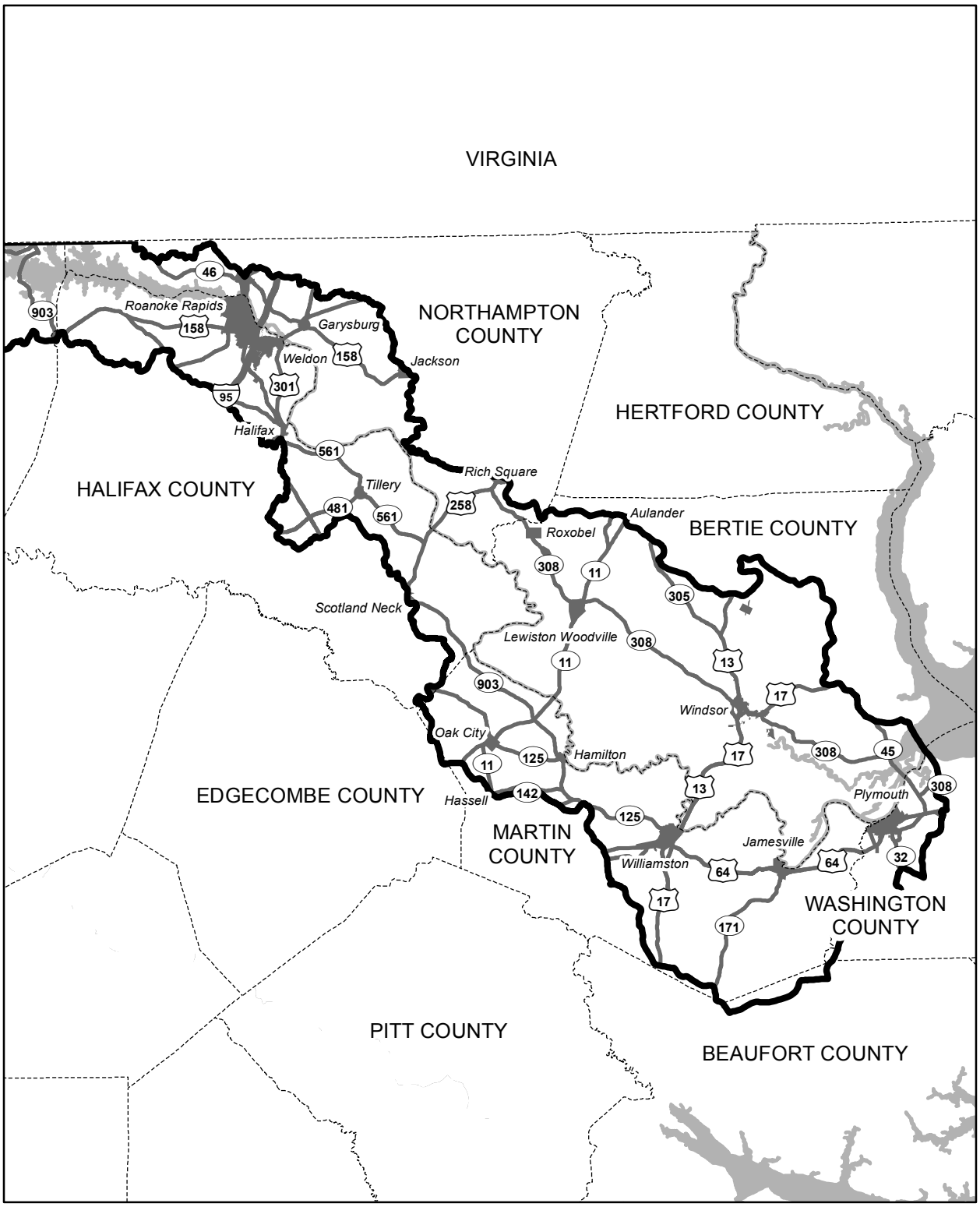

Figure 1. Towns and Major Roads in the Roanoke River Floodplain.

Topography and Physiography

The Roanoke River is actually the name of the lower portion of the Dan River system, which begins in western Virginia and extreme northwestern North Carolina. The Dan/Roanoke flows in an easterly and east-southeasterly direction, and empties into Albemarle Sound in North Carolina. According to the N.C. Division of Water Quality, the Roanoke River carries more water and has the widest floodplain (up to 5 miles wide) of any river in the state. Three large reservoirs – John H. Kerr Reservoir, Lake Gaston, and Roanoke Rapids Lake – interrupt the river system (see Figure 2). That portion of the main stem of the Dan/Roanoke below Roanoke Rapids Lake dam is the Roanoke River. The Fall Line, which separates the Piedmont from the Coastal Plain, lies between Roanoke Rapids (in the Piedmont) and Weldon (in the Coastal Plain); extensive large rocks and boulders create rapids in the river in this region. Below these rapids, the river is essentially devoid of rocks, though some areas of rock can be seen along the river banks south to at least the town of Halifax.

The primary Coastal Plain terrace above the floodplain averages from 90-100 feet above sea level, with the river in the upper portion of this province being about 40 feet above sea level, yielding slopes as great as 60 feet in places. Throughout the length of the river in the Coastal Plain, the meandering of the river over the centuries has resulted in one side of the floodplain being narrow and the other being broad. Where the river abrades the upland terrace, such as at Hills Ferry (near Palmyra) and at Rainbow Banks (near Hamilton), near-vertical bluffs of 60 feet or more are visible. In the upper part of the province, near Weldon, the floodplain averages about 2 miles wide, normally with rather discrete slopes marking the edges of the floodplain. Farther downriver, the floodplain widens, such that at the US 258 bridge crossing, it is at least 3.5 miles wide. By the time the NC 11/42 bridge crossing is reached, the floodplain is now about 5 miles wide, though the boundary on the north side is more difficult to ascertain. This roughly 5-mile width extends to Albemarle Sound.

This lower portion of the Dan/Roanoke system has a very narrow drainage basin for one of the major brownwater rivers along the Atlantic coast. Very few creeks extend outward from the Roanoke and extend much past the floodplain. Though the basin is upwards of 30 miles wide in the lower portions in southern Bertie County, it narrows upriver to as little as 10 miles wide near US 258.

General Vegetation

The Roanoke River floodplain contains all of the major fluvial features typical of river systems. As it is a brownwater system – its origin ranges into the mountains of Virginia – it carries a heavy sediment load, although much is deposited within the three large reservoirs. The reservoirs are relatively recent (mid-20th Century) structures, and the river formations were long since established. Along the river frontage is a well defined and usually high natural levee, several feet above the remainder of the floodplain (at least in the upper quarter of the floodplain). Typical levee trees include sugarberry (*Celtis laevigata*), sycamore (*Platanus occidentalis*), and green ash (*Fraxinus pennsylvanica*), with much silver maple (*Acer saccharinum*) often present.

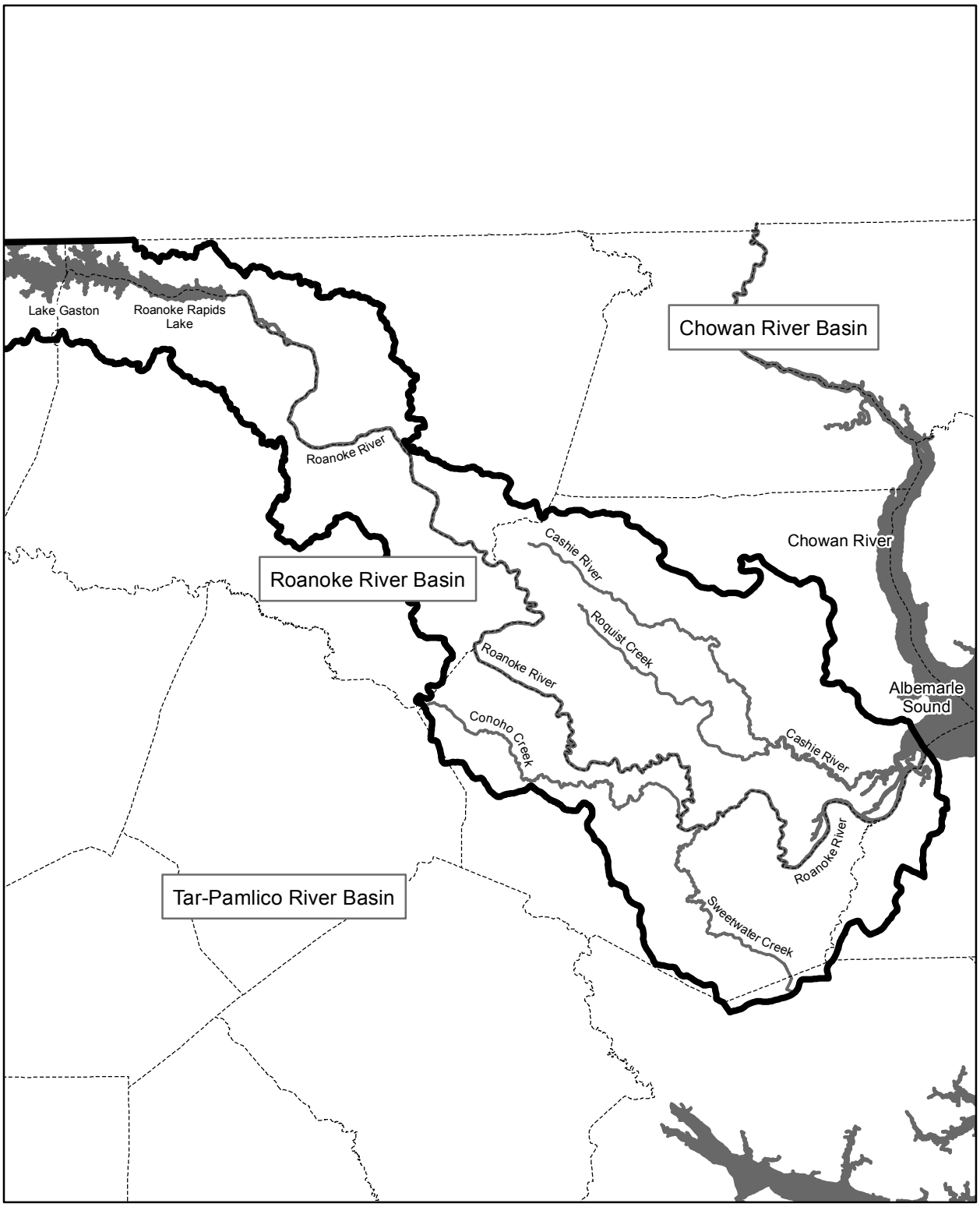

Figure 2. Major Hydrographic Features of the Roanoke River Floodplain.

A rich herb layer is usually present, with several rare species such as dwarf stinging nettle (*Urtica chamaedryoides*) being characteristic. Farther downriver, levees are lower in stature, often just a foot above the land behind them. In some areas, levees can extend 0.5-mile or more back from the river; such levees are the Medium Levee or Low Levee natural community subtypes, as opposed to the High Levee subtype, which is typically narrow and well defined.

Behind the levees are usually backswamps, dominated by water tupelo (*Nyssa aquatica*) and bald-cypress (*Taxodium distichum*); these can be hundreds to several thousand acres in size. Behind the backswamps, at least on the side of the floodplain farther away from the active river channel, are remnant levees that are now alluvial flats or low ridges; some higher ridges occur farthest from the river. These drier sites, though still wetlands, often contain bottomland hardwoods with a variety of oaks. Between these ridges are sloughs and channels, some of which are dry most of the year and some of which are wet and act as distributaries, creating islands within the floodplain. Here and there, beavers have blocked some sloughs, and occasionally the mouths of some backswamps, to create beaver ponds with extensive areas of open water, dead or living trees in the water, and marsh vegetation. Unlike a few other river systems in the Coastal Plain, oxbow lakes are quite rare along the Roanoke River, but a few are present where the river has cut across the neck of the meander and filled the meander with standing water.

The lowest end of the floodplain, east of Plymouth, contains a mix of nonriverine sediments, underlain by peat. Pocosin vegetation occurs with riverine vegetation; Atlantic white cedar (*Chamaecyparis thyoides*) and numerous broadleaf species rare elsewhere in the floodplain are present here, although these are common eastward in pocosin/nonriverine habitats.

Slopes found within and along the margins of the floodplain contain another major set of natural communities and significant vegetation. Lynch (1981) identifies the first of these as "Terrace I Slopes," stating (on page 48) that "These slopes are the eroded margins of an older Pleistocene river terrace. The river terraces are the abandoned portion of the Roanoke River floodplain, formed during the late Pleistocene when the river carried greater volumes of water than it does today." These slopes contain soils rich in iron and magnesium with a high pH. Basic Mesic Forest communities occur on these slopes, with a high diversity of herbaceous species and many rare or disjunct plants. Wild hyacinth (*Camassia scilloides*), Eastern isopyrum (*Enemion biternatum*), and Dutchman's breeches (*Dicentra cucullaria*) are notable plants. Some of these slopes occur as far downriver as Conoho Creek, where magnolia vine (*Schisandra glabra*) grows in high pH soils. The second set of slopes is called "Valley Wall or Upland Slopes," which are slopes literally along the valley wall rather than being located in the rich, former alluvial deposits where the "Terrace I Slopes" vegetation is found. Such valley wall vegetation is similar to that on other bluffs and steep slopes along other brownwater rivers. American beech (*Fagus grandifolia*) and flowering dogwood (*Cornus florida*) are numerous; however, on the steepest bluffs, mountain laurel (*Kalmia latifolia*), wild hydrangea (*Hydrangea arborescens*), and galax (*Galax aphylla*) can be found.

SUMMARY OF RESULTS

Natural Areas

This inventory describes a total of 31 Significant Natural Heritage Areas (see Table 4 and Figure 3) within the floodplain, downstream of the Roanoke Rapids Lake dam. The comprehensive survey of the floodplain by Lynch (1981) contained descriptions of 20 natural areas. Since 1981, the NCNHP identified a number of additional sites within the floodplain, including some well back from the river itself. As a result of this inventory, one new SNHA was identified, Mud Castle Slopes, in 2012. On the other hand, several of the previous sites identified by the Program were merged. The following sites in the current list on Table 4 are "new" sites that represent mergers of two or more previous sites: Larkspur Ridge/Roanoke Big Oak Woods, Looking Glass Run Swamp and Bluffs, Buzzard Point Floodplain Forests, Hills Ferry/Palmyra Slopes, Broadneck Swamp/Company Swamp, and Jamesville Island/Warren Neck. The site descriptions for these sites identify the original sites that have been merged.

In 2013, the NCNHP began using a new site rating system. Each site now has two ratings – a Representational Value and a Collective Value, which are described in the Methods section of this report. There are five categories for each – Exceptional, Very High, High, Moderate, and General. These ratings are based on the quality, rarity, and number of the occurrences of the elements (natural communities and rare plants and animals) in a particular site, in comparison with other occurrences of the same species or natural community elsewhere in the state.

Table 4. Significant Sites in the Roanoke River Floodplain

Site Number	Site Name	Representational Value	Collective Value	% Conservation/Land Owner
1	Roanoke Earthworks and Fall Line Islands	Very High	High	35/NCDCR (DNP) , TNC
2	Phlox Woods	General	General	35/PRV (RHA)
3	Mush Island	High	General	0
4	Mud Castle Slopes +	Very High	Moderate	0
5	Halifax Bluffs	High	Moderate	0
6	Larkspur Ridge/Roanoke Big Oak Woods	Very High	High	70/TNC (part DNP)
7	Occoneechee Neck Floodplain Forest	Very High	General	0
8	Camassia Slopes/Gumberry Swamp	Very High	High	60/TNC (DNP), NCWRC
9	Odom Floodplain and Bluffs	Very High	Moderate	90/NCWRC (DNP), NCDPS
10	Pollocks Ferry Natural Area	High	General	100/NCWRC (DNP), NCDPS
11	Looking Glass Run Swamp and Bluffs	Moderate	General	0
12	Bull Neck Swamp and Bluffs	General	General	0
13	Cypress Swamp/Sandy Run Floodplain Forest	Very High	High	55/NCWRC (DNP)
14	Buzzard Point Floodplain Forests	Very High	High	30/TNC,NCWRC (DNP)
15	Hills Ferry/Palmyra Slopes	General	Moderate	0
16	Big Swash	High	General	100/TNC (EAS)
17	Roanoke River/NC 11 Floodplain Forests	High	Moderate	25/TNC (EAS)
18	Indian Woods/Broadneck Swamp	High	Moderate	0
19	Broadneck Swamp/Company Swamp	Very High	High	95/USFWS,NCWRC (DNP)
20	Coniott Ridge	High	Moderate	85/USFWS
21	Fort Branch Bluffs	High	Moderate	0
22	Poplar Point Slopes	General	General	0
23	Conoho Neck Swamp	Very High	Moderate	85/NCWRC (DNP)
24	Conoho Creek Slopes and Floodplain	Very High	Moderate	65/NCWRC (DNP)
25	Conine Island	Very High	Moderate	98/USFWS
26	Sweetwater Creek Swamp	High	General	0
27	Conine Terrace Forest	Moderate	General	0
28	Devil's Gut	Very High	High	100/TNC (DNP)
29	Jamesville Island/Warren Neck	Very High	General	90/TNC,TNC (EAS),USFWS
30	Roanoke River Delta Islands	Moderate	General	85/TNC,USFWS
31	Conaby Creek/Swan Bay Swamp	Moderate	Moderate	35/TNC

Sites are arranged from upstream (west) to downstream (east). Newly-identified sites in this inventory are indicated by a plus (+). The approximate percentage (by GIS) of the site in conservation ownership is given in the final column. Rep. Value = Representational Value; Col. Value = Collective Value

Significance Ratings:

- Representational Value –
  - Exceptional = R1
  - Very High = R2
  - High = R3
  - Moderate = R4
  - General = R5
- Collective Value –
  - Exceptional = C1
  - Very High = C2
  - High = C3
  - Moderate = C4
  - General = C5

Conservation Owner:

- DNP = Dedicated Nature Preserve
- EAS = Easement
- NCDCR = N.C. Department of Cultural Resources
- NCDPS = N.C. Department of Public Safety
- NCWRC = N.C. Wildlife Resources Commission [Upper and Lower Roanoke River Wetlands Game Land]
- PRV = Private
- RHA = Registered Heritage Area
- TNC = The Nature Conservancy
- USFWS = U.S. Fish & Wildlife Service [Roanoke River National Wildlife Refuge]

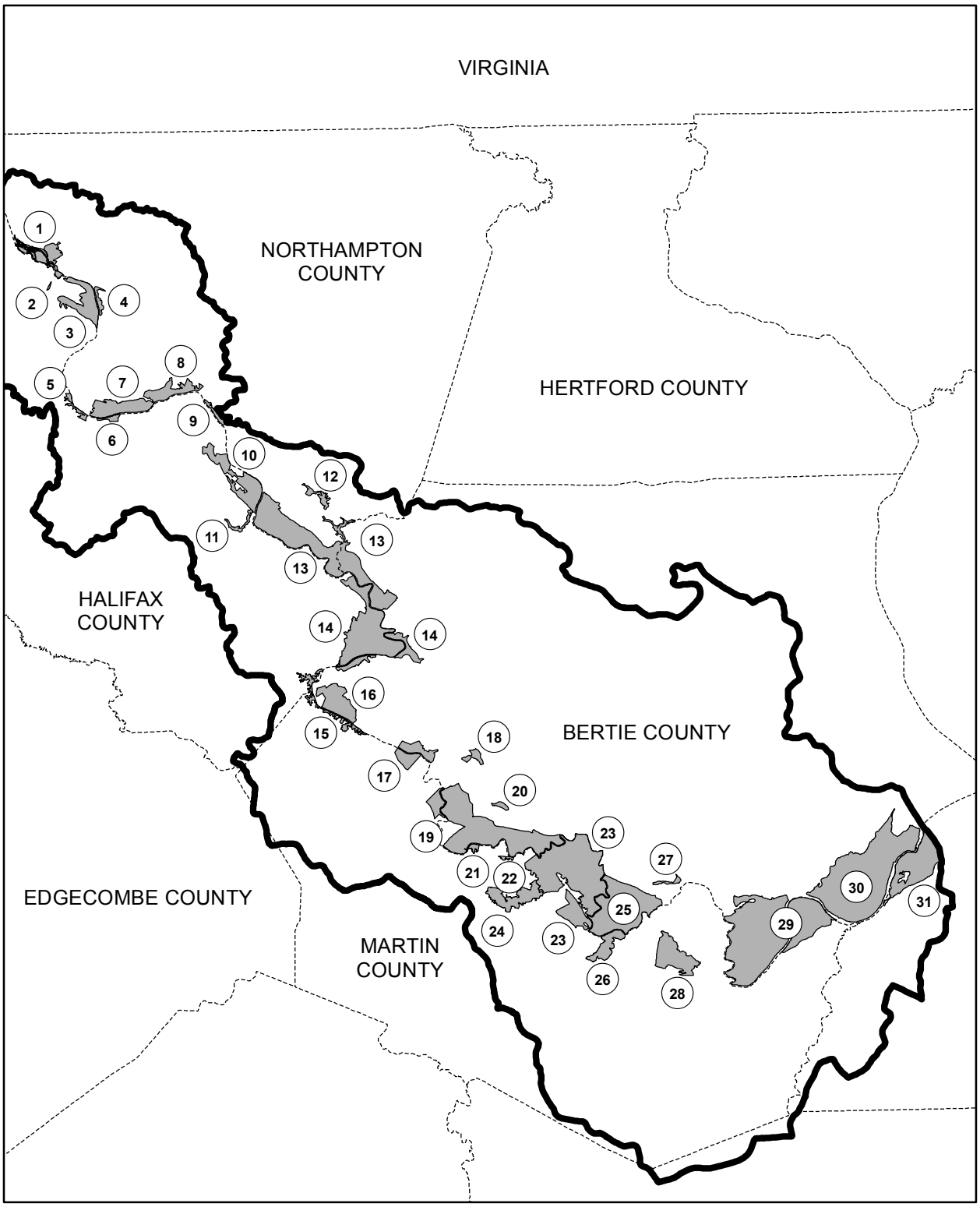

Figure 3. Location of Significant Natural Areas in the Roanoke River Floodplain.

The 31 sites are scattered along the entire length of the floodplain (see Figure 3). Not surprisingly, because the floodplain is narrower in the upper reaches, sites in the western (upper) quarter of the floodplain are often quite small, relative to those in the lower portions. Many of the first nine sites on Table 4 feature rich slopes, which are not extensive on the landscape, and these sites generally average about 100 – 300 acres, except where extensive floodplains are incorporated within the site boundaries. Sites from Pollocks Ferry Natural Area downriver often average more than 1,000 acres, and a handful are more than 5,000 acres. The exception in the lower portions are sites featuring either steep slopes and bluffs (such as Fort Branch Bluffs and Poplar Point Slopes) or sites located near or along the outer edge of the floodplain (such as Indian Woods/Broadneck Swamp and Conine Terrace Forest).

Sites in North Carolina with Exceptional (= R1) ratings for Representational Value are those with globally very rare species or natural communities (i.e., G1 or G2 elements). Such elements tend to be absent along the Roanoke, as the floodplain simply does not contain globally rare elements, which are more often found in bogs, savannas, high mountain habitats, and other specialized habitats. In addition, there are no sites in the floodplain with Exceptional ratings for Collective Value (= C1); such sites usually contain 10 or more rare species or natural communities, and a number of these elements would need to be of G1 or G2 rank to produce such a rating. There are numerous sites with a Very High (R2) Representational Value ratings; such a rating is produced when the site has one of the two best occurrences of a G3, G4, or G5 element in the state. An excellent total of 14 of the 31 sites have a Very High Representational Value rating. A few sites have rare plants as the sole "defining element occurrence," such as Mud Castle Slopes and Conoho Creek Slopes and Floodplain; at least one has an animal as the defining element (i.e., Occoneechee Neck Floodplain Forest). A few sites have a natural community as the defining element occurrence, such as Jamesville Island/Warren Neck. However, most of the Very High (R2) natural areas have both a rare species and a natural community as defining element occurrences.

Because no site in the floodplain has a Very High (= C2) Collective Value rating, the most significant sites are those with a site rating of (R2,C3) – Very High Representational Value and High Collective Value. Though there is a slight bias regarding size of a natural area and Collective Value (i.e., larger sites have the potential to have more rare elements than do small sites), this does not seem to be a concern along the Roanoke, as several of the C3 sites are well under 2,000 acres. The seven sites scoring R2,C3 are Roanoke Earthworks and Fall Line Islands, Larkspur Ridge/Roanoke Big Oak Woods, Camassia Slopes/Gumberry Swamp, Cypress Swamp/Sandy Run Floodplain Forest, Buzzard Point Floodplain Forests, Broadneck Swamp/Company Swamp, and Devil's Gut.

The NCNHP does not "average" the Representational Value and Collective Value ratings, but prefers to take the higher of the two ratings when considering protection efforts. That is, a site with an R2,C4 rating should have a higher priority for protection than an R3,C3 site; an R2,C5 (or R5,C2) site should have protection priority over a R3,C4 (or R4,C3), and so forth. Thus, the next tier of significant sites are those five sites with an R2,C4 rating: Mud Castle Slopes, Odom Floodplain and Bluffs, Conoho Neck Swamp, Conoho Creek Slopes and Floodplain, and Conine Island. An additional two sites score an R2,C5 rating: Occoneechee Neck Floodplain Forest and Jamesville Island/Warren Neck.

A handful of sites have a High (R3) Representational Value and are thus worthy of mention for their significance. Those scoring R3,C4 are Halifax Bluffs, Roanoke River/NC 11 Floodplain Forests, Indian Woods/Broadneck Swamp, Coniott Ridge, and Fort Branch Bluffs. Scoring R3,C5 are Mush Island, Pollocks Ferry Natural Area, Big Swash, and Sweetwater Creek Swamp.

Many places within the floodplain did not get surveyed, but could contain significant natural areas, or might be significant enough to add to an existing natural area. In the upper portions and especially in the lower portions, there are large and seemingly roadless areas that have been very poorly surveyed or have not yet been surveyed on the ground. Also, many of the natural areas included in this report are likely to include, upon further inventory, newly discovered populations of rare species (especially of groups such as moths) or newly identified natural communities that would increase the significance rating of the site, especially the Collective Value portion of the ratings.

Two additional SNHAs within the floodplain are not described in this report, which focuses specifically on terrestrial resources; these are aquatic habitats. The Roanoke River Fall Zone Aquatic Habitat consists of the main channel of the river from the Roanoke Rapids Lake Dam downstream to the large island adjacent to the Roanoke Rapids Waste Water Treatment Plant below Weldon. This site has a C3 site rating, based on the presence of nine rare mussel species. The second natural area is at the opposite (lower) end of the floodplain – the Lower Roanoke River Aquatic Habitat. This site extends from about 5 miles upriver of the US 13/17 bridge downstream to the mouth of the river, where it empties into Albemarle Sound. It has a C4 site rating, with three rare mussels and one rare crayfish species present within the site.

Natural Communities

General Comments

A natural community is defined by the NCNHP as a "distinct and reoccurring assemblage of populations of plants, animals, bacteria, and fungi naturally associated with each other and their physical environment" (Schafale and Weakley 1990). In this inventory, most of the significant natural areas were identified on the basis of natural communities, rather than on the basis of rare plant or rare animal locations and habitats.

Natural communities occur where they do because of the abiotic conditions at the site, including factors such as soil, moisture levels, and fire history. Natural communities transition with others as abiotic and biotic conditions change. The transition may be sharp, especially where the topography is steep or where soil and rock types vary in close proximity. A steep slope may have three or four natural communities arranged from the base of the slope to the top of the slope. In other cases, transitions are gradual and communities seem to blend, such that features in between two communities can be seen on the same piece of ground. This can also occur where the environment is intermediate, such as on soil that is intermediate between acidic and basic.

This report describes a total of 29 natural communities (including subtypes and variants), based on Schafale (2012) (see Table 5). Many of these are newly described subtypes of long-recognized natural community types (from Schafale and Weakley 1990). In some cases, the natural community name has no subtypes listed for it, whereas most described here are indeed subtypes of larger communities; a few of the subtypes are even divided into variants. In Schafale (2012), these variants are mentioned by name within the appropriate subtype but are not yet given full descriptions. Schafale (2012) does mention a "rich alluvial terrace slopes" variant for Basic Mesic Forest (Coastal Plain Subtype). Three rather distinct variations or "forms" were found on rich alluvial terrace slopes during the inventory, suggesting that this variant could be replaced by several new variants instead. These forms are the Basic form, the Intermediate form, and the Umbrella Magnolia form.

Table 5. Natural Communities Present in the Roanoke River Floodplain, with Natural Areas for Each. Communities are listed in an ecological manner, generally from wet to dry conditions and riverine to non-alluvial/peatland systems. Community types, subtypes, and variants are from Schafale (2012) , except for those labeled as "form."

Natural Communities	Element Rank	Sites
Wetland Communities		
Brownwater Levee Forest (High Levee subtype)	G3G5/S3	Larkspur Ridge/Roanoke Big Oak Woods
		Broadneck Swamp/Company Swamp
		Buzzard Point Floodplain Forests
		Camassia Slopes/Gumberry Swamp
		Cypress Swamp/Sandy Run Floodplain Forest
		Occoneechee Neck Floodplain Forest
		Odom Floodplain and Bluffs
		Pollocks Ferry Natural Area
		Roanoke River/NC 11 Floodplain Forests
Brownwater Levee Forest (Medium Levee subtype)	G4?/S3S4	Cypress Swamp/Sandy Run Floodplain Forest
		Big Swash
		Broadneck Swamp/Company Swamp
		Buzzard Point Floodplain Forests
		Fort Branch Bluffs
Brownwater Levee Forest (Low Levee subtype)	G3G4/S3S4	Conoho Neck Swamp
		Conine Island
		Devil's Gut
Piedmont Levee Forest (Typic subtype)	G3G4/S3S4	Roanoke Earthworks and Fall Line Islands
Brownwater Bottomland Hardwoods (High subtype)	G3G4/S3	Bull Neck Swamp and Bluffs
		Broadneck Swamp/Company Swamp
		Buzzard Point Floodplain Forests
		Coniott Ridge

Natural Communities	Element Rank	Sites
		Conoho Creek Slopes and Floodplain
		Cypress Swamp/Sandy Run Floodplain Forest
		Devil's Gut
		Indian Woods/Broadneck Swamp
		Roanoke River/NC 11 Floodplain Forests
Brownwater Bottomland Hardwoods (Low subtype)	G4?/S3	Broadneck Swamp/Company Swamp
		Conine Island
Brownwater Bottomland Hardwoods (Swamp Transition subtype)	G3G4/S3	Cypress Creek/Sandy Run Floodplain Forest
		Indian Woods/Broadneck Swamp
		Roanoke River Delta Islands
Piedmont Bottomland Forest (Typic subtype)	G2?/S2	Roanoke Earthworks and Fall Line Islands
Cypress-Gum Swamp (Brownwater subtype)	G5?/S4	Broadneck Swamp/Company Swamp
		Bull Neck Swamp and Bluffs
		Buzzard Point Floodplain Forests
		Conine Island
		Conoho Creek Slopes and Floodplain
		Conoho Neck Swamp
		Cypress Swamp/Sandy Run Floodplain Forest
		Devil's Gut
		Fort Branch Bluffs
		Hills Ferry/Palmyra Slopes
		Indian Woods/Broadneck Swamp
		Jamesville Island/Warren Neck
		Larkspur Ridge/Roanoke Big Oak Woods
		Looking Glass Run Swamp and Bluffs
		Occoneechee Neck Floodplain Forest
		Roanoke River/NC 11 Floodplain Forests
		Sweetwater Creek Swamp
Coastal Plain Small Stream Swamp	G4?/S4	Hills Ferry/Palmyra Slopes
Tidal Swamp (Cypress--Gum subtype)	G3G4/S4	Conaby Creek/Swan Bay Swamp
		Roanoke River Delta Islands
Piedmont Swamp Forest	G3G4/S2	Roanoke Earthworks and Fall Line Islands
Piedmont Headwater Stream Forest	G3G4/S3S4	Roanoke Earthworks and Fall Line Islands
Low Elevation Seep (Typic subtype)	G3?/S3	Hills Ferry/Palmyra Slopes
Coastal Plain Semipermanent Impoundment (Open Water subtype)	G5/S4	Cypress Swamp/Sandy Run Floodplain Forest
		Larkspur Ridge/Roanoke Big Oak Woods
		Occoneechee Neck Floodplain Forest
		Odom Floodplain and Bluffs

Natural Communities	Element Rank	Sites
Coastal Plain Semipermanent Impoundment (Typic Marsh subtype)	G4?/S4	Odom Floodplain and Bluffs
Coastal Plain Semipermanent Impoundment (Cypress-Gum subtype)	G4G5/S4	Broadneck Swamp/Company Swamp
		Buzzard Point Floodplain Forests
		Cypress Swamp/Sandy Run Floodplain Forest
		Occoneechee Neck Floodplain Forest
		Odom Floodplain and Bluffs
Nonriverine Swamp Forest (Mixed subtype)	G3/S3	Conaby Creek/Swan Bay Swamp
Peatland Atlantic White Cedar Forest	G2/S2	Conaby Creek/Swan Bay Swamp
Terrestrial Communities		
Basic Mesic Forest (Coastal Plain subtype, Rich Alluvial Terrace Slopes variant, Basic form)	G4/S2	Camassia Slopes/Gumberry Swamp
		Halifax Bluffs
		Larkspur Ridge/Roanoke Big Oak Woods
		Mud Castle Slopes
		Phlox Woods
Basic Mesic Forest (Coastal Plain subtype, Rich Alluvial Terrace Slopes variant, Intermediate form)	G4/S2	Odom Floodplain and Bluffs
		Looking Glass Run Swamp and Bluffs
		Hills Ferry/Palmyra Slopes
		Poplar Point Slopes
Basic Mesic Forest (Coastal Plain subtype, Rich Alluvial Terrace Slopes variant, Umbrella Magnolia form)	G4/S2	Fort Branch Bluffs
		Conoho Creek Slopes and Floodplain
Basic Mesic Forest (Piedmont subtype, Basic variant)	G3G4/S3S4	Roanoke Earthworks and Fall Line Islands
Basic Mesic Forest (Piedmont subtype, Intermediate variant)	G3G4/S3S4	Roanoke Earthworks and Fall Line Islands
Mesic Mixed Hardwood Forest (Coastal Plain subtype, Bluff/Slope variant)	G3/S3	Camassia Slopes/Gumberry Swamp
		Looking Glass Run Swamp and Bluffs
		Bull Neck Swamp and Bluffs
		Hills Ferry/Palmyra Slopes
Mesic Mixed Hardwood Forest (Coastal Plain subtype, Swamp Island variant)	G3/S3	Coniott Ridge
		Conoho Creek Slopes and Floodplain
		Conine Terrace Forest
Dry-Mesic Oak-Hickory Forest (Coastal Plain subtype)	G3G4/S3	Halifax Bluffs
		Larkspur Ridge/Roanoke Big Oak Woods
		Camassia Slopes/Gumberry Swamp
		Conine Terrace Forest

Natural Communities	Element Rank	Sites
Dry Oak-Hickory Forest (Coastal Plain subtype)	G4?/S3	Larkspur Ridge/Roanoke Big Oak Woods
Piedmont/Coastal Plain Heath Bluff	G3/S3	Halifax Bluffs
		Hills Ferry/Palmyra Slopes
		Fort Branch Bluffs

Explanation of Rank Codes

Global Rank:

G1 = Critically imperiled globally because of extreme rarity (5 or fewer occurrences or very few remaining individuals) or because of some factor(s) making it especially vulnerable to extinction.

G2 = Imperiled globally because of rarity (6 to 20 occurrences or few remaining individuals) or because of some factor(s) making it very vulnerable to extinction throughout its range.

G3 = Either very rare and local throughout its range or found locally (even abundantly at some of its locations) in a restricted range (e.g., a single physiographic region) or because of other factors making it vulnerable to extinction throughout its range; in the range of 21 to 100 occurrences.

G4 = Apparently secure globally, though it may be quite rare in parts of its range, especially at the periphery.

G5 = Demonstrably secure globally, though it may be quite rare in parts of its range, especially at the periphery.

T_ = The rank of a subtype or variant of a community. As an example, G4T1 would apply to a subtype of a natural community with an overall rank of G4, but the subtype warranting a rank of G1.

_NR = Not ranked. Generally, this is a community (or subtype or variant) not yet identified or classified by NatureServe.

? = Uncertain - Denotes inexact or uncertain numeric rank.

State Rank:

S1 = Critically imperiled in North Carolina because of extreme rarity (5 or fewer occurrences or very few remaining individuals) or because of some factor(s) making it especially vulnerable to extirpation from North Carolina.

S2 = Imperiled in North Carolina because of rarity (6 to 20 occurrences or few remaining individuals) or because of some factor(s) making it very vulnerable to extirpation from North Carolina.

S3 = Vulnerable in North Carolina. Typically 21-100 populations.

S4 = Apparently secure in North Carolina, with many occurrences.

S5 = Secure in North Carolina. Common, widespread, and abundant in North Carolina.

SNR = Not ranked. Generally, this is a community (or subtype or variant) not yet ranked by the NCNHP.

? = Uncertain - Denotes inexact or uncertain numeric rank.

Note: State Ranks have not been assigned to variants. Thus, the State Rank is for the subtype only and not for that particular variant.

The following is a brief overview of the natural communities found along the Roanoke River floodplain and its adjacent slopes. Detailed descriptions of the typical vegetation for a given community (across its range in the state) can be found in Schafale (2012) "Guide to the Natural Communities of North Carolina – Fourth Approximation." The overview below describes the typical vegetation (species often found in the canopy, subcanopy, shrub layer, and herb layer) along the Roanoke River, and it highlights the general geographic location, topographic position, and relative abundance of each community in the project area, along with comments on related communities. As wetland communities dominate the project area, these are listed first, starting

with levees and generally moving back from the river frontage. Upland (terrestrial) communities follow, generally from the more moist (rich) ones to the driest ones.

Wetland Communities

BROWNWATER LEVEE FOREST (HIGH LEVEE SUBTYPE). This community occurs along the upper 35-40% of the Roanoke River floodplain, mainly above US 258. This levee subtype often is raised one to several feet above the floodplain behind it. The canopy is usually dominated by sycamore (*Platanus occidentalis*), sugarberry (*Celtis laevigata*), green ash (*Fraxinus pennsylvanica*), and sweetgum (*Liquidambar styraciflua*). Other canopy trees often include American elm (*Ulmus americana*), Florida maple (*Acer barbatum*), bitternut hickory (*Carya cordiformis*), silver maple (*Acer saccharinum*), and river birch (*Betula nigra*). Box-elder (*Acer negundo*) is the most common understory tree. Tall pawpaw (*Asimina triloba*), spicebush (*Lindera benzoin*), and painted buckeye (*Aesculus sylvatica*) are usually the dominant shrubs, but the invasive exotic Chinese privet (*Ligustrum sinense*) is often common to very common, at least in disturbed areas. The herb layer in spring often covers 100% of the ground, though the exotic common chickweed (*Stellaria media*) is the most numerous species. Other common herbs of this community include cleavers (*Galium aparine*), baby blue-eyes (*Nemophila aphylla*), and yellow fumewort (*Corydalis flavula*). The rare dwarf stinging nettle (*Urtica chamaedryoides*) is locally common and is mainly restricted to this community. Notable spring wildflowers of this community include, at least locally, sessile-flowered trillium (*Trillium sessile*), Virginia bluebells (*Mertensia virginica*), green violet (*Hybanthus concolor*), and veined skullcap (*Scutellaria nervosa*).

BROWNWATER LEVEE FOREST (MEDIUM LEVEE SUBTYPE). This subtype of levee forest mainly occurs in the middle third of the river's floodplain, generally from US 258 downstream to US 13/17; it can also occur on the lower, back sides of broad levees in the upper third of the river's floodplain. The canopy is dominated by green ash (*Fraxinus pennsylvanica*) along with sugarberry (*Celtis laevigata*), and sycamore (*Platanus occidentalis*). A few water hickories (*Carya aquatica*) are present, but most hickories in this community are bitternut hickories (*C. cordiformis*). Eastern cottonwood (*Populus deltoides*) can be locally common. As with the High subtype, box-elder (*Acer negundo*) is the dominant understory tree. Tall pawpaw (*Asimina triloba*) is common in the small tree/shrub zone, and spicebush (*Lindera benzoin*) is also present; however, painted buckeye (*Aesculus sylvatica*) is generally scarce to absent. Common greenbrier (*Smilax rotundifolia*), and several other *Smilax* species, are locally abundant; some sites have sizable patches of cane (*Arundinaria gigantea*). The herb layer is much poorer in diversity from that on High Levees, likely owing to less rich (lower pH) sediments; most examples are weedy and contain exotic species in abundance, such as common chickweed (*Stellaria media*) and Japanese stilt-grass (*Microstegium vimineum*). However, sunlit openings and edges of this community can contain sizable patches of the rare smooth hedge-nettle (*Stachys tenuifolia*), and can have a few locations of the very rare limestone wild-petunia (*Ruellia strepens*). Other native herbs that can be locally common include false nettle (*Boehmeria cylindrica*) and wild mudwort (*Dicliptera brachiata*).

BROWNWATER LEVEE FOREST (LOW LEVEE SUBTYPE). This subtype is found primarily along the lower 30-35% of the river's floodplain, mostly below US 13/17, but it can be found -- sometimes

extensively -- on the lower, back sides of levees farther upriver. However, in this lower third of the floodplain, nearly all hickories on the levees are water hickory (*Carya aquatica*), and laurel oak (*Quercus laurifolia*) becomes fairly numerous; these are relatively scarce farther upriver. Green ash (*Fraxinus pennsylvanica*) is the dominant canopy tree, and sycamore (*Platanus occidentalis*) and river birch (*Betula nigra*) can be numerous. Some overcup oak (*Q. lyrata*) can be present; and trees of swamp forest such as water tupelo (*Nyssa aquatica*) and bald-cypress (*Taxodium distichum*) can also be found. The understory is poorly represented, as is the shrub layer. Tall pawpaw (*Asimina triloba*) is present, but buckeye (*Aesculus sylvatica*) and spicebush (*Lindera benzoin*) are essentially absent. Woody vines such as greenbriers (*Smilax* spp.) are more prevalent. The herb layer features many grasses, and forbs such as false nettle (*Boehmeria cylindrica*) can be common.

PIEDMONT LEVEE FOREST (TYPIC SUBTYPE). This community is limited in the study area to the extreme upriver areas above the rocky shoals at Weldon. This community is quite similar to that of the Brownwater Levee Forest (High Levee subtype), which is a Coastal Plain community. The canopy is dominated by a varying mix of sugarberry (*Celtis laevigata*), green ash (*Fraxinus pennsylvanica*), sycamore (*Platanus occidentalis*), and sweetgum (*Liquidambar styraciflua*). River birch (*Betula nigra*) and cherrybark oak (*Quercus pagoda*) are also common. The understory consists of box-elder (*Acer negundo*), American hornbeam (*Carpinus caroliniana*), and the canopy species. Painted buckeye (*Aesculus sylvatica*), tall pawpaw (*Asimina triloba*), and some spicebush (*Lindera benzoin*) are present, but the exotic Chinese privet (*Ligustrum sinense*) can be locally abundant. The herb layer is variable and patchy. It is sparse under dense privet stands, but otherwise is dense. At the one studied example in the project area (Roanoke Earthworks and Fall Line Islands), the rare dwarf stinging nettle (*Urtica chamaedryoides*) dominates large areas, and early wild-rye (*Elymus macgregori*) and sedges (*Carex* spp.) dominate other areas. The fact that the dwarf stinging nettle is common here ties this community to the Brownwater Levee Forests downstream and suggests the community here at the fall line is already transitional to Coastal Plain character.

BROWNWATER BOTTOMLAND HARDWOODS (HIGH SUBTYPE). This community is normally found on relatively high-and-dry ridges well back from the river, on former (old) levees. It may occur immediately behind the levees, but usually is separated by a lower area. Oaks such as cherrybark oak (*Quercus pagoda*), swamp chestnut oak (*Q. michauxii*), and laurel oak (*Q. laurifolia*) generally dominate, along with sweetgum (*Liquidambar styraciflua*). Some green ash (*Fraxinus pennsylvanica*) and American elm (*Ulmus americana*), both numerous on levees, can be present, but other levee species such as sugarberry (*Celtis laevigata*), sycamore (*Platanus occidentalis*), and river birch (*Betula nigra*) are scarce. Box-elder (*Acer negundo*) is common in the subcanopy. Tall pawpaw (*Asimina triloba*) can be common in the low understory or tall shrub layers. Cane (*Arundinaria gigantea*) can be common. The herb layer can be quite diverse and is usually less impacted by exotics than are the levees. Species may include sedges (*Carex* spp.), mayapple (*Podophyllum peltatum*), violets (*Viola* sp.), spotted jewelweed (*Impatiens capensis*), and Atamasco lily (*Zephyranthes atamasco*).

BROWNWATER BOTTOMLAND HARDWOODS (LOW SUBTYPE). This community is also found mostly on old former levees, but generally farther downriver than the High subtype. Because they occur farther downriver, elevation differences between such a community and the adjacent

ones, normally a Cypress-Gum Swamp subtype, are somewhat less than with the High Subtype. Water tupelo (*Nyssa aquatica*) and bald-cypress (*Taxodium distichum*) are normally absent. The canopy is generally dominated by laurel oak or overcup oak, often along with sweetgum. Green ash (*Fraxinus pennsylvanica*) may also be common in the canopy. Box-elder (*Acer negundo*) is common in the subcanopy, as is American hornbeam (*Carpinus caroliniana*). Shrubs are not numerous, though possum-haw (*Ilex decidua*) is important. Herbs are dense, with several sedges (*Carex* spp.) being common, along with false nettle (*Boehmeria cylindrica*) and (locally) lizard's-tail (*Saururus cernuus*).

BROWNWATER BOTTOMLAND HARDWOODS (SWAMP TRANSITION SUBTYPE). This subtype of "bottomland forest" occurs mainly on gentle ridges in the lower half of the floodplain, generally from US 258 toward the river mouth, though it can be present in shallow sloughs or the lower edges of higher ridges upstream. The canopy is a mix consisting mainly of laurel oak (*Quercus laurifolia*), red maple (*Acer rubrum*), overcup oak (*Quercus lyrata*), green ash (*Fraxinus pennsylvanica*), and bald-cypress (*Taxodium distichum*). Swamp cottonwood (*Populus heterophylla*) can also be present, but usually in small numbers. The understory is dominated by red maple (*Acer rubrum*), with American hornbeam (*Carpinus caroliniana*) and other canopy species. Shrubs are sparse. The herb layer is fairly dense, with various grasses (such as *Leersia* spp.) and sedges (*Carex* spp.) being dominant.

PIEDMONT BOTTOMLAND FOREST (TYPIC LOW SUBTYPE). This community is limited in the project area to just above the Fall Line, near Weldon. It occurs on higher ridges or terraces on the floodplain, back from the river. There is generally a distinct rise to the areas of this community from the levee forest. The canopy is dominated by cherrybark oak (*Quercus pagoda*), with sweetgum (*Liquidambar styraciflua*) common and some shagbark hickory (*Carya ovata*) present. The understory includes American hornbeam (*Carpinus caroliniana*), Florida maple (*Acer barbatum*), and tall pawpaw (*Asimina triloba*), as well as canopy species. The shrub layer is generally quite open. Herbs are often sparse, but dwarf stinging nettle (*Urtica chamaedryoides*) and early wild-rye (*Elymus macgregori*) dominate in parts.

CYPRESS—GUM SWAMP (BROWNWATER SUBTYPE). This is the most abundant community, in terms of acreage, in the project area. Large backswamp basins, for example, can have extensive patches. It also is present along narrower sloughs, which can add up to substantial area. Along the Roanoke, water tupelo (*Nyssa aquatica*) and bald-cypress (*Taxodium distichum*) are the primary canopy trees. Water ash (*Fraxinus caroliniana*) is the dominant understory tree, and often there are few shrubs. Few herbs are found because of the deep water levels, though some floating species can be present.

COASTAL PLAIN SMALL STREAM SWAMP. This is a common natural community in the Coastal Plain, though the Roanoke River is a brownwater system and thus examples in the project area are quite small and limited. There are places, however, where small streams that flow into the Roanoke contain swampy or seepage vegetation, often between steep slopes on either side of the stream. Where ravines emerge to the floodplain, bald-cypress (*Taxodium distichum*) is usually present, though green ash (*Fraxinus pennsylvanica*) is dominant in the canopy. Possum-haw (*Ilex decidua*) is a numerous shrub; the herb layer is very dense, with sedges (*Carex* spp.), false

nettle (*Boehmeria cylindrica*), netted chain-fern (*Woodwardia areolata*), cinnamon fern (*Osmunda cinnamomea*), royal fern (*O. regalis*), and other herbs being thick.

TIDAL SWAMP (CYPRESS—GUM SUBTYPE). This community is limited in the project area only to the extreme downriver end, where some tidal influence (mostly from wind) is present. Bald-cypress (*Taxodium distichum*), water tupelo (*Nyssa aquatica*), and swamp tupelo (*N. biflora*) are dominant trees. Common in the understory are red maple (*Acer rubrum*) and water ash (*Fraxinus caroliniana*). Some sites contain a moderate amount of peat and can contain more pocosin-like species, including sweetbay (*Magnolia virginiana*) and redbay (*Persea palustris*) and with dense vines, especially greenbriers (*Smilax* spp.).

PIEDMONT SWAMP FOREST. This is a relatively rare natural community, and even within the project area it is known only from the Roanoke Earthworks site. It occurs in a distinctive backswamp basin at the base of the upland slope on the northwest side of the site. This is a wide spot on the floodplain, which nearly pinches off downstream against the bluff. The basin holds water for long periods, and has some shallow standing water for much of the year. The basin has a drainage channel that empties from it toward the river. The canopy is dominated by sweetgum (*Liquidambar styraciflua*) and green ash (*Fraxinus pennsylvanica*), with overcup oak (*Quercus lyrata*) in the middle and a few swamp cottonwood (*Populus heterophylla*) around the margins. There is little understory or shrub layer, but there are some small buttonbushes (*Cephalanthus occidentalis*) in the middle. The herb layer is patchy, with dense cover near the edges and in patches elsewhere, but with large areas devoid of herbs. Species include sedges (*Carex* spp.), lizard's-tail (*Saururus cernuus*), false nettle (*Boehmeria cylindrica*), sharp-wing monkey-flower (*Mimulus alatus*), ditch stonecrop (*Penthorum sedoides*), spotted knotweed (*Persicaria punctata*), Walter's St. John's-wort (*Triadenum walteri*), swamp dock (*Rumex verticillatus*), bugleweed (*Lycopus* sp.), and arrow arum (*Peltandra virginica*).

PIEDMONT HEADWATER STREAM FOREST. This is very common in the Piedmont province but is limited in the project area. The best example found, also on the Roanoke Earthworks tract, occurs along the small west-flowing stream in the middle of the tract. The narrow floodplain has a forest with a diverse mixed canopy. White oak (*Quercus alba*) is most abundant, followed by willow oak (*Q. phellos*) and cherrybark oak (*Q. pagoda*); however, sweetgum (*Liquidambar styraciflua*), tuliptree (*Liriodendron tulipifera*), and river birch (*Betula nigra*) are also common. The understory includes American holly (*Ilex opaca*), Florida maple (*Acer barbatum*), red maple (*A. rubrum*), flowering dogwood (*Cornus florida*), and American hornbeam (*Carpinus caroliniana*), as well as canopy species. The shrub layer ranges from nearly absent to an open stratum of possum-haw (*I. decidua*), with painted buckeye (*Aesculus sylvatica*) present in places. The herb layer is often dense, and includes lady fern (*Athyrium asplenioides*), slender spikegrass (*Chasmanthium laxum*), New York fern (*Thelypteris noveboracensis*), sedges (*Carex* spp.) and many others. The Watch List wafer-ash (*Ptelea trifoliata*) and the Lewis's heartleaf (*Hexastylis lewisii*) were noted in this community during the inventory.

LOW ELEVATION SEEP (TYPIC SUBTYPE). This natural community is always very limited in size on the landscape, and examples along the Roanoke River are likely not rare, but very few have been described. These communities are somewhat boggy, but are always shaded, and are located near or at the base of slopes within ravines. One example at Hills Ferry/Palmyra Slopes contains

inkberry (*Ilex glabra*), possum-haw viburnum (*Viburnum nudum*), climbing hydrangea (*Decumaria barbara*), primrose-leaved violet (*Viola primulifolia*), netted chain-fern (*Woodwardia areolata*), partridge-berry (*Mitchella repens*), and Pennsylvania bittercress (*Cardamine pensylvanica*).

COASTAL PLAIN SEMIPERMANENT IMPOUNDMENT (OPEN WATER SUBTYPE). Semipermanent impoundments can be either natural, usually a beaver pond, or man-made, usually a millpond. Those along the Roanoke are essentially all found in beaver ponds, and this subtype occurs in the middle of impoundments, normally with a fringing Typic Marsh subtype (see below) and also with a Cypress—Gum subtype (also see below) around the margins. A handful of examples are present of the Open Water subtype, with the best example likely being at the Odom Floodplain and Bluffs natural area. It occupies much of the backswamp basin behind the natural levee. The pond includes several areas of open water, with a narrow zone of floating pennywort (*Hydrocotyle ranunculoides*).

COASTAL PLAIN SEMIPERMANENT IMPOUNDMENT (TYPIC MARSH SUBTYPE). This subtype normally occurs around the fringes of the Open Water subtype, though in some places it may occupy the entire beaver pond. The Odom Floodplain and Bluffs impoundment's marshy zone has patches dominated by a cutgrass (*Leersia hexandra*?), knotweeds (*Persicaria* spp.), and the invasive exotic marsh dewflower (*Murdannia keisak*). Other common species include arrow arum (*Peltandra virginica*), arrowhead (*Sagittaria* spp.), and sedges (*Carex* spp.).

COASTAL PLAIN SEMIPERMANENT IMPOUNDMENT (CYPRESS—GUM SUBTYPE). These examples normally occur within a beaver pond, though elsewhere in the Coastal Plain they can occur at millponds. In beaver ponds, they may occur either as a zone at the upper end, or as a natural successional phase. The successional phase follows the other subtypes after the pond has drained, or possibly just with the opportunity for these water-tolerant tree species to become established. That is, over time, flood-tolerant trees such as bald-cypress (*Taxodium distichum*) and water tupelo (*Nyssa aquatica*) become established in the open water or along the edge of the marsh, eventually replacing those subtypes with one that contains a canopy. This community can be difficult to distinguish from Cypress—Gum Swamp (Brownwater subtype) where it occurs in a backswamp, as opposed to an obvious millpond.

NONRIVERINE SWAMP FOREST (MIXED SUBTYPE). This natural community occurs typically in broad and poorly drained flats and is not generally found within floodplains. This subtype occurs on moderate to deep peat soil, with loblolly pine (*Pinus taeda*), pond pine (*P. serotina*), and/or Atlantic white cedar (*Chamaecyparis thyoides*) being present in the canopy in substantial numbers, usually with the much more widespread swamp tupelo (*Nyssa biflora*), red maple (*Acer rubrum*), and bald-cypress (*Taxodium distichum*). A wide variety of pocosin small trees and shrubs are present, including titi (*Cyrilla racemiflora*) and redbay (*Persea palustris*). In the project area, it is found only near the mouth of the river, in Conaby Creek/Swan Bay Swamp, where flood levels are not deep enough to inundate the bottomland areas away from the river channel.

PEATLAND ATLANTIC WHITE CEDAR FOREST. This is a rather rare community in the state and is very rare in the project area, being found only in small patches near the mouth of the river in the

southern part of the floodplain (in the Conaby Creek/Swan Bay Swamp natural area). As with the above community, it is always found growing over fairly deep peat deposits. Atlantic white cedar (*Chamaecyparis thyoides*) may grow in dense stands, and where it does, there is little else growing beneath them. In some stands, fire suppression can lead to red maple (*Acer rubrum*) and sweetgum (*Liquidambar styraciflua*) overtaking the cedars and eventually turning the stand into a Nonriverine Swamp Forest. Even though mature cedars do not survive strong fires, the cones need fire to germinate and thus re-establish a new stand of white cedars.

Terrestrial Communities

BASIC MESIC FOREST (COASTAL PLAIN SUBTYPE, RICH ALLUVIAL TERRACE SLOPE VARIANT, BASIC FORM). This form of Rich Alluvial Terrace Slope Variant is the most species-rich natural community located along the Roanoke River, and the one that contains the greatest number of rare plant species. On moderate to steep slopes along the upper portions of the river, from the Odom Prison to the Fall Line, this is the primary natural community; it can occur on both north-facing and on south-facing settings. Florida maple (*Acer barbatum*) is the dominant canopy tree, but bitternut hickory (*Carya cordiformis*) is usually present, and scattered on slopes are species such as shagbark hickory (*C. ovata*) and some oaks such as Shumard oak (*Quercus shumardii*). This maple and slippery elm (*Ulmus rubra*) are in the sparse subcanopy. The shrub layer is often dense and is dominated by tall pawpaw (*Asimina triloba*) and painted buckeye (*Aesculus sylvatica*), with the latter being very characteristic of this community type. The herb layer is very rich and covers 100% of the ground in the spring, though the exotic common chickweed (*Stellaria media*) is overly abundant at that season. Also abundant is cleavers (*Galium aparine*). Typical herbs that are common, at least locally, are baby blue-eyes (*Nemophila aphylla*), yellow fumewort (*Corydalis flavula*), American trout-lily (*Erythronium americanum*), sessile-flowered trillium (*Trillium sessile*), Eastern isopyrum (*Enemion biternatum*), giant chickweed (*Stellaria pubera*), and Dutchman's breeches (*Dicentra cucullaria*). Several rare species are limited to only this natural community form, including wild hyacinth (*Camassia scilloides*) and Eastern isopyrum (*Enemion biternatum*). Other locally scarce plants include dwarf larkspur (*Delphinium tricorne*), wild blue phlox (*Phlox divaricata*), blunt-leaf waterleaf (*Hydrophyllum canadense*), and heartleaf skullcap (*Scutellaria ovata* var. *bracteata*). Interestingly, a few species – such as Dutchman's breeches – are found only on the cooler and more shaded north-facing slopes, whereas the very rare wild hyacinth is found only on south-facing slopes.

BASIC MESIC FOREST (COASTAL PLAIN SUBTYPE, RICH ALLUVIAL TERRACE SLOPE VARIANT, INTERMEDIATE FORM). This form is not quite as numerous as is the Basic form near the river, and it is found mainly farther downriver, especially in the middle third of the river between Palmyra and Hamilton (i.e., below US 258). Most of the very steep slopes in this part of the river contain a flora that is not as rich as that farther upriver but is still within the range of Basic Mesic Forest rather than Mesic Mixed Hardwood Forest. This community form is seen at many places within Hills Ferry/Palmyra Slopes. American beech (*Fagus grandifolia*), northern red oak (*Quercus rubra*), and tuliptree (*Liriodendron tulipifera*) are the main canopy trees; however, Florida maple (*Acer barbatum*) is of more limited presence. The understory is sparse, though tall pawpaw (*Asimina triloba*) is present there and in the shrub layer. Characteristic shrubs in this community, in addition to pawpaw, are painted buckeye (*Aesculus sylvatica*) and bladdernut (*Staphylea trifolia*); some bigleaf snowbell (*Styrax grandifolia*) can be present. The herb layer is

nearly 100% cover. In addition to the exotic common chickweed (*Stellaria media*) and ground-ivy (*Glechoma hederacea*), native species include cutleaf toothwort (*Cardamine concatenata*), mayapple (*Podophyllum peltatum*), wild geranium (*Geranium maculatum*), black cohosh (*Actaea racemosa*), broad beech fern (*Thelypteris hexagonoptera*), white snakeroot (*Ageratina altissima*), and smooth sweet-cicely (*Osmorhiza longistylis*). The rare James's sedge (*Carex jamesii*) is present in this community, as is the Watch List heart-leaf skullcap (*Scutellaria ovata* var. *bracteata*).

BASIC MESIC FOREST (COASTAL PLAIN SUBTYPE, RICH ALLUVIAL TERRACE SLOPE VARIANT, UMBRELLA MAGNOLIA FORM). This form of Basic Mesic Forest occurs on slopes along Conoho Creek, just west of Williamston, and sparingly is found elsewhere in this lower third of the floodplain, as far up-river as Fort Branch Bluffs. These rich slopes downriver from Hamilton, where the Basic Mesic Forest (Intermediate form) generally ends, have a different vegetation composition from it. For whatever reason, the typically "Piedmontane" umbrella magnolia (*Magnolia tripetala*) is often common in the understory of this form. The canopy is dominated by beech (*Fagus grandifolia*), though tuliptree (*Liriodendron tulipifera*), bitternut hickory (*Carya cordiformis*), and Florida maple (*Acer barbatum*) are also numerous. The understory is quite varied, and hop-hornbeam (*Ostyra virginiana*) is numerous, along with umbrella magnolia and flowering dogwood (*Cornus florida*). The shrub layer is rather spotty, though there are dense patches of silky camellia (*Stewartia malacodendron*) and beauty-berry (*Callicarpa americana*), and bigleaf snowbell (*Styrax grandifolia*) is also present. Vines are quite diverse, with climbing hydrangea (*Decumaria barbara*) being locally common. The herb layer is very dense, and not impacted much by exotics. Dense stands of broad beech fern (*Thelypteris hexagonoptera*) are present, and Christmas fern (*Polystichum acrostichoides*) is very widespread. Black cohosh (*Actaea racemosa*) is locally numerous, but most other herbs are scattered. This community form is notable for several rare species found nowhere else in the project area, and they are primarily found on mafic soils – magnolia vine (*Schisandra glabra*) and Virginia stickseed (*Hackelia virginiana*). In fact, the magnolia vine is found at only one other site in the state, in Gaston County. Ginseng (*Panax quinquefolius*), far disjunct to the east of its normal range, formerly was found in this natural community; it is another good indicator of rich soils.

BASIC MESIC FOREST (PIEDMONT SUBTYPE, BASIC VARIANT). This community is scarce in the state, and in the project area is limited only to sites above the Fall Line; there is an example at the Roanoke Earthworks, but it is moderately impacted by exotic plant invasion. The canopy is a varying mix that includes Florida maple (*Acer barbatum*), bitternut hickory (*Carya cordiformis*), northern red oak (*Quercus rubra*), American beech (*Fagus grandifolia*), Shumard oak (*Quercus shumardii*), tuliptree (*Liriodendron tulipifera*), and black walnut (*Juglans nigra*). Unfortunately, there are scattered exotic Tree-of-Heaven (*Ailanthus altissima*) in the canopy. The understory includes hop-hornbeam (*Ostrya virginiana*), tall pawpaw (*Asimina triloba*), flowering dogwood (*Cornus florida*), redbud (*Cercis canadensis*), and canopy species. There is little shrub layer, but painted buckeye (*Aesculus sylvatica*) is present in places. The herb layer is generally dense. Sedges (*Carex jamesii*?) dominate large areas, as does early wild-rye (*Elymus macgregori*). A number of herbs characteristic of rich sites are present, including baby blue-eyes (*Nemophila aphylla*), smooth sweet-cicely (*Osmorhiza longistylis*), yellow fumewort (*Corydalis flavula*), large-seed forget-me-not (*Myosotis macrosperma*), and mayapple (*Podophyllum peltatum*). Note that this community does not contain the rare or uncommon species as found downriver in the

Coastal Plain subtype, and this Piedmont slope is only marginally distinct from the Intermediate Variant.

BASIC MESIC FOREST (PIEDMONT SUBTYPE, INTERMEDIATE VARIANT). This is the primary natural community located at Roanoke Earthworks in the ravine that extends eastward from the floodplain of the river. American beech (*Fagus grandifolia*) is the dominant canopy tree, but some shagbark hickory (*Carya ovata*) is present. Hop-hornbeam (*Ostrya virginiana*) is quite numerous in the understory. The shrub layer is sparse, however. Characteristic herbs at this site/community type are broad beech fern (*Thelypteris hexagonoptera*), black cohosh (*Actaea racemosa*), Canada horse-balm (*Collinsonia canadensis*), lopseed (*Phryma leptostachya*), and maidenhair fern (*Adiantum pedatum*).

MESIC MIXED HARDWOOD FOREST (COASTAL PLAIN SUBTYPE, BLUFF/SLOPE VARIANT). This community variant is rather heterogeneous in the project area, with many variations in vegetation, degree of slope, direction of slope, and other factors. Beech (*Fagus grandifolia*) and northern red oak (*Quercus rubra*) are the main canopy trees. The understory species are rather few, but include American holly (*Ilex opaca*) and flowering dogwood (*Cornus florida*). On some slopes, mountain laurel (*Kalmia latifolia*) can be numerous, but it is typically absent; sweetleaf (*Symplocos tinctoria*) and smooth black-haw (*Viburnum prunifolium*) can also be present. On steep bluffs, wild hydrangea (*Hydrangea arborescens*) is present; goldenrods (*Solidago arguta* and *S. caesia*) may be found with the hydrangea. The herb layer is rather sparse, in contrast with the Basic Mesic Forests. Christmas fern (*Polystichum acrostichoides*) is the most characteristic species, but mayapple (*Podophyllum peltatum*) can be numerous, along with several other ferns.

MESIC MIXED HARDWOOD FOREST (COASTAL PLAIN SUBTYPE, SWAMP ISLAND VARIANT). This variant is topographically distinct from the other variant of the community; however, there is some blending of it with Brownwater Bottomland Hardwoods. The best example is at Coniott Ridge; the climax forest on the ridge is dominated by cherrybark oak (*Quercus pagoda*), but also common are swamp chestnut oak (*Q. michauxii*), sweetgum (*Liquidambar styraciflua*), and beech (*Fagus grandifolia*). A good variety of other tree species is also present, including at least three species of hickories (*Carya cordiformis*, *C. ovata*, and *C. tomentosa*) and at least five oak species. The well-developed understory layer shows an interesting mixture of bottomland and upland species. Bottomland species such as American hornbeam (*Carpinus caroliniana*) and tall pawpaw (*Asimina triloba*) grow in association with more mesic species such as flowering dogwood (*Cornus florida*), American holly (*Ilex opaca*), and hop-hornbeam (*Ostrya virginiana*). The shrub layer is rather sparse, thus giving the ridge a park-like appearance. In the Conoho Creek area, shrubs such as silky camellia (*Stewartia malacodendron*) and sweetleaf (*Symplocos tinctoria*) are fairly numerous; the uncommon log fern (*Dryopteris celsa*) grows in this natural community, especially in the Conoho Creek area.

DRY-MESIC OAK—HICKORY FOREST (COASTAL PLAIN SUBTYPE). Good or extensive examples of this natural community are not common in the state's Coastal Plain, as most have been damaged or destroyed by logging, clearing for agriculture or development, or for other reasons. Fortunately, a few examples are present in the project area in sites such as Larkspur Ridge, Camassia Slopes, and Halifax Bluffs. These are found either on terrace flats or on gentle ravine

slopes, but normally deeper ravines contain Mesic Mixed or Basic Mesic forest types. White oak (*Quercus alba*) is the dominant tree, but some northern red oak (*Q. rubra*), southern red oak (*Q. falcata*), post oak (*Q. stellata*), and other oaks are present. Flowering dogwood (*Cornus florida*) is numerous in the understory, and smooth black-haw (*Viburnum prunifolium*), beauty-berry (*Callicarpa americana*), and small black blueberry (*Vaccinium tenellum*) are typical shrubs. The herb layer is rather poor; Virginia oak-leach (*Aureolaria virginica*) and Christmas fern (*Polystichum acrostichoides*) are often present.

DRY OAK—HICKORY FOREST (COASTAL PLAIN SUBTYPE). This is a rare vegetation type in the Roanoke River area, as most soils are too moist for this community. One example, which blends with Dry-Mesic Oak—Hickory Forest, occurs at Larkspur Ridge, as described in Schafale (1995). It contains a mixture of white oak (*Quercus alba*), southern red oak (*Q. falcata*), and post oak (*Q. stellata*) in the canopy. However, it does contain more mesic-soil species, such as occasional Florida maple (*Acer barbatum*) and shagbark hickory (*Carya ovata*) in the canopy, and beech (*Fagus grandifolia)* in the understory in some places. Of interest is a sandy soil area a few miles to the west, just outside the Halifax Bluffs natural area. Several populations of the locally rare sundial lupine (*Lupinus perennis*) grow in the sand.

PIEDMONT/COASTAL PLAIN HEATH BLUFF. This may be the natural community most depauperate of plant species in the project area, being quite rare and limited to just a few small bluffs and dry slopes. There are at least two such sites within Halifax Bluffs, near the upper end of the floodplain. Mountain laurel (*Kalmia latifolia*) forms fairly dense thickets, under a sparse canopy. Oddly, giant cane (*Arundinaria gigantea*) grows up the slope into this stand. A few slopes contain galax (*Galax aphylla*), which is rather rare and confined to this community type in the Coastal Plain. Other woody species include sweetleaf (*Symplocos tinctoria*), coast pepper-bush (*Clethra alnifolia*), and sparkleberry (*Vaccinium arboreum*). Dwarf heartleaf (*Hexastylis minor*) is a frequent herb. There appears to be a major disjunction of this community until the Palmyra area, near the Halifax/Martin county line. Hills Ferry has a heath bluff community that is similar in composition to that at Halifax Bluffs, though trailing arbutus (*Epigaea repens*) is present there but not at Halifax Bluffs. Farther down the river, just below Hamilton, is a roughly 60 ft.-high bluff with beech (*Fagus grandifolia*) over a dense stand of mountain laurel. This site – Fort Branch Bluffs -- has much wild hydrangea (*Hydrangea arborescens*) on the bluff face.

Flora

Overview

The Roanoke River floodplain has very diverse flora, and almost certainly has the most diverse array of plant species found within any floodplain in the Coastal Plain, if not the entire state. Brownwater rivers carry a high nutrient load, and these rich sediments are deposited on the banks and elsewhere within the floodplain during flooding events. Many of these sediments are from eroded rocks and minerals in the Piedmont that contain iron, magnesium, and other such elements. These soils are typically “basic” or circumneutral and support Brownwater Levee Forests along the river and Basic Mesic Forests on slopes. These Basic Mesic Forests occur on slopes that have eroded into old terrace deposits laid down by the river when it carried much

more water than it does today and thus had a much wider floodplain. Although in the past few decades the river has had most of its sediment load deposited in the three reservoirs, the soils in the study area are still quite rich and still contain the flora characteristic of these natural communities.

The Roanoke River has a very high diversity of hardwood tree species, including a good mix of several species "pairs" – eastern cottonwood (*Populus deltoides*) and swamp cottonwood (*P. heterophylla*), bitternut hickory (*Carya cordiformis*) and water hickory (*C. aquatica*), and willow oak (*Quercus phellos*) and laurel oak (*Q. laurifolia*), among others. The eastern cottonwood, bitternut hickory, and willow oak are the more dominant of the pairs in the upriver half of the floodplain, whereas these become scarce in the downriver half. Swamp cottonwood, water hickory, and laurel oak are scarce in the upriver parts of the floodplain, though swamp cottonwood can occur even into the Piedmont portion. Species such as Shumard oak (*Q. shumardii*), shagbark hickory (*C. ovata*), and silver maple (*Acer saccharinum*) are quite numerous along the Roanoke River, and the last species is generally rare elsewhere in the state. The lower portions (below Hamilton) have slopes containing woody species such as umbrella magnolia (*Magnolia tripetala*), bigleaf snowbell (*Styrax grandifolia*), hop-hornbeam (*Ostrya virginiana*), and silky camellia (*Stewartia malacodendron*). The lowest regions of the floodplain contain peaty soils, with a good array of pocosin species – pond pine (*Pinus serotina*), Atlantic white cedar (*Chamaecyparis thyoides*), redbay (*Persea palustris*), and many others – that are common farther to the east on nonriverine sites.

Of most significance for diversity is the relative abundance of Basic Mesic Forests along the up-river half of the floodplain; only the upper portion of the Cape Fear River (in Harnett and Cumberland counties) can claim Basic Mesic Forests within a brownwater floodplain in the Coastal Plain province. Such natural communities have a 100% ground cover of herbaceous species in the spring. Native species such as baby blue-eyes (*Nemophila aphylla*), yellow fumewort (*Corydalis flavula*), Dutchman's breeches (*Dicentra cucullaria*), lowland brittle fern (*Cystopteris protrusa*), two species of trout lilies (*Erythronium americanum* and *E. umbilicatum*), and cutleaf toothwort (*Cardamine concatenata*) can cover large areas of slopes. Many rare species are found on these soils (see below). These very rich soils are also favored by exotic plants, and common chickweed (*Stellaria media*), Japanese honeysuckle (*Lonicera japonica*), Chinese privet (*Ligustrum sinense*), and Japanese stilt-grass (*Microstegium vimineum*) are locally abundant. The latter two are found mainly on floodplains and levees, but they can occur upslope; chickweed and honeysuckle can occur anywhere on slopes and in floodplains.

Rare Species

The Roanoke River floodplain contains, by far, the most rare plants of any brownwater river floodplain in the North Carolina Coastal Plain, even though the other rivers (in this province), such as the Tar, Neuse, and Cape Fear, are considerably longer. Unlike rare plants of savannas, longleaf pine sandhills, and various marshes, nearly all of the rare species in the Roanoke River floodplain are fairly widespread (i.e., G4 or G5 global ranks). Thus, none is a Federally listed species, and none is considered as a Federal Species of Concern (by the U.S. Fish and Wildlife Service) (see Table 6).

On the other hand, perhaps because the Roanoke River lies fairly close to a state line (i.e., Virginia), several plant species are found in North Carolina only in this river's floodplain. These "Roanoke only" species are sessile-flowered trillium (*Trillium sessile*), smooth hedge-nettle (*Stachys tenuifolia*), smooth swallowwort (*Cynanchum laeve*), and dwarf stinging nettle (*Urtica chamaedryoides*). The first three are primarily northern in range; however, the nettle is a southern species that is oddly disjunct from South Carolina to the Roanoke River floodplain.

Several additional species occur along the Roanoke River that have only one or two small populations elsewhere. Wild hyacinth (*Camassia scilloides*), arguably the most significant rare plant along the Roanoke, is found only at one or two sites elsewhere, but the bulk of the population occurs within Camassia Slopes/Gumberry Swamp natural area. Another highly significant plant is magnolia vine (*Schisandra glabra*); for several decades, this globally scarce plant was known in the state only within the Conoho Creek Slopes and Floodplain site, until a small population was discovered in 1997 in Gaston County. All known current locations in the state for big shellbark hickory (*Carya laciniosa*) are within the Buzzard Point Floodplain Forests site, except for one site in Durham County; oddly, this tree is not even known to occur in Virginia, it being disjunct mainly from the Ohio River valley. Populations of limestone wild-petunia (*Ruellia strepens*) were newly discovered during the inventory along the river; it is known from only two other sites in the state.

There are several key habitats for rare plants in the floodplain. By far the most important are the rich slopes, especially the Basic Mesic Forests, which are primarily located in the upriver third or quarter of the floodplain (above US 258). Wild camassia, sessile-flowered trillium, Eastern isopyrum (*Enemion biternatum*), and James's sedge (*Carex jamesii*) are plants found in this type of habitat. Basic Mesic Forests in the lower half of the floodplain, near Williamston, contain magnolia vine and Virginia stickseed (*Hackelia virginiana*). Natural levees, especially those along the up-river parts of the floodplain, also have very rich soil. Dwarf stinging nettle is essentially limited to this habitat, and many populations of the trillium are found there, as well. The only current site in the state for veined skullcap (*Scutellaria nervosa*) is found on a levee. Where there are openings or edges along levees, especially in the central and lower parts of the floodplain, rare plants such as limestone wild-petunia and smooth hedge-nettle are found in partial sunlight conditions. Several rare sedges and grasses are found in backswamps or in the wetter portions of natural levees. Two rare plants – yellow-water crowfoot (*Ranunculus flabellaris*) and featherfoil (*Hottonia inflata*) – grow in standing water of pools and swamps.

Table 6. Rare Plant Species Known from the Roanoke River Floodplain

Scientific Name	Common Name	Element Rank		Status	
		Global	State	Federal	State
Camassia scilloides	Wild hyacinth	G4G5	S1	-	T
Carex cherokeensis +	Cherokee sedge	G4G5	S1	-	E
Carex crus-corvi *	Crowfoot sedge	G5	S1	-	SR
Carex emmonsii *	Emmons's sedge	G5	S1	-	SR
Carex jamesii	James's sedge	G5	S2	-	SR
Carex lupuliformis +	Hop-like sedge	G4	S1	-	SR

Scientific Name	Common Name	Element Rank		Status	
		Global	State	Federal	State
Carya laciniosa	Big shellbark hickory	G5	S1	-	T
Cynanchum laeve	Smooth swallowwort	G5	S1	-	W7
Desmodium fernaldii	Fernald's tick-trefoil	G4	S1	-	SR
Diplazium pycnocarpon +	Glade fern	G5	S3	-	W1
Enemion biternatum	Eastern isopyrum	G5	S2	-	SC-V
Fleischmannia incarnata *	Pink thoroughwort	G5	S2	-	T
Erythronium americanum ssp. Americanum	American trout lily	G5T5	S2?	-	W7
Euonymus atropurpureus	Eastern wahoo	G5	S2	-	W7
Hackelia virginiana	Virginia stickseed	G5	S1S2	-	SR
Heteranthera multiflora +	Multiflowered mud-plantain	G4	S1	-	SR
Heteranthera reniformis	Kidneyleaf mud-plantain	G5	S2?	-	W7
Hexastylis lewisii	Lewis's heartleaf	G3	S3	-	W1
Hottonia inflata *	Featherfoil	G4	S1?	-	SR
Hypericum adpressum *	Bog St. John's-wort	G3	SH	-	SC-H
Iresine rhizomatosa	Rootstock bloodleaf	G5	S2S3	-	W1
Leersia lenticularis	Catchfly cutgrass	G5	S2?	-	SR
Listera australis	Southern twayblade	G4	S3	-	W1
Mertensia virginica	Virginia bluebells	G5	S2	-	W7
Panax quinquefolius *	Ginseng	G3G4	S3S4	-	W5B
Paspalum fluitans *	Horsetail Crown Grass	G5	S1	-	SR
Phanopyrum gymnocarpon +	Swamp panic grass	G5	S1	-	SR
Phlox divaricate	Wild blue phlox	G5	S2	-	W7
Ptelea trifoliate	Wafer-ash	G5	S3	-	W1
Quercus palustris	Pin oak	G5	S2	-	W1
Ranunculus flabellaris +	Yellow water-crowfoot	G5	S1	-	SC-H
Ruellia strepens	Limestone wild-petunia	G4G5	S1	-	E
Schisandra glabra	Magnolia vine	G3	S1	-	T
Scutellaria nervosa	Veined skullcap	G5	S1	-	E
Scutellaria ovata var. bracteata	Heartleaf skullcap	G5T3T5	S2?	-	W7
Stachys tenuifolia	Smooth hedge-nettle	G5	S1	-	SR
Triadenum tubulosum	Marsh St. John's-wort	G4?	S2?	-	W7
Trifolium reflexum *	Buffalo clover	G3G4	S1S2	-	T

Scientific Name	Common Name	Element Rank		Status	
		Global	State	Federal	State
Trillium sessile	Sessile-flowered trillium	G4G5	S1	-	T
Triphora trianthophoros *	Three birds orchid	G3G4	S2S3	-	W1
Urtica chamaedryoides	Dwarf stinging nettle	G4G5	S1	-	E
Verbena hastate	Blue vervain	G5	S2S3	-	W7

+ = Not seen during the inventory, but has been observed in the floodplain within the past 25 years; not considered historical.

* = Historical records; species not observed in the floodplain within the past 25 years. However, the species might still occur in the county and be re-discovered.

EXPLANATION OF STATUS AND RANK CODES FOR PLANTS

Global Rank:

G1 = Critically imperiled globally because of extreme rarity or because of some factor making it especially vulnerable to extinction throughout its range. Typically 5 or fewer occurrences globally.

G2 = Imperiled globally because of rarity or because of some factor making it very vulnerable to extinction throughout its range. Typically 6-20 occurrences globally.

G3 = Either vulnerable and local throughout its range or found locally (even abundantly at some of its locations) in a restricted range or because of other factors making it vulnerable to extinction throughout its range. Typically 21-100 occurrences.

G4 = Apparently secure globally, though it may be quite rare in parts of its range, especially at the periphery.

G5 = Secure globally, though it may be quite rare in parts of its range, especially at the periphery.

Q = Questionable taxonomic assignment.

T = The rank of a subspecies or variety. As an example, G4T1 would apply to a subspecies or variety of a species with an overall rank of G4, with the subspecies or variety warranting a rank of G1.

? = Unranked, or rank uncertain.

State Rank:

S1 = Critically imperiled in North Carolina because of extreme rarity or because of some factor making it especially vulnerable to extirpation from the state. Typically 1-5 populations.

S2 = Imperiled in North Carolina because of rarity or because of some factor making it very vulnerable to extirpation from the state. Typically 6-20 populations.

S3 = Vulnerable in North Carolina. Typically 21-100 populations.

S4 = Apparently secure in North Carolina, with many occurrences.

SH = Of historical occurrence in North Carolina, not having been verified in more than 20 years, and suspected to be still extant.

An S or G rank involving two numbers indicates uncertainty of rank. For example, a G2G3 rank indicates that the species appears to warrant either a G2 or a G3 ranking, but that existing data do not allow that determination to be made.

U.S. Status:

E = Endangered. A plant that is in danger of extinction throughout all or a significant portion of its range.

T = Threatened. A plant that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

FSC = Federal Species of Concern. A species under consideration for listing, for which there is insufficient information to support listing at this time. "...The Service remains concerned about these species, but further biological research and field study are needed to resolve the conservation status of these taxa. Many

species of concern will be found not to warrant listing, either because they are not threatened or endangered or because they do not qualify as species under the definition in the [Endangered Species] Act. Others may be found to be in greater danger of extinction than some present candidate taxa. Such species are the pool from which future candidates for listing will be drawn." (Federal Register, February 28, 1996).

U.S. Status is determined by the U.S. Fish and Wildlife Service and the U.S. National Marine Fisheries Service in accordance with the U.S. Endangered Species Act of 1973, as amended (U.S. ESA). Plants and plant varieties, (including fungi and lichens), animal species and subspecies, and vertebrate populations are considered for Endangered or Threatened status according to the criteria established under the U.S. ESA. Consult the Asheville or Raleigh Ecological Services Field Offices for more information.

State Status:

E = Endangered. "Any species or higher taxon of plant whose continued existence as a viable component of the State's flora is determined to be in jeopardy" (GS 19B 106: 202.12). Endangered species may not be removed from the wild except when a permit is obtained for research, propagation, or rescue which will enhance the survival of the species.

T = Threatened. "Any resident species of plant which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range" (GS 19B 106:202.12). Regulations are the same as for Endangered species.

SC-V= Special Concern-Vulnerable. Any species or higher taxon of plant which is likely to become a threatened species within the foreseeable future.

SC-H = Special Concern-Historical. Any species or higher taxon of plant that occurred in North Carolina at one time, but for which all known populations are currently considered to be either historical or extirpated.

Plant statuses above are determined by the Plant Conservation Program, N.C. Department of Agriculture, revised December 1, 2010. The most current plant-related laws and regulations for North Carolina can be found at www.ncplant.com.

SR = Significantly Rare. Any species not listed by the N.C. Plant Conservation Program as Endangered, Threatened, or Candidate, which is rare in North Carolina, generally with 1-100 populations in the state, frequently substantially reduced in numbers by habitat destruction (and sometimes also by direct exploitation or disease). The Significantly Rare status is a NCNHP designation indicating the need for population monitoring and possible conservation action for species not currently listed as Endangered, Threatened, or Special Concern.

W1-W7 = Watch List. Any other species believed to be rare and of conservation concern in the state, but not warranting active monitoring at this time. Watch List Categories 1 – 7 are discussed in the Natural Heritage Program List of Rare Plant Species of North Carolina (Gadd and Finnegan 2012).

Status and rank codes for plants are derived from the Natural Heritage Program database -- 2012.

Fauna

Overview of Previous Surveys

The Roanoke River floodplain is extremely important for terrestrial animal species. Populations in the floodplain of White-tailed Deer (*Odocoileus virginianus*) and Wild Turkey (*Meleagris gallopavo*) are well-known to be among the highest in the state, if not the highest. Black Bears (*Ursus americanus*) occur mainly in the lowest portions, near the Albemarle Sound, though the population is slowly moving upriver. Other game species are common to abundant as well, such as Eastern Gray Squirrel (*Sciurus carolinensis*) and Eastern Cottontail (*Sylvilagus floridanus*). Medium to large, and rather secretive, mammal species are present in good numbers, as evidenced by tracks seen during the inventory – Coyote (*Canis latrans*), Gray Fox (*Urocyon*

cinereoargenteus), Red Fox (*Vulpes vulpes*), Bobcat (*Lynx rufus*), Raccoon (*Procyon lotor*), American Mink (*Mustela vison*), Northern River Otter (*Lontra canadensis*), and many others.

The floodplain has a very high diversity of breeding birds. Lynch (1981) indicated that 88 species of birds breed in the floodplain; detailed surveys conducted in 1992 and 1993 yielded 85 species of breeding birds (Lynch et al., 1994). The floodplain has more heronries than any other area of similar size away from the immediate coast; there a number of nesting sites for Great Blue Herons (*Ardea herodias*) and Great Egrets (*A. alba*), as well as smaller numbers of the scarce Yellow-crowned Night-Heron (*Nyctanassa violacea*) and Anhinga (*Anhinga anhinga*) (data from NCWRC). Raptors favoring forested wetlands – Red-shouldered Hawk (*Buteo lineatus*), Mississippi Kite (*Ictinia mississippiensis*), Bald Eagle (*Haliaeetus leucocephalus*), and Barred Owl (*Strix varia*) -- are quite numerous. Of most significance is a highly disjunct breeding population of Cerulean Warblers (*Setophaga cerulea*), from Weldon downriver to Williamston; the population is in steep decline, and the species is now uncommon near the river. The uncommon Swainson's Warbler (*Limnothlypis swainsonii*) and Kentucky Warbler (*Geothlypis formosa*) are likely more numerous here than anywhere in the state. In fact, the floodplain perhaps has the densest populations of nesting landbirds in the state, acre per acre, owing to the richness of the soil and the vegetation layers. The lower portions of the river host fairly good numbers of wintering waterfowl.

Brownwater river systems are not generally considered to be high in diversity of reptiles and amphibians, at least as compared with other habitats, such as Carolina bays and sandhills systems. Totals of 19 amphibian and 21 reptile species were found in an 18-month survey in the 1990s (Lamb et al., 1997). Surveys of moths have revealed several hundred species in a small area, such as at Devil's Gut (Hall 1999). Butterfly diversity is high in sunlit areas along levees and nearby uplands.

The aquatic fauna is widely appreciated by the public, especially in the spring season. Spawning runs of Striped Bass (*Morone saxatilis*), American Shad (*Alosa sapidissima*), Hickory Shad (*A. mediocris*), and "river herring" – Blueback Herring (*A. aestivalis*) and Alewife (*A. pseudoharengus*) – bring thousands of anglers to the river, both to the lower reaches and to the upper reaches just below the dam.

Summary of the Current (2012) Survey

A total of 721 species were recorded in 2012 that belong to the taxonomic groups currently included in NCNHP field surveys for animals (see Table 7). These include 150 species of vertebrates, 560 species of insects, and 11 species of land snails.

Table 7. Number of Species Recorded in Each Taxonomic Group of Animals

TAXON	NUMBER OF SPECIES
Birds	95
Butterflies	63
Frogs	15
TAXON	**NUMBER OF SPECIES**
Lizards	4
Mammals	18
Moths	430
Odonates	35
Orthopterans	29
Salamanders	5
Snakes	7
Tiger Beetles	3
Turtles	6
Total	**721**

General 2012 Survey Comments by Taxonomic Group

MAMMALS. Mammals were not specifically targeted for survey; however, tracks, scats, foraging sign, and direct observations were recorded whenever found, with particular attention given to those of carnivores. Coyotes appear to be well-established in the area, perhaps at the expense of Red Foxes and Gray Foxes, whose tracks were observed on only a few occasions. Bobcat tracks were also found on only one occasion, but Black Bear tracks and foraging sign – extensive disturbances to the litter layer, including snout probes – were seen at many of the sites, including as far up-river as Roanoke Big Oak Woods. American Mink and Northern River Otter tracks and sign were recorded only a couple of times, but relatively little time was spent surveying the river banks. Striped Skunks (*Mephitis mephitis*) may be increasing in the area; road-kills were common, and one skunk was seen at a burrow at Camassia Slopes and tracks were found at another site.

Feral Hogs (*Sus scrofa*) are apparently increasing in the Roanoke River floodplain, but appear to occur primarily downriver from US 258 (A. Mynatt, pers. comm.). Fortunately, no tracks were seen during the survey, nor were any foraging signs with deep rooting-up of the soil. Increase in the Feral Hog population, however, is likely to occur, with significant impacts to herbaceous plants and ground-dwelling animals.

Deer browse was frequently observed, but did not appear to be excessive; White-tailed Deer populations are well-controlled in this area due to the heavy hunting pressure. Nonetheless, browsing damage was noted to a small, remnant patch of veined skullcap (*Scutellaria nervosa*),

and it is possible that deer browsing could have been responsible for some failures to find other rare herbaceous species previously documented at some of the sites.

BIRDS. Fairly thorough lists for diurnal breeding birds were obtained for majority of the survey sites sampled from late April to mid-June. However, some sites were surveyed from late March to mid-April, before the complete set of breeding species had appeared; and some sites -- primarily in Martin and Bertie counties – were sampled only after late June, when breeding behavior, including singing, sharply drops off. Surveys for nightjars, owls, and other nocturnal species were not done systematically, though. Although the junior author was out after dark on several occasions setting out moth traps, no nightjars were recorded and only one species of owl -- Barred Owl -- was recorded, mostly during day trips. American Woodcocks (*Scolopax minor*) were also flushed during the day on two occasions.

Most of the species formerly or currently on the NCNHP Rare List or Watch List were found in moderate to good numbers and show no obvious declines since Lynch's surveys 20 or more years ago. In fact, two species have increased to the point that the NCNHP removed them from the Watch List late in 2012 -- Mississippi Kite and Swainson's Warbler; the latter species is now utilizing the numerous dense stands of Chinese privet in the floodplain for breeding habitat. Bald Eagles continue their steady increase across the state, and perhaps as many as 5-10 pairs now nest in the study area, whereas only 1-2 pairs were known to nest in the 1980s. Eagles were seen in small numbers daily on the boat trips, as were Ospreys (*Pandion haliaetus*). Black Vultures (*Coragyps atratus*) are holding steady or are increasing, as are Wild Turkeys and Anhingas.

The great majority of the breeding species appear to be at roughly the same population level as reported in Lynch et al. (1994), which gives abundance statuses for each species. However, population levels of three species are notably down from 1993. The State Special Concern Cerulean Warbler is much reduced in numbers. LeGrand and Hall did not see or hear a single Cerulean Warbler in their surveys in 2012, though several other birders who boated along the upper portion of the river between Halifax and Weldon did report hearing or seeing a handful of birds in 2012. As the breeding habitat appears to be similar to that in the 1990s, either Brown-headed Cowbird (*Molothrus ater*) nest parasitism or loss of habitat on the wintering grounds seem to be likely culprits for this strong decline. The Northern Bobwhite (*Colinus virginianus*) breeds in the floodplain only in disturbed habitats such as fairly recent clear-cut; however, it is now rather uncommon not only in the study area but across the eastern United States. Reasons for this strong decline are not clear and are somewhat controversial, with increase in various predators and loss of brushy habitats being the primary suggestions. The Wood Thrush (*Hylocichla mustelina*) is another bird strongly declining over the eastern United States; at best, it is uncommon to fairly common, as opposed to fairly common to common 20 years ago. Loss of breeding habitat seems to not be a factor; potential factors suggested include cowbird parasitism, loss of wintering habitat, and decline in small snails (a prey item).

REPTILES. No single species of reptile was specifically targeted for searching in 2012, there being very few on either the Rare List or Watch list or in the Landscape Habitat Indicator (LHI) Guilds for this region. However, all reptiles were recorded when encountered and searches were

routinely conducted under logs, bark, and other woody debris for snakes (as well as for salamanders and land snails).

One noteworthy finding was the observation of Green Anoles (*Anolis carolinensis*) at Roanoke Big Oak Woods in Halifax County. This appears to be a new county record and one of the few for the northeastern part of the state (J. Beane, pers. comm.).

The negative results with regard to snakes also appear to be noteworthy. Apart from Racers (*Colubris constrictor*), almost no large diurnal snakes were encountered. Only two Rat Snakes (*Elaphe obsoleta*) were seen; but no kingsnakes (*Lampropeltis getula*, *L. calligaster*, and *L. triangulum*), Garter Snakes (*Thamnophis sirtalis*), Ribbon Snakes (*T. sauritus*), or Eastern Hognose Snakes (*Heterodon platirhinos*) were noted. Only one Cottonmouth (*Agkistrodon piscivorus*) was encountered and no water snakes, but that may have been due to the relatively small amount of time spent surveying stream banks and river banks. All of the effort spent on the debris searches turned up only a few Eastern Worm Snakes (*Carphophis amoenus*), whereas one Smooth Earth Snake (*Virginia valeriae*) was collected by vehicle.

Fewer snakes were observed than had been expected, for no obvious reason. Black Bears appear to be on the increase, and their extensive foraging in leaf litter may be one factor. Feral Hog predation is also likely be significant, but no obvious evidence of their presence was noted at any of the sites visited.

AMPHIBIANS. Several species of salamanders and some species of frogs were targeted for surveys due to their inclusion within LHI Guilds. Salamanders were searched for primarily by turning over logs and other woody debris. Frogs were detected both by sound and by visual observation as the biologists walked through the forests. No systematic attempt was made to survey for breeding choruses at night, but these were recorded opportunistically.

As with the small snakes, few salamanders were found in the debris searches; most were Atlantic Coast Slimy Salamanders (*Plethodon chlorobryonis*) and Marbled Salamanders (*Ambystoma opacum*). No Red-backed Salamanders (*P. cinereus*) were found, despite targeting them for specific searches along the bluffs in early spring. Searching around the margins of seeps turned up a few Southern Two-lined Salamanders (*Eurycea cirrigera*) and Southern Dusky Salamanders (*Desmognathus auriculatus*); however, no Chamberlain's Dwarf Salamanders (*E. chamberlaini*), another species that was targeted, could be found.

Frog surveys were more successful, with most of the expected species recorded at multiple sites. The most noteworthy record was for a Barking Treefrog (*Hyla gratiosa*) that was heard at the Conoho Neck Swamp natural area near Williamston. While there are records for this species in southeastern Virginia, it does not appear to have been recorded in the northeastern corner of North Carolina previously (Beane et al., 2010). Our records for Squirrel Treefrogs (*H. squirella*) may also represent range extensions. This species was previously only sparsely recorded in the northeastern part of the state (Beane et al., 2010), but was among the most commonly recorded frog in our survey, occurring in multiple sites on both sides of the river. The one record for Pickerel Frog (*Rana palustris*) from the Garibaldi Tract (within the Camassia Slopes/Gumberry

Swamp natural area) in Northampton County also appears to be located along the edge of the range for this species in the northern Coastal Plain.

Upland Chorus Frogs (*Pseudacris feriarum*) and a few Spring Peepers (*P. crucifer*) were observed at several of the sites during the survey, despite the fact that both these species are rarely observed outside their breeding period in late winter and early spring. No Brimley's Chorus Frogs (*P. brimleyi*) were heard or observed, however, nor were Wood Frogs (*Rana sylvatica*), which Hall and LeGrand had hoped might have a slim chance of occurring along the lower portion of the Roanoke River. Cope's Gray Treefrogs (*Hyla chrysoscelis*) were often recorded, with none sounding even vaguely like Eastern Gray Treefrog (*H. versicolor*), which has been found in the state close to the Virginia border from Warren County westward.

Outside of the floodplain, the State Significantly Rare Oak Toad (*Bufo quercicus*) was observed at the NCWRC Wildlife Depot at Tillery, and several choruses of Pine Woods Treefrogs (*Hyla femoralis*) were heard along NC 903 near Halifax. Both may represent first Halifax County records for these species.

LAND SNAILS. Only larger (> 5 mm) species of snails were included in the survey. Snails were searched for under woody debris, along with the reptiles and amphibians mentioned above. However, many of the individuals recorded in this survey were found foraging on tree trunks, fallen logs, or on the foliage of herbaceous plants.

The most noteworthy record was a population of an ambersnail, apparently the Squatty Ambersnail (*Succinea unicolor*), found at the Woods Island tract within the Cypress Swamp/Sandy Run Floodplain Forest natural area in Bertie County. *S. unicolor* is primarily a Floridian species that has a few disjunct populations known as far north as Camden and Pasquotank counties in North Carolina (Hubricht 1985). However, this group of snails is in need of systematic revision, and it is possible that the Bertie County populations represent a different species from those farther south; a specimen collected during this survey is currently undergoing DNA analysis to determine its identity. Following the discovery of this population in June 2012, efforts were made to find it at other sites with similar levee forest habitats. None were found, however.

Another noteworthy species that was found at most of the survey sites is the Blunt Wedge (*Xolotrema caroliniense*). This fairly large and distinctive species was previously known in the state almost solely from Anson County in the Yadkin/Pee Dee River Basin (Hubricht 1985). However, it was recently discovered in the northern Coastal Plain (A. Van Devender, pers. comm.), and it turned out to be one of the most common snails encountered during this survey. In contrast, no *X. caroliniense* were found in the recent NCNHP survey conducted in the Uwharrie Mountains, and it remains to be seen if any other populations exist between the Roanoke and the Pee Dee rivers.

ODONATES [DRAGONFLIES AND DAMSELFLIES]. The survey found 28 species of dragonflies and 7 species of damselflies, mostly representing species that were expected to occur within the floodplain and adjoining fields. The most success for finding species was by walking along the shoreline of the river in midsummer and late summer, when the river banks were lower and there

were more rocks and sticks available for perching sites. However, the survey team spent very little time working the rapids and rocks in the Fall Line portion of the river, where there is the potential for several rare or uncommon dragonflies, especially clubtail species.

Though no Significantly Rare species were noted, the biologists did find two Watch List species, not previously recorded from the floodplain. The Cocoa Clubtail (*Gomphus hybridus*) was seen frequently in April, at three sites in the uppermost part of the floodplain. This species was previously known in the state north only to the Neuse River floodplain, according to the "Dragonflies and Damselflies of North Carolina" website, and thus this represents a major range extension northward; it has yet to be found in Virginia. The Riverine Clubtail (*Stylurus amnicola*) was seen at three locations within the large Cypress Swamp/Sandy Run Floodplain Forest natural area. It also represents a northward range extension, according to the above website; it was previously known northward only to the Tar River system.

Two other dragonflies were notable for the Coastal Plain portion of the range; they occur mainly in the mountains and Piedmont. Several Brown Spiketails (*Cordulegaster bilineata*) were seen in spring in the upriver portions of the floodplain; this is a species usually found in seeps and small pools within floodplains, though it does forage in nearby clearings. A sighting of a male Twelve-spotted Skimmer (*Libellula pulchella*) in a field in the Cypress Swamp/Sandy Run Floodplain Forest was notable, though it might have been a migrant, as the species seems not to have resident populations in the eastern half of the state.

BUTTERFLIES. The surveys in 2012 were quite successful in revealing many dozens of butterfly species in the floodplain. As most adults require sunlight for foraging, best results were found by walking along sunlit tracks within the floodplains, most notably within Conoho Neck Swamp, Cypress Swamp/Sandy Run Floodplain Forest, Conine Island, and Buzzard Point Floodplain Forests. Most of the sites in the up-river floodplain were too shaded or too hilly for a good butterfly diversity, with the exception of the Roanoke Canal Trail, which traverses many power-line clearings and other sunny areas.

No Significantly Rare species were found, though there were few such species possible for the floodplain. One Watch List species was found, at two sites in the floodplain – the Carolina Roadside-Skipper (*Amblyscirtes carolina*); this floodplain lies at or near the northwestern portion of its range. A major range extension was made for the Broad-winged Skipper (*Poanes viator*). Previously known from tidal marshes and a few inland marshes from Wake and Chatham counties, a fairly large population was seen around a man-made pond just north of Roanoke Rapids, along the Roanoke Canal Trail. This pond was ringed with southern wild rice (*Zizaniopsis miliacea*), its host plant in the inner parts of its range. A few Harvesters (*Feniseca tarquinius*) were seen in the middle portions of the floodplain; this is rarely seen in the Coastal Plain. Eastward range extensions were documented for two species whose occurrence in the Coastal Plain appears to be limited to the Roanoke River floodplain. The Silvery Checkerspot (*Chlosyne nycteis*) was seen at several sites, most notably in the far eastern tip of Halifax County in Buzzard Point Floodplain Forests, and especially in Bertie County in the Woods Island tract of Cypress Swamp/Sandy Run Floodplain Forest. It was previously known in the region only from along the Roanoke Canal Trail. Likewise, the Northern Pearly-eye (*Lethe anthodon*) was also

documented from this latter site, which provided first county records for Bertie County for these two floodplain species.

The extensive levees, swamps, and bottomlands provide excellent habitats for several additional satyr/brown species, besides the Northern Pearly-eye. Large numbers of Southern Pearly-eyes (*L. portlandia*) and Appalachian Browns (*L. appalachia*) were noted in 2012; in fact, the state's highest one-day count of the former (120 individuals) and the second highest one-day count of the latter (60 individuals) were both made on August 22 within the Buzzard Point Floodplain Forests site. A few of the scarce Creole Pearly-eye (*L. creola*) were also seen on that date.

MOTHS. Macro-moths were one of the main groups targeted in this survey, with many species on the Rare List and Watch List and many more included in the LHI Guilds. Most species were collected by Hall using light traps set out overnight, but at least a few day-flying species were recorded during routine survey visits. On several of the moth sampling trips, he was joined by Dr. J.B. Sullivan, whose collecting samples greatly added to the species list.

The following noteworthy species were found during the inventory:

Catocala mira – a hawthorn-feeding species not previously reported in the Coastal Plain (NCNHP records are all from the mountains, but it has also been reported from the western Piedmont by the Moth Photographers Group [MPG] website)

Catocala nebulosa – a bitternut-feeding species not previously reported in North Carolina from the Coastal Plain (NCNHP records are all from the mountains, but it has also been reported from the Piedmont by the MPG website and by Parker Backstrom)

Catocala robinsoni – a shagbark-feeding species not previously reported in the Coastal Plain (NHP records are all from the eastern Piedmont)

Heterocampa subrotata – a *Celtis*-feeding species previously recorded in the Coastal Plain only at Greenbank Bluff in Brunswick County (all other NCNHP records are from the mountains, although at least a few have been reported from the eastern Piedmont)

Leucania calidior – a rare cane-feeding species previously recorded in North Carolina only in the Croatan National Forest

Papaipema rutila – a mayapple-feeding species that has only been recorded in North Carolina at Island Creek in the Croatan National Forest

Phalaenostola metonalis – a litter-feeding species not previously recorded in North Carolina outside the mountains

Rivula stepheni – a recently described species associated with wetland graminoids; previously recorded in North Carolina only at a few sites in the southern Coastal Plain and Sandhills

Sphinx kalmiae – an ash-feeding species not previously recorded in the Coastal Plain (all NCNHP records are from the mountains, but the MPG website shows several records from the Piedmont)

Spilosoma latipennis – a northern forb-feeding species not previously recorded in North Carolina outside the mountains

ORTHOPTERANS [GRASSHOPPERS AND KATYDIDS]. Grasshoppers were recorded whenever observed, with one species, *Melanoplus mirus*, specifically targeted in the survey. This flightless species appears to be known only from North Carolina. It was first found in 1913 at Weldon (the

type locality for the species) by Rehn and Hebard (1916) and has apparently been observed only there and at Pilot Mountain in the western Piedmont. Despite making a significant effort to search specifically for this species, none were found.

However, another flightless species of *Melanoplus* – recorded at the Garibaldi tract within Camassia Slopes/Gumberry Swamp in Northampton County – may be one of the most noteworthy finds of the survey. This species, referred to here as *Melanoplus nr. tepidus*, has been identified as a species currently being described by JoVonn Hill (Mississippi State University, pers. comm.). Apart from populations found at Torreya State Park and a few other ravines along the Appalachicola River in Florida and neighboring Georgia, the only records for this species come from the Garibaldi tract, obtained during this survey, and from previous surveys conducted by Hall at the Devil's Gut Preserve and at Rocky Point Marl Forest in the southern Coastal Plain of North Carolina. This species is currently placed on the NCNHP Watch List but appears to be Globally Rare and probably highly imperiled. All known populations are very localized in their occurrence, making them vulnerable to extirpation. How a small, flightless grasshopper copes with the frequent flooding of its sedge meadow habitats along the Roanoke is completely unknown.

One other noteworthy Orthopteran found during the survey was the Modest Katydid (*Montezumina modesta*), a poorly known species that has been recorded only twice now in NCNHP surveys. Although this species is rarely recorded across its entire range, too little is known about its habitat and distribution to accurately assess its conservation status.

Rare Species

As seen on Table 8, there are several dozen rare species recorded from the study area; most are moths and mussels. However, unlike with plants, there are almost no species in North Carolina known only from the Roanoke River, in particular because most species can easily move over large distances. The most notable rare species in the floodplain is likely the Cerulean Warbler, as it is a Federal Species of Concern and has a breeding population disjunct from the main range (the Appalachian Mountains and westward). Two rare bat species – Southeastern Myotis (*Myotis austroriparius*) and Rafinesque's Big-eared Bat (*Corynorhinus rafinesquii*) – are also Federal Species of Concern and have been found at several sites in the lower half of the floodplain; the river's swamps and bottomlands provide excellent habitat for them. Perhaps surprisingly, there are no reptiles or amphibians that are on the Rare List, and just one reptile is on the Watch List.

The absence of rare reptiles and amphibians is more than made up of by the abundance of rare mussels in the river. Most of these are found immediately below the Roanoke Rapids Lake dam, where the dam blocks sediments and thus provides relatively silt-free conditions for mussels; in addition, the rocks in this portion of the river provide riffles that are important for the mussels, as well. Of those seen within the past 25 years, the most significant are the Roanoke Slabshell (*Elliptio roanokensis*), Yellow Lampmussel (*Lampsilis cariosa*), and the Green Floater (*Lasmigona subviridis*). The other rare species known from this area are the Triangle Floater (*Alasmidonta undulata*), Alewife Floater (*Anodonta implicata*), Atlantic Pigtoe (*Fusconaia masoni*), Eastern Lampmussel (*Lampsilis radiata*), the Tidewater Mucket (*Leptodea ochracea*),

and the Eastern Pondmussel (*Ligumia nasuta*). Another hotspot for rare mussels is the lowest portions of the river, close to Albemarle Sound. The Tidewater Mucket and Eastern Pondmussel occur there, and the Alewife Floater occurs in the lower portions of the Cashie River and likely is present here as well; each of these three also is found in the Fall Line zone with the above group of rare mussels. The Chowanoke Crayfish (*Orconectes virginiensis*) is also found in this aquatic habitat.

Though most of the "rare" moths are actually on the Watch List, there are seven species on the Significantly Rare list; two species of underwing moths – Lincoln Underwing (*Catocala lincolnana*) and Marbled Underwing (*C. marmorata*) – are the most notable. The only noteworthy dragonflies and butterflies are Watch List species, though the inventory did provide the first Roanoke River floodplain records for both the Cocoa Clubtail and the Riverine Clubtail Dragonflies. A rather unusual snail was found in the Cypress Swamp/Sandy Run Floodplain Forest natural area that might be an undescribed species; however, for the moment is it being considered as the Squatty Ambersnail.

Table 8. Rare Animal Species Known from the Roanoke River Floodplain

Scientific Name	Common Name	Element Rank		Status	
		Global	State	Federal	State
MAMMALS					
Corynorhinus rafinesquii macrotis	Rafinesque's Big-eared Bat – Coastal Plain Population	G3G4TNR	S3	FSC	SC
Myotis austroriparius	Southeastern Myotis	G3G4	S2	FSC	SC
Sciurus niger	Eastern Fox Squirrel	G5	S3	-	WL
BIRDS					
Ammodramus savannarum	Grasshopper Sparrow	G5	S3B, S1N	-	WL
Anhinga anhinga	Anhinga	G5	S3B	-	WL
Euphagus carolinus	Rusty Blackbird [winter season only]	G4	S3N	-	WL
Haliaeetus leucocephalus	Bald Eagle	G5	S3B, S3N	-	T
Lanius ludovicianus	Loggerhead Shrike	G4	S3B, S3N	-	WL, SC
Nyctanassa violacea	Yellow-crowned Night-Heron	G5	S2B	-	SR
Setophaga cerulea	Cerulean Warbler	G4	S2B	FSC	SC
Vireo gilvus	Warbling Vireo	G5	S2B	-	SR
REPTILES					
Virginia valeriae	Smooth Earth Snake	G5	S3	-	WL
FISHES					
Carpiodes cyprinus	Quillback	G5	S2?	-	SR
Etheostoma vitreum	Glassy Darter	G4G5	S3	-	WL
MOLLUSKS – MUSSELS					

Scientific Name	Common Name	Element Rank		Status	
		Global	State	Federal	State
Alasmidonta undulata	Triangle Floater	G4	S2	-	T
Anodonta implicata	Alewife Floater	G5	S1	-	T
Elliptio roanokensis	Roanoke Slabshell	G3	S1	-	T
Fusconaia masoni *	Atlantic Pigtoe	G2	S1	FSC	E
Lampsilis cariosa	Yellow Lampmussel	G3G4	S1	FSC	E
Lampsilis radiata	Eastern Lampmussel	G5	S1S2	-	T
Lasmigona subviridis	Green Floater	G3	S1	FSC	E
Leptodea ochracea	Tidewater Mucket	G3G4	S1	-	T
Ligumia nasuta	Eastern Pondmussel	G4	S1	-	T
MOLLUSKS – SNAILS					
Succinea unicolor	Squatty Ambersnail	G3G4	S1S2	-	SR
Xolotrema caroliniense	Blunt Wedge	G4	S3?	-	WL
CRUSTACEANS					
Orconectes virginiensis	Chowanoke Crayfish	G3	S3	-	SC
INSECTS – DRAGONFLIES					
Arigomphus villosipes	Unicorn Clubtail	G5	S3	-	WL
Gomphus dilatatus	Blackwater Clubtail	G5	S3?	-	WL
Gomphus hybridus	Cocoa Clubtail	G4	S3	-	WL
Stylurus amnicola	Riverine Clubtail	G4	S3	-	WL
INSECTS – KATYDIDS					
Montezumina modesta	Montezuma Katydid	GU	SU	-	WL
INSECTS – BUTTERFLIES					
Amblyscirtes carolina	Carolina Roadside-Skipper	G3G4	S3S4	-	WL
INSECTS – MOTHS					
Acrapex relicta	a canebrake moth	G4	S3	-	WL
Anacamptodes cypressaria	an inchworm moth	G2G4	SU	-	SR
Apameine new genus 2 sp. 3	an undescribed cane moth	GNR	S2S3	-	SR
Argillophora furcilla	a cane moth	G3G4	S2S3	-	WL
Caripeta aretaria	Southern Pine Looper	G4	S3S4	-	WL
Catocala lincolnana	Lincoln Underwing	G3	S2S3	-	SR
Catocala marmorata	Marbled Underwing	G3G4	S1S3	-	SR
Catocala orba	Orb Underwing	G4	S2S3	-	SR
Cerma cora	a bird-dropping moth	G3G4	S2S3	-	SR
Cisthene kentuckiensis	Kentucky Lichen Moth	G4	SU	-	WL
Gondysia smithii	Smith's Darkwing	G4	S3?	-	WL
Hypomecis longipectinaria	a wave	G2G4	S3S4	-	WL
Idaea scintillularia	Diminutive Wave	GNR	SU	-	WL
Leucania calidior	Cane Wainscot	G2G4	S1S2	-	SR
Lithacodia sp. 1	a bird-dropping moth	G1G3	S1S3	-	WL

Scientific Name	Common Name	Element Rank		Status	
		Global	State	Federal	State
Lithacodia sp. 2	a bird-dropping moth	G1G3	S1S3	-	WL
Orgyia detrita	a tussock moth	G3G4	S2S3	-	WL
Papaipema araliae	Aralia Shoot Borer Moth	G3G4	S2S4	-	WL
Papaipema sp. 3	Southeastern Cane Borer Moth	G4	S3S4	-	WL
Properigea tapeta	an owlet moth	GNR	SU	-	WL
Rivula stepheni	Stephen's Grass Moth	GNR	SU	-	WL
Tornos abjectarius	a gray	GNR	S2S4	-	WL
Tripudia flavofasciata	an owlet moth	GNR	SU	-	WL
Zale sp. 3 nr. buchholzi	an owlet moth	G3G4	S2S3	-	WL
Zanclognatha atrilineella	an owlet moth	GU	S1S3	-	WL

* = Historical records; species not observed in the county within at least 25 years. However, the species might still occur in the county and be re-discovered.

EXPLANATION OF STATUS AND RANK CODES FOR ANIMALS

Global Rank: (additional code not found in Table 6)
_NR = Not Ranked. Global rank of the species or subspecies not yet assessed.

State Rank: (additional codes not found in Table 6)
SU = Currently unrankable in the state due to lack of information or substantially conflicting information about status or trends. Need more information.
_B = Rank of the breeding population in the state. Used for migratory species only.
_N = Rank of the non-breeding population in the state. Used for migration species only.

State Status:
E = Endangered. Any native or once-native species of wild animal whose continued existence as a viable component of the State's fauna is determined by the Wildlife Resources Commission to be in jeopardy or any species of wild animal determined to be an 'endangered species' pursuant to the Endangered Species Act. (Article 25 of Chapter 113 of the General Statutes; 1987).
T = Threatened. Any native or once native species of wild animal which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range, or one that is designated as a threatened species pursuant to the Endangered Species Act. (Article 25 of Chapter 113 of the General Statutes; 1987).
SC = Special Concern. Any species of wild animal native or once-native to North Carolina which is determined by the Wildlife Resources Commission to require monitoring but which may be taken under regulations adopted under the provisions of this Article. (Article 25 of Chapter 113 of the General Statutes; 1987).
SR = Significantly Rare. Any species which has not been listed by the N.C. Wildlife Resources Commission as an Endangered, Threatened, or Special Concern species, but which exists in the state (or recently occurred in the state) in small numbers and has been determined by the N.C. Natural Heritage Program to need monitoring. (This is a N.C. Natural Heritage Program designation.) Significantly Rare species include "peripheral" species, whereby North Carolina lies at the periphery of the species' range (such as Hermit Thrush), as well as species of historical occurrence with some likelihood of re-discovery in the state.

Species considered extirpated in the state, with little likelihood of re-discovery, are given no State Status (unless already listed by the N.C. Wildlife Resources Commission as E, T, or SC).

WL = Watch List. Any other species believed to be rare and of conservation concern in the state, but not warranting active monitoring at this time. (This is a N.C. Natural Heritage Program designation.)

DISCUSSION

Impacts of the Reservoirs on the Roanoke River and its Floodplain

The creation of three large reservoirs – John H. Kerr Reservoir, Lake Gaston, and Roanoke Rapids Lake – along the middle portion of the Dan/Roanoke River has brought about significant changes in the flow of the river and the sediment load of the river, as well. Prior to their construction, the river behaved as did other brownwater rivers in the state. There were frequent but brief flooding events, most often in winter and early spring; floodwaters carried a heavy load of silt that was often deposited throughout the floodplain, even on the farthest ridges from the river channel, if the flood levels were very high. Waters from such flood events often returned to the river banks within a few days, and seldom remained for more than a week. Deposits of sediment covered the floodplain, with the thickest deposits on the natural levees.

However, since the 1960s and 1970s, the natural water flow has been altered by these reservoirs and dams, as the U.S. Army Corps of Engineers now controls the timing and amount of water releases from the dams. Lynch et al. (1994, p. 12-13) state that:

> "The high runoff during late winter and early spring is now captured for temporary storage in Kerr Reservoir, and released more gradually in following months. This results in diminished flow releases during the flood peak, and more prolonged, higher rates of flooding during the onset of the growing season in April through June. In wet years, this prolonged period of higher runoff may persist throughout the summer season.
>
> "Another impact of the dams upon the hydrologic regime has been the near elimination of extreme flood flows. The large flood events are thought to have been integral to many ecological processes such as nutrient enrichment of higher terraces, as well as the constant re-working of the floodplain topography necessary to drive forest successional processes.
>
> "The large pre-dam floods also moved huge volumes of sediment downriver, where much of the rich silt and clay was deposited on floodplain terraces. Most of the sediment is now being captured behind the upstream dams. It is suspected that the hydrologic changes have adversely affected the regeneration of certain tree species, the natural succession process, the growth rates of hardwood trees, and the behavior and relative abundance of wildlife species. The interruption of complex ecological processes on the floodplain may have far-reaching negative implications for the flora and fauna along the Roanoke if not mitigated."

Changes in Natural Resources since the 1970s

The surveys conducted along the river and its floodplain in 2012 can be useful to serve as a comparison with the original surveys of natural areas and rare species as far back as the 1970s. In the 1970s, if not earlier, classes from the University of North Carolina visited selected sites along the river and tributaries for studies of plant composition; sites included Conoho Creek Slopes and Floodplain and Phlox Woods, among others. J. Merrill Lynch conducted the most intensive surveys in the late 1970s, compiling reports a few years later (Lynch and Crawford 1980; Lynch 1981).

Perhaps the most obvious change has been an increase in timber harvest, often in the form of clear-cuts, in recent years, especially on the northern side in Northampton County. A moderate number of timber cuts have been done in the central third of the floodplain in Bertie County, above NC 11/42. Most of the floodplain forests below this highway are either in conservation ownership or are generally too swampy to conduct sizable timber harvests. Essentially all of these cuts retain a 30 ft.-wide (or wider) buffer along the river; in a few cases, such clear-cuts are barely visible to boaters along the river.

A second change has been an apparent increase in the amount of herbaceous exotic plant invasion in the upriver portions of the floodplain. Japanese stilt-grass (*Microstegium vimineum*) is a relatively recent invader of the state's floodplains; in the 1970s, it likely was quite scarce, and no mention was made of this grass in older reports. Though common chickweed (*Stellaria media*) was mentioned on plant lists for various sites, it was generally not mentioned as a serious threat to native plants. However, surveys in 2012 of Basic Mesic Forests revealed a very heavy cover or thatch of chickweed on nearly all levees, and growing to the top of many slopes, being worse on the lower slopes. Thus, native plants, especially rare and low-growing spring ephemeral species, are being impacted now by chickweed on the slopes and by both chickweed and Japanese stilt-grass on the levees. The two other major exotic offenders -- Japanese honeysuckle (*Lonicera japonica*) and Chinese privet (*Ligustrum sinense*) – were mentioned as threats in the earlier reports, and this status has not changed, though it seems likely that these two woody species have not greatly impacted rare herbaceous species in recent decades.

On the other hand, in the 2012 survey, very few new man-made structures are visible along the river since the earlier surveys. As mentioned in the Study Area section, this part of North Carolina is generally losing population, and very few new houses, docks, or other structures were noted during the boat trips. In fact, one or two railroad trestles have been, or are being, removed. Scattered camping shelters have been erected near the river downstream from Hamilton for overnight lodging by canoeists and kayakers.

The 2012 surveys did not concentrate on aquatic surveys, and it was not obvious that water levels in the river have changed much since the 1970s. The releases of water from the Roanoke Rapids Lake dam are probably similar in flow and duration, though it is possible that some improvements to the water release regime have been made, as several environmental groups are working with the U.S. Army Corps of Engineers to make sure that delicate natural resources – both to fisheries in the river and to plants and animals on land -- are not greatly impacted by too much and too lengthy flooding, or too little water release, as well. Certainly, the trapping of

large amounts of sediment behind the dams has allowed for reasonably silt-free waters just below Roanoke Rapids Lake dam, and thus the dams have probably enhanced the habitat for mussels in the river along the Fall Line.

Researchers in 2012 noted that many of the floodplains behind levees seemed to contain very few shrubs or regeneration of saplings, leaving a mature canopy and a dense herb layer. Such a vegetation structure can occur as a result of long periods of flooding or standing water, so that seedlings and saplings are killed by standing water. These lower portions of the levees (Brownwater Levee Forest – Low Levee Subtype) naturally flood more than the higher levees, and like Cypress-Gum Swamps, tend to have little shrub layer. However, ongoing research (J. White, in prep.) has found increased tree mortality and lack of regeneration in these communities on the Roanoke River compared with similar communities on other rivers. This is believed to be caused by the altered flood regime.

There were no recent signs of silt deposits in 2012, and it is possible that no flooding occurred during the several years of drought before that. Chickweed and Japanese stilt-grass were very abundant in these communities in 2012. It is possible they have benefited from several years without flooding to spread into lower areas.

In addition to concerns about the altered water flows and sediment loads, there are a few other concerns for the future. Salt water intrusion and the slow sea level rise, which are already converting swamp forests to marshes farther east in the Albemarle Sound, will almost certainly begin to kill trees in the lowest reaches east of Plymouth, if this is not already happening. Thus, Conaby Creek/Swan Bay Swamp and the Roanoke River Delta Islands sites will presumably see an increase in fresh to slightly brackish marshes and a corresponding loss in forested habitats. Clearcutting of forest stands, for timber, pulp, wood chips, or wood pellets, occurs throughout much of the state, as well as in the Roanoke River floodplain. Many of these clearcuts observed along the Roanoke during the survey were hundreds of acres in size, and some had very minimal buffer left between the harvested areas and the river itself. With increased demand for wood products, clearcutting may well expand along the Roanoke in the near future. Also, exotic plant and animal pathogens likely will hit key species in the future; ash, dogwood, redbay, and other trees are being affected in various parts of the eastern United States, and thus the health of many forest stands might be impacted.

Lands in Conservation Ownership

The greatest positive comparison from the 1970s to 2012 is in "lands in conservation ownership." When Lynch (1981) was conducting surveys in the Roanoke River area, there were essentially no lands in conservation ownership along the river; there was no Roanoke River National Wildlife Refuge, no Upper and Lower Roanoke River Wetlands Game Lands, and The Nature Conservancy had no preserves yet along the river. Today, the USFWS has almost 21,000 acres protected in the Roanoke River National Wildlife Refuge; these lands – all in Bertie County -- extend as far upriver as the Hamilton area at Broadneck Swamp and as far down-river as the mouth at Goodmans Island. The NCWRC has protected roughly 8,850 acres in the Lower Roanoke River Wetlands Game Land, which extends upriver north of Hamilton and down-river

to the Conoho Farms tract just north of Williamston. NCWRC has even larger holdings upriver of NC 11/42, roughly containing 10,200 acres in the Upper Roanoke River Wetlands Game Land; it extends upriver to the Garibaldi tract just east of Halifax and downriver to the Urquhart tract at Buzzard Point.

The other key private conservation partner is The Nature Conservancy, which owns a number of tracts (approximately 11), totaling roughly 22,500 acres, extending upriver to the Fall Line at I-95 and downriver to the Conaby Creek area near the mouth. It also holds easements totaling approximately 9,860 acres at the Big Swash and Warren Neck. Additional conservation lands are held by the N.C. Department of Cultural Resources, which owns 265 acres at the Roanoke Earthworks State Historic Site across the river from Weldon. There are several Wetland Reserve Program easements held by the U.S. Department of Agriculture's Natural Resources Conservation Service scattered within the floodplain. The N.C. Department of Public Safety administers the large Tillery (Caledonia) Prison Farm in Halifax County and the smaller Odom Prison Farm across the river in Northampton County; though not technically conservation areas, small portions of each contain good forests along the river that have been incorporated into nearby natural area boundaries.

A number of these tracts have additional protection as Dedicated State Nature Preserves. Many of The Nature Conservancy parcels, and much of the NCWRC's Upper and Lower Roanoke River Wetlands Game Lands, have this permanent protection. The Cultural Resources tract at the Roanoke Earthworks is also a Dedicated State Nature Preserve.

Priorities for Protection

Many, if not the majority of the most significant natural areas along the Roanoke River, are already in some form of conservation status. However, most of these protected lands are concentrated in the lower 40% of the floodplain, below NC 11/42, where much of these lands consist of swamp forests and low levees. The middle 30-40% of the floodplain has a moderate number of natural areas and tracts protected, but most of these are flatlands, leaving essentially all of the slopes and bluffs here (and below NC 11/42) still unprotected. The upper 20% of the study area (above the two prison farms) does contain a scattering of protected natural areas, but a handful of key sites there are not yet afforded protection.

Both the Mud Castle Slopes and the Halifax Bluffs are unprotected and contain at least a mile length of Basic Mesic Forest natural community, with many rare plants. Though such sites are similar ecologically to the protected portions of Camassia Slopes/Gumberry Swamp and Larkspur Ridge/Roanoke Big Oak Woods, these two sites add to this rich diversity of plants in the upper Roanoke, and certainly they contain a few species and features not protected elsewhere along the river. Farther downriver, in the central portions, rich slopes and bluffs at Hills Ferry/Palmyra Slopes remain unprotected; there are no protected slopes and bluffs anywhere within 10 air miles of this site, and several notable natural communities are found there. The closely-spaced Fort Branch Bluffs and Poplar Point Slopes, about 10 air-miles down-river from Hills Ferry/Palmyra Slopes, also are not protected; these contain rich slopes and a 70 ft.-high vertical bluff. Lastly, the majority of the Basic Mesic Forest slopes in the Conoho Creek Slopes

and Floodplain natural area remain unprotected. These slopes include an unusual variant of Basic Mesic Forest and two rare plants.

The upper portion of the study area contains two large unprotected floodplain forests – Mush Island and Occoneechee Neck Floodplain Forest. Both of these contain several miles of river frontage, with populations of the severely declining Cerulean Warbler (*Setophaga cerulea*). The first site is also within the acquisition boundary for the Roanoke River National Wildlife Refuge, as it contains one to several impounded areas with open water and other features amenable to a great array of wildlife. The middle portions of the river have protection needs, mostly to add to existing conservation lands. Only 30% of the Buzzard Point Floodplain Forests is protected; important lands to the west of the protected lands, as well as across the river in Bertie County, are worthy of protection. The large Cypress Swamp/Sandy Run Floodplain Forest is roughly 55% protected; there are a number of large tracts between existing NCWRC land that are worth acquiring to provide a protected corridor on this north side of the river. In the lower portion of the river, Sweetwater Creek Swamp is an important site, in part because it contains one of the few currently known sites in the state for featherfoil (*Hottonia inflata*).

The other major targets for protection work are natural areas along and close to the outer edges of the floodplain, especially the northern margins. For example, Indian Woods/Broadneck Swamp and Conine Terrace Forest are notable for their forests on medium-to-high ridges, well back from the main natural levees.

Landowner Protection Options

A moderate number of privately-owned sites are mentioned in the section above. Though most public and private conservation entities would prefer to acquire tracts in fee simple, in order to have complete control over management of the tracts, in some cases the landowners do not wish to sell the tracts, but are interested in other forms of protection of their land. Several protection/ conservation options are available.

If the site contains a significant natural area as identified by the NCNHP, one protection option is the N.C. Registry of Natural Heritage Areas. This voluntary, non-binding agreement with the State can provide the landowner with management recommendations or prescriptions (if desired), some degree of statutory protection of the land from construction of pipelines and transmission lines, and public recognition (if desired). For more information, contact the N.C. Natural Heritage Program, Office of Land and Water Stewardship, 1601 MSC, Raleigh, NC 27699-1601 (website: http://www.ncnhp.org.)

A permanent protection option, which is fixed to the property deed, is the conservation easement. This popular option allows the owner to retain title of the property and to exercise certain property rights, including control of access to the public. At the owner's discretion, other rights, such as the right to develop the site, can be deeded over to a recognized conservation organization established to preserve such land in a natural condition. Conservation easements can be sold or donated, and they can confer State and Federal tax benefits to the owner. There is one regional land trust operating in the Roanoke River floodplain area – the North Carolina

Coastal Land Trust. For more information, contact this organization at: North Carolina Coastal Land Trust, 131 Racine Drive, Suite 202, Wilmington, NC 28403; website: http://www.coastallandtrust.org/.

An umbrella organization for local land trusts is The Conservation Trust for North Carolina, 1028 Washington Street, Raleigh, NC 27605; website: http://www.ctnc.org/. This organization has publications that discuss conservation options for private landowners.

The Natural Resources Conservation Service of the U.S. Department of Agriculture is another agency that maintains conservation easements in the region. Their contact information is: http://www.nrcs.usda.gov/wps/portal/nrcs/site/national/home/.

The U.S. Fish and Wildlife Service also manages conservation easements in the Roanoke River area. For conservation assistance by this agency, contact the Service's Raleigh office at: U.S. Fish and Wildlife Service, Raleigh Field Office, P.O. Box 33726, Raleigh, NC 27636-3726; website: http://www.fws.gov/raleigh/.

One program that offers assistance in achieving forest management goals is the Forest Stewardship Program that is sponsored by the U.S. Forest Service, working mainly through State forestry agency partners. This management plan offers owners assistance in controlled burning, re-forestation of natural vegetation, and maintenance of vegetative buffer strips along watercourses. For more information, see the Service's website at: http://www.fs.fed.us/spf/coop/programs/loa/fsp.shtml .

If an owner does wish to part with his or her tract, and donate or sell the land to a conservation organization or agency, there may be State or Federal tax benefits associated with the transfer of the property. Such direct transfer of land to a conservation entity is the simplest and most effective way of ensuring long-term protection of land. The main conservation organization in the state that acquires private land is the North Carolina chapter of The Nature Conservancy. Contact them at: The Nature Conservancy, North Carolina Chapter Office, 334 Blackwell Street, Suite 300, Durham, NC 27701; website: <http://www.nature.org/northcarolina>.

Areas for Further Study

ANIMAL SURVEYS. Most of the field work was focused on location of extensive and high quality examples of natural communities, with a lesser emphasis on surveys for rare plants. Animal work was done mainly while in the process of identification of natural plant communities and their significances, such as taking notes on birds seen and heard during the surveys. Specific trips targeted toward animals were limited to several moth collecting trips made by Hall.

Compared with most county inventories conducted by NCNHP, there was a stronger emphasis placed on animal field work for this inventory, in part because of the known rich diversity of animal species previous reported (Lynch 1981) and in part because of the high potential to find rare species, especially insects (such as moths and dragonflies) . Even so, much more field work would be needed to do a thorough job of surveying terrestrial animals; Hall (1999) identified several hundred moth species just in one preserve (Devil's Gut), and thus one would expect upwards of 1,000 moth species to occur in the floodplain as a whole. More surveys of bats, through mist-netting, would be highly recommended, as such previous surveys found two rare species. Trapping for small terrestrial mammals might yield large numbers of records, though there might not be rare species in the floodplain. More survey work for reptiles and amphibians might uncover a few rare species such as Four-toed Salamander (*Hemidactylium scutatum*) or Eastern Gray Treefrog (*Hyla versicolor*). There was a sufficient survey for birds, as well as butterflies; these groups are readily visible or readily heard. Aquatic animal surveys were not conducted as part of this inventory, as portions of the river are surveyed every few years by other agencies; however, the area below the Roanoke Rapids Lake dam likely harbors more rare fishes, mussels, and other species than is currently known.

PLANT SURVEYS. In general, survey for noteworthy plants was moderate to fairly good; however, as many of them are spring ephemerals, it was impossible to cover all rich slopes in the prime mid-March to mid-May periods, and even mid-May was likely too late for some species. Thus, more surveys in spring, especially in the sites down-river from Camassia Slopes, are needed. Coverage was also focused on the rich slopes, and thus few of the more remote floodplain ridges were surveyed. Another group of plants poorly surveyed were the floating species found in creeks, impoundments, or heavily flooded swamps. No surveys were conducted by boat in the spring or early summer to look for rare species such as featherfoil or yellow water-crowfoot (*Ranunculus flabellaris*); had they been done, it is likely that new populations for them could have been located.

NATURAL COMMUNITY/GEOMORPHIC FEATURES SURVEYS. The majority of the field work was concentrated in the upper half of the floodplain, as that portion has the greatest topographical diversity, the greatest diversity of natural communities, and the richest slopes for plant species. Thus, survey work in the lower half was limited mainly to easily accessible sites by car and foot, such as Conine Island and portions of Conoho Neck Swamp. No field work occurred on the more remote natural areas at the outer margins of the floodplain; therefore, natural communities on floodplain ridges, such as Brownwater Bottomland Forests (of all subtypes) were inadequately surveyed. In addition, because they are very common and often very wet, little work was done in Cypress—Gum Swamp forests. There was no field work done in the pocosin-like vegetation at Conaby Creek/Swan Bay Swamp, in part because of difficulty of access and

partly because of the low likelihood of finding noteworthy plant and animal species. Boat surveys were limited to areas above NC 11/42, and thus river channels, any oxbow lakes, or other notable geomorphic features in the lower part of the river were not surveyed, either.

POTENTIAL NATURAL AREAS. One of the tasks of the inventory was to identify potential significant natural areas, or potential areas that could be added to existing natural areas. Many areas as seen on recent aerial photos, or as seen from boating along the river, appear to contain middle-aged to mature forests and to be worthy of natural area status, but a ground inventory is needed first. (NCNHP staff decided not to incorporate large areas of unsurveyed lands into existing natural areas, nor identify a new natural area without such a field survey.)

Figure 4 shows sizable areas in the Roanoke River floodplain that appear to contain good-to-excellent quality forests and have the potential to be a new natural area, or a part of an existing natural area, and eventually to be recommended for protection. The most upriver potential natural area lies about 0.7-mile west of Occoneechee Neck Floodplain Forest. This forested floodplain (Site 1 on Figure 4) is roughly 1.5 miles long, on the northeastern side of the river, and it extends back from the river for at least 0.5-mile. It could be connected to that site, though most of the intervening land lies in pine stands. Just east of Larkspur Ridge/Roanoke Big Oak Woods is an area (Site 2) of apparently mature hardwoods on fairly steep north-facing slopes, with a very narrow floodplain. This area extends about 1.5 miles east from The Nature Conservancy's Larkspur Ridge tract boundary. It would be worth visiting in the spring to determine if the flora is as rich as that of Larkspur Ridge and neighboring natural areas.

Across the river (to the east) from Pollocks Ferry Natural Area is a several-mile stretch of floodplain forest; only the northern portion (Site 3), directly across from the northern boundary of the game land, appears to be relatively intact floodplain forest. Farther downriver, just south of the end of the Woods Island tract within Cypress Swamp/Sandy Run Floodplain Forest, is another area (Site 4) of floodplain forest that extends along the eastern and northern sides of the river for nearly 1.5 miles.

Farther downriver, lying between Buzzard Point Floodplain Forests and Hills Ferry/Palmyra Slopes, is an apparently unexplored area (Site 5) that has a 0.85-mile frontage on the northern side of the river and that contains some locally rare south-facing slopes. It would be beneficial to know what type of natural communities and flora exist on such slopes, as well as in the floodplains. Another potential natural area connector lies between Roanoke River/NC 11 Floodplain Forests and Broadneck Swamp/Company Swamp, on both sides of the river. This area (Site 6) is roughly 1.5 miles wide along the river and might contain additional notable plants on the levees, as the "Mertensia Levee" portion of the latter natural area lies not far down-river.

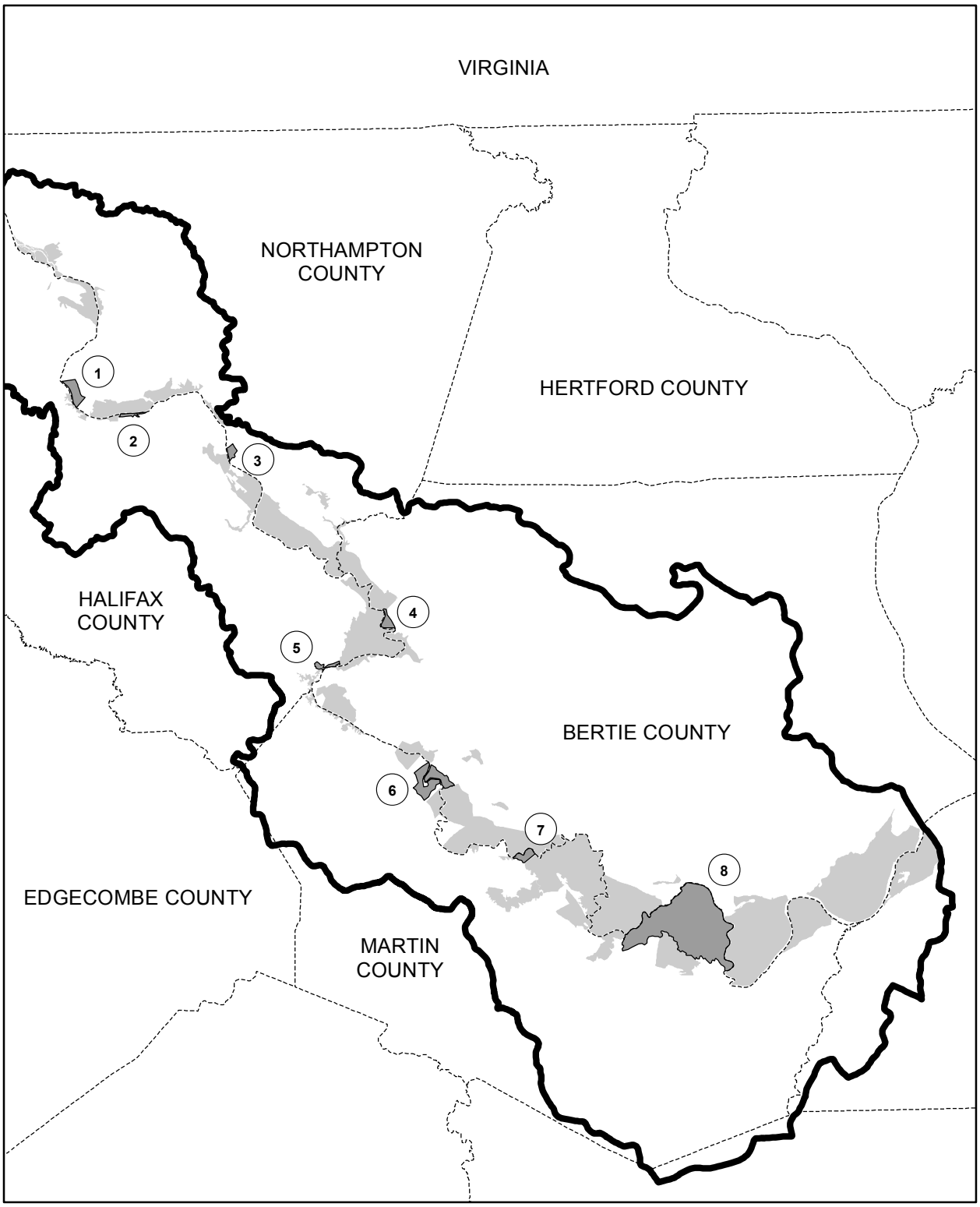

Figure 4. Location of Potential Significant Natural Areas in the Roanoke River Floodplain.

The slopes along the river between Hamilton and Williamston are essentially in private ownership and have been poorly surveyed, at least in recent decades. Thus, survey work on slopes (Site 7) that extend almost ¾-mile east from the Poplar Point Slopes natural area is needed. This potential natural area, which might contain the rare Umbrella Magnolia form of Basic Mesic Forest, would connect that natural area with the Conoho Neck Swamp natural area just downriver. By far the largest potential natural area (Site 8) lies between Devil's Gut and the river. It is known as Bull Run Island, owned by The Nature Conservancy; this tract is roughly 9,275 acres in size. Though inventory might be difficult because of the very wet, swampy conditions, records of rare species, in addition to a few bats and moths already known, are likely to be found. There is also swamp forest between Devil's Gut and Sweetwater Creek Swamp that needs survey work.

BIOLOGICAL SURVEYS AND ENDANGERED SPECIES LAWS

Obtaining landowner permission to survey is an integral part of biological inventory. Occasionally, however, permission to survey on private lands is not granted due to a belief that if a rare species is discovered, restrictions and land-use limitations will be imposed. Clearly, when this occurs the search for scientific information is hindered. A secondary effect of not granting permission to survey is that owners of biologically significant lands do not learn about the conservation options and tax incentives that are available to them. Those who grant permission and are found to own significant lands are given results from the biological survey and, if they wish, are put in contact with an appropriate conservation organization, or are made aware of other management or protection options.

In reality, there is very little reason for landowners to have concerns about the presence of rare species on their land. A summary of federal and state endangered species laws relevant to private landowners was recently prepared by Mark A. Cantrell of the U.S. Fish and Wildlife Service and Kenneth A. Bridle of the Piedmont Land Conservancy in Greensboro, NC. Some of that information is presented below to help dispel concerns that landowners may have about rare species and to provide clarification on potential land-use restrictions.

Federal Law

1. The Endangered Species Act (ESA) protects only plants and animals that are federally listed as Endangered or Threatened. Since federally listed species are by definition very rare, the likelihood of any occurring on a given tract of private land is very small.

2. The ESA protects federally listed animal species from the potentially harmful actions of private landowners. Because this may lead to restrictions on their use of lands, Congress, the U.S. Fish and Wildlife Service (USFWS), and other partners have worked to develop flexible tools for resolving conflicts. These tools include Section 10 permits, such as habitat conservation plans, safe harbor agreements, and candidate conservation agreements. Federal funds are also available to assist landowners with management and conservation of listed and candidate species (rare federally but not officially listed) on their land. Plants on private land are not subject to provisions of the ESA, unless federal funding or permitting is involved.

3. Engaging in interstate or foreign trade of a federally listed species without a permit is illegal for plants and animals. "Taking" (i.e., harassing, harming, pursuing, hunting, killing, trapping) or possessing illegally taken animals is a violation of the ESA. Removing, digging up, cutting, damaging, or destroying a federally listed plant is illegal on federal lands.

4. Through the habitat conservation planning process, the USFWS may issue a permit so that private landowners may lawfully "take" a federally listed animal species if it is "incidental to and not the purpose of carrying out otherwise lawful activities." These permits are available as long as the landowner implements an approved habitat conservation plan, and the "taking" does not jeopardize the continued existence of the species. A private landowner is not required to prepare

a conservation plan for the "taking" of listed plant species as long as the activity does not involve federal funding or permitting, or is not in violation of other laws.

5. Under the ESA, private developers can obtain permits to legally harm or even kill federally listed species on their property provided that they show that attempts were made to minimize impacts on the species in other ways.

6. The existence of a federally listed plant species on private property has no legal effect on the landowner unless a project requires a federal permit or uses federal funds and will clearly result in adverse impacts to the listed plant. Landowners, individuals, and agencies are prohibited from taking listed animals without authorization, whether the action is private or federally funded.

7. When critical habitat is designated for federally listed species, it applies only to federal actions, not to state or local projects, and not to the actions of private landowners unless there is federal funding or permitting involved.

State Law

1. North Carolina endangered species laws apply to species listed by the state as Endangered, Threatened, or Special Concern.

2. The state plant and animal endangered species laws are modeled after the ESA, in that they prohibit illegal trafficking or poaching of listed species.

3. The state endangered animal species law states that "no rule may be adopted that restricts use or development of private property."

4. The state endangered plant species law states that "the incidental disturbance of protected plants during agricultural, forestry, or development operations is not illegal so long as the plants are not collected for sale or commercial use." Collection of federal or state listed plants from public or private land can only be done with the landowner's written permission and a permit from the N.C. Department of Agriculture's Plant Conservation Program.

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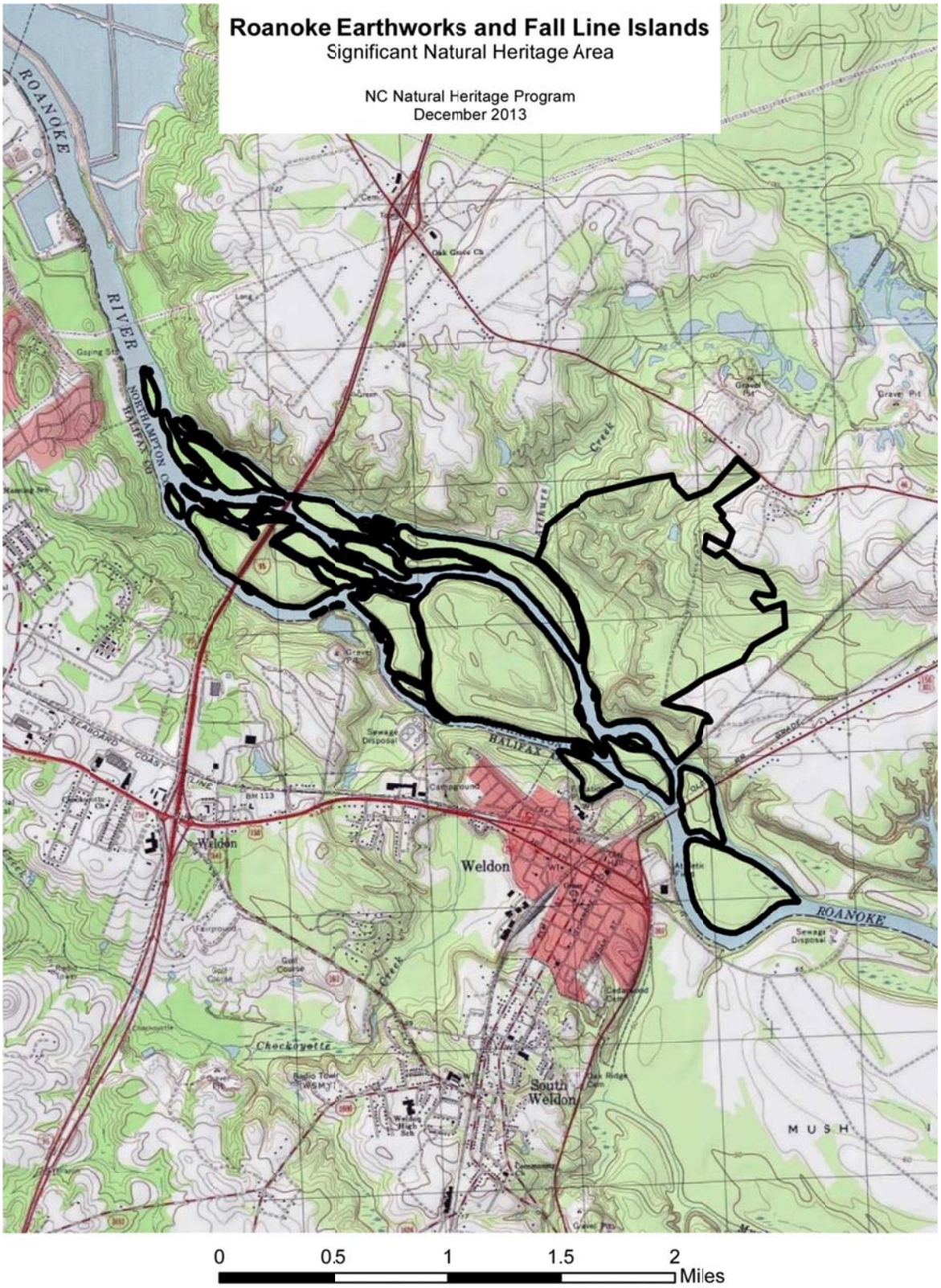
SITE DESCRIPTIONS


Roanoke Earthworks and Fall Line Islands
Significant Natural Heritage Area
NC Natural Heritage Program
December 2013
ROANOKE
RIVER
NORTHAMPTON CO
HALIFAX CO
Weldon
Weldon
South Weldon
Chockoyotte
Creek
ROANOKE
MUSH
0
0.5
1
1.5
2
Miles

Roanoke River Inventory

ROANOKE EARTHWORKS AND FALL LINE ISLANDS
Significant Natural Heritage Area

Site Significance:
Representational Value: Very High (R2)
Collective Value: High (C3)
Quadrangles: Weldon, Roanoke Rapids

Size: 1,202 acres
Ownership: N.C. Department of Cultural Resources, The Nature Conservancy, private

SIGNIFICANT FEATURES: This large site, consisting of many river islands and land on the Northampton County side of the river, contains a good array of natural communities, and the only Piedmont examples of natural communities in the project area. An unusual and rare Piedmont Swamp Forest is present, as well as many types of mesic forests on slopes, and a Bottomland Forest and several seeps. The floodplain north of the river supports the best known population in North Carolina of the State Endangered dwarf stinging nettle (*Urtica chamaedryoides*), which is the basis of the Very High Representational Value (R2). The State Special Concern Cerulean Warbler (*Setophaga cerulea*) occurs on some of the river islands. The collection of six natural communities, two rare plants, and one rare animal give the site the High Collective Value rating (C3).

LANDSCAPE RELATIONSHIPS: This is the only significant site in the river corridor located partially above the Fall Line. The Fall Line essentially passes through the lower part of the site. The lower end of the natural area lies about 0.2-mile above (upriver from) Mush Island. Phlox Woods lies about 0.4-mile to the south of this natural area.

SITE DESCRIPTION: The portion of the site located on the Northampton County "mainland" is primarily within the Roanoke Earthworks tract. There are fairly steep slopes next to the river at the southern end; these are somewhat high in pH and are best considered as Basic Mesic Forest (Piedmont subtype, Basic variant) natural community. Farther west, the slopes are more gradual, and there is a distinct floodplain, highlighted by an unusual Piedmont Swamp Forest, which retains water for much if not most of the year. Surrounding the swamp, and mostly to the south, is a Piedmont Bottomland Forest (Typic subtype), where a large population of dwarf stinging nettle (*Urtica chamaedryoides*) grows. Where the slopes bend away from the river, there is a steep ravine along a small creek that contains a good example of Basic Mesic Forest (Piedmont subtype, Intermediate variant); the herb layer here does not support the lush spring flora found in the Basic variant, and species more typical of the Piedmont, such as black cohosh (*Actaea racemosa*) and hop-hornbeam (*Ostrya virginiana*), are found.

In the center of this Roanoke Earthworks tract is a small creek and narrow floodplain, and this floodplain contains a Piedmont Headwater Stream Forest. Interestingly, two Watch List plants – wafer-ash (*Ptelea trifoliata*) and Lewis' heartleaf (*Hexastylis lewisii*) -- occur here. The Watch List Cocoa Clubtail [dragonfly] (*Gomphus hybridus*) was observed along an access road in the northern part of the tract.

The river islands contain a small and declining breeding population of State Special Concern Cerulean Warbler (*Setophaga cerulea*). The Significantly Rare sessile-flowered trillium (*Trillium sessile*) and additional populations of dwarf stinging nettle grow on these heavily forested river islands, which probably support a mix of Piedmont Bottomland Forest and Basic Mesic Forest. Numerous rare aquatic animals are present in the river in this vicinity: fish – Quillback (*Carpiodes cyprinus*); mussels – Triangle Floater (*Alasmidonta undulata*), Alewife Floater (*Anodonta implicata*), Roanoke Slabshell (*Elliptio roanokensis*), Atlantic Pigtoe (*Fusconaia masoni*), Eastern Lampmussel (*Lampsilis radiata*), Green Floater (*Lasmigona subviridis*), and Tidewater Mucket (*Leptodea ochracea*).

PROTECTION AND MANAGEMENT: The Roanoke Earthworks tract is administered by the N.C. Department of Cultural Resources, and most of the tract has been protected as a Dedicated State Natural Preserve. Several of the numerous islands are owned and protected by The Nature Conservancy, as the Roanoke River Islands Preserve. The remainder of the significant natural area is privately owned and not protected. Ideally, The Nature Conservancy will continue to acquire more islands, especially the largest one, which is a mile long by 0.5-mile wide and which contains the only known trillium locale in the natural area. Little management of most of the natural area is needed; however, the floodplain on the "mainland" has locally dense stands of the invasive exotic Chinese privet (*Ligustrum sinense*), which should be removed to improve the natural community condition.

NATURAL COMMUNITIES: Piedmont Levee Forest (Typic subtype), Piedmont Bottomland Forest (Typic subtype), Piedmont Swamp Forest, Piedmont Headwater Stream Forest, Basic Mesic Forest (Piedmont subtype, Basic variant), Basic Mesic Forest (Piedmont subtype, Intermediate variant).

RARE PLANTS: Sessile-flowered trillium (*Trillium sessile*), dwarf stinging nettle (*Urtica chamaedryoides*); Watch List -- Lewis' heartleaf (*Hexastylis lewisii*), wafer-ash (*Ptelea trifoliata*).

RARE ANIMALS: Cerulean Warbler (*Setophaga cerulea*); Watch List – Cocoa Clubtail (*Gomphus hybridus*).

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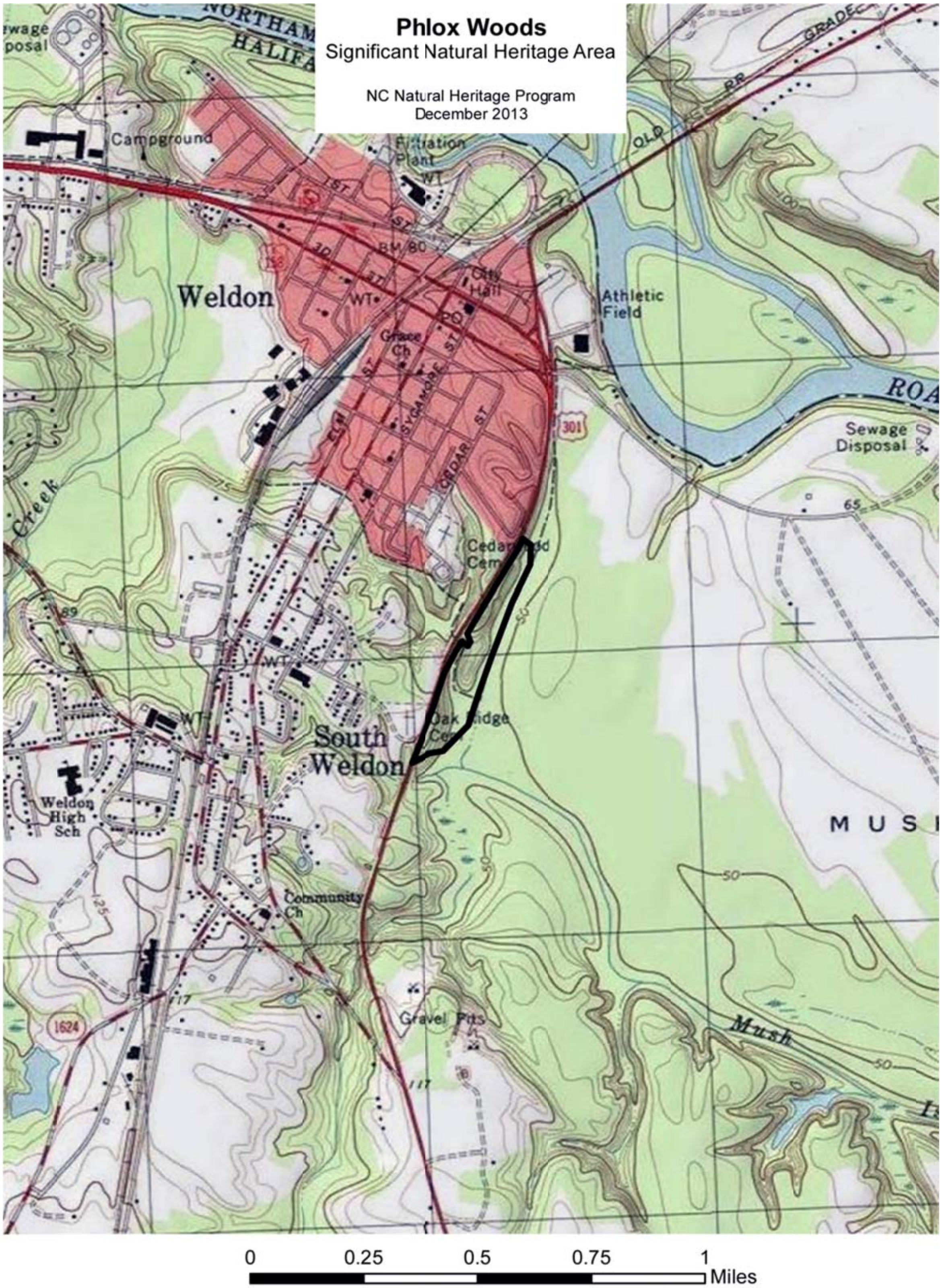

Phlox Woods
Significant Natural Heritage Area
NC Natural Heritage Program
December 2013
Campground
Weldon
South Weldon
Athletic Field
Sewage Disposal
Weldon High Sch
Community Ch
Gravel Pits
0
0.25
0.5
0.75
1
Miles

Roanoke River Inventory

PHLOX WOODS
Significant Natural Heritage Area

Site Significance:
Representational Value: General (R5)
Collective Value: General (C5)
Quadrangle: Weldon

Size: 21 acres
Ownership: Town of Weldon, private

SIGNIFICANT FEATURES: This site is of General significance for North Carolina's biodiversity (Representational Value and Collective Value ratings of 5), and it supports one natural community that is not among the best examples of this type in the state. The small natural area contains a fairly good example of the uncommon Basic Mesic Forest (Coastal Plain subtype, Rich Alluvial Terrace Slopes variant, Basic form) natural community. It has a rich flora, with three rare plant species historically documented from the site.

LANDSCAPE RELATIONSHIPS: This natural area is located along the Fall Line that separates the Piedmont from the Coastal Plain, though the flora present is similar to Coastal Plain sites slightly downstream. The Roanoke Earthworks and Fall Line Islands natural area lies about 0.4-mile to the north, and Mush Island lies about 0.7-mile to the east and southeast.

SITE DESCRIPTION: This is a well-known natural area and was first reported as being significant in the 1970s. It consists of several mostly east-facing slopes, over very rich (high pH) soil, with a diverse Basic Mesic Forest (Coastal Plain subtype, Rich Alluvial Terrace Slopes variant, Basic form). Though the site visit for this current inventory showed little signs of human disturbance, none of the rare plants previously known from the site – eastern isopyrum (*Enemion biternatum*), sessile-flowered trillium (*Trillium sessile*), and James's sedge (*Carex jamesii*) – could be found, despite two observers covering the slopes in early spring (at the optimal survey time). However, the Watch List eastern wahoo (*Euonymus atropurpureus*) is present, as are sizable patches of the "namesake" species, wild blue phlox (*Phlox divaricata*), which is locally rare east of the mountains.

PROTECTION AND MANAGEMENT: Most of the southern third of the site is protected by a private owner as a Registered Natural Heritage Area. The Town of Weldon owns most of the middle third of the site, though this tract has no formal protection. It appears that the invasive exotic common chickweed (*Stellaria media*), present on all Basic Mesic Forest and levee sites along the Roanoke River, has smothered the populations of the rare plants, though it is possible that a few of these rare plants might still be present and were overlooked. Hand-removal of chickweed would be difficult. Traffic and human activities should be minimized at the site, as chickweed and other exotics can take advantage of canopy openings and soil disturbance and can smother native plants.

NATURAL COMMUNITIES: Basic Mesic Forest (Coastal Plain subtype, Rich Alluvial Terrace Slopes variant, Basic form)

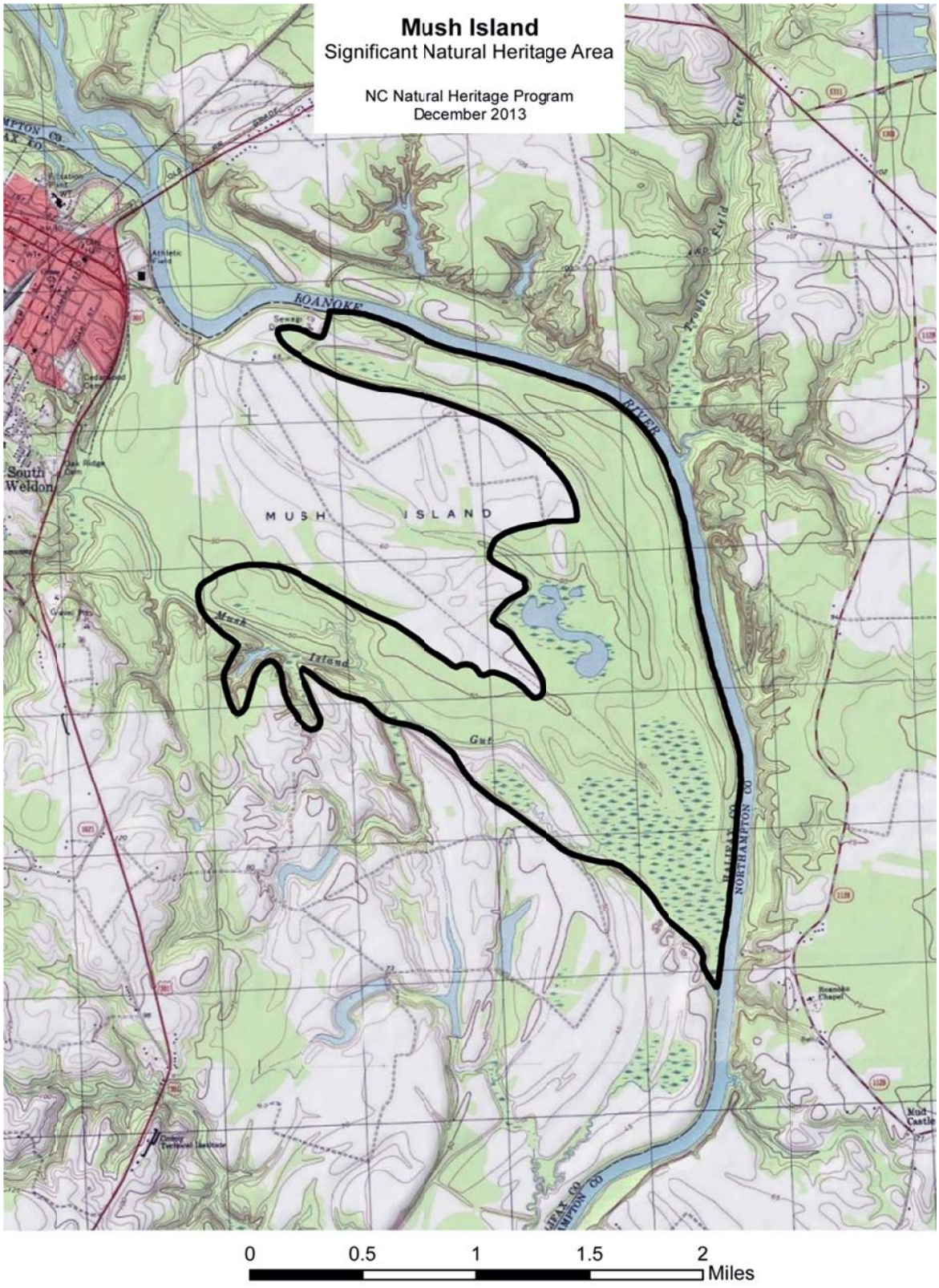
RARE PLANTS: James's sedge (*Carex jamesii*) (historical), eastern isopyrum (*Enemion biternatum*) (historical), sessile-flowered trillium (*Trillium sessile*) (historical); Watch List — eastern wahoo (*Euonymus atropurpureus*).

RARE ANIMALS: Watch List – Blunt Wedge [snail] (*Xolotrema caroliniense*).

REFERENCES:

LeGrand, H. 2012. Site Survey Report: Phlox Woods. N.C. Natural Heritage Program, Office of Land and Water Stewardship, DENR, Raleigh.

Lynch, M. 1979. Phlox Woods. N.C. Natural Heritage Program.


Mush Island
Significant Natural Heritage Area
NC Natural Heritage Program
December 2013
ROANOKE
RIVER
MUSH
ISLAND
Mush
Island
Gut
South
Weldon
Trouble
Creek
HALIFAX CO
NORTHAMPTON CO
0
0.5
1
1.5
2
Miles

Roanoke River Inventory

MUSH ISLAND
Significant Natural Heritage Area

Site Significance:
Representational Value: High (R3)
Collective Value: General (C5)
Quadrangle: Weldon

Size: 1,677 acres
Ownership: private

SIGNIFICANT FEATURES: This large site contains rather wide, forested natural levees that host one of the better Coastal Plain populations of the State Special Concern Cerulean Warbler (*Setophaga cerulea*). This population of the warbler, considered between the 3rd and 6th best in the state, gives a High Representational Value (R3) to the site. Mush Island also contains a nest of the State Threatened Bald Eagle (*Haliaeetus leucocephalus*). A heronry was present at the site in the 1980s, but it is apparently no longer active. As there are no natural community descriptions yet available for the site, the total of two rare animals known from the site yields a General Collective Value (C5) for the natural area.

LANDSCAPE RELATIONSHIPS: This site occupies most of the southwestern shoreline of the Roanoke River, just below the Fall Line, for over 3 miles. It lies only 0.2-mile downstream from the lower end of the Roanoke Earthworks and Fall Line Islands natural area, and directly across the river, to the east, is the Mud Castle Slopes natural area. On the other hand, it is over 4 miles farther downstream to the next series of natural areas (below the town of Halifax).

SITE DESCRIPTION: Mush Island, as named on the USGS topographic map, is currently not an island, but it contains low ground on the west side, just below the Fall Line, that possibly floods from time to time. Mush Island Gut is a creek on the south side of the "island." Much of Mush Island consists of agricultural fields, though the natural area as designed eliminates the fields and thus contains essentially fairly mature forests, close to the river and along Mush Island Gut. Within this forested area was a site known as "Pierce's Farm Heronry," located in an impounded slough; in 1985 it contained a nesting colony of Great Blue Herons (*Ardea herodias*) and possibly Anhingas (*Anhinga anhinga*), but it has apparently been abandoned. Few site descriptions of the vegetation of the levee forests exist, and the primary significance of the site is the small-to-modest (but declining) population of Cerulean Warblers, which can be heard singing in the levee trees from boats/canoes along the adjacent river.

PROTECTION AND MANAGEMENT: The site lies essentially in a single private ownership and has no protection status. All of Mush Island lies within the acquisition boundary of the Roanoke River National Wildlife Refuge, even though all current refuge landholdings lie far downriver, in Bertie County. In order to maintain the Cerulean Warbler population, the forest on the natural levee should not be disturbed, and any timber harvest done should attempt to maintain a mature canopy close to the river.

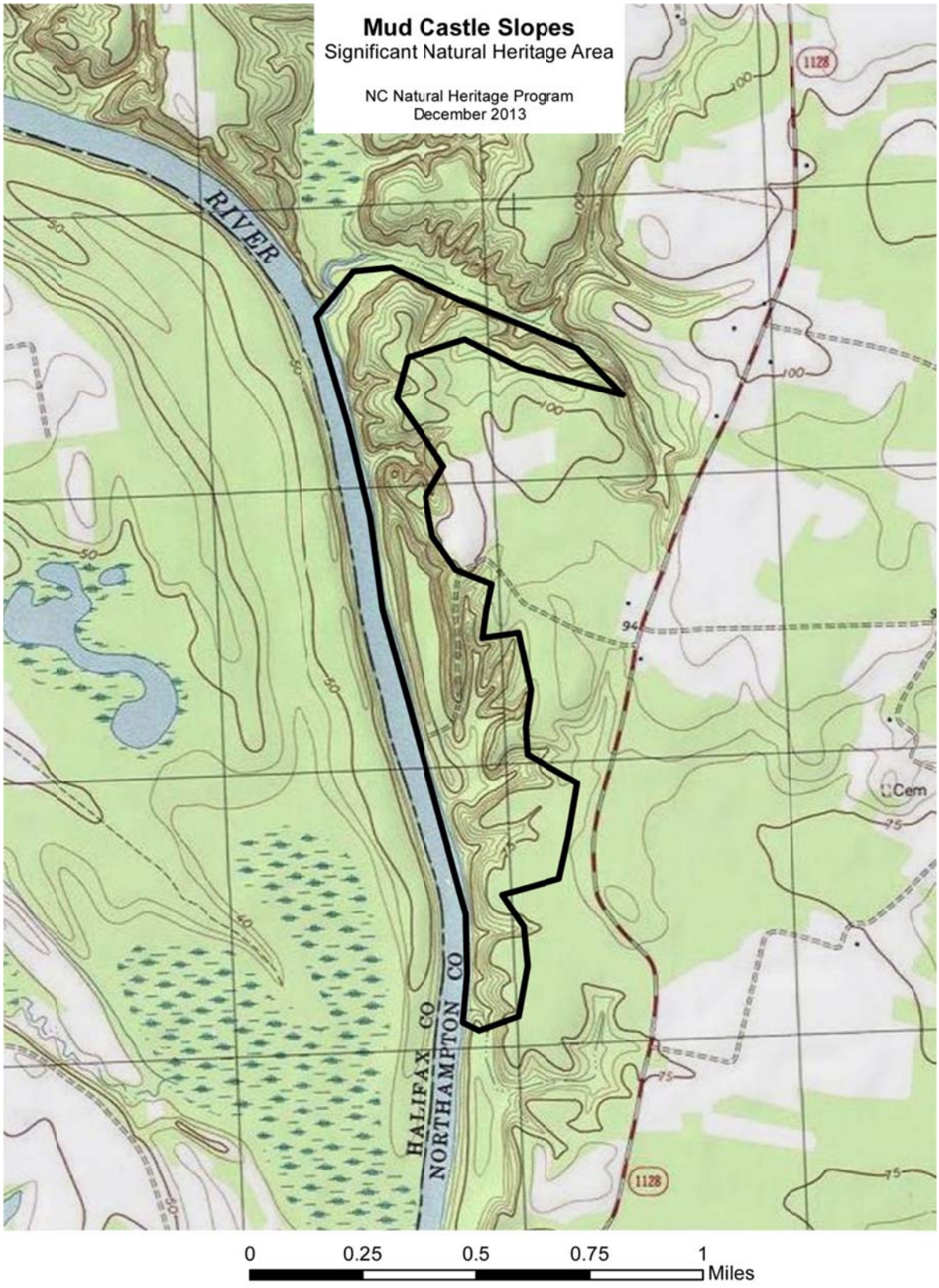
NATURAL COMMUNITIES: None described.

RARE PLANTS: None known.

RARE ANIMALS: Bald Eagle (*Haliaeetus leucocephalus*), Cerulean Warbler (*Setophaga cerulea*).

REFERENCES:

LeGrand, H. 1985. Preliminary Site Reconnaissance Survey: Pierce's Farm Heronry. N.C. Natural Heritage Program.


Mud Castle Slopes
Significant Natural Heritage Area
NC Natural Heritage Program
December 2013
RIVER
HALIFAX CO
NORTHAMPTON CO
1128
1128
Cem
0
0.25
0.5
0.75
1
Miles

Roanoke River Inventory

MUD CASTLE SLOPES
Significant Natural Heritage Area

Site Significance:
Representational Value: Very High (R2)
Collective Value: Moderate (C4)
Quadrangle: Weldon

Size: 232 acres
Ownership: private

SIGNIFICANT FEATURES: This natural area contains extensive Basic Mesic Forest (Coastal Plain subtype, Rich Alluvial Terrace Slopes variant, Basic form) on the slopes, with extant populations of three rare plants – the State Threatened sessile-flowered trillium (*Trillium sessile*), the State Special Concern Eastern isopyrum (*Enemion biternatum*), and the State Significantly Rare James's sedge (*Carex jamesii*). As the trillium population is considered one of the two best in the state, the Representational Value is Very High (R2). The total of three rare plants, plus one natural community, yields a Moderate Collective Value (C4) for the natural area.

LANDSCAPE RELATIONSHIPS: Mud Castle Slopes lies directly across (east of) the Roanoke River from Mush Island. However, it is the only natural area on the east side of the river for several miles, as the Roanoke Earthworks and Fall Line Islands are about 2.7- miles up-river, and Occoneechee Neck Floodplain Forest lies at least 6 miles farther down-river.

SITE DESCRIPTION: This natural area extends for over 1.5 miles along the eastern side of the Roanoke River, and along most of this length there are moderate-to-steep slopes that front the river, leaving very little width of floodplain forest. Most of these west-facing slopes contain the uncommon and very rich Basic Mesic Forest (Coastal Plain subtype, Rich Alluvial Terrace Slopes variant, Basic form); all three rare plants have sizable populations in the community, and thousands of sessile-flowered trillium (*Trillium sessile*) and Eastern isopyrum (*Enemion biternatum*) are present, as well as smaller stands of James's sedge (*Carex jamesii*). The Watch List wafer-ash (*Ptelea trifoliata*) occurs in this community, and what appears to be the Watch List white bear sedge (*Carex albursina*) was observed, but not confirmed. Other notable plants of this community include dwarf larkspur (*Delphinium tricorne*) and lowland brittle fern (*Cystopteris protrusa*).

The natural area contains a few other natural communities, but in small stands. Mesic Mixed Hardwood Forest occurs along the ravines cutting back from the river. Brownwater Levee Forest (High subtype) occurs in some places next to the river, whereas a few slopes transition from the Basic variant of Basic Mesic Forest to the Intermediate variant, as evidenced by populations of black cohosh (*Actaea racemosa*) and Canada horse-balm (*Collinsonia canadensis*) as indicator species.

PROTECTION AND MANAGEMENT: This natural area lies in several private ownerships and has no protection status. There are one or two tracks through the site that reach the river, used for occasional fishing or boat launching. The presence of vehicular traffic into the

floodplain and on the levee is likely to contribute the spread of this and other exotic, invasive species. Timber harvest should be avoided, as such an activity also creates soil disturbance.

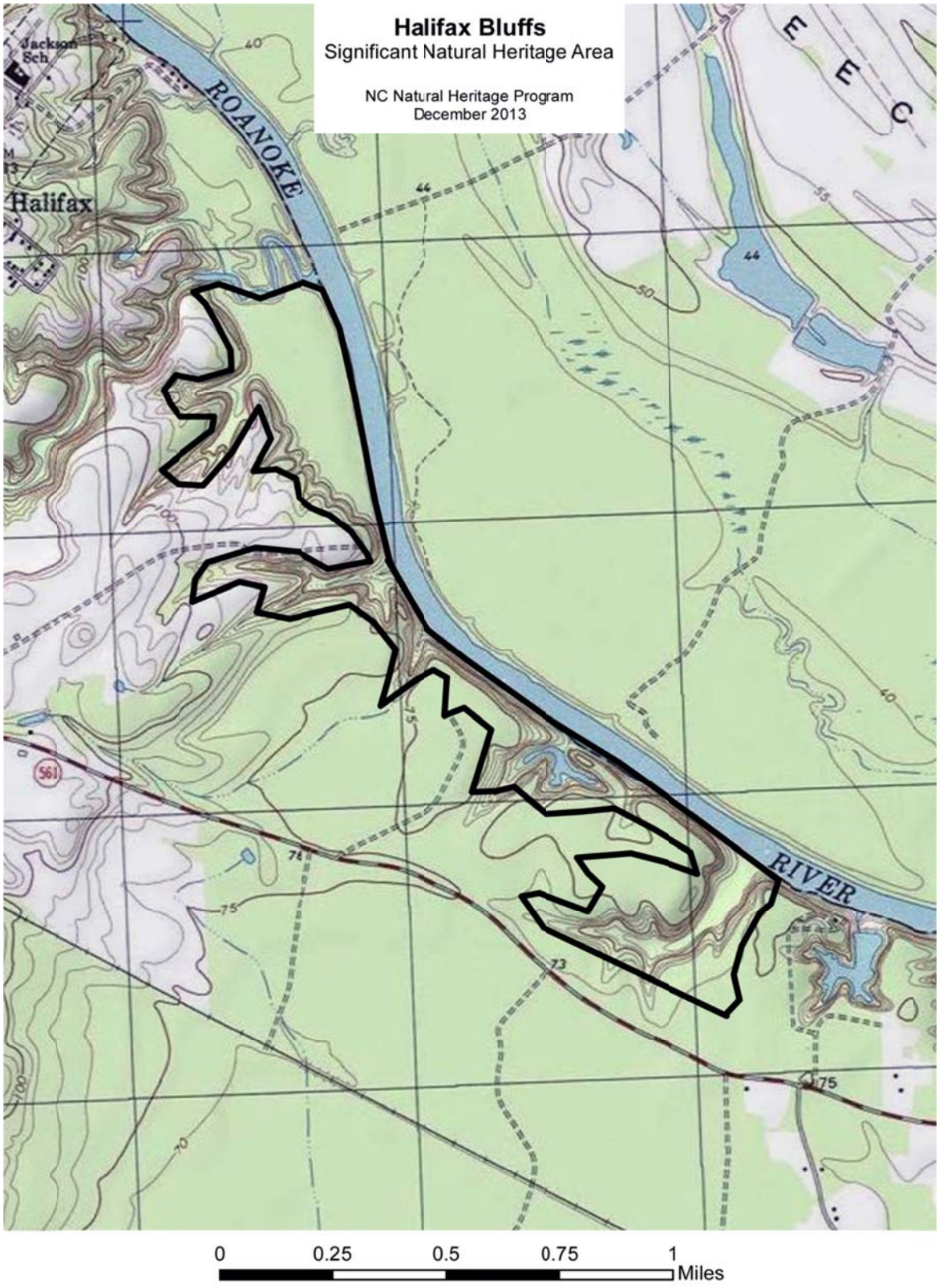
NATURAL COMMUNITIES: Basic Mesic Forest (Coastal Plain subtype, Rich Alluvial Terrace Slopes variant, Basic form).

RARE PLANTS: James's sedge (*Carex jamesii*), Eastern isopyrum (*Enemion biternatum*), sessile-flowered trillium (*Trillium sessile*); Watch List — wafer-ash (*Ptelea trifoliata*), white bear sedge (*Carex albursina*) (unconfirmed).

RARE ANIMALS: None known.

REFERENCES:

LeGrand, H. 2012. Site Survey Report: Mud Castle Slopes. N.C. Natural Heritage Program, Office of Land and Water Stewardship, DENR, Raleigh.


Halifax Bluffs
Significant Natural Heritage Area
NC Natural Heritage Program
December 2013
ROANOKE
RIVER
Halifax
Jackson Sch
561
0
0.25
0.5
0.75
1
Miles

Roanoke River Inventory

HALIFAX BLUFFS
Significant Natural Heritage Area

Site Significance:
Representational Value: High (R3)
Collective Value: Moderate (C4)
Quadrangle: Halifax

Size: 264 acres
Ownership: private

SIGNIFICANT FEATURES: This natural area contains a good example of the uncommon Basic Mesic Forest (Coastal Plain subtype, Rich Alluvial Terrace Slopes variant, Basic form); within this community are four rare plant species – the State Endangered dwarf stinging nettle (*Urtica chamaedryoides*), the State Threatened sessile-flowered trillium (*Trillium sessile*), the State Special Concern Eastern isopyrum (*Enemion biternatum*), and (at least historically) the State Significantly Rare James's sedge (*Carex jamesii*). The State Special Concern Cerulean Warbler (*Setophaga cerulea*) was present several decades ago, but its current status is not known. Examples of Dry-Mesic Oak—Hickory Forest and Piedmont/Coastal Plain Heath Bluff are also found within the site. The site has a High Representational Value (R3) due to the populations of the trillium and the nettle, each being among the 3rd to 6th best ones in the state. The collection of three rare plants known at the present time, plus several natural communities, gives the site a Collective Value of Moderate (C4).

LANDSCAPE RELATIONSHIPS: This natural area, which lies along roughly 1.75 miles of the southwestern banks of the Roanoke River, is only 0.5-mile east of the town of Halifax at its upriver end. At its downriver end, it lies about 0.6-mile west of Larkspur Ridge/Roanoke Big Oak Woods. Diagonally across the river, to the northeast, is the Occoneechee Neck Floodplain Forest natural area.

SITE DESCRIPTION: This natural area was first identified and described by Lynch in the late 1970s (Lynch 1979, 1981), as "Roanoke Bluffs." However, most of the site was heavily timbered during the spring of 1981, and the NCNHP dropped the site from its list of Significant Natural Heritage Areas. Thankfully, the site has somewhat recovered, and by spring 2012, the Basic Mesic Forest was in fairly good condition, though with scattered light gaps. Even so, the populations of rare and other notable plants reported by Lynch were still present in 2012, and thus the site was re-identified as a Significant Natural Heritage Area, though now named "Halifax Bluffs," to remove the overly generic "Roanoke" from the site name and to replace it with "Halifax," which is the nearest town.

The site has only a very narrow floodplain/levee, and thus moderate-to-steep slopes front the river over most of the site. Within this Basic Mesic Forest grow all of the rare species — dwarf stinging nettle (*Urtica chamaedryoides*), sessile-flowered trillium (*Trillium sessile*), Eastern isopyrum (*Enemion biternatum*), and (at least historically) James's sedge (*Carex jamesii*). Other notable plants in this community are American trout lily (*Erythronium americanum* ssp. *americanum*), Dutchman's breeches (*Dicentra cucullaria*), blunt-leaf waterleaf (*Hydrophyllum*

canadense), and wild blue phlox (*Phlox divaricata*). Lynch (1981) reported that squirrel corn (*D. canadensis*) was highly disjunct from the mountains to this site; large numbers of non-flowering *Dicentra* (either *cucullaria* or *canadensis*) plants were noted on the 2012 surveys, and it is possible that the squirrel corn might still be present.

Several north-facing slopes in the northern portion of the site contain the locally scarce Piedmont/Coastal Plain Heath Bluff natural community, where the locally uncommon galax (*Galax aphylla*) is present beneath mountain laurels (*Kalmia latifolia*). The southeastern end of the site contains gentle hardwood slopes featuring Dry-Mesic Oak—Hickory Forest natural community; though not scarce in the Coastal Plain, this might be the best example of it within the Roanoke River project area.

The State Special Concern Cerulean Warbler (*Setophaga cerulea*) was reported by Lynch (1981) for this site. Site visits in 2012 were too early in spring to record the species; thus its current status within the natural area is not known. A Watch List snail — the Blunt Wedge (*Xolotrema caroliniense*) – was found during the inventory.

PROTECTION AND MANAGEMENT: The entire natural area exists within a single private ownership and a conservation easement or other form of protection for this important natural area would be one option to consider. In addition to the rich slopes on this property, an easement that includes a buffer along the top of the slopes would help protect native species from the effects of disturbance, particularly the invasion by exotic plants that often gain their first foothold in newly opened areas with disturbed soils.

NATURAL COMMUNITIES: Basic Mesic Forest (Coastal Plain subtype, Rich Alluvial Terrace Slopes variant, Basic form), Dry-Mesic Oak—Hickory Forest (Coastal Plain subtype), Piedmont/Coastal Plain Heath Bluff.

RARE PLANTS: Eastern isopyrum (*Enemion biternatum*), sessile-flowered trillium (*Trillium sessile*), dwarf stinging nettle (*Urtica chamaedryoides*), James's sedge (*Carex jamesii*) (historical); Watch List — American trout lily (*Erythronium americanum* ssp. *americanum*).

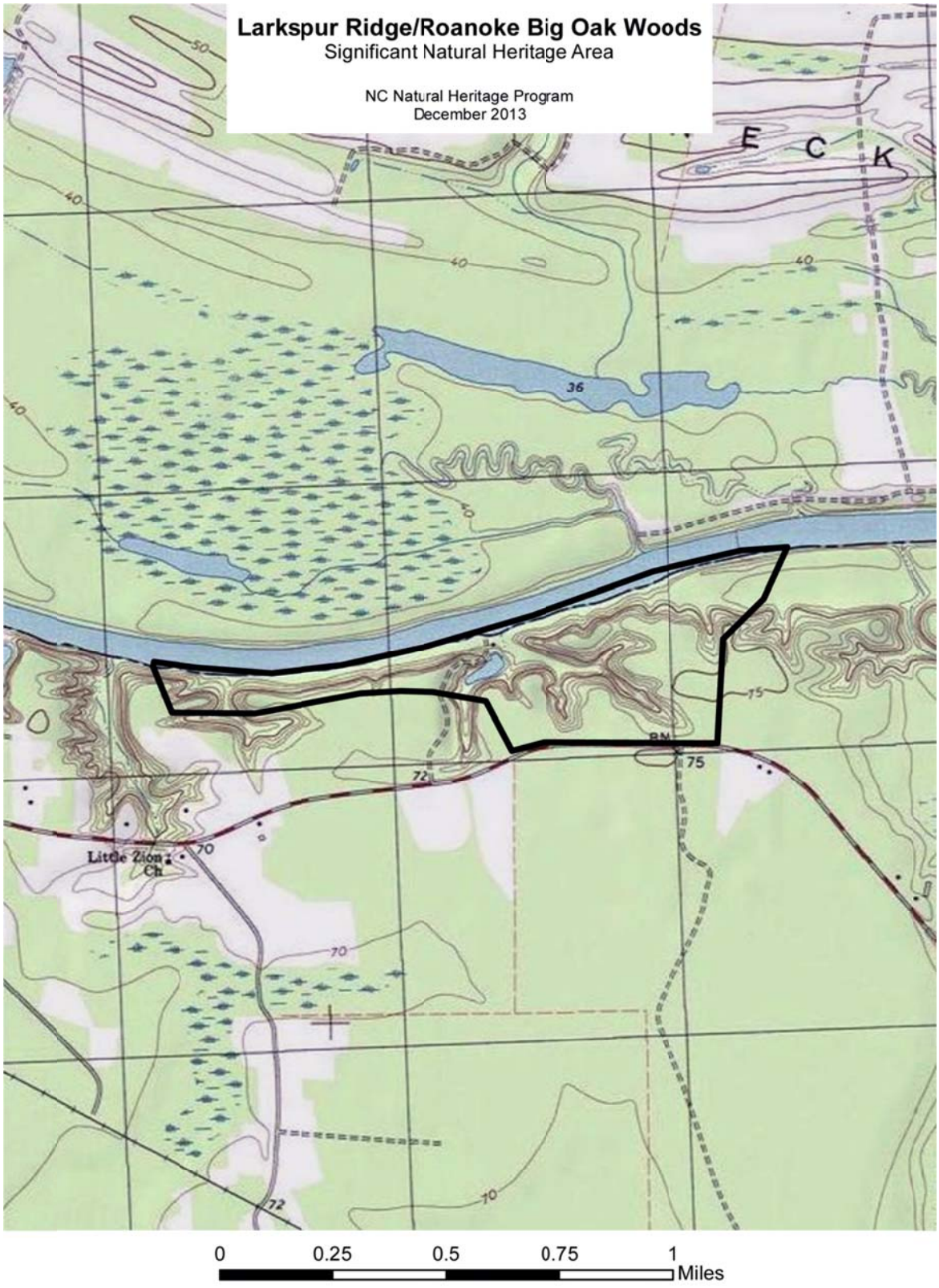
RARE ANIMALS: Cerulean Warbler (*Setophaga cerulea*) (at least formerly); Watch List — Blunt Wedge [snail] (*Xolotrema caroliniense*).

REFERENCES:

LeGrand, H. 2012. Site Survey Report: Halifax Bluffs. N.C. Natural Heritage Program, Office of Land and Water Stewardship, DENR, Raleigh.

Lynch, J.M. 1979. Site report: Roanoke River Bluffs. N.C. Natural Heritage Program, DNRCD, Raleigh.

Lynch, J.M. 1981. Roanoke River Preserve Design Project. N.C. Natural Heritage Program and the N.C. Nature Conservancy.


Larkspur Ridge/Roanoke Big Oak Woods
Significant Natural Heritage Area
NC Natural Heritage Program
December 2013
E C K
36
75
72
70
Little Zion Ch
0
0.25
0.5
0.75
1
Miles

Roanoke River Inventory

LARKSPUR RIDGE/ROANOKE BIG OAK WOODS
Significant Natural Heritage Area

Site Significance:
Representational Value: Very High (R2)
Collective Value: High (C3)
Quadrangle: Halifax

Size: 164 acres
Ownership: The Nature Conservancy, private

SIGNIFICANT FEATURES: This natural area encompasses two well-known preserves that were recently merged into a single natural area. Three rare plants are currently present – the State Endangered veined skullcap (*Scutellaria nervosa*), the State Special Concern Eastern isopyrum (*Enemion biternatum*), and the State Significantly Rare James's sedge (*Carex jamesii*); present at least formerly are the State Endangered dwarf stinging nettle (*Urtica chamaedryoides*) and the State Threatened sessile-flowered trillium (*Trillium sessile*). The State Special Concern Cerulean warbler (*Setophaga cerulea*) was also known to occur in the site, and the inventory recorded a rare moth – Cane Wainscot (*Leucania calidior*), in addition to many Watch List moths. The presence of the veined skullcap, one of the best two populations in the state, gives the site a Very High Representational Value (R2). In addition to the rare species, the natural area also contains examples of five natural communities. These rare species and natural communities combine to give the site a High Collective Value (C3).

LANDSCAPE RELATIONSHIPS: This natural area lies on the south side of the Roanoke River, only 0.6-mile down-river (east) of Halifax Bluffs; however, there is a small development that splits these sites. Across the river to the north is the large Occoneechee Neck Floodplain Forest natural area. About 2 miles downstream, also on the north side of the river, is Camassia Slopes/Gumberry Swamp.

SITE DESCRIPTION: Until this inventory, this natural area consisted of two sites – Larkspur Ridge and Roanoke Big Oak Woods. However, as the intervening 0.3-mile is essentially forested, these two sites, both Nature Conservancy preserves, were merged as a single site, as the rare species and natural communities are similar. The community of most significance is the Basic Mesic Forest (Coastal Plain subtype, Rich Alluvial Terrace Slopes variant, Basic form). The Eastern isopyrum, sessile-flowered trillium, and James's sedge are found in this natural community. Other notable species in this community include the Watch List heartleaf skullcap (*Scutellaria ovata* var. *bracteata*), American trout lily (*Erythronium americanum* ssp. *americanum*), and eastern wahoo (*Euonymus atropurpureus*); and locally rare dwarf larkspur (*Delphinium tricorne*), Dutchman's breeches (*Dicentra cucullaria*), and wood stonecrop (*Sedum ternatum*).

The natural area has a narrow but rich Brownwater Levee Forest (High Levee subtype); rare plants found here include the veined skullcap and (at least formerly) dwarf stinging nettle. Other natural communities present in the site include Dry-Mesic Oak—Hickory Forest (Coastal Plain subtype), Coastal Plain Semipermenent Impoundment (Open Water subtype), and Cypress—Gum Swamp (Brownwater subtype).

This natural area is important for animal species. At least formerly, the rare Cerulean Warbler (*Setophaga cerulea*) was present in the breeding season. The Watch List Smooth Earth Snake (*Virginia valeriae*) was noted during the inventory, on the Roanoke Big Oak Woods tract. The Watch List Cocoa Clubtail [dragonfly] (*Gomphus hybridus*) was found to be common in the upland forested sections of Larkspur Ridge; presumably it breeds in the nearby river, but the juveniles soon fly well away from the river to feed in openings in upland forests.

Moth trapping was conducted on the Roanoke Big Oak Woods tract during the inventory. An excellent eight Watch List species of moths were recorded, in addition to the rare Cane Wainscot (*Leucania calidior*).

PROTECTION AND MANAGEMENT: About 70% of the natural area is protected by The Nature Conservancy. The eastern portion – the Larkspur Ridge Preserve – is a Dedicated State Nature Preserve. The western portion of the site lies within the Big Oak Woods Preserve, though it is not a Dedicated preserve. The intervening 30% of the site lies is private ownership and is not protected. Because this intervening forested area splits the two preserves, it is a high priority for protection, either by easement or by outright acquisition. The two preserves are relatively pristine, and need little management; however, the invasive exotic common chickweed (*Stellaria media*) is very abundant and has likely impacted several rare plants already. Thus, disturbances need to be kept to a minimum, as even natural treefall (from hurricanes and other storms) leads to a marked increase in chickweed and perhaps also in Japanese stilt-grass (*Microstegium vimineum*).

NATURAL COMMUNITIES: Basic Mesic Forest (Coastal Plain subtype, Rich Alluvial Terrace Slopes variant, Basic form), Brownwater Levee Forest (High Levee subtype), Dry-Mesic Oak—Hickory Forest (Coastal Plain subtype), Coastal Plain Semipermenent Impoundment (Open Water subtype), Cypress—Gum Swamp (Brownwater subtype).

RARE PLANTS: James's sedge (*Carex jamesii*), Eastern isopyrum (*Enemion biternatum*), veined skullcap (*Scutellaria nervosa*), sessile-flowered trillium (*Trillium sessile*) (formerly), dwarf stinging nettle (*Urtica chamaedryoides*) (formerly); Watch List — American trout lily (*Erythronium americanum* ssp. *americanum*), eastern wahoo (*Euonymus atropurpureus*), heartleaf skullcap (*Scutellaria ovata* var. *bracteata*).

RARE ANIMALS: Cane Wainscot [moth] (*Leucania calidior*), Cerulean Warbler (*Setophaga cerulea*) (formerly); Watch List – a cane moth (*Argillophora furcilla*), Southern Pine Looper [moth] (*Caripeta aretaria*), Cocoa Clubtail (*Gomphus hybridus*), a wave [moth] (*Hypomecis longipectinaria*), Diminutive Wave [moth] (*Idaea scintillularia*), a tussock moth (*Orgyia detrita*), Stephen's Grass Moth (*Rivula stepheni*), a gray [moth] (*Tornos abjectarius*), Smooth Earth Snake (*Virginia valeriae*), an owlet moth (*Zanclognatha atrilineella*).

REFERENCES:

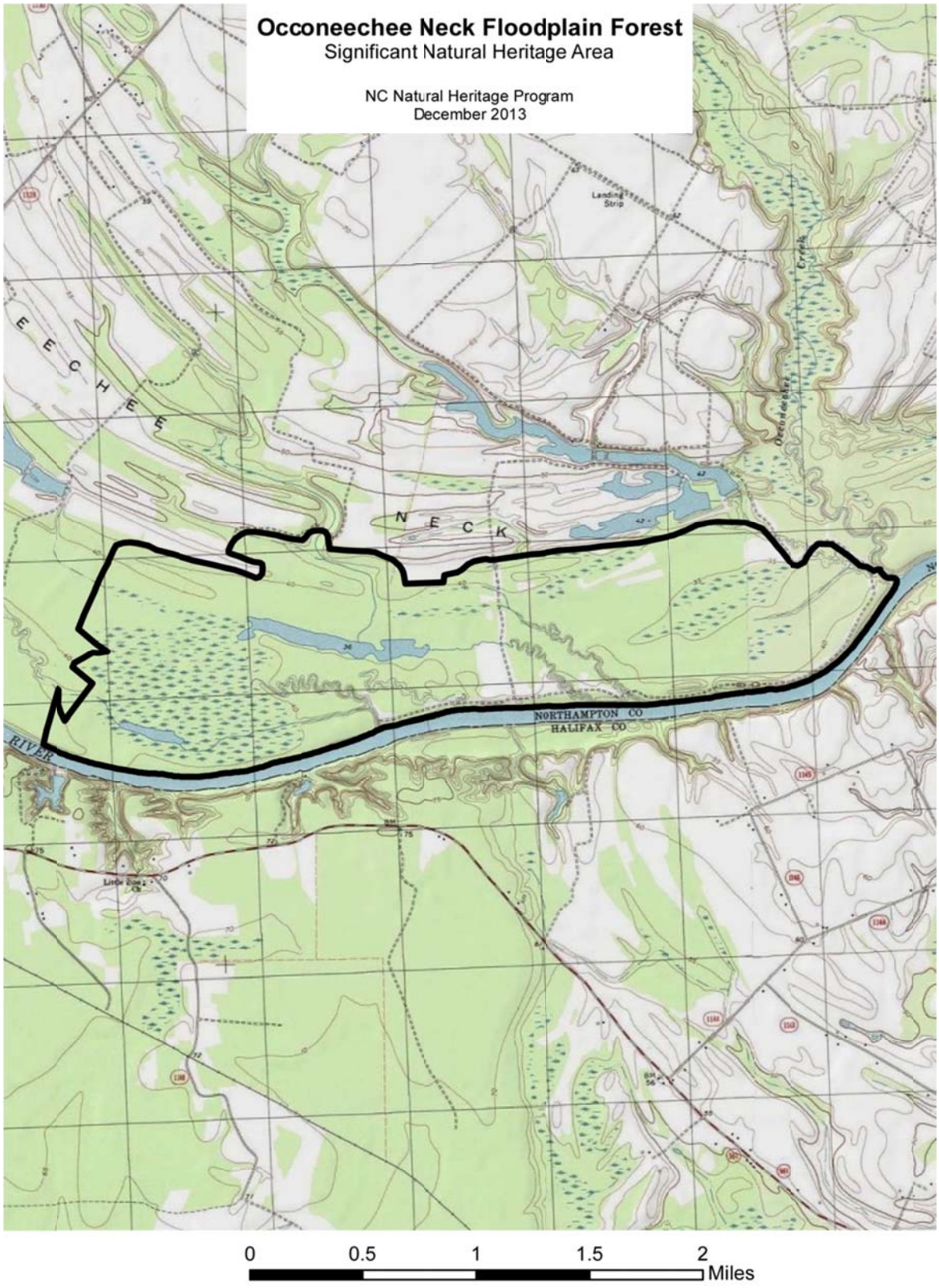
LeGrand, H. 2012. Site Survey Report: Larkspur Ridge. N.C. Natural Heritage Program, Office of Land and Water Stewardship, DENR, Raleigh.

LeGrand, H. 2012. Site Survey Report: Roanoke Big Oak Woods. N.C. Natural Heritage Program, Office of Land and Water Stewardship, DENR, Raleigh.

LeGrand, H., and M. Lynch. 1985. Preliminary Site Reconnaissance Survey: Roanoke Big Oak Woods. N.C. Natural Heritage Program, Raleigh.

Lynch, J.M. 1981. Roanoke River Preserve Design Project. N.C. Natural Heritage Program and the N.C. Nature Conservancy.

Seaton, K. 1981. Larkspur Ridge Natural Area. UNC -- Chapel Hill report.


Occoneechee Neck Floodplain Forest
Significant Natural Heritage Area
NC Natural Heritage Program
December 2013
EECHEE
NECK
NORTHAMPTON CO
HALIFAX CO
RIVER
0
0.5
1
1.5
2
Miles

OCCONEECHEE NECK FLOODPLAIN FOREST
Significant Natural Heritage Area

Site Significance:
Representational Value: Very High (R2)
Collective Value: General (C5)
Quadrangles: Halifax, Boones Crossroads

Size: about 1,708 acres
Ownership: private

SIGNIFICANT FEATURES: This large natural area contains the most extensive remaining floodplain forest on the upper Roanoke River (above US 258), though portions have been clear-cut in recent years. It contains a large extent of Brownwater Levee Forest (High Levee subtype), in addition to Cypress—Gum Swamp (Brownwater subtype) and Coastal Plain Semipermanent Impoundment (both the Cypress—Gum subtype and the Open Water subtype). Its main significance is the moderate population of the State Special Concern Cerulean Warbler (*Setophaga cerulea*), which provides the natural area with a Very High Representational Value (R2). Because the natural community types are not rare, the Collective Value of the site is of General (C5) rating.

LANDSCAPE RELATIONSHIPS: This site extends along approximately 4 river miles of the north side of the Roanoke River. Immediately to the east, across Occoneechee Creek, is the somewhat large Camassia Slopes/Gumberry Swamp natural area. Larkspur Ridge/Roanoke Big Oak Woods lies directly across the river, to the south, from the western half of Occoneechee Neck Floodplain Forest. Diagonally across the river, to the southwest, is the Halifax Bluffs natural area.

SITE DESCRIPTION: Unlike most of the other natural areas in the upper portion of the Roanoke River floodplain, which contain slopes, bluffs, and ravines, this site consists solely of floodplain forests -- a combination of levee forest and various swampy habitats. The western 1.5 miles of river frontage contain a good example of Brownwater Levee Forest (High Levee subtype), and in some places it extends back from the river for as much as 0.5-mile. Behind the levee in the western part of the site is a large backswamp, which is a Cypress—Gum Swamp, with an embedded area of water that is an old beaver pond. This site at least formerly held a sizable nesting colony of Great Blue Herons (*Ardea herodias*) and Great Egrets (*A. alba*). Another Cypress—Gum Swamp, in a backwater, lies in the eastern part of the natural area.

The levee forest contains one of the state's largest breeding populations of the rare Cerulean Warbler (*Setophaga cerulea*), though the population along the Roanoke River has declined steeply in the past 10 years, for unknown reasons. In the 1970s, there were 10-15 pairs of birds in this natural area, though the current population is likely just a few birds.

PROTECTION AND MANAGEMENT: This site lies in several private ownerships and has no protection. Perhaps the portions remaining in good-to-excellent condition can be protected with easements. Over the past few decades, more and more of the site has been clear-cut or heavily thinned, and much now exists in a Secondary Area. Ideally, future timber harvest will be

reduced from the current levels and harvest limited to the swamps and but not the levee. Levee forests are highly sensitive to invasion of exotic plants by soil disturbance; Chinese privet (*Ligustrum sinense*), Japanese stilt-grass (*Microstegium vimineum*), and common chickweed (*Stellaria media*) are noxious weeds that are locally abundant on Roanoke River levees.

NATURAL COMMUNITIES: Brownwater Levee Forest (High Levee subtype), Cypress—Gum Swamp (Brownwater subtype), Coastal Plain Semipermanent Impoundment (Cypress—Gum subtype), Coastal Plain Semipermanent Impoundment (Open Water subtype).

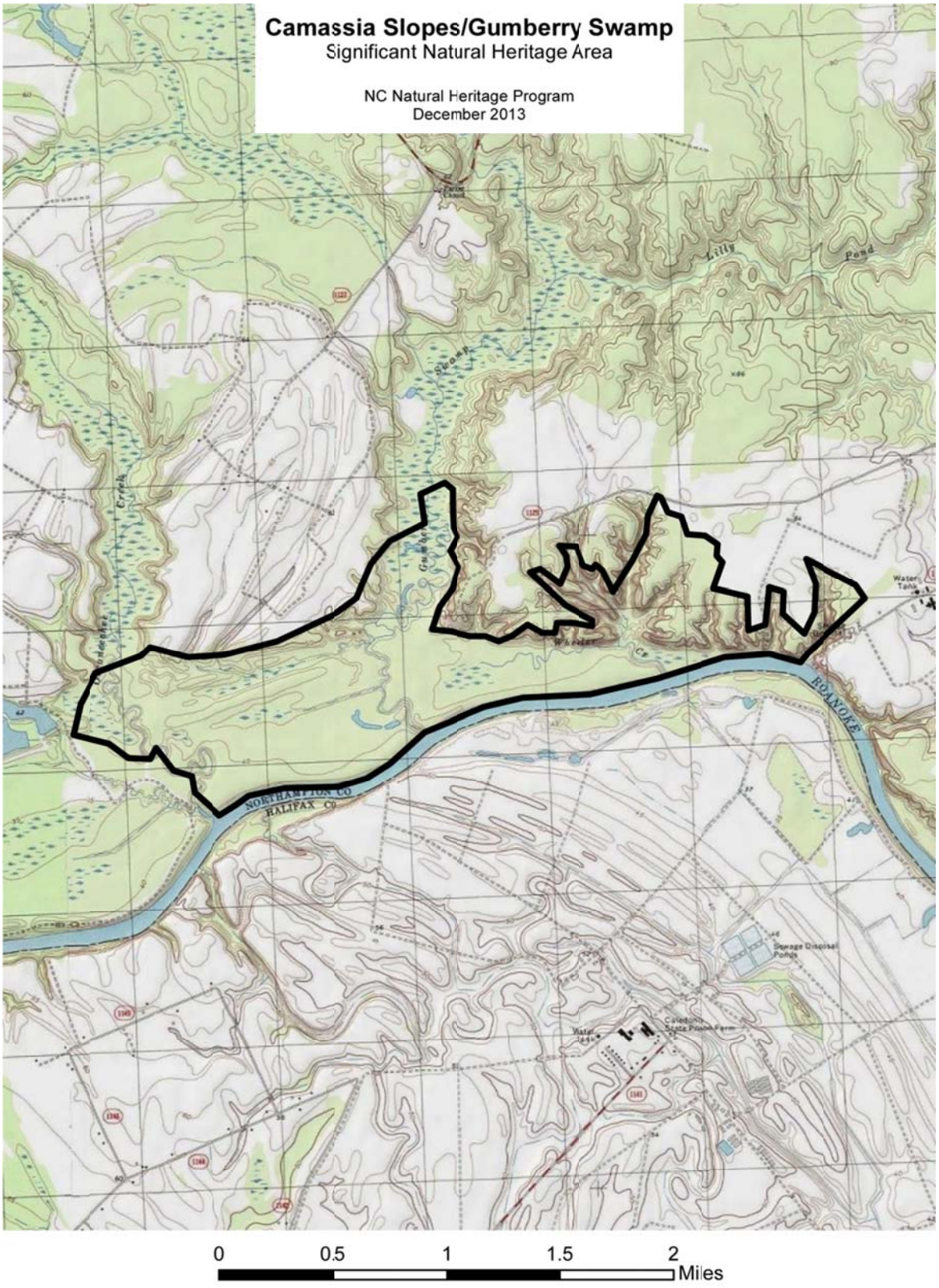
RARE PLANTS: None known.

RARE ANIMALS: Cerulean Warbler (*Setophaga cerulea*).

REFERENCES:

Lynch, J.M. 1978. Site report: Occoneechee Neck Floodplain Forest. N.C. Natural Heritage Program.

Lynch, J.M. 1981. Roanoke River Preserve Design Project. N.C. Natural Heritage Program and the N.C. Nature Conservancy.


Camassia Slopes/Gumberry Swamp
Significant Natural Heritage Area
NC Natural Heritage Program
December 2013
Lilly Pond
Swamp
Creek
ROANOKE
NORTHAMPTON CO
HALIFAX CO
Water Tank
Sewage Disposal Ponds
0
0.5
1
1.5
2
Miles

CAMASSIA SLOPES/GUMBERRY SWAMP
Significant Natural Heritage Area

Site Significance:
Representational Value: Very High (R2)
Collective Value: High (C3)
Quadrangle: Boones Crossroads

Size: about 1,156 acres
Ownership: The Nature Conservancy, N.C. Wildlife Resources Commission, private

SIGNIFICANT FEATURES: This is probably the most significant natural area along the Roanoke River, as it has a Very High Representational Value (R2) due to it containing the best population in North Carolina of the State Threatened wild hyacinth (*Camassia scilloides*). The population of the State Threatened sessile-flowered trillium (*Trillium sessile*) is also one of the two best in the state, though there are numerous populations of it along the Roanoke River. In addition, the site contains four other rare plants – the State Endangered dwarf stinging nettle (*Urtica chamaedryoides*), the Special Concern Eastern isopyrum (*Enemion biternatum*), the State Significantly Rare James's sedge (*Carex jamesii*), and (at least formerly) the State Endangered veined skullcap (*Scutellaria nervosa*). Also, there are good-to-excellent examples of four natural communities, highlighted by a Basic Mesic Forest (Coastal Plain subtype, Rich Alluvial Terrace Slopes variant, Basic form), a nest (at least formerly) of the State Threatened Bald Eagle (*Haliaeetus leucocephalus*), and the rare Orb Underwing [moth] (*Catocala orba*). These numerous rare species and natural communities combine to give the site a High Collective Value rating (C3).

LANDSCAPE RELATIONSHIPS: This natural area, which has been expanded based on the current inventory, forms nearly 3 miles of the northern bank of the Roanoke River, due east of Occoneechee Creek. Thus, the large Occoneechee Neck Floodplain Forest adjoins this site on the west. About 0.6-mile farther downriver, to the southeast, is the Odom Floodplain and Bluffs, separated from this site by a state prison farm.

SITE DESCRIPTION: This site was formerly called "Camassia Slopes," but field work in 2012 on adjacent properties to the west showed that rich slopes and bluffs extended farther to the west, and the narrow floodplain at Camassia Slopes continues and widens farther to the west. Thus, the new site boundary extends westward beyond Gumberry Swamp, to include floodplain forest west to Occoneechee Creek. As with several other sites farther upriver, very rich, high pH slopes and bluffs exist here, and these are somewhat unusual in that most are south-facing, as opposed to north- or west-facing. Despite such south-facing slopes being slightly drier than those facing other directions, this Basic Mesic Forest contains the only populations of wild hyacinth (*Camassia scilloides*) along the Roanoke River; there are only two other known sites, both with small populations, for the species in the state. The species occurs both east and west of Gumberry Swamp, as does the sessile-flowered trillium (*Trillium sessile*) and the James's sedge (*Carex jamesii*). There are a few north-facing slopes and bluffs on the site, and these cooler sites are the only places that Dutchman's breeches (*Dicentra cucullaria*) are found here. In addition to the rare species, other notable plants of this community include dwarf larkspur (*Delphinium*

tricorne), wild blue phlox (*Phlox divaricata*), heartleaf skullcap (*Scutellaria ovata* var. *bracteata*), and (at least formerly) the Watch List three birds orchid (*Triphora trianthophoros*).

The site has a Brownwater Levee Forest (High Levee subtype), best represented west of Gumberry Swamp. The rare dwarf stinging nettle (*Urtica chamaedryoides*) is present there. This levee extends back from the river in some places for about 0.3-mile, where it presumably grades into swamp forest. Most of the slopes farther from the river contain less rich soil and feature a Mesic Mixed Hardwood Forest (Coastal Plain subtype, Bluff/Slope variant). Forests on the terrace flats in the northeastern part of the site mostly contain the Dry-Mesic Oak—Hickory Forest (Coastal Plain subtype).

The State Special Concern Cerulean Warbler (*Setophaga cerulea*) was occasionally present in the site about 25-30 years ago, but recent sightings have been lacking for this declining species. In 2008, a Bald Eagle nest was located in the floodplain; however, no evidence of eagles or a nest was noted during the 2012 surveys. Moth sampling during the inventory yielded the rare Orb Underwing (*Catocala orba*) and four Watch List species. A Watch List land snail was also found in the site during the inventory.

PROTECTION AND MANAGEMENT: Most of the eastern 20% of the site is protected by The Nature Conservancy as a Dedicated State Nature Preserve, called the Camassia Slopes Preserve. The central 40% of the site is owned by the N.C. Wildlife Resources Commission and is administered as part of the Upper Roanoke River Wetlands Game Land. This (Garibaldi) tract was recently transferred to them by the N.C. Department of Correction (now the N.C. Department of Public Safety); a portion had been protected as a Registered Natural Heritage Area, but this designation was terminated when the land was transferred. Nonetheless, the N.C. Natural Heritage Program is working with the Commission to protect the natural area portion of this large tract, and any timber operations or other management activities would take place elsewhere in the tract in pine stands or fields. The land west of Gumberry Swamp, as well as a small tract east of Camassia Slopes Preserve, is in private ownership. As with nearly all sites in the upper Roanoke River floodplain, the exotic common chickweed (*Stellaria media*) is overly abundant and is smothering some rare plant populations. The presence of vehicular traffic into the floodplain and on the levee is likely to contribute to further soil disturbance, which contributes to the spread of this and other exotic, invasive species.

NATURAL COMMUNITIES: Basic Mesic Forest (Coastal Plain subtype, Rich Alluvial Terrace Slopes variant, Basic form), Brownwater Levee Forest (High Levee subtype), Mesic Mixed Hardwood Forest (Coastal Plain subtype, Bluff/Slope variant), Dry-Mesic Oak—Hickory Forest (Coastal Plain subtype).

RARE PLANTS: Wild hyacinth (*Camassia scilloides*), James's sedge (*Carex jamesii*), Eastern isopyrum (*Enemion biternatum*), veined skullcap (*Scutellaria nervosa*) (at least formerly), sessile-flowered trillium (*Trillium sessile*), dwarf stinging nettle (*Urtica chamaedryoides*); Watch List – American trout lily (*Erythronium americanum* ssp. *americanum*), heartleaf skullcap (*Scutellaria ovata* var. *bracteata*), three birds orchid (*Triphora trianthophoros*).

RARE ANIMALS: Orb Underwing (*Catocala orba*), Bald Eagle (*Haliaeetus leucocephalus*) (formerly?); Watch List – a cane moth (*Acrapex relicta*), a cane moth (*Argillophora furcilla*), a geometrid moth (*Hypomecis longipectinaria*), a noctuid moth (*Tripudia flavofasciata*), Blunt Wedge [snail] (*Xolotrema caroliniense*).

REFERENCES:

LeGrand, H. 2012. Site Survey Report: Camassia Slopes (TNC tract). N.C. Natural Heritage Program, Office of Land and Water Stewardship, DENR, Raleigh.

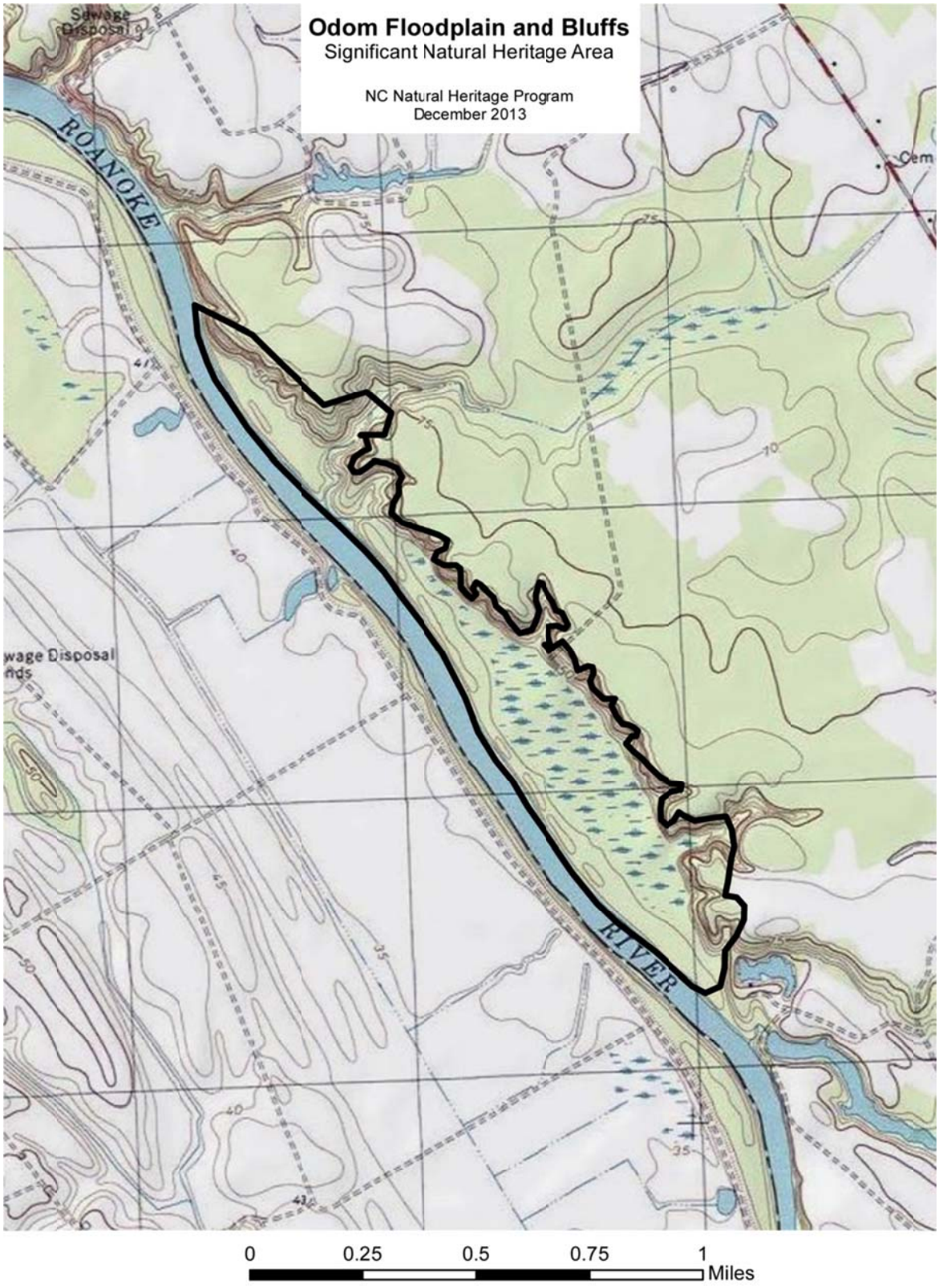
LeGrand, H. 2012. Site Survey Report: Camassia Slopes (Garibaldi – WRC tract). N.C. Natural Heritage Program, Office of Land and Water Stewardship, DENR, Raleigh.

LeGrand, H. 2012. Site Survey Report: Lewis Bull Hill Properties LLC tract. N.C. Natural Heritage Program, Office of Land and Water Stewardship, DENR, Raleigh.

Lynch, J.M. 1979. Site report: Camassia Slopes. N.C. Natural Heritage Program.

Lynch, J.M. 1981. Roanoke River Preserve Design Project. N.C. Natural Heritage Program and the N.C. Nature Conservancy.

Lynch, J.M. 1981. Site report: Camassia Slopes Natural Area. N.C. Natural Heritage Program.


Odom Floodplain and Bluffs
Significant Natural Heritage Area
NC Natural Heritage Program
December 2013
ROANOKE
RIVER
0
0.25
0.5
0.75
1
Miles

Roanoke River Inventory

ODOM FLOODPLAIN AND BLUFFS
Significant Natural Heritage Area

Site Significance:
Representational Value: Very High (R2)
Collective Value: Moderate (C4)
Quadrangle: Boones Crossroads

Size: 236 acres
Ownership: N.C. Wildlife Resources Commission, N.C. Department of Public Safety, private

SIGNIFICANT FEATURES: This natural area contains one of the two best examples in the state of the Coastal Plain Semipermanent Impoundment (Typic Marsh subtype), located in a very large (apparent) beaver pond; thus, the site has a Very High Representational Value (R2) for this natural community. The site also contains several other natural communities, including a Basic Mesic Forest (Coastal Plain subtype, Rich Alluvial Terrace Slopes variant, Intermediate form) on fairly steep slopes overlooking the pond, as well as a good example of a Brownwater Levee Forest (High Levee subtype). There is a fairly large population of the State Threatened sessile-flowered trillium (*Trillium sessile*), as well as (formerly) the State Special Concern Eastern isopyrum (*Enemion biternatum*). The five natural communities and two rare plants give the site a Moderate Collective Value rating (C4).

LANDSCAPE RELATIONSHIPS: This site is located about 0.6-mile downriver from Camassia Slopes/Gumberry Swamp, on the same side (northeast) of the river. Odom Prison Farm separates these two natural areas. It is nearly 2 miles farther downriver to the next natural area – Pollocks Ferry Natural Area, located on the opposite (southwestern) side of the river.

SITE DESCRIPTION: This is a rather narrow site, only extending about 0.3-mile back from the river, but occupying nearly 2 miles of frontage along the river. It consists of a well-defined natural levee (Brownwater Levee Forest (High Levee subtype), with a somewhat narrow floodplain behind it, bordered by a "line" of southwest-facing slopes. Of most significance is a very large backswamp, perhaps a beaver pond, that now consists of some open water, some marsh, and some swamp along the margins; thus, three Semipermanent Impoundment natural community subtypes are present. Within the pond is a heronry, at least of Great Blue Herons (*Ardea herodias*). The Brownwater Levee Forest composition is rather similar to that of sites farther upriver; sessile-flowered trillium (*Trillium sessile*) is common on it, and Eastern isopyrum (*Enemion biternatum*) formerly was present, though both have likely been impacted by the abundant exotic common chickweed (*Stellaria media*). On the other hand, the slopes are either far enough downriver, or far enough back from the river, that they are no longer the Basic form of Basic Mesic Forest (Coastal Plain subtype). Vegetation composition from a spring visit indicates that this is the Intermediate variant, with much yellow fumewort (*Corydalis flavula*) and baby blue-eyes (*Nemophila aphylla*), among other herbs, beneath a considerable amount of painted buckeye (*Aesculus sylvatica*).

PROTECTION AND MANAGEMENT: The central 80% of the site is owned by the N.C. Wildlife Resources Commission and managed as part of the Upper Roanoke River Wetlands

Game Land. The tract is also a Dedicated State Nature Preserve, giving additional protection. The northwestern 10% of the site lies on the Odom Prison Farm, administered by the N.C. Department of Public Safety. This has no official protection, though the agency should be contacted regarding some form of protection for that corner of the tract. The southeastern 10% of the site lies in private ownership and has no protection. As with most sites in the upper portion of the floodplain, common chickweed is already rampant, and it would be very difficult to remove. The presence of vehicular traffic into the floodplain and on the levee is likely to contribute to further soil disturbance, which contributes to the spread of this and other exotic, invasive species. Wildlife staff should monitor the large pond, and hopefully can maintain the dam; such large ponds provide excellent habitat for waterfowl, turtles, frogs, and many other kinds of animal and plant species.

NATURAL COMMUNITIES: Coastal Plain Semipermanent Impoundment (Typic Marsh subtype), Coastal Plain Semipermanent Impoundment (Open Water subtype), Coastal Plain Semipermanent Impoundment (Cypress—Gum subtype), Brownwater Levee Forest (High Levee subtype), Basic Mesic Forest (Coastal Plain subtype, Rich Alluvial Terrace Slopes variant, Intermediate form).

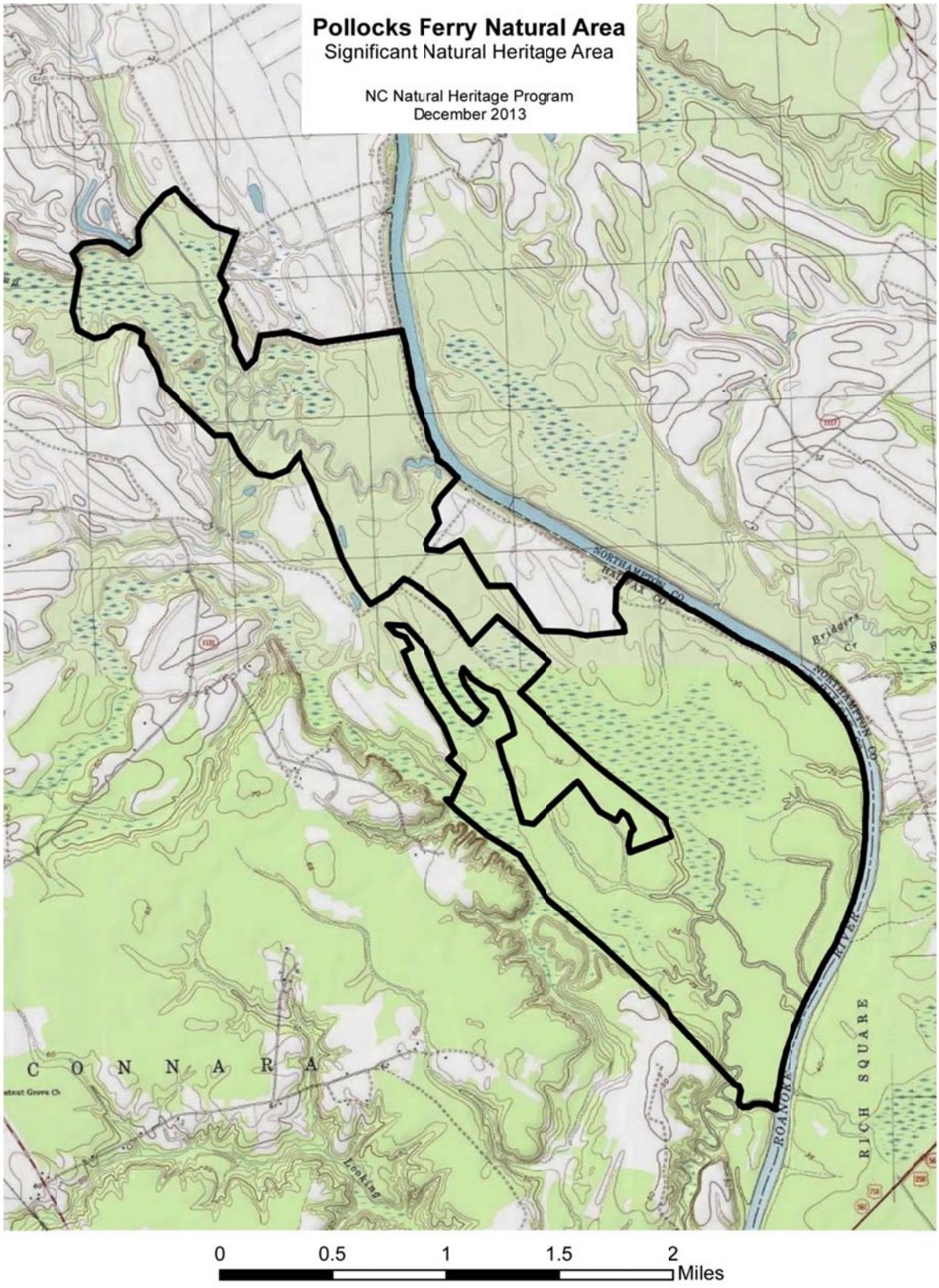
RARE PLANTS: Eastern isopyrum (*Enemion biternatum*) (formerly), sessile-flowered trillium (*Trillium sessile*).

RARE ANIMALS: None known.

REFERENCES:

LeGrand, H. 2012. Site Survey Report: Odom Floodplain and Bluffs. N.C. Natural Heritage Program, Office of Land and Water Stewardship, DENR, Raleigh.

Schafale, M. 2006. Site Survey Report: Odom Floodplain and Bluffs. N.C. Natural Heritage Program, Office of Land and Water Stewardship, DENR, Raleigh.


Pollocks Ferry Natural Area
Significant Natural Heritage Area
NC Natural Heritage Program
December 2013
C O N N A R A
RICH SQUARE
0
0.5
1
1.5
2
Miles

Roanoke River Inventory

POLLOCKS FERRY NATURAL AREA
Significant Natural Heritage Area

Site Significance:
Representational Value: High (R3)
Collective Value: General (C5)
Quadrangles: Boones Crossroads, Scotland Neck

Size: about 2,302 acres
Ownership: N.C. Wildlife Resources Commission, N.C. Department of Public Safety

SIGNIFICANT FEATURES: This large site contains moderate populations of two rare plants – the State Endangered dwarf stinging nettle (*Urtica chamaedryoides*) and the State Threatened sessile-flowered trillium (*Trillium sessile*); as each is among the 3rd to 6th best populations in the state, the site has a High Representational Value (R3). However, it receives a General Collective Value (C5) because there is only one additional significant element at the site, a good example of Brownwater Levee Forest (High Levee subtype). Nonetheless, the site contains important habitat for a great array of wildlife species, as well as for several Watch List plant species.

LANDSCAPE RELATIONSHIPS: This natural area lies about 1.6 river-miles south of Odom Floodplain and Bluffs, but on the opposite (southwest) side of the Roanoke River. Bordering Pollocks Ferry Natural Area on its southern end is the small and narrow Looking Glass Run Swamp and Bluffs site. In addition, the very large Cypress Swamp/Sandy Run Floodplain Forest natural area lies across the river from the southern end of this site.

SITE DESCRIPTION: This natural area contains nearly 4 river-miles of the western side of the Roanoke River, and it includes the southern (forested) end of the Tillery Prison Farm, as well as nearly all of the land owned by the N.C. Wildlife Resources Commission (with several fields and other inholdings excluded). The northern portion, just south of Conoconnara Swamp, contains several areas of gentle slopes, with a few populations of sessile-flowered trillium (*Trillium sessile*). However, most of the natural area consists of a natural levee that gradually descends in elevation toward a backswamp. On the levee grow several more populations of trilliums, plus several dense stands of dwarf stinging nettle (*Urtica chamaedryoides*). The levees also provide habitat for the Watch List Virginia bluebells (*Mertensia virginica*) and rootstock bloodleaf (*Iresine rhizomatosa*), each known from just one other site in the river floodplain. The locally rare green violet (*Hybanthus concolor*) also grows on the levee.

Behind the levee is a backswamp that is of moderate age, but at least formerly it contained a large breeding colony of Great Blue Herons (*Ardea herodias*) and Great Egrets (*A. alba*). Growing along the margin of the backswamp are several mature pin oaks (*Quercus palustris*), a Watch List species found during the inventory and just the second known site for that species along the Roanoke River in North Carolina.

The natural area contains notable animal species, such as Mississippi Kite (*Ictinia mississippiensis*), Swainson's Warbler (*Limnothlypis swainsonii*), Kentucky Warbler (*Geothlypis formosa*), and the Watch List Cocoa Clubtail [dragonfly] (*Gomphus hybridus*). The site has a

sizable Wild Turkey (*Meleagris gallopavo*) population. Moth collecting field work during the inventory yielded a good diversity of species, including four Watch List species.

PROTECTION AND MANAGEMENT: Nearly all of the Wildlife Resources Commission tract is a Dedicated State Nature Preserve. The portion north of Conoconnara Swamp, owned by the Department of Public Safety, is not protected; however, efforts to have this forested area transferred to Wildlife Resources might be warranted. Even if not, it might be worthwhile to pursue a Registry agreement on this portion of Tillery Farm. Much of the levee has a jeep track running along it, though it is gated for much of the year. A great array of exotic plants has already been established on the levee, especially the portion near the large fields. Some removal of woody species such as Chinese privet (*Ligustrum sinense*) might be helpful; however, the removal of the invasive exotic common chickweed (*Stellaria media*) would not be feasible. The presence of vehicular traffic along the jeep track beyond the large fields is likely to contribute to further soil disturbance, which contributes to the spread of this and other exotic, invasive species.

NATURAL COMMUNITIES: Brownwater Levee Forest (High Levee subtype).

RARE PLANTS: Sessile-flowered trillium (*Trillium sessile*), dwarf stinging nettle (*Urtica chamaedryoides*); Watch List — rootstock bloodleaf (*Iresine rhizomatosa*), Virginia bluebells (*Mertensia virginica*), pin oak (*Quercus palustris*).

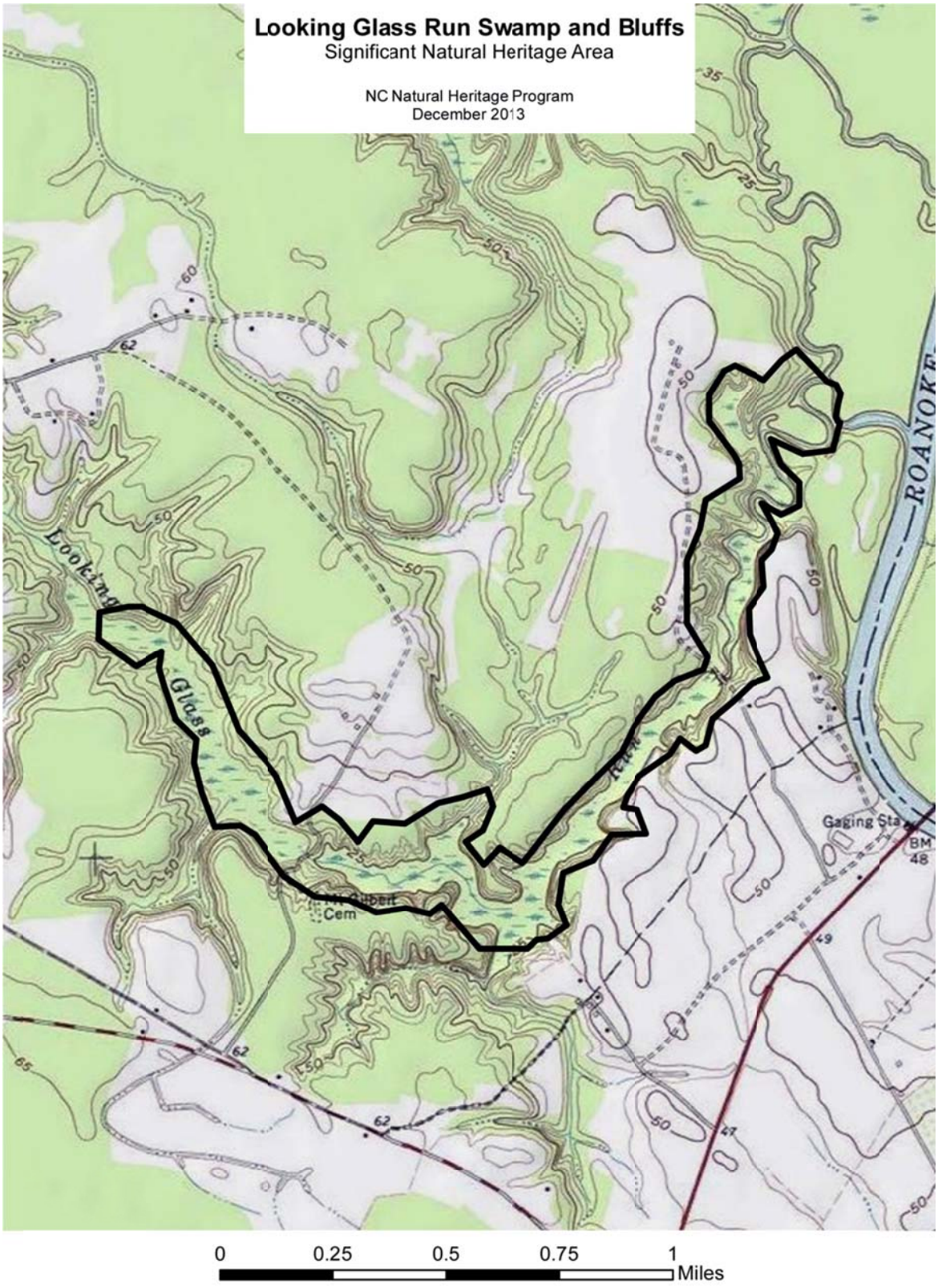
RARE ANIMALS: Watch List -- Cocoa Clubtail (*Gomphus hybridus*), a bird-dropping moth (*Lithacodia* sp. 2), Aralia Shoot Borer Moth (*Papaipema araliae*), Stephen's Grass Moth (*Rivula stepheni*), an owlet moth (*Tripudia flavofasciata*). Anhinga (*Anhinga anhinga*), also a Watch List species, has been seen at the site and possibly nests.

REFERENCES:

LeGrand, H. 2003. Site report: Pollocks Ferry (two tracts). N.C. Natural Heritage Program.

LeGrand, H. 2004. Site report: Pollocks Ferry – March 2004 visit. N.C. Natural Heritage Program.

LeGrand, H. 2012. Site Survey Report: Pollocks Ferry Natural Area. N.C. Natural Heritage Program, Office of Land and Water Stewardship, DENR, Raleigh.


Looking Glass Run Swamp and Bluffs
Significant Natural Heritage Area
NC Natural Heritage Program
December 2013
ROANOKE
Looking Glass
Gaging Sta
BM 48
Cem
0
0.25
0.5
0.75
1
Miles

Roanoke River Inventory

LOOKING GLASS RUN SWAMP AND BLUFFS
Significant Natural Heritage Area

Site Significance:
Representational Value: Moderate (R4)
Collective Value: General (C5)
Quadrangle: Scotland Neck

Size: 245 acres
Ownership: private

SIGNIFICANT FEATURES: This small natural area contains three natural communities; and both Basic Mesic Forest (Coastal Plain subtype, Rich Alluvial Terrace Slopes variant, Intermediate form) and Mesic Mixed Hardwood Forest (Coastal Plain subtype, Bluff/Slope variant) are present, as well as Cypress—Gum Swamp (Brownwater subtype). As the Basic Mesic Forest is among the 10 best examples of that subtype in the state, the site has a Moderate Representational Value rating (R4), whereas the Collective Value – three fairly numerous natural communities – has a General significance (C5). However, previous site visits were made in late fall (in 1991), and thus the current significance of the natural area is not known; the full significance will not be known until spring season surveys are conducted.

LANDSCAPE RELATIONSHIPS: This site abuts Pollocks Ferry Natural Area on its north end. The large Cypress Swamp/Sandy Run Floodplain Forest lies across the Roanoke River, separated by recently cleared land on the west side of the river.

SITE DESCRIPTION: This site formerly consisted of two smaller sites – Looking Glass Run Swamp and Bluffs, and North Looking Glass Run Bluffs (Smith et al. 1993). They were merged in 2012, as the separation distance was only about 0.3-mile along the narrow floodplain of Looking Glass Run, a short tributary that enters the Roanoke River just east of the site. Even with the merger, this is a rather small site. Most of the floodplain contains a good example of Cypress—Gum Swamp (Brownwater subtype). The northern (downstream) portion of the site contains the most significant feature, steep slopes dominated in the shrub layer by large painted buckeyes (*Aesculus sylvatica*), along with bladdernut (*Staphylea trifolia*), indicative of a Basic Mesic Forest. As the site lies far downriver from the "easternmost" of the Basic forms at Camassia Slopes, it is hereby considered as an Intermediate form. However, survey work in the spring season is needed to confirm the natural community; several rare or Watch List plant species have the potential to be present in such rich soils. Farther upstream, in the southwestern part of the site, the steep slopes lack buckeye and bladdernut, and instead are considered to be the less rich Mesic Mixed Hardwood Forest (Bluff/Slope variant) natural community.

PROTECTION AND MANAGEMENT: The natural area is in private ownership and is not protected. No management appears to be needed at the present time. However, as the site surveys were conducted in October 1991, new surveys (especially in the spring season) are needed to search for notable plant species and to further delineate the site boundaries and the natural communities.

NATURAL COMMUNITIES: Basic Mesic Forest (Coastal Plain subtype, Rich Alluvial Terrace Slopes variant, Intermediate form), Mesic Mixed Hardwood Forest (Coastal Plain subtype, Bluff/Slope variant), Cypress—Gum Swamp (Brownwater subtype).

RARE PLANTS: None known.

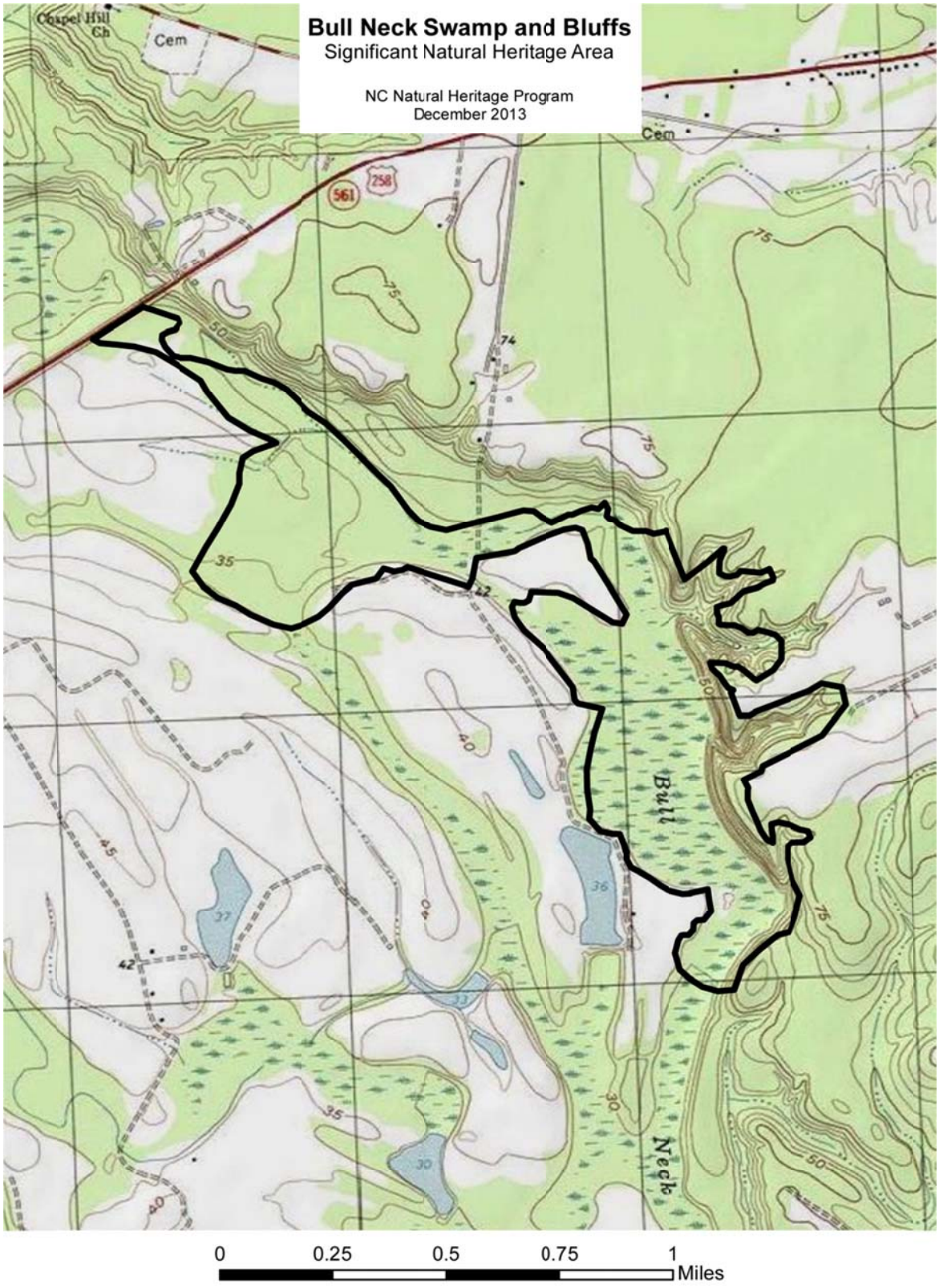
RARE ANIMALS: None known.

REFERENCES:

Murrell, Z.E. 1991. Site Survey Report: North Looking Glass Run Bluffs. N.C. Natural Heritage Program.

Murrell, Z.E. 1991. Site Survey Report: Looking Glass Run Swamp & Bluffs. N.C. Natural Heritage Program.

Smith, I.K., H.E. LeGrand, Jr., S.P. Hall, Z.E. Murrell, C.W. Nordman, and M.P. Schafale. 1993. Regional Inventory for Critical Natural Areas, Wetland Ecosystems, and Endangered Species Habitats of the Albemarle-Pamlico Estuarine Region: Phase 3. A/P Report No. 92-21. N.C. Natural Heritage Program.


Bull Neck Swamp and Bluffs
Significant Natural Heritage Area
NC Natural Heritage Program
December 2013
Chapel Hill Ch
Cem
Cem
561
258
Bull Neck
0
0.25
0.5
0.75
1
Miles

Roanoke River Inventory

BULL NECK SWAMP AND BLUFFS
Significant Natural Heritage Area

Site Significance:
Representational Value: General (R5)
Collective Value: General (C5)
Quadrangle: Norfleet

Size: 353 acres
Ownership: private

SIGNIFICANT FEATURES: This site, far from the Roanoke River but at the northern base of the floodplain, contains good examples of three natural communities – Mesic Mixed Hardwood Forest (Coastal Plain subtype, Bluff/Slope variant), Cypress—Gum Swamp (Brownwater subtype), and Brownwater Bottomland Hardwoods (High subtype). However, as none are among the ten best in the state, the site has a General Representational Value (R5). In addition, as these are not rare communities, the Collective Value rating is also General (C5).

LANDSCAPE RELATIONSHIPS: This site lies in the extreme northern edge of the Roanoke River floodplain. It is about 1.75 miles inward from Cypress Swamp/Sandy Run Floodplain Forest, though the two sites are as close as 0.4-mile along Bull Neck Swamp.

SITE DESCRIPTION: This site abuts the upland terrace that lies to the north, and thus all along the northern border of the site is a series of moderate slopes about 30 feet in height. Below the slopes is a small lower terrace, but most of the remainder of the site consists of typical Cypress—Gum Swamp along Bull Neck Swamp. The Mesic Mixed Hardwood Forest (Bluff/Slope variant) is quite well developed; its most significant feature is the Watch List glade fern (*Diplazium pycnocarpon*), which is scarce away from the mountains and reported nowhere else in the Roanoke River floodplain. The Brownwater Bottomland Hardwoods (High subtype), dominated by willow oak (*Quercus phellos*) and swamp chestnut oak (*Q. michauxii*), lies on the terrace at the base of some of the slopes. The locally uncommon log fern (*Dryopteris celsa*) is found here.

PROTECTION AND MANAGEMENT: This site lies in multiple private ownerships and is not protected. A few small areas of the site have been damaged by timber harvest, but most of the site appears to remain intact, based on recent aerial photos. New surveys are needed, especially in the spring season, to truly determine the significance of this natural area.

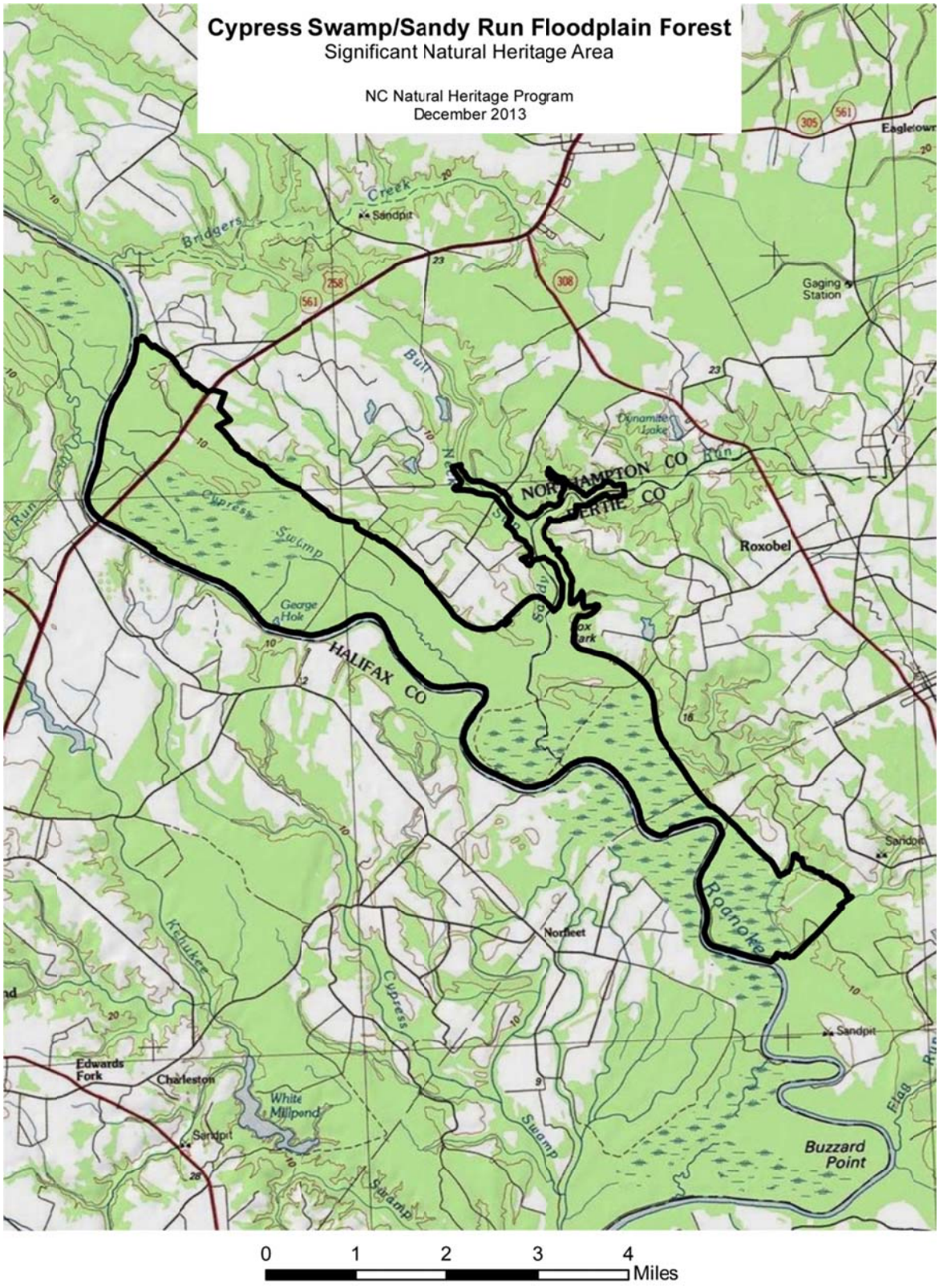
NATURAL COMMUNITIES: Mesic Mixed Hardwood Forest (Coastal Plain subtype, Bluff/Slope variant), Cypress—Gum Swamp (Brownwater subtype), Brownwater Bottomland Hardwoods (High subtype).

RARE PLANTS: Watch List – glade fern (*Diplazium pycnocarpon*).

RARE ANIMALS: None known.

REFERENCES:

Z.E. Murrell. 1991. Site Survey Report: Bull Neck Swamp and Bluffs. N.C. Natural Heritage Program.


Cypress Swamp/Sandy Run Floodplain Forest
Significant Natural Heritage Area
NC Natural Heritage Program
December 2013
HALIFAX CO
NORTHAMPTON CO
BERTIE CO
Roxobel
Gaging Station
Eagletown
Sandpit
Bridgers Creek
Cypress Swamp
George Hole
Dynamite Lake
Roanoke
Norfleet
Edwards Fork
Charleston
White Millpond
Buzzard Point
0 1 2 3 4
Miles

Roanoke River Inventory

CYPRESS SWAMP/SANDY RUN FLOODPLAIN FOREST
Significant Natural Heritage Area

Site Significance:
Representational Value: Very High (R2)
Collective Value: High (C3)
Quadrangles: Scotland Neck, Norfleet, Kelford

Size: about 7,565 acres
Ownership: N.C. Wildlife Resources Commission, private

SIGNIFICANT FEATURES: This very long site is one of the more significant ones in the Roanoke River floodplain. Because it contains the state's largest population (by far) of the State Endangered limestone wild-petunia (*Ruellia strepens*), as well as one of the best examples of Brownwater Levee Forest (Medium Levee subtype), it receives a Very High (R2) Representational Value. The high diversity of good-quality natural communities (seven in all), three rare plants, two rare birds, two rare moths, and a heronry lead to the site to a High (C3) Collective Value.

LANDSCAPE RELATIONSHIPS: The upriver (northwestern) end of this site lies directly across the Roanoke River from the Pollocks Ferry Natural Area, which lies on the southwestern side of the river. The northern portion of the Buzzard Point Floodplain Forests lies across the river, to the southwest, from the downriver (southeastern) portion of the Cypress Swamp/Sandy Run Floodplain Forest.

SITE DESCRIPTION: This is a very long (upriver to downriver) site, flanking the northeastern side of the river for about 12-13 miles from just above US 258 southeastward toward the town of Lewiston Woodville. As expected, this site contains a mosaic of mature forests and recently cleared areas, as well as some areas that are regenerating in floodplain forest types. Unlike with most sites farther upriver, there are embedded old natural levees well removed from the river, clearly indicating that the river was formerly located next to the levee and has migrated southwestward. Most of these levees are the Brownwater Levee Forest (Medium Levee subtype). However, along the current river location are some Brownwater Levee Forest (High Levee subtype) communities, and these contain locally dense stands of the State Endangered dwarf stinging nettle (*Urtica chamaedryoides*). A very large population of the State Endangered limestone wild-petunia (*Ruellia strepens*) was discovered during the inventory along the margins of a jeep track that traverses such a high levee. A population of the State Significantly Rare smooth hedge-nettle (*Stachys tenuifolia*) was also found in the inventory in a similar setting.

The site contains a few backswamps between the high levees along the river and the lower and older levees. A nest of the State Threatened Bald Eagle (*Haliaeetus leucocephalus*) and at least one heronry have been reported from these swamps. The State Special Concern Cerulean Warbler (*Setophaga cerulea*) formerly occurred in tall trees along the river margins. The State Significantly Rare Squatty Ambersnail (*Succinea unicolor*) was found along a high levee during

the inventory; this is a very poorly known species in the state and is the first recent record, with the others being from counties much farther to the east.

PROTECTION AND MANAGEMENT: Roughly half of the natural area is owned by the N.C. Wildlife Resources Commission and operated as the Upper Roanoke River Wetlands Game Land. These tracts, acquired from the International Paper Company in 2007, are also protected as a Dedicated State Nature Preserve, though only portions are Primary Areas (high quality forests). The remainder of the site consists of many privately owned, unprotected sites. The Commission could attempt to consolidate their landholdings by trying to acquire major tracts lying between their own, especially just downriver from US 258. Much of the levees forests, both along the river and farther away from the river, are overrun by the exotic Chinese privet (*Ligustrum sinense*). Removal of as much of the privet as possible would provide much better wildlife habitat for species such as Wild Turkey (*Meleagris gallopavo*) and nesting songbirds, in addition to providing better habitat for rare herbaceous plants.

NATURAL COMMUNITIES: Brownwater Levee Forest (High Levee subtype), Brownwater Levee Forest (Medium Levee subtype), Brownwater Bottomland Hardwoods (High subtype), Brownwater Bottomland Hardwoods (Swamp Transition subtype), Cypress—Gum Swamp (Brownwater subtype), Coastal Plain Semipermanent Impoundment (Open Water subtype), Coastal Plain Semipermanent Impoundment (Cypress—Gum subtype).

RARE PLANTS: Limestone wild-petunia (*Ruellia strepens*), smooth hedge-nettle (*Stachys tenuifolia*), dwarf stinging nettle (*Urtica chamaedryoides*); Watch List – smooth swallowwort (*Cynanchum laeve*), blue vervain (*Verbena hastata*).

RARE ANIMALS: An undescribed cane moth (*Apameine* new genus 2 sp. 3), Bald Eagle (*Haliaeetus leucocephalus*), Cane Wainscot [moth] (*Leucania calidior*), Cerulean Warbler (*Setophaga cerulea*) (formerly), Squatty Ambersnail (*Succinea unicolor*); Watch List – Carolina Roadside-Skipper [butterfly] (*Amblyscirtes carolina*), a cane moth (*Argillophora furcilla*), a noctuid moth (*Lithacodia* sp. 2), Montezuma Katydid (*Montezumina modesta*), Stephen's Grass Moth (*Rivula stepheni*), Riverine Clubtail [dragonfly] (*Stylurus amnicola*), Blunt Wedge [snail] (*Xolotrema caroliniense*). An adult Yellow-crowned Night-Heron (*Nyctanassa violacea*) [State Significantly Rare] and an Anhinga (*Anhinga anhinga*) [Watch List] were seen in summer during the inventory and might nest within the site.

REFERENCES:

LeGrand, H. 2012. Site Survey Report: Cypress Swamp – Sandy Run Floodplain Forest (Boone – WRC tract). N.C. Natural Heritage Program, Office of Land and Water Stewardship, DENR, Raleigh.

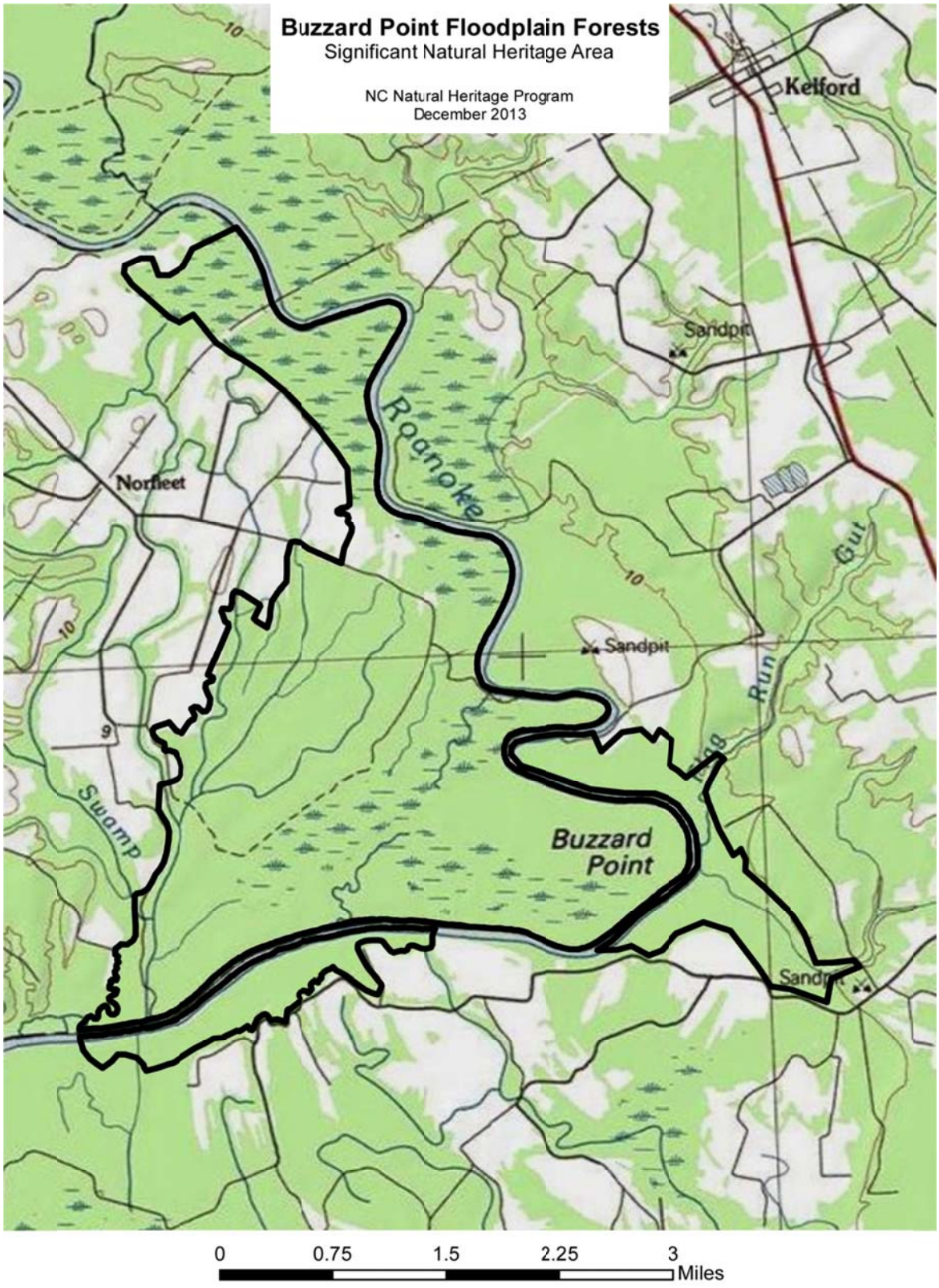
LeGrand, H. 2012. Site Survey Report: Cypress Swamp – Sandy Run Floodplain Forest (Cypress Swamp – WRC tract). N.C. Natural Heritage Program, Office of Land and Water Stewardship, DENR, Raleigh.

LeGrand, H. 2012. Site Survey Report: Cypress Swamp – Sandy Run Floodplain Forest (Woods Island – WRC tract). N.C. Natural Heritage Program, Office of Land and Water Stewardship, DENR, Raleigh.

Schafale, M. 2006. Site Survey Report: Cypress Swamp – Sandy Run Floodplain (IP portion). N.C. Natural Heritage Program, Office of Land and Water Stewardship, DENR, Raleigh.

Schafale, M. 2008. Site Survey Report: Cypress Swamp – Sandy Run Floodplain (IP 258 tract and Boone tract). N.C. Natural Heritage Program, Office of Land and Water Stewardship, DENR, Raleigh.

Schafale, M. 2008. Site Survey Report: Cypress Swamp – Sandy Run Floodplain -- IP Blackjack tract portion. N.C. Natural Heritage Program, Office of Land and Water Stewardship, DENR, Raleigh.


Buzzard Point Floodplain Forests
Significant Natural Heritage Area
NC Natural Heritage Program
December 2013
Kelford
Sandpit
Roanoke
Norfleet
Gut
Sandpit
Run
Swamp
Buzzard
Point
Sandpit
10
10
9
0
0.75
1.5
2.25
3
Miles

Roanoke River Inventory

BUZZARD POINT FLOODPLAIN FORESTS
Significant Natural Heritage Area

Site Significance:
Representational Value: Very High (R2)
Collective Value: High (C3)
Quadrangles: Norfleet, Palmyra, Woodville

Size: about 6,157 acres
Ownership: N.C. Wildlife Resources Commission, The Nature Conservancy, private

SIGNIFICANT FEATURES: This very large site contains one of just two currently known populations of the State Threatened big shellbark hickory (*Carya laciniosa*) in North Carolina, giving the site a Very High (R2) Representational Value. It also has one of the best two populations of the State Endangered dwarf stinging nettle (*Urtica chamaedryoides*), also giving a Very High Representational Value. The combination of five natural communities of high quality, four rare plants, three rare animals, and a heronry yield a High (C3) Collective Value for the natural area.

LANDSCAPE RELATIONSHIPS: This site incorporates nearly all of the former Norfleet Cottonwood Forest natural area. This newly defined natural area lies mostly on the west (Halifax County) side of the Roanoke River. The northern portion of the site lies opposite the Cypress Swamp/Sandy Run Floodplain Forest natural area, which is located east of the river in Northampton and Bertie counties. About 0.8-mile below (downriver) of this site lies the Hills Ferry/Palmyra Slopes natural area.

SITE DESCRIPTION: Buzzard Point Floodplain Forests contains land on both the west and east sides of the Roanoke River, though only about 15% of the site lies on the east (Bertie County) side; in fact, this Bertie land consists of two separate areas, one due east of Buzzard Point and one well to the south (farther downriver). Because the terrain in this central part of the floodplain is generally flat and with few slopes, geographic areas tend to have similar natural communities and rare species and thus can be joined into a few large sites (e.g., this site and the Cypress Swamp/Sandy Run Floodplain Forest natural area). This site encompasses perhaps 12-13 miles of the western shoreline of the river, with the very large meander at Buzzard Point being near the center of the site. Though fairly well downriver, good examples of Brownwater Levee Forest (High Levee subtype) are still present, highlighted by several large populations of dwarf stinging nettle (*Urtica chamaedryoides*). Also in this community, as well as in the Brownwater Levee Forest (Medium Levee subtype), are small but notable populations of the very rare big shellbark hickory (*Carya laciniosa*), the only known locale in the state away from the Piedmont. In the latter community grows the State Significantly Rare catchfly cutgrass (*Leersia lenticularis*), newly discovered during the inventory. A small population of the State Endangered limestone wild-petunia (*Ruellia strepens*) was discovered during the inventory along the margin of a levee forest.

Good examples of Brownwater Bottomland Hardwoods (High subtype), Cypress—Gum Swamp (Brownwater subtype), and Coastal Plain Semipermanent Impoundment (Cypress—Gum

subtype) are also present. A heronry was located in the last community, though it is not known if it is currently active. Two of the three rare animals – the State Special Concern Cerulean Warbler (*Setophaga cerulea*) and the State Significantly Rare Warbling Vireo (*Vireo gilvus*) – formerly occurred in summer in the site, but they were not noted during the inventory. The State Special Concern Southeastern Myotis (*Myotis austroriparius*) is also known from the site; this bat should be assumed to still be present.

PROTECTION AND MANAGEMENT: Only about 25-30% of the site lies in conservation land. The N.C. Wildlife Resources Commission property (the Urquhart tract) is additionally protected as a Dedicated State Nature Preserve. Immediately to the north of this tract is the Shellbark Hickory Preserve tract owned by The Nature Conservancy. The remainder of the tract lies in a relatively small number of private landowners. The primary protection recommendation is for additional land to be acquired by the Commission, to add to the isolated Urquhart tract, which currently has legal access only from the river. Easements should be sought on other tracts. Some of the site has recently been clear-cut immediately to the west of the Urquhart tract. Such timber harvest allows invasive exotics such as Chinese privet (*Ligustrum sinense*), Japanese stilt-grass (*Microstegium vimineum*), and common chickweed (*Stellaria media*) to spread rapidly, even into adjacent mature forests. These effects can be minimized if future timber harvest is eliminated within the natural area boundary.

NATURAL COMMUNITIES: Brownwater Levee Forest (High Levee subtype), Brownwater Levee Forest (Medium Levee subtype), Brownwater Bottomland Hardwoods (High subtype), Cypress—Gum Swamp (Brownwater subtype), Coastal Plain Semipermanent Impoundment (Cypress—Gum subtype).

RARE PLANTS: Big shellbark hickory (*Carya laciniosa*), catchfly cutgrass (*Leersia lenticularis*), limestone wild-petunia (*Ruellia strepens*), dwarf stinging nettle (*Urtica chamaedryoides*); Watch List – smooth swallowwort (*Cynanchum laeve*), rootstock bloodleaf (*Iresine rhizomatosa*).

RARE ANIMALS: Southeastern Myotis (*Myotis austroriparius*), Cerulean Warbler (*Setophaga cerulea*) (at least formerly), Warbling Vireo (*Vireo gilvus*) (formerly); Watch List – Carolina Roadside-Skipper (*Amblyscirtes carolina*), Blunt Wedge [snail] (*Xolotrema caroliniense*).

REFERENCES:

LeGrand, H. 2012. Site Survey Report: Buzzard Point – Ventosa Plantation: Shellbark Hickory Preserve (TNC tract). N.C. Natural Heritage Program, Office of Land and Water Stewardship, DENR, Raleigh.

LeGrand, H. 2012. Site Survey Report: Buzzard Point – Ventosa Plantation: Urquhart (WRC) tract. N.C. Natural Heritage Program, Office of Land and Water Stewardship, DENR, Raleigh.

LeGrand, H. 2012. Site Survey Report: Buzzard Point – Ventosa Plantation: Griffin tracts (Bertie County). N.C. Natural Heritage Program, Office of Land and Water Stewardship, DENR, Raleigh.

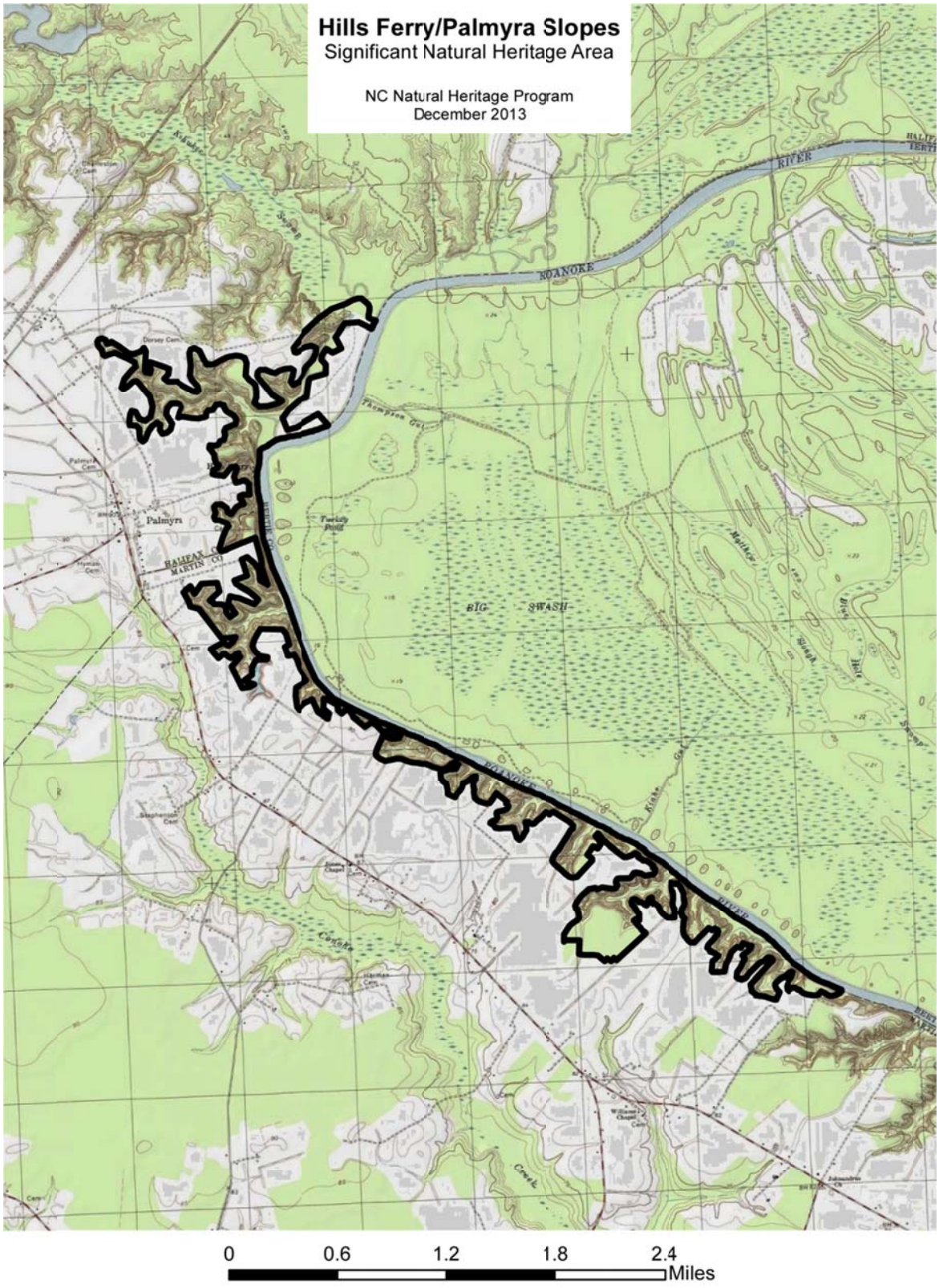
LeGrand, H. 2012. Site Report: Ward tract. N.C. Natural Heritage Program, Office of Land and Water Stewardship, DENR, Raleigh.

Lynch, J.M. 1981. Buzzard Point Heronry Natural Area. N.C. Natural Heritage Program.

Lynch, J.M. 1981. Ventosa Plantation Alluvial Floodplain. N.C. Natural Heritage Program.

Lynch, J.M. 1981. Roanoke River Preserve Design Project. N.C. Natural Heritage Program and the N.C. Nature Conservancy.

Lynch, J.M. 1985. Urquhart Tract: Roanoke River – Buzzard Point. The Nature Conservancy.


Hills Ferry/Palmyra Slopes
Significant Natural Heritage Area
NC Natural Heritage Program
December 2013
ROANOKE
RIVER
Palmyra
BIG SWASH
0
0.6
1.2
1.8
2.4
Miles

Roanoke River Inventory

HILLS FERRY/PALMYRA SLOPES
Significant Natural Heritage Area

Site Significance:
Representational Value: General (R5)
Collective Value: Moderate (C4)
Quadrangle: Palmyra

Size: about 820 acres
Ownership: private

SIGNIFICANT FEATURES: This natural area contains a lengthy series of slopes and bluffs. Though no natural communities or rare plant populations are among the 10 best in the state – the reason for the General (R5) Representational Value -- it has an array of six natural communities in good condition, with the most significant being Basic Mesic Forest (Coastal Plain subtype, Rich Alluvial Terrace Slopes variant, Intermediate form). One rare plant – the State Significantly Rare James's sedge (*Carex jamesii*) – is located within the site. These seven significant features give the natural area a Moderate (C4) Collective Value rating.

LANDSCAPE RELATIONSHIPS: Two previously identified natural areas have been merged into one, as both contain bluffs and steep slopes and as these sites border each other. The former "Martin Slopes" has been renamed "Palmyra Slopes," as the community of Palmyra lies nearby. This expanded natural area lies about 0.8-mile down-river (to the west) of the large Buzzard Point Floodplain Forests natural area. Lying on the opposite (northeastern) side of the Roanoke River from the southern half of the site is Big Swash natural area. Nearly 2 miles farther downriver is the Roanoke River/NC 11 Floodplain Forests natural area.

SITE DESCRIPTION: This natural area is somewhat of an anomaly in the central third of the floodplain, as most other natural areas in this portion of the floodplain consist of wide, flat terrain with hardly any slopes or bluffs. However, on the southwestern side of the river is a series of strongly eroded land, where tiny tributaries flowing northeast to the river have formed gullies and ravines and where the migrating river has been scouring southward into the terrace to form bluffs. The northern portion of the site, formerly called Hills Ferry Bluffs, contains a remarkable array of communities, highlighted by the disparate Piedmont/Coastal Plain Heath Bluff and the Basic Mesic Forest (Intermediate form). The first has a locally scarce population of galax (*Galax aphylla*) growing under dense stands of mountain laurel (*Kalmia latifolia*). The second contains characteristic species such as baby blue-eyes (*Nemophila aphylla*) and yellow fumewort (*Corydalis flavula*), along with the locally rare eastern columbine (*Aquilegia canadensis*) and carpenter's-square figwort (*Scrophularia marilandica*).

Farther southward, into Martin County – the Palmyra Slopes portion of the natural area -- the Basic Mesic Forest (Intermediate form) contains notable species such as the James's sedge (*Carex jamesii*) and the Watch List heartleaf skullcap (*Scutellaria ovata* var. *bracteata*). These Intermediate form slopes contain indicator species such as baby blue-eyes, yellow fumewort, black cohosh (*Actaea racemosa*), and broad beech fern (*Thelypteris hexagonoptera*) but they lack the rich soil species found in the upper third of the river – such as Dutchman's breeches

(*Dicentra cucullaria*), sessile-flowered trillium (*Trillium sessile*), and Eastern isopyrum (*Enemion biternatum*). The southern part of the site contains good examples of Mesic Mixed Hardwood Forest (Bluff/Slope variant) on ravine slopes back from the river. Where the tributaries meet the narrow floodplain, Coastal Plain Small Stream Swamp communities, along with several Low Elevation Seeps, are present.

PROTECTION AND MANAGEMENT: This site lies entirely in several private ownerships and is not protected. Because of the great diversity of natural communities, plus good to excellent examples of bluff/slope communities found in the middle third of the floodplain, this site is an important protection priority, despite the seemingly low significance. There are no protected examples of bluffs or slopes in the floodplain down-river of Odom Floodplain and Bluffs; essentially all protected sites in this portion of the river corridor consist only of broad floodplains and their levees. Also, little management of this site is needed, as these natural communities tend to be less invaded by exotic plants than are floodplains. (Nearly all of the tracts contain much upland terrace, which has been cleared for farmland for many generations; however, the slopes have been left mainly intact.)

NATURAL COMMUNITIES: Piedmont/Coastal Plain Heath Bluff, Basic Mesic Forest (Coastal Plain subtype, Rich Alluvial Terrace Slopes variant, Intermediate form), Mesic Mixed Hardwood Forest (Coastal Plain subtype, Bluff/Slope variant), Low Elevation Seep (Typic subtype), Cypress—Gum Swamp (Brownwater subtype), Coastal Plain Small Stream Swamp.

RARE PLANTS: James's sedge (*Carex jamesii*); Watch List — heartleaf skullcap (*Scutellaria ovata* var. *bracteata*).

RARE ANIMALS: None known.

REFERENCES:

LeGrand, H. 1985. Preliminary Site Reconnaissance Survey: Hills Ferry. N.C. Natural Heritage Program.

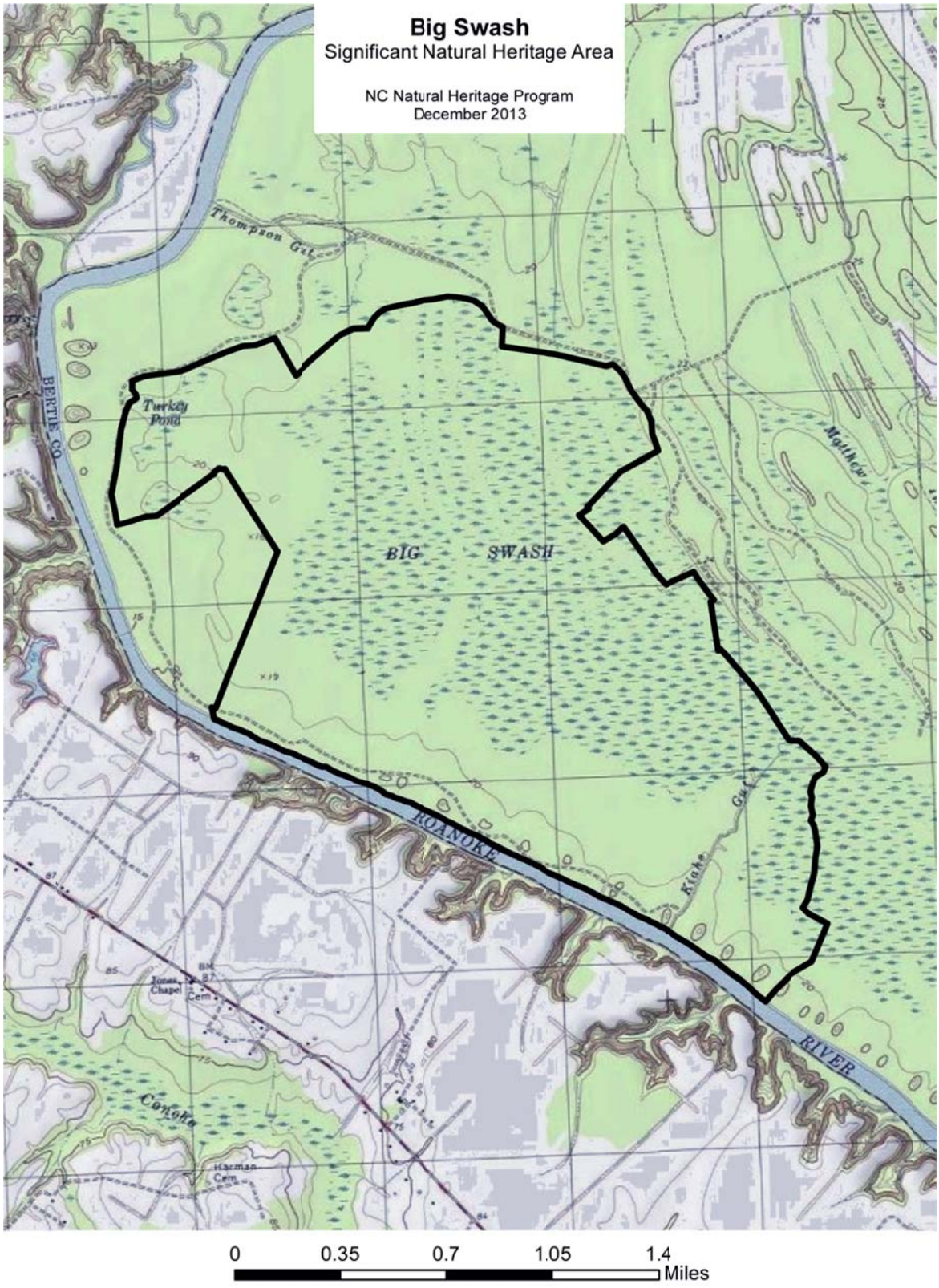
LeGrand, H. 2012. Site Survey Report: Martin Slopes (Harrison tracts). N.C. Natural Heritage Program, Office of Land and Water Stewardship, DENR, Raleigh.

LeGrand, H. 2012. Site Survey Report: Martin Slopes (Wilson tract). N.C. Natural Heritage Program, Office of Land and Water Stewardship, DENR, Raleigh.

Lynch, J.M. 1981. Roanoke River Preserve Design Project. N.C. Natural Heritage Program and the N.C. Nature Conservancy.

Lynch, J.M. 1989. Vascular Flora of the Hills Ferry Natural Area. N.C. Natural Heritage Program.

Schneider, R. 1989. Site Survey Report: Roanoke Slopes (s.e. of Palmyra). N.C. Natural Heritage Program.


Big Swash
Significant Natural Heritage Area
NC Natural Heritage Program
December 2013
Thompson Cut
BERTIE CO
Turkey Pond
BIG SWASH
Matthew
ROANOKE
RIVER
Kiah Cut
Jones Chapel Cem
Harman Cem
0
0.35
0.7
1.05
1.4
Miles

Roanoke River Inventory

BIG SWASH
Significant Natural Heritage Area

Site Significance:
Representational Value: High (R3)
Collective Value: General (C5)
Quadrangle: Palmyra

Size: about 1,760 acres
Ownership: private (with easement held by The Nature Conservancy)

SIGNIFICANT FEATURES: This natural area contains an extensive example of Brownwater Levee Forest (Medium Levee subtype); as it is considered to be the 4th or 5th best example of this type in the state, the site receives a High Representational Value (R3). Though several small examples of other natural communities are present, only the above community is considered significant at the site, and thus the natural area has a General (C5) Collective Value rating.

LANDSCAPE RELATIONSHIPS: This site lies in Bertie County, within the very large area known as the Big Swash, west of NC 11/42. Directly across the Roanoke River, to the southwest, is the Hills Ferry/Palmyra Slopes natural area. Roughly 0.9-mile to the north is the southern end of the very large Buzzard Point Floodplain Forests natural area. About 3.3 miles down-river is the Roanoke River/NC 11 Floodplain Forests natural area.

SITE DESCRIPTION: Big Swash is the topographic map name for the westernmost portion of a very extensive (over 10,000 acres) floodplain, covering much of extreme western Bertie County. Most of the forests in this area have been thinned and are braided with logging or hunting tracks, but a portion in the western section is still in good condition, though this site was not visited during the inventory. The primary feature of the natural area is the very wide natural levee, which gradually lowers in elevation back from the river and which is roughly 0.5-mile in width. Though there is likely a High subtype of Brownwater Levee Forest immediately along the river, most of the site exists as a Brownwater Levee Forest (Medium Levee subtype). This subtype contains a considerable amount of cherrybark oak (*Quercus pagoda*), which is more typical of a bottomland forest community; however, most of the dominants are typical levee species, such as green ash (*Fraxinus pennsylvanica*), sweetgum (*Liquidambar styraciflua*), and sycamore (*Platanus occidentalis*). The herb layer is dense, with sedges being dominant. Some areas of Cypress—Gum Swamp (Brownwater subtype) and Brownwater Bottomland Hardwoods (Low subtype) are present.

The State Special Concern Cerulean Warbler (*Setophaga cerulea*) potentially could occur in the levee forests along the river, but it has yet to be reported here. However, the site is important for a good array of wildlife species, especially breeding bird species.

PROTECTION AND MANAGEMENT: The natural area lies in a single private ownership, but the site is protected through a conservation easement held by The Nature Conservancy. This easement consists not only of the entire Big Swash natural area, but it consists of 8,177 acres. This large tract was part of the International Paper Company sale of their lands in northern North

Carolina in the mid-2000s; The Nature Conservancy was able to find a conservation buyer for the tract. Though most of the natural area appears to still be intact, it has not been visited by staff of the N.C. Natural Heritage Program in several years, and thus management recommendations are not being made at this time.

NATURAL COMMUNITIES: Brownwater Levee Forest (Medium Levee subtype).

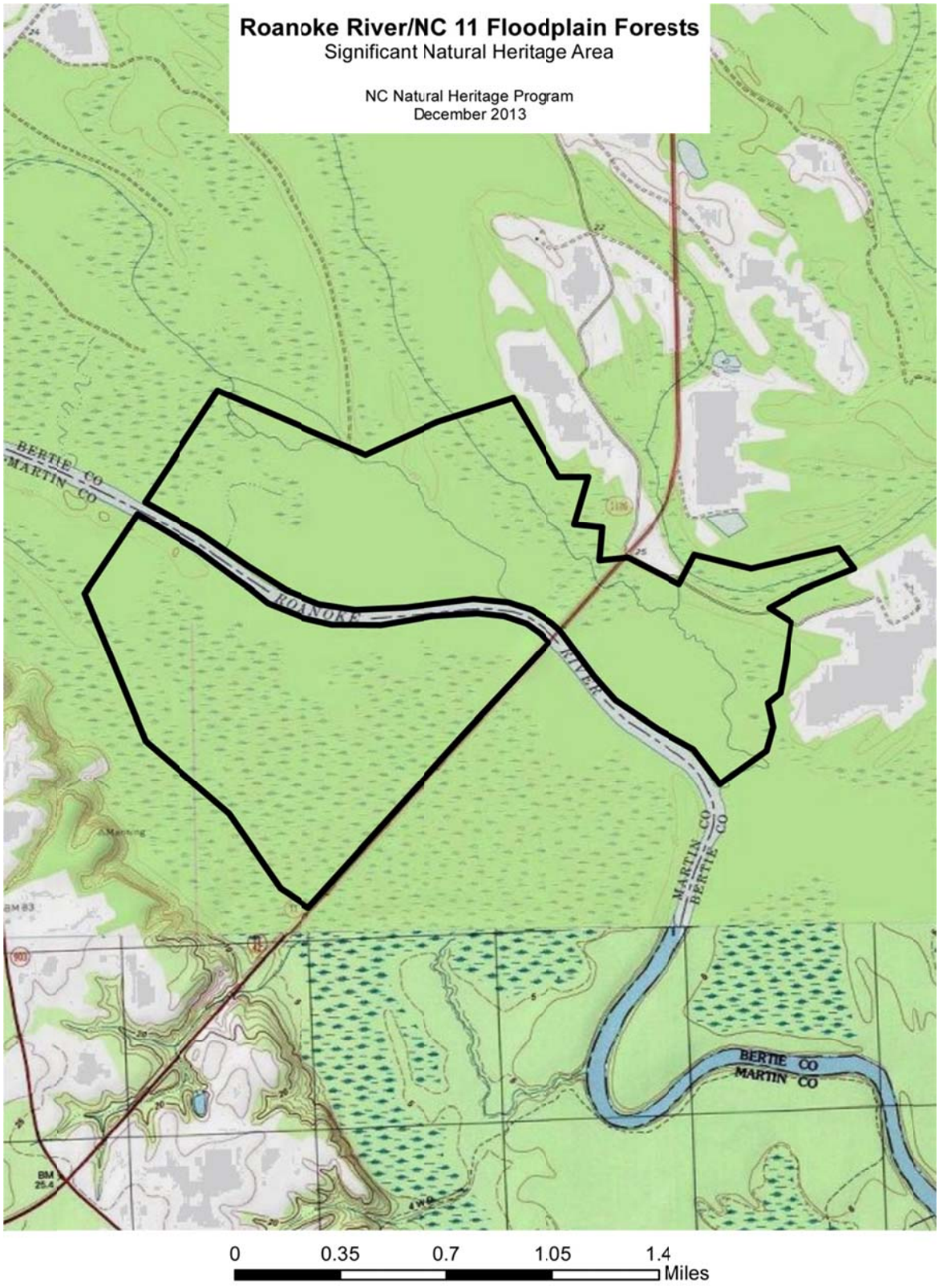
RARE PLANTS: None known.

RARE ANIMALS: None known.

REFERENCES:

Lynch, J.M., and K.M. Lynch. 1985. Site Survey Summary: Clark Estate. The Nature Conservancy.

Schafale, M. 2004. Site report: Big Swash, N.C. Natural Heritage Program.


Roanoke River/NC 11 Floodplain Forests
Significant Natural Heritage Area
NC Natural Heritage Program
December 2013
BERTIE CO
MARTIN CO
ROANOKE
RIVER
MARTIN CO
BERTIE CO
BERTIE CO
MARTIN CO
0
0.35
0.7
1.05
1.4
Miles

Roanoke River Inventory

ROANOKE RIVER/NC 11 FLOODPLAIN FORESTS
Significant Natural Heritage Area

Site Significance:
Representational Value: High (R3)
Collective Value: Moderate (C4)
Quadrangle: Woodville

Size: about 1,325 acres
Ownership: private (one tract has a conservation easement held by The Nature Conservancy)

SIGNIFICANT FEATURES: As this site contains the 3rd or 4th best of the few known populations of the State Significantly Rare smooth hedge-nettle (*Stachys tenuifolia*) in North Carolina – all in the Roanoke River floodplain – it receives a High (R3) Representational Value. Good examples of three widespread natural communities are also present; coupled with the rare plant, the site receives a Moderate (C4) Collective Value rating.

LANDSCAPE RELATIONSHIPS: This site's boundary has been re-configured due to recent logging activities. It lies on both the north and south sides of the Roanoke River. Big Swash lies about 3.3 miles upriver, on the north (Bertie County) side; Hills Ferry/Palmyra Slopes lies slightly under 2 miles upriver on the south (Martin County) side. About 1.6 miles to the east is the Indian Woods/Broadneck Swamp natural area. Also about 1.6 miles to the southeast, along both sides of the river, is the very large Broadneck Swamp/Company Swamp natural area.

SITE DESCRIPTION: The latter part of the site name has been changed from "Alluvial Flats" to a more appropriate "Floodplain Forests." Nearly all of the former site east of NC 11/42, on the Martin County side, was clear-cut in the 1990s, and this section of the natural area has been removed from the site boundary. Other portions west of the highway in Martin County have also been heavily timbered, leaving a patchwork of good quality forest there. There is a fair example of Brownwater Bottomland Hardwoods (High subtype) on this west side, as well as along Apple Tree Road in the far northeastern section. The Brownwater Levee Forest (High Levee subtype) is better represented, occurring on both sides of the river. Silver maple (*Acer saccharinum*), rare over most of the state, is fairly common along the river bank here and elsewhere along much of the Roanoke River. Both eastern cottonwood (*Populus deltoides*) and swamp cottonwood (*P. heterophylla*) are present in the natural area. Along the river banks, water hickory (*Carya aquatica*) is numerous, about as far upriver as this tree is considered common.

The openings along the highway, especially near the bridge over the river, provide habitat for an array of herbaceous species of floodplains that favor some sunlight. A population of smooth hedge-nettle (*Stachys tenuifolia*) is present along the margin of a track on the Martin County side. The Watch List smooth swallowwort (*Cynanchum laeve*) sprawls over other vegetation under the bridge; it is limited in the state essentially to the Roanoke River corridor. The State Special Concern Cerulean Warbler (*Setophaga cerulea*) was once noted along the river, but it has been many decades since it has been found, and the species is not included as an element occurrence for the site.

PROTECTION AND MANAGEMENT: The site lies in several private ownerships. The northwestern 30% of the site – the majority of the land north of the river and west of NC 11/42 — is part of a large landholding that is an easement held by The Nature Conservancy. It is possible that some timber harvest is allowed, but the land is protected from development and probably from clear-cutting. Otherwise, the remainder of the site has no protection.

Both the U.S. Fish and Wildlife Service and the N.C. Wildlife Resources Commission own land less than 2 miles downriver; however, some clear-cuts lie between these tracts and this natural area, and thus acquisition by a public agency might not be a high priority. Even so, additional easements might be pursued, especially to help eliminate clear-cutting within the current site boundary, as such an activity promotes rapid invasion of exotic plant species such as Chinese privet (*Ligustrum sinense*).

NATURAL COMMUNITIES: Brownwater Levee Forest (High Levee subtype), Brownwater Bottomland Hardwoods (High subtype), Cypress—Gum Swamp (Brownwater subtype).

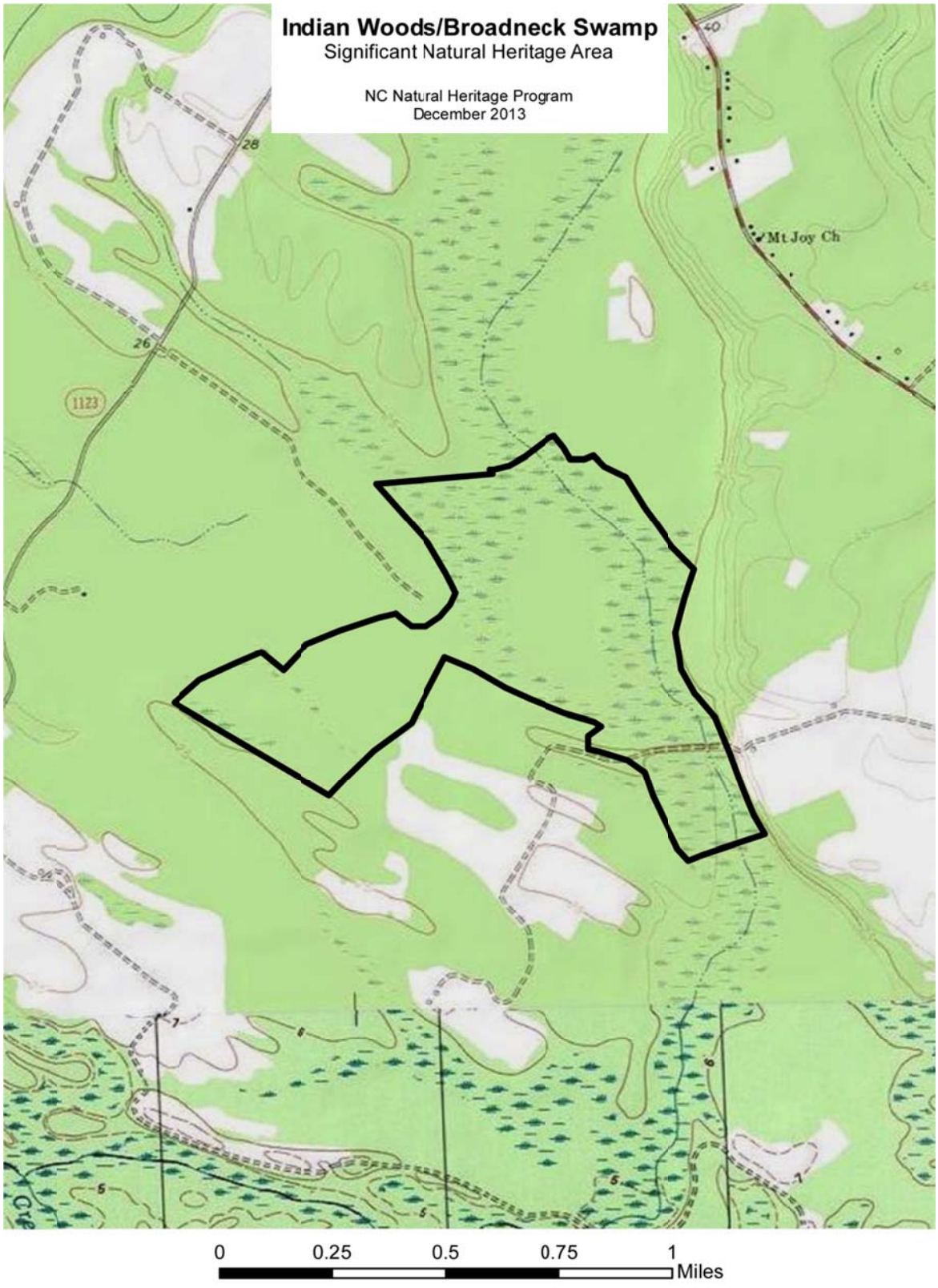
RARE PLANTS: Smooth hedge-nettle (*Stachys tenuifolia*); Watch List — smooth swallowwort (*Cynanchum laeve*).

RARE ANIMALS: None known.

REFERENCES:

LeGrand, H. 1989. Site Survey Report: Roanoke River/NC 11 Alluvial Flats. N.C., Natural Heritage Program.

LeGrand, H. 2012. Site Survey Report: Roanoke River/NC 11 Floodplain Forest. N.C. Natural Heritage Program, Office of Land and Water Stewardship, DENR, Raleigh.


Indian Woods/Broadneck Swamp
Significant Natural Heritage Area
NC Natural Heritage Program
December 2013
Mt Joy Ch
1123
0
0.25
0.5
0.75
1
Miles

Roanoke River Inventory

INDIAN WOODS/BROADNECK SWAMP
Significant Natural Heritage Area

Site Significance:
Representational Value: High (R3)
Collective Value: Moderate (C4)
Quadrangle: Woodville

Size: 302 acres
Ownership: private

SIGNIFICANT FEATURES: This site contains roughly the 3rd to 6th best examples of Brownwater Bottomland Hardwoods (High subtype) and Brownwater Bottomland Hardwoods (Swamp Transition subtype) in the state, providing for a High Representational Value (R3) rating. The site also contains the State Significantly Rare hop-like sedge (*Carex lupuliformis*). The combination of three high-quality natural communities and one rare plant gives the site a Moderate (C4) Collective Value rating.

LANDSCAPE RELATIONSHIPS: This site lies well back from the Roanoke River itself, at the inner edge of the broad floodplain, about 2 miles from the river. About 1.6 miles to the west, along the river, is the Roanoke River/NC 11 Floodplain Forests natural area; about 1.4 miles to the south is Broadneck Swamp/Company Swamp.

SITE DESCRIPTION: This site contains a series of low, wet ridges on a terrace of the river; gentle slopes at the base of the upland terrace form the eastern boundary of the natural area. Several subtypes of Brownwater Bottomland Hardwoods are present, with the most significant or unusual being the Swamp Transition subtype, which has the locally rare and Watch List pin oak (*Quercus palustris*) as a co-dominant in the canopy. This tree is very rare in the Coastal Plain and has been reported at just one other site -- Pollocks Ferry Natural Area —- in the Roanoke River floodplain. The rare hop-like sedge (*Carex lupuliformis*) occurs in several small populations within this subtype; this is one of just two known locales for it in the Roanoke River floodplain.

The more widespread (in the Roanoke floodplain) Brownwater Bottomland Hardwoods (High subtype) is also of high quality. The lowest and wettest sites in the natural area contain Cypress—Gum Swamp (Brownwater subtype) natural community; swamp cottonwood (*Populus heterophylla*) is reasonably common here, more so than in the majority of such stands in the project area.

PROTECTION AND MANAGEMENT: The site lies in private ownership and is not protected. A conservation easement is a possible protection strategy. Little management is needed, and timber harvest should be excluded, if at all possible.

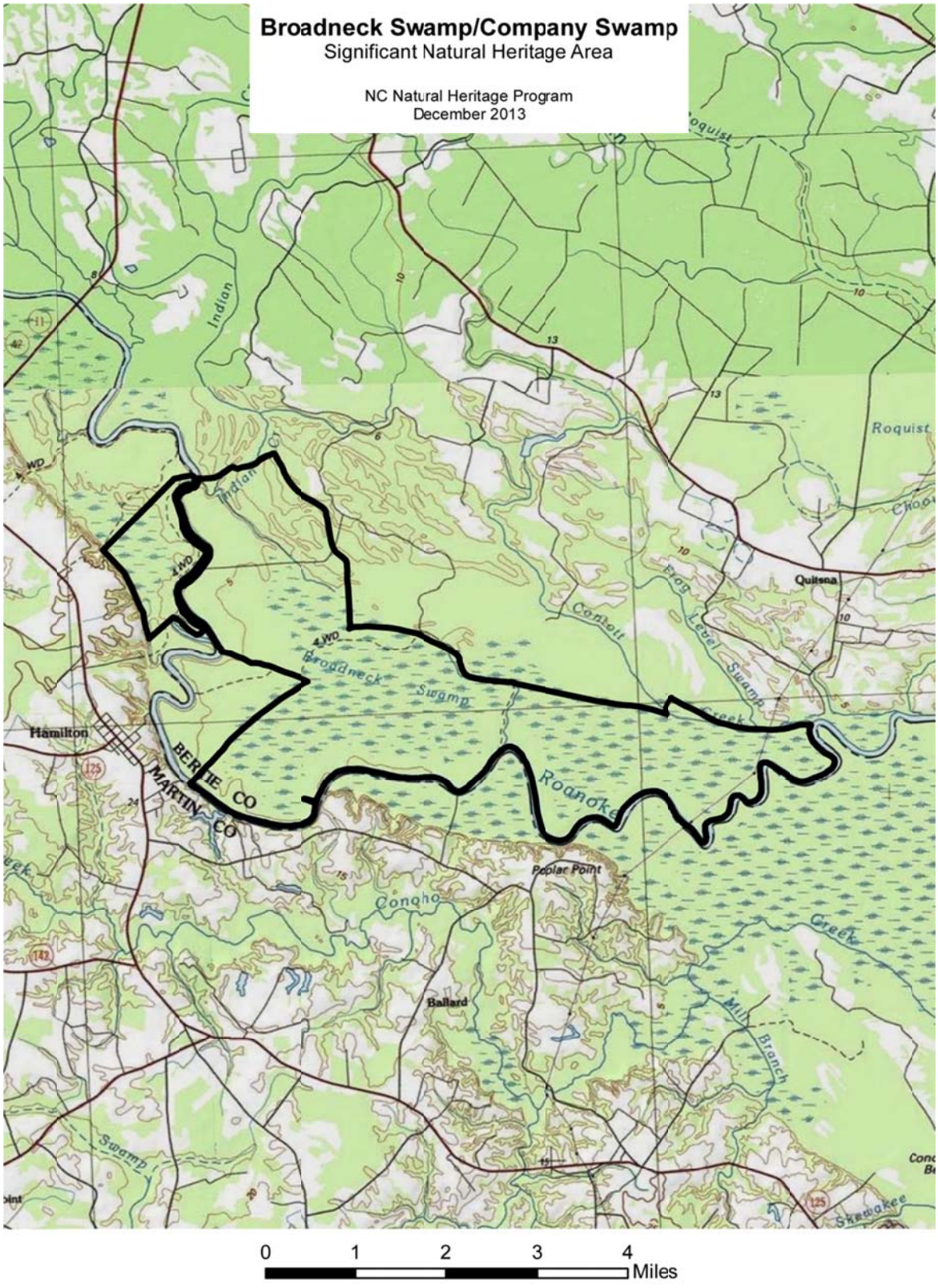
NATURAL COMMUNITIES: Brownwater Bottomland Hardwoods (High subtype), Brownwater Bottomland Hardwoods (Swamp Transition subtype), Cypress—Gum Swamp (Brownwater subtype).

RARE PLANTS: Hop-like sedge (*Carex lupuliformis*); Watch List – pin oak (*Quercus palustris*).

RARE ANIMALS: None known.

REFERENCES:

Schafale, M. 1998. Site Survey Report: Indian Woods Broadneck Swamp. N.C. Natural Heritage Program.


Broadneck Swamp/Company Swamp
Significant Natural Heritage Area
NC Natural Heritage Program
December 2013
Roquist
Indian
Roquist
Quitsna
Comott
Frog Level Swamp
Broadneck Swamp
Hamilton
BERTIE CO
MARTIN CO
Roanoke
Poplar Point
Conoho
Creek
Ballard
Mill Branch
Swamp
Skewakee
0 1 2 3 4
Miles

Roanoke River Inventory

BROADNECK SWAMP/COMPANY SWAMP
Significant Natural Heritage Area

Site Significance:
Representational Value: Very High (R2)
Collective Value: High (C3)
Quadrangles: Hamilton, Quitsna

Size: about 7,745 acres
Ownership: U.S. Fish and Wildlife Service, N.C. Wildlife Resources Commission, private

SIGNIFICANT FEATURES: This very large site contains among the best examples in the state (generally within the top two) of three features: Brownwater Levee Forest (High Levee subtype), the State Endangered Cherokee sedge (*Carex cherokeensis*), and the State Special Concern Southeastern Myotis (*Myotis austroriparius*). The great collection of rare species and natural communities – six high-quality natural communities, five rare animals, and two rare plants, plus a heronry – gives the site a High (C3) Collective Value rating.

LANDSCAPE RELATIONSHIPS: This site consists of two former sites that have been merged, to include private land between them; Broadneck Swamp and Company Swamp are each part of the Roanoke River National Wildlife Refuge. In addition, a forested area across the Roanoke River, on the west, has been added to the site, as all three of these large areas contain relatively similar vegetation and natural communities. Slightly less than 2 miles upriver lies the Roanoke River/NC 11 Floodplain Forests site. About 1.4 miles to the north lies Indian Woods/Broadneck Swamp, and also to the north, by roughly 0.9-mile, is the Coniott Ridge natural area. Across the river, immediately to the south, are two small sites – Fort Branch Bluffs and Poplar Point Slopes. Across the river, on the east, is the very large Conoho Neck Swamp natural area.

SITE DESCRIPTION: Because this site now consists of over 12 square miles of floodplain forest, it contains a very wide variety of swamp, bottomland, and levee natural communities. Even this far downriver, the Brownwater Levee Forest (High Levee subtype) is present. An example on the western part of Broadneck Swamp, named "Mertensia Levee" (Lynch 1981), is one of the best in the state, as it contains a large population of the Watch List Virginia bluebells (*Mertensia virginica*), far to the east of other state occurrences. This levee also contains the State Endangered dwarf stinging nettle (*Urtica chamaedryoides*), the farthest downriver that this endemic to the Roanoke in the state species has been found. Behind the levee is a large backswamp, containing a mature Cypress—Gum Swamp (Brownwater subtype). Behind the backswamp, on the Broadneck Swamp portion, are several Brownwater Bottomland Hardwoods communities – both High and Low subtypes – on gentle floodplain ridges.

The Company Swamp portion of the site, farther downriver, has a more gentle levee that is a Brownwater Levee Forest (Medium Levee subtype), as painted buckeye (*Aesculus sylvatica*) is scarce there, and the Virginia bluebells are absent. This levee contains a population of the State Endangered Cherokee sedge (*Carex cherokeensis*). Behind this levee is another very large Cypress—Gum Swamp in an extensive backswamp area. Colonial wading bird colonies are

present in these backswamps, as well. The portion of the site west of the river contains an extensive Cypress—Gum Swamp.

The natural area is very important for several animal species. Two rare bats — the Southeastern Myotis (*Myotis austroriparius*) and the Rafinesque's Big-eared Bat (*Corynorhinus rafinesquii*) – both State Special Concern, have been mist-netted at several locations in the natural area. They certainly forage over most of the natural area. The State Threatened Bald Eagle (*Haliaeetus leucocephalus*) nests (at least in 2010) in the natural area, and the State Special Concern Cerulean Warbler (*Setophaga cerulea*) nests not only in tall trees along the river but at a few hardwood stands back from the river. However, this warbler is strongly declining, though it presumably still nests in the natural area. The State Significantly Rare Yellow-crowned Night-Heron (*Nyctanassa violacea*) has been seen in the summer and is assumed to nest at the site.

PROTECTION AND MANAGEMENT: Perhaps 85% of the natural area is owned by the U.S. Fish and Wildlife Service and operated as the Roanoke River National Wildlife Refuge. Nearly all of the portion west of the river is the Beach House tract, owned by the N.C. Wildlife Resources Commission and operated as part of the Lower Roanoke River Wetlands Game Land. This tract, about 635 acres in size, has additional protection as a Dedicated State Nature Preserve. The remaining portion of the site, mostly a 0.5-mile gap between Broadneck Swamp and Company Swamp, lies in private, unprotected ownership. If the Service can acquire this tract in the near future, that would greatly help to coalesce their landholdings and to avoid any potential clear-cutting or other impacts that would split these two large tracts.

NATURAL COMMUNITIES: Brownwater Levee Forest (High Levee subtype), Brownwater Levee Forest (Medium Levee subtype), Brownwater Bottomland Hardwoods (High subtype), Brownwater Bottomland Hardwoods (Low subtype), Cypress—Gum Swamp (Brownwater subtype), Coastal Plain Semipermanent Impoundment (Cypress—Gum subtype).

RARE PLANTS: Cherokee sedge (*Carex cherokeensis*), dwarf stinging nettle (*Urtica chamaedryoides*); Watch List – Virginia bluebells (*Mertensia virginica*).

RARE ANIMALS: Rafinesque's Big-eared Bat (*Corynorhinus rafinesquii*), Bald Eagle (*Haliaeetus leucocephalus*), Southeastern Myotis (*Myotis austroriparius*), Yellow-crowned Night-Heron (*Nyctanassa violacea*), Cerulean Warbler (*Setophaga cerulea*); Watch List – Anhinga (*Anhinga anhinga*).

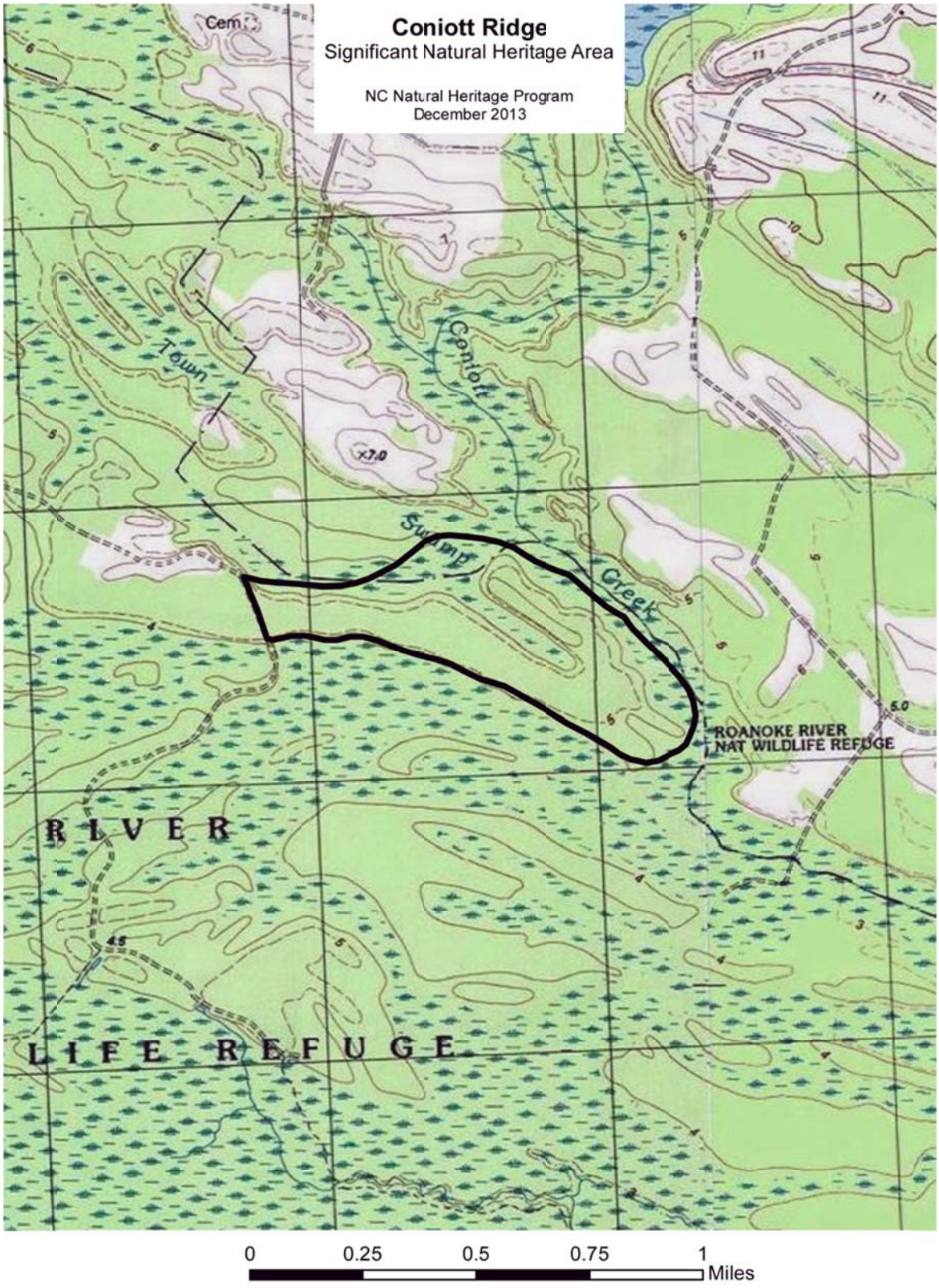
REFERENCES:

Lynch, J.M. 1981. Roanoke River Preserve Design Project. N.C. Natural Heritage Program and the N.C. Nature Conservancy.

Lynch, J.M. 1981. Site report: Mertensia Levee. N.C. Natural Heritage Program.

Lynch, J.M. 1985. Site report: Company Swamp. The Nature Conservancy.

Lynch, J.M. 1985. Site report: Broadneck Ridge. The Nature Conservancy.


Coniott Ridge
Significant Natural Heritage Area
NC Natural Heritage Program
December 2013
Cem
Town
Coniott
Swamp
Creek
ROANOKE RIVER
NAT WILDLIFE REFUGE
RIVER
LIFE REFUGE
0
0.25
0.5
0.75
1
Miles

Roanoke River Inventory

CONIOTT RIDGE
Significant Natural Heritage Area

Site Significance:
Representational Value: High (R3)
Collective Value: Moderate (C4)
Quadrangle: Hamilton

Size: 141 acres
Ownership: U.S. Fish and Wildlife Service, private

SIGNIFICANT FEATURES: This site, located on a narrow but well-defined ridge, has one of the better examples (3rd thru 6th) of Brownwater Bottomland Hardwoods (High subtype) in the state, and thus the site is given a High (R3) Representational Value rating. Though there are just two elements known from the site, the above community and the Mesic Mixed Hardwood Forest (Coastal Plain subtype, Swamp Island variant), the site has a Moderate (C4) Collective Value rating.

LANDSCAPE RELATIONSHIPS: This site is located in the northern portion of the Roanoke River floodplain, which is over 3 miles wide and poorly defined in this part of Bertie County. It lies immediately south of the Rascoe Millpond natural area, which is not considered as a part of this inventory of the floodplain. Broadneck Swamp/Company Swamp lies about 0.9-mile to the south; this is the only other nearby natural area in the floodplain.

SITE DESCRIPTION: Where the floodplain of the Roanoke River is quite wide, there are typically parallel band of ridges (old levees) and channels; those farther from the active channel are usually highest and driest. Coniott Ridge, also known as "Coniott Cherrybark Oak Ridge," is such a ridge, and it contains one of the most mature and better examples of Brownwater Bottomland Hardwoods (High subtype) in the state. An excellent variety of oak and hickory species is present; as the former site name suggests, cherrybark oak (*Quercus pagoda*) is the dominant species. This community transitions to an upland community – Mesic Mixed Hardwood Forest (Swamp Island variant) – on slightly higher ground, where species such as American beech (*Fagus grandifolia*) and hop-hornbeam (*Ostrya virginiana*) are good indicators of this type instead of a bottomland type. The uncommon (and rare in the Coastal Plain) lesser ladies'-tresses (*Spiranthes ovalis*) is present in the natural area; it is known from one other site in the floodplain.

PROTECTION AND MANAGEMENT: The majority of the site was recently acquired by the U.S. Fish and Wildlife Service, and added to the Roanoke River National Wildlife Refuge. Small portions of the eastern end and the northwestern corner remain in private ownership and are not protected. Ideally, the Service can expand its protection efforts to acquire the remainder of the site. Because the forest is climax, there is very little issue with exotic plants at the present time, though any timber harvest would open up the site for such invasion. Thus, little management is currently needed.

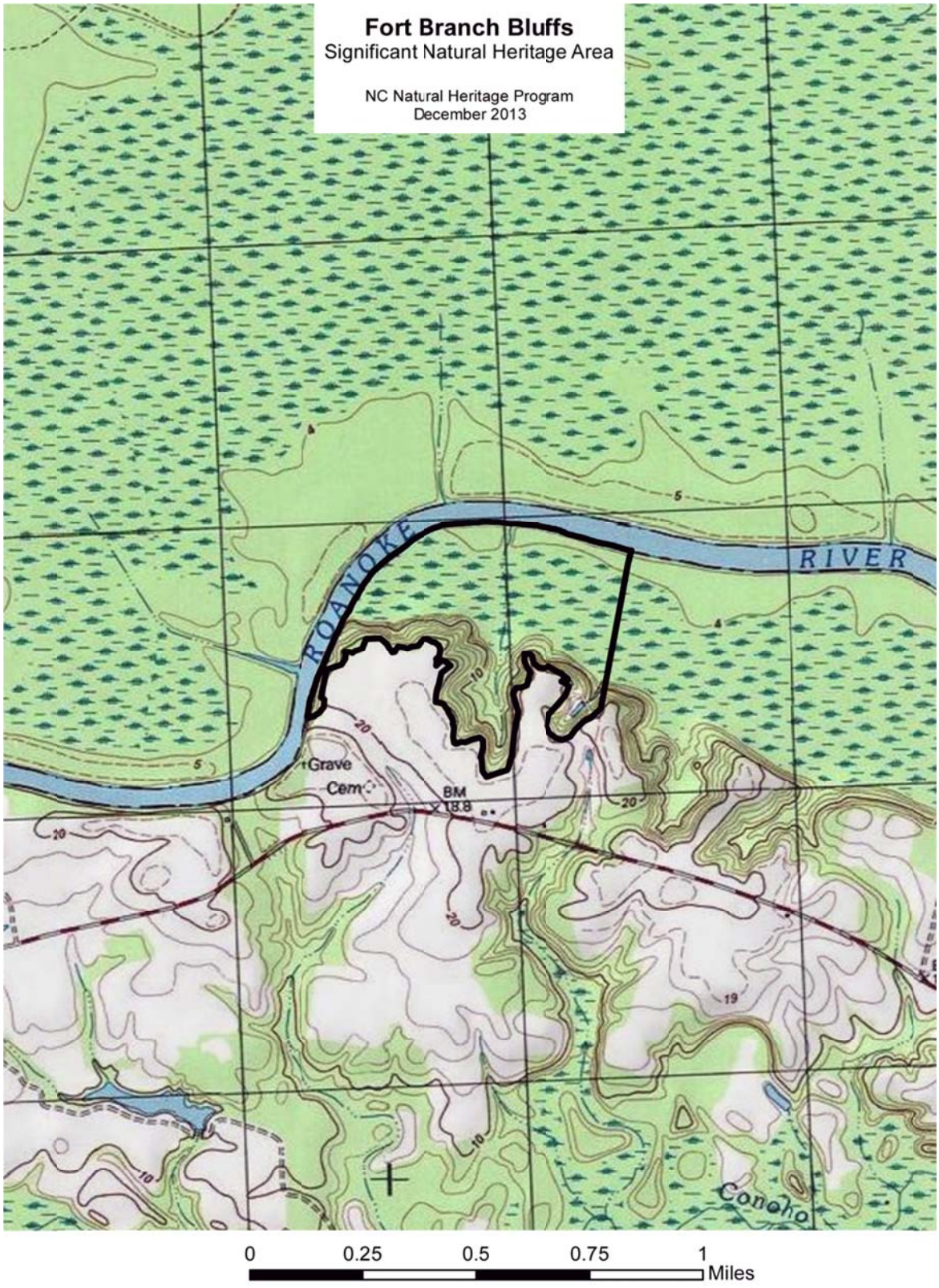
NATURAL COMMUNITIES: Brownwater Bottomland Hardwoods (High subtype), Mesic Mixed Hardwood Forest (Coastal Plain subtype, Swamp Island variant).

RARE PLANTS: None known.

RARE ANIMALS: None known.

REFERENCES:

LeGrand, H. 1985. Preliminary Site Reconnaissance Survey: Coniott Cherrybark Oak Ridge. N.C. Natural Heritage Program.


Fort Branch Bluffs
Significant Natural Heritage Area
NC Natural Heritage Program
December 2013
ROANOKE
RIVER
Grave
Cem
BM
18.8
Conoho
0
0.25
0.5
0.75
1
Miles

Roanoke River Inventory

FORT BRANCH BLUFFS
Significant Natural Heritage Area

Site Significance:
Representational Value: High (R3)
Collective Value: Moderate (C4)
Quadrangle: Hamilton

Size: 133 acres
Ownership: private
.

SIGNIFICANT FEATURES: This site contains one of the better examples of the Brownwater Levee Forest (Medium Levee subtype) in the state, giving it a High (R3) Representational Value. There are a total of four significant natural communities, and thus the site has a Moderate (C4) Collective Value rating.

LANDSCAPE RELATIONSHIPS: This small natural area is located about 2.5 miles east-southeast of Hamilton, on the south side of the Roanoke River. The somewhat similar Poplar Point Slopes natural area lies 1.25 miles to the east. Directly across the river, to the north, is the very large Broadneck Swamp/Company Swamp natural area.

SITE DESCRIPTION: The general area of the site is well known to local citizens as a Civil War fort/historic site, and the steep bluffs and slopes below the fort site are known to them as "Rainbow Banks." The most conspicuous natural feature of the site is a near-vertical, west-facing bluff of close to 70 feet, between the river and the fort. This bluff contains the locally scarce Piedmont/Coastal Plain Heath Bluff, with an abundance of mountain laurel (*Kalmia latifolia*), and the locally scarce wild hydrangea (*Hydrangea arborescens*). Slopes and ravines farther east contain a Basic Mesic Forest (Coastal Plain subtype, Rich Alluvial Terrace Slopes variant, Umbrella Magnolia form). These rich slopes, which are close in composition to a Basic Mesic Forest (Intermediate form), contain umbrella magnolia (*Magnolia tripetala*), painted buckeye (*Aesculus sylvatica*), cutleaf toothwort (*Cardamine concatenata*), and maidenhair fern (*Adiantum pedatum*); however, this community lacks the truly Intermediate form mafic species such as baby blue-eyes (*Nemophila aphylla*) and yellow fumewort (*Corydalis flavula*), which are found downriver to the Hills Ferry/Palmyra Slopes vicinity. These slopes become drier farther eastward, and blend into Dry-Mesic Oak—Hickory Forest and Dry Oak—Hickory Forest.

The majority of the natural area consists of floodplain, and fronting the river is a good example of Brownwater Levee Forest (Medium Levee subtype); this community contains eastern cottonwood (*Populus deltoides*), which is not common this far downriver. Behind the levee, and just below the slopes, is a Cypress—Gum Swamp (Brownwater subtype).

The Special Concern Cerulean Warbler (*Setophaga cerulea*) was noted at least once at the site in the 1970s, but there have been no recent reports, and this declining species likely is absent from the site now.

PROTECTION AND MANAGEMENT: The most recent tract data show that the natural area lies in two private ownerships. However, the upland terrace portions of one or both tracts are open to the public at certain times of the year, as the "Fort Branch Confederate Earthern Fort Civil War Site," operated by the Fort Branch Battlefield Commission, Inc. Its mission is to preserve the fort and its heritage; a battle re-enactment is held there each November. The fort, trenches, and other Civil War features all appear to be just to the south of the natural area, and thus there appears to be little disturbance to the natural area. A conservation easement would be an excellent means to protect the bluff, slopes, and floodplain in perpetuity. The natural area apparently needs little management at the present time, as most or all public activities take place to the south of the natural area.

NATURAL COMMUNITIES: Piedmont/Coastal Plain Heath Bluff, Basic Mesic Forest (Coastal Plain subtype, Rich Alluvial Terrace Slopes variant, Umbrella Magnolia form), Brownwater Levee Forest (Medium Levee subtype), Cypress—Gum Swamp (Brownwater subtype).

RARE PLANTS: None known.

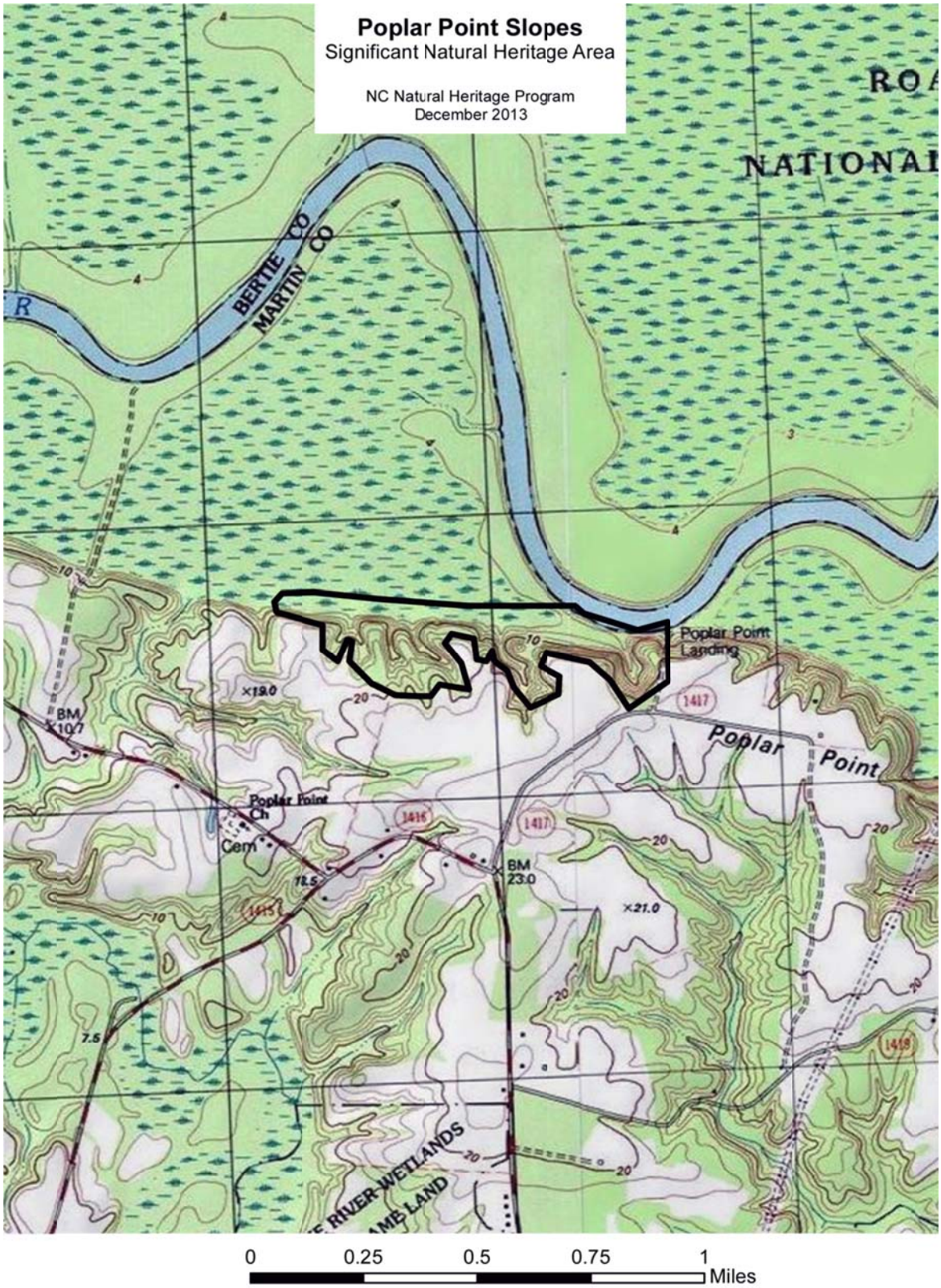
RARE ANIMALS: Cerulean Warbler (*Setophaga cerulea*) (formerly).

REFERENCES:

Lynch, J.M. 1978. Site report: Rainbow Banks – Fort Branch. N.C. Natural Heritage Program.

Pridgen, V., and S. Corda. 1978. Site report: Fort Hamilton Bluffs Area. East Carolina University.

Schneider, R. 1989. Site Survey Report: Winslow's Roanoke Slopes. N.C. Natural Heritage Program.


Poplar Point Slopes
Significant Natural Heritage Area
NC Natural Heritage Program
December 2013
BERTIE CO
MARTIN CO
Poplar Point Landing
Poplar Point
Poplar Point Ch
Cem
BM 23.0
BM 10.7
0
0.25
0.5
0.75
1
Miles

Roanoke River Inventory

POPLAR POINT SLOPES
Significant Natural Heritage Area

Site Significance:
Representational Value: General (R5)
Collective Value: General (C5)
Quadrangles: Hamilton, Quitsna

Size: 79 acres
Ownership: private

SIGNIFICANT FEATURES: This small site contains a good example of the Basic Mesic Forest (Coastal Plain subtype, Rich Alluvial Terrace Slopes variant, Intermediate form) natural community. However, as this example is not one of the ten best in the state, it has a General (R5) Representational Value. As there is only one natural community described, it also has a General (C5) Collective Value rating.

LANDSCAPE RELATIONSHIPS: This site is located south of the Roanoke River, just west of "Poplar Point Landing" as indicated on the topographic map. Fort Branch Bluffs lies 1.25 miles to the west, whereas Conoho Neck Swamp lies about 0.7-mile downriver, to the east. Directly across the river, to the north, lies the very large Broadneck Swamp/Company Swamp natural area.

SITE DESCRIPTION: From Fort Branch Bluffs on the west, eastward for roughly 3.25 miles, is a series of north-facing slopes and bluffs, indicating that the river formerly occurred at the base of these slopes but is migrating northward, leaving some floodplain between the river channel and the slopes. Not surprisingly, there are numerous tributary streams flowing northward to the river that have cut fairly deep ravines, aligned north-south, into this east-west line of slopes. The steepness of the topography has allowed the forests to become mature, and most slopes are covered in Basic Mesic Forest (Coastal Plain subtype, Intermediate form); however, it transitions to the Umbrella Magnolia form, as truly mafic species such as baby blue-eyes (*Nemophila aphylla*) and yellow fumewort (*Corydalis flavula*) are lacking at Poplar Point Slopes. Characteristic Intermediate form species at this site include broad beech fern (*Thelypteris hexagonoptera*), black cohosh (*Actaea racemosa*), giant chickweed (*Stellaria pubera*), and bloodroot (*Sanguinaria canadensis*). The uncommon log fern (*Dryopteris celsa*) is also present in the site.

PROTECTION AND MANAGEMENT: This site lies in private ownership and is not protected. As the N.C. Wildlife Resources Commission owns considerable land within a mile to the east, at the Conoho Neck area (part of the Lower Roanoke River Wetlands Game Land), the best protection option might be acquisition by that agency. Very few rich/mesic slopes in the lower two-thirds of the river corridor lie in protected ownership. Even though there might not be an invasive plant issue on the slopes, croplands extend on the upland terrace right to the upper edge of the slopes, and thus exotics can spread down a slope from the top, especially Japanese honeysuckle (*Lonicera japonica*). At any rate, it is important to keep human impact to a minimum on the slopes.

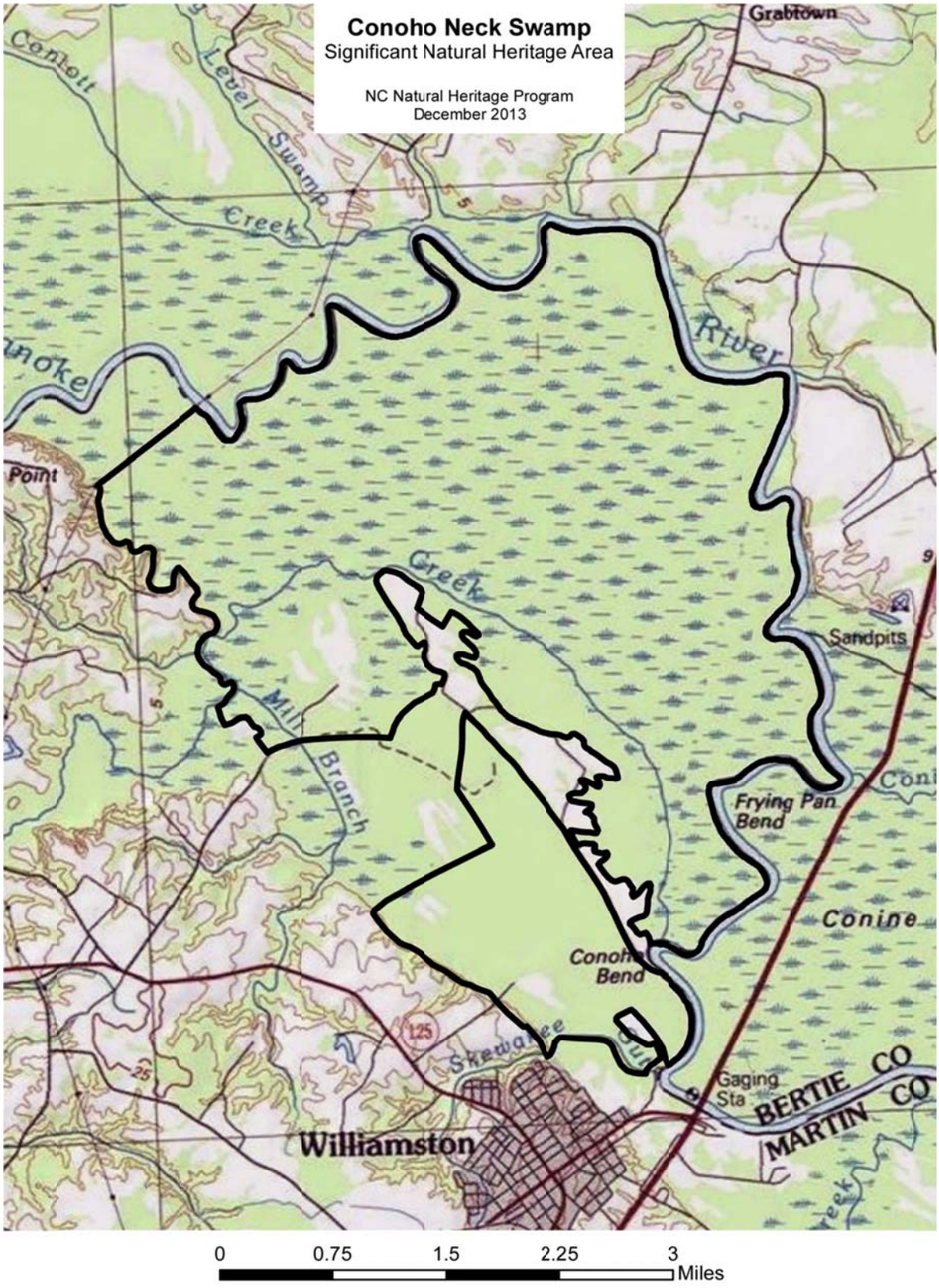
NATURAL COMMUNITIES: Basic Mesic Forest (Coastal Plain subtype, Rich Alluvial Terrace Slopes variant, Intermediate form).

RARE PLANTS: None known.

RARE ANIMALS: None known.

REFERENCES:

Lynch, J.M. 1981. Roanoke River Preserve Design Project. N.C. Natural Heritage Program and the N.C. Nature Conservancy.


Conoho Neck Swamp
Significant Natural Heritage Area
NC Natural Heritage Program
December 2013
Grabtown
Level Swamp
Creek
River
Point
Creek
Sandpits
Mill Branch
Frying Pan Bend
Conine
Conoho Bend
Skewalee
Gaging Sta
BERTIE CO
MARTIN CO
Williamston
0
0.75
1.5
2.25
3
Miles

Roanoke River Inventory

CONOHO NECK SWAMP
Significant Natural Heritage Area

Site Significance:
Representational Value: Very High (R2)
Collective Value: Moderate (C4)
Quadrangles: Quitsna, Williamston

Size: about 8,915 acres
Ownership: N.C. Wildlife Resources Commission, private

SIGNIFICANT FEATURES: The state's largest population of the Significantly Rare smooth hedge-nettle (*Stachys tenuifolia*) is present at the site, giving the natural area a Very High Representational Value (R2). In addition, it contains good to excellent examples of Brownwater Levee Forest (Low Levee subtype) and Cypress—Gum Swamp (Brownwater subtype) natural communities. These features, along with a rare animal, another rare plant, and a heronry, give the site a Moderate Collective Value (C4) rating.

LANDSCAPE RELATIONSHIPS: This very large natural area occupies the wide floodplain north of Williamston, on the south side of the Roanoke River. It lies immediately downstream from the eastern end of Broadneck Swamp/Company Swamp, even though that site lies north of the river. The northeastern (downstream) end of Conoho Creek Slopes and Floodplain natural area abuts the Conoho Neck Swamp natural area, but as it contains rich slopes with a different flora, it is considered as a separate site. Across the river, to the east, is the large Conine Island natural area. Thus, the meandering of the river has shifted the widest part of the floodplain from the north (Bertie) side at Company Swamp, to the south (Martin) side at Conoho Neck Swamp, to back again to the north at Conine Island.

SITE DESCRIPTION: Conoho Creek flows roughly eastward from central Martin County, and it empties into the river about a mile north of Williamston. Most of this large natural area consists of a huge backswamp – a Cypress—Gum Swamp (Brownwater subtype) natural community — between Conoho Creek and the river. Within this backswamp, there is a heronry and a record for the State Special Concern Southeastern Myotis (*Myotis austroriparius*). This bat presumably occurs throughout the natural area.

Perhaps of more significance is a good example, though bisected by a gravel road in the southern portion, of a Brownwater Levee Forest (Low Levee subtype). Water hickory (*Carya aquatica*) is common and is a good indicator species for this vegetation type. Growing inside this community are several populations of the State Significantly Rare catchfly cutgrass (*Leersia lenticularis*). Probably the state's largest population of the rare smooth hedge-nettle (*Stachys tenuifolia*) grows along margins of the levee forest, visible from the access road. The Watch List smooth swallowwort (*Cynanchum laeve*) grows along this forested edge, as well.

This large area is quite important to wildlife. A locally uncommon Barking Treefrog (*Hyla gratiosa*) was heard during the inventory, and a great variety of breeding birds are present,

including the uncommon Mississippi Kite (*Ictinia mississippiensis*). An excellent butterfly diversity was noted along the gravel road margins during the inventory, as well.

PROTECTION AND MANAGEMENT: Perhaps 85% of the natural area is owned by the N.C. Wildlife Resources Commission and managed as the Lower Roanoke River Wetlands Game Land. Nearly all of these holdings are also protected as a Dedicated State Nature Preserve. The remainder, mainly at the northwestern end of the site, lies in private ownership and is not protected. Because of the already large landholdings here, acquiring the remaining portions of the natural area is not a high priority, other than eliminating in-holdings. Portions of the site contain weedy, exotic vegetation, but most areas appear to be in good condition. Avoidance of creating additional roads or tracks into the forest should be a major conservation objective.

NATURAL COMMUNITIES: Brownwater Levee Forest (Low Levee subtype), Cypress—Gum Swamp (Brownwater subtype).

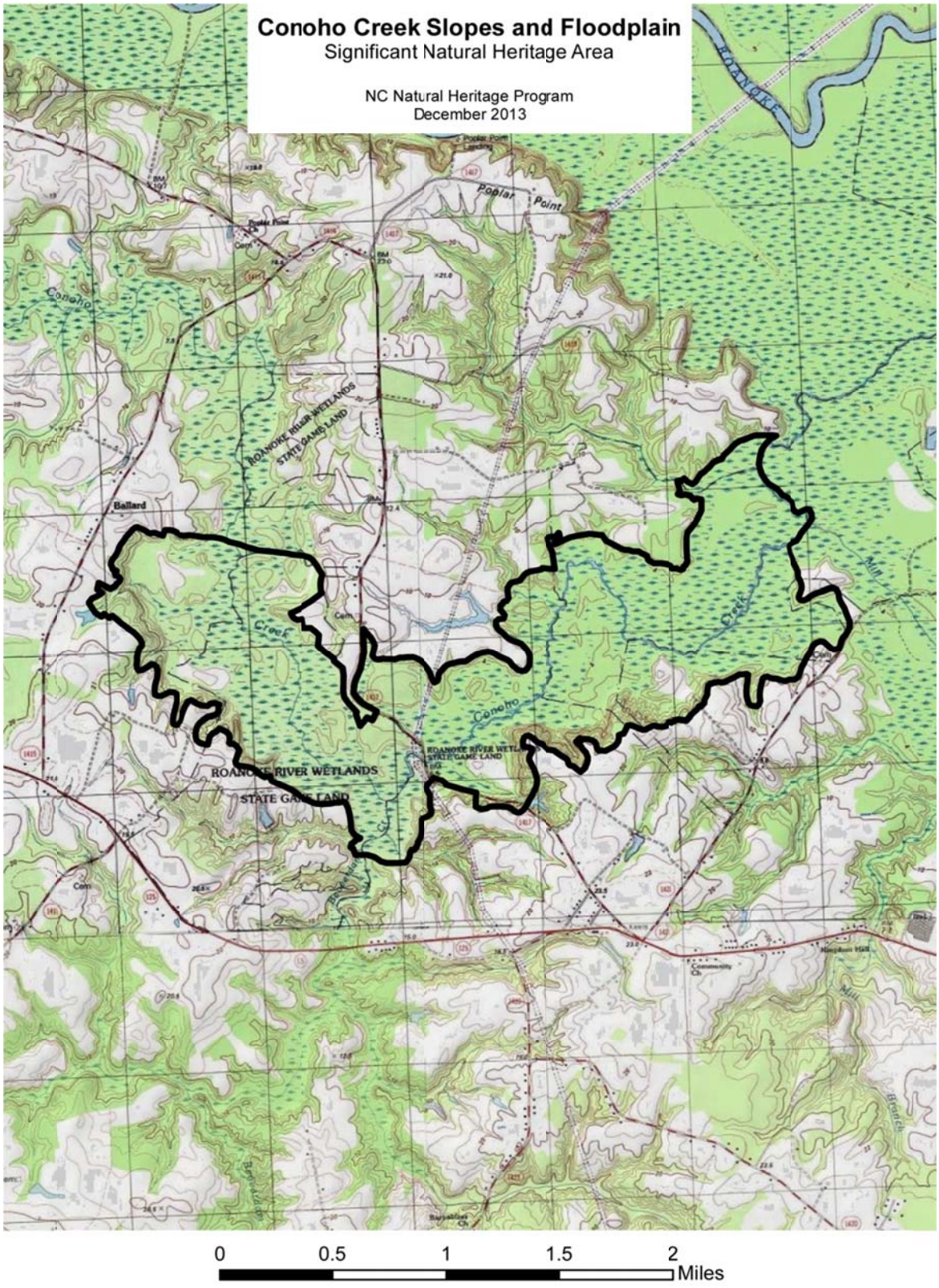
RARE PLANTS: Catchfly cutgrass (*Leersia lenticularis*), smooth hedge-nettle (*Stachys tenuifolia*); Watch List -- smooth swallowwort (*Cynanchum laeve*).

RARE ANIMALS: Southeastern Myotis (*Myotis austroriparius*).

REFERENCES:

LeGrand, H. 2012. Site Survey Report: Conoho Farms – Roanoke River access, Deveraux Swamp, and Minges Impoundment. N.C. Natural Heritage Program, Office of Land and Water Stewardship, DENR, Raleigh.

Lynch, J.M. 1981. Roanoke River Preserve Design Project. N.C. Natural Heritage Program and the N.C. Nature Conservancy.


Conoho Creek Slopes and Floodplain
Significant Natural Heritage Area
NC Natural Heritage Program
December 2013
Poplar Point
Conoho
ROANOKE RIVER WETLANDS
STATE GAME LAND
Ballard
Creek
Mill
Conoho
ROANOKE RIVER WETLANDS
STATE GAME LAND
0
0.5
1
1.5
2
Miles

Roanoke River Inventory

CONOHO CREEK SLOPES AND FLOODPLAIN
Significant Natural Heritage Area

Site Significance:
Representational Value: Very High (R2)
Collective Value: Moderate (C4)
Quadrangles: Hamilton, Quitsna

Size: about 1,605 acres
Ownership: N.C. Wildlife Resources Commission, private

SIGNIFICANT FEATURES: Nearly all of the state's population of the State Threatened magnolia vine (*Schisandra glabra*) occurs in this site, in several locations; thus, the Representational Value rating of the site is Very High (R2). The state's best example of the Basic Mesic Forest (Coastal Plain subtype, Rich Alluvial Terrace Slopes variant, Umbrella Magnolia form) is present on many slopes. The combination of three natural communities and two rare plants in the site give it a Moderate (C4) Collective Value rating.

LANDSCAPE RELATIONSHIPS: This site abuts the much larger Conoho Neck Swamp natural area on the northeast, as Conoho Creek flows eastward and northeastward through both sites. No other sites are nearby, though Poplar Point Slopes lies about 1.7 miles to the north.

SITE DESCRIPTION: This natural area, featuring unusually rich slopes and noteworthy Piedmont disjunct plants, has been known to ecologists at least since the early 1970s (e.g., several University of North Carolina class reports). The slopes near Poplar Point Road and extending northeastward for nearly a mile contain the rather unusual Basic Mesic Forest (Umbrella Magnolia form); this community "form" is newly described in this report. Characteristic woody plants of this vegetation type include umbrella magnolia (*Magnolia tripetala*), hop-hornbeam (*Ostrya virginiana*), redbud (*Cercis canadensis*), bigleaf snowbell (*Styrax grandifolia*), and silky camellia (*Stewartia malacodendron*). Magnolia vine (*Schisandra glabra*), a woody vine, grows at several locales within the natural area; there is a small site for it in Gaston County in the Piedmont, but it is known from nowhere else in the state. Notable herbs include the State Significantly Rare Virginia stickseed (*Hackelia virginiana*) and the Watch List ginseng (*Panax quinquefolius*) (at least formerly). The Mesic Mixed Hardwood Forest (Coastal Plain subtype, Swamp Island variant) also occurs in the site on slightly raised ground amid the Cypress—Gum Swamp (Brownwater subtype). The scarce log fern (*Dryopteris celsa*) is found in this community, as is the magnolia vine.

Most of the acreage of the site consists in Cypress—Gum Swamps. Also within the swamps are one or two examples of Brownwater Bottomland Hardwoods (High subtype).

PROTECTION AND MANAGEMENT: Roughly two-thirds of the natural area is owned by the N.C. Wildlife Resources Commission and managed as the Lower Roanoke River Wetlands Game Land. These lands are also protected as a Dedicated State Nature Preserve. Unfortunately, about 80-85% of the rich slopes are in private, unprotected ownership; thankfully, a few of the floodplain "islands" with magnolia vine are located on the Commission's land.

Because the Commission land protects the eastern third of the site, plus most of the western third of the site, it should be a high priority to connect these lands by acquiring the intervening private lands; there is approximately a 0.6-mile gap between these wildlife tracts. There are very few rich slopes in conservation ownership in the lower 75% of the floodplain (i.e., downriver of the Odom Floodplain and Bluffs). Because of the sensitive nature of the herbaceous plants on rich slopes, it is important that timber harvest or other disturbances be kept to a minimum, if not avoided completely (on private lands).

NATURAL COMMUNITIES: Basic Mesic Forest (Coastal Plain subtype, Rich Alluvial Terrace Slopes variant, Umbrella Magnolia form), Mesic Mixed Hardwood Forest (Coastal Plain subtype, Swamp Island variant), Cypress—Gum Swamp (Brownwater subtype), Brownwater Bottomland Hardwoods (High subtype).

RARE PLANTS: Virginia stickseed (*Hackelia virginiana*), magnolia vine (*Schisandra glabra*); Watch List — ginseng (*Panax quinquefolius*) (formerly).

RARE ANIMALS: None known.

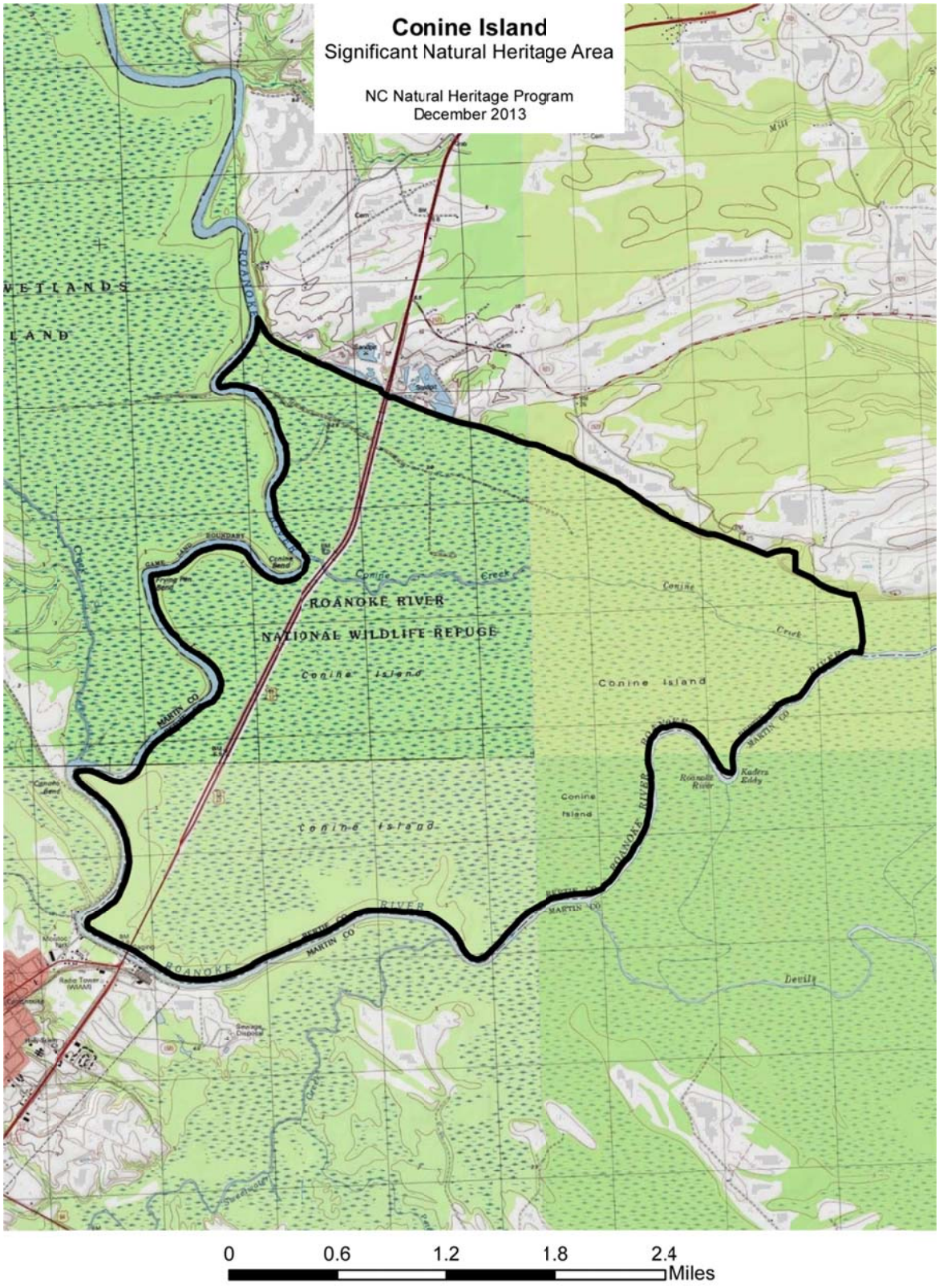
REFERENCES:

LeGrand, H. 1989. Site Survey Report: Conoho Creek Schisandra Slopes (north of SR 1417). N.C. Natural Heritage Program.

LeGrand, H. 2012. Site Survey Report: Conoho Creek Slopes and Floodplain (Conoho Farms – WRC Robeson tract). N.C. Natural Heritage Program, Office of Land and Water Stewardship, DENR, Raleigh.

LeGrand, H. 2012. Site Survey Report: Conoho Creek Slopes and Floodplain (private portion). N.C. Natural Heritage Program, Office of Land and Water Stewardship, DENR, Raleigh.

Schafale, M. 1993. Site Survey Report: Conoho Creek. N.C. Natural Heritage Program.


Conine Island
Significant Natural Heritage Area
NC Natural Heritage Program
December 2013
ROANOKE RIVER
NATIONAL WILDLIFE REFUGE
Conine Island
Conine Creek
MARTIN CO
ROANOKE RIVER
0
0.6
1.2
1.8
2.4
Miles

Roanoke River Inventory

CONINE ISLAND
Significant Natural Heritage Area

Site Significance:
Representational Value: Very High (R2)
Collective Value: Moderate (C4)

Size: about 5,275 acres
Ownership: U.S. Fish and Wildlife Service, private

Quadrangles: Quitsna, Windsor South, Williamston, Jamesville

SIGNIFICANT FEATURES: Two features – an excellent series of Brownwater Levee Forest (Low Levee subtype) natural communities and large populations of the State Significantly Rare smooth hedge-nettle (*Stachys tenuifolia*) – each give the site a Very High (R2) Representational Value rating. These elements, along with excellent examples of Cypress—Gum Swamp (Brownwater subtype), one or more heronries, one rare animal, and two other rare plants – combine to give the natural area a Moderate (C4) Collective Value rating.

LANDSCAPE RELATIONSHIPS: This very large natural area lies directly across the Roanoke River (to the east) from the equally large Conoho Neck Swamp natural area. Across the river to the south is the Sweetwater Creek Swamp natural area. About 0.6-mile to the northeast, away from the river, is the Conine Terrace Forest. Devil's Gut natural area lies about 1.4 miles to the southeast, well away from the riverfront.

SITE DESCRIPTION: Conine Island fronts the Roanoke River for an estimate 9.75 miles. Along all of this frontage, as well as farther back from the river on older remnant ridges, is the Brownwater Levee Forest (Low Levee subtype); this site contains some of the best examples in the state. In fact, the Kuralt Trail follows one such ridge southeastward from US 13/17. The presence of laurel oak (*Quercus laurifolia*) and water hickory (*Carya aquatica*), along with typical levee trees, identify this as a levee forest type and not a bottomland hardwoods type. Within this habitat, Lynch (1985) found the State Significantly Rare catchfly cutgrass (*Leersia lenticularis*). Growing in sunlit openings at several sites along the levees is the rare smooth hedge-nettle (*Stachys tenuifolia*); this is the second largest population in the state, based on the inventory field work. The majority of the site is dominated by large backswamps, almost solely composed of the very common Cypress—Gum Swamp natural community. One or more large heronries are present; these may be the largest inland heronries in the state. The heronry in 2012 contained an estimated 350 nests of Great Blue Heron (*Ardea herodias*) and 2,400 nests of Great Egret (*A. alba*).

A major divided highway (US 13/17) that bisects this natural area has somewhat wide, sunny rights-of-way between the road surface and the forests. Growing in these mowed, herbaceous zones are species such as the State Significantly Rare multiflowered mud-plantain (*Heteranthera multiflora*) and the Watch List smooth swallowwort (*Cynanchum laeve*). Though neither was seen during the inventory, both are likely still present, as suitable habitat is still abundant.

The site is very important for wildlife, owing to its large size. Large animals such as Black Bear (*Ursus americanus*), Bobcat (*Lynx rufus*), and Northern River Otter (*Lontra canadensis*) are present, as are dozens of breeding bird species. The Significantly Rare Yellow-crowned Night-Heron (*Nyctanassa violacea*) and the Watch List Anhinga (*Anhinga anhinga*) are present as a breeding species.

PROTECTION AND MANAGEMENT: Practically all of the site, except for a small area in the northeastern corner, is owned by the U.S. Fish and Wildlife Service and administered as the Roanoke River National Wildlife Refuge. There are little additional protection needs at the present time. As most of the site is protected, with essentially no timber removal, there is little disturbance to the forests of the natural area. Because of the presence of US 13/17, as well as several small refuge roads extending from the highway, there are light gaps that could be used by invasive exotic plants to reach the edges of the forests, if not penetrate them. This large site needs much more biological field work, from animals to plants to identifying additional natural communities.

NATURAL COMMUNITIES: Brownwater Levee Forest (Low Levee subtype), Cypress—Gum Swamp (Brownwater subtype).

RARE PLANTS: Multiflowered mud-plantain (*Heteranthera multiflora*), catchfly cutgrass (*Leersia lenticularis*), smooth hedge-nettle (*Stachys tenuifolia*); Watch List — smooth swallowwort (*Cynanchum laeve*).

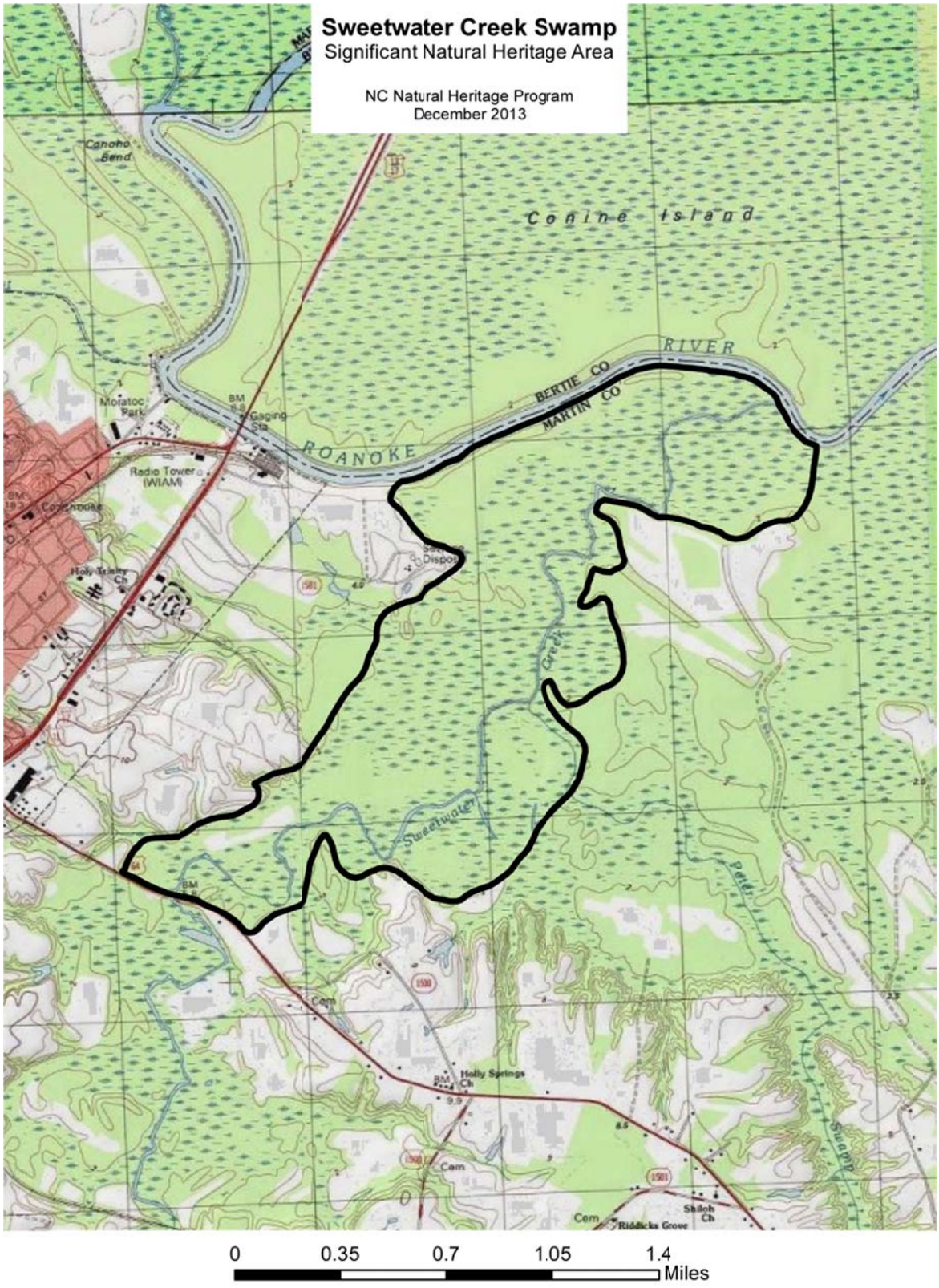
RARE ANIMALS: Yellow-crowned Night-Heron (*Nyctanassa violacea*); Watch List — Anhinga (*Anhinga anhinga*).

REFERENCES:

LeGrand, H. 2012. Site Survey Report: Conine Island. N.C. Natural Heritage Program, Office of Land and Water Stewardship, DENR, Raleigh.

Lynch, J.M. 1985. Site report: Conine Island. The Nature Conservancy.

U.S. Fish and Wildlife Service. 2004. Roanoke River National Wildlife Refuge bird list.


Sweetwater Creek Swamp
Significant Natural Heritage Area
NC Natural Heritage Program
December 2013
Canoho Bend
Conine Island
ROANOKE RIVER
BERTIE CO
MARTIN CO
Gaging Sta
Radio Tower (WIAM)
Holly Springs Ch
Sweetwater Creek
Peter Swamp
Shiloh Ch
Riddicks Grove
0
0.35
0.7
1.05
1.4
Miles

Roanoke River Inventory

SWEETWATER CREEK SWAMP
Significant Natural Heritage Area

Site Significance:
Representational Value: High (R3)
Collective Value: General (C5)
Quadrangle: Williamston

Size: about 1,003 acres
Ownership: private

SIGNIFICANT FEATURES: The site contains of the few known extant records in the state for the Significantly Rare featherfoil (*Hottonia inflata*). The natural area is one of the few within the Roanoke River floodplain that contains an extensive Cypress--Gum Swamp along a tributary stream; most such swamps are located in backswamps behind natural levees of the river. The Representational Value rating is High (R3) because the featherfoil population is probably the 3rd or 4th best occurrence in the state. The site contains one significant natural community and one other rare plant, giving it a General (C5) Collective Value rating.

LANDSCAPE RELATIONSHIPS: This site lies south of the Roanoke River about a mile east of Williamston, with the very large Conine Island natural area just across the river, to the north. On the same (south) side of the river, Conoho Neck Swamp lies about 1.2 miles to the northwest and Devil's Gut lies about 2 miles to the east.

SITE DESCRIPTION: Sweetwater Creek is a short tributary that flows northward and empties into the Roanoke River about two miles east of Williamston. Unlike so many of the Cypress—Gum Swamp (Brownwater subtype) communities in the floodplain, which are located mainly in large backswamps, this community flanks Sweetwater Creek, as it has no levee and thus it floods frequently. Though the creek technically is a blackwater stream, the N.C. Natural Heritage Program considers the community to not be a Blackwater subtype because it is found within the greater floodplain of the Roanoke River and because water tupelo (*Nyssa aquatica*), as opposed to swamp tupelo (*N. biflora*), is the dominant canopy tree. The rare featherfoil (*Hottonia inflata*) was reported as common when discovered in 1977; however, there were no recent reports until a population was re-discovered in spring 2013 by a biologist not on this inventory project. There is also an historical record of the Significantly Rare crowfoot sedge (*Carex crus-corvi*), from 1958. This site contained the largest population of Spanish-moss (*Tillandsia usneoides*) in the Roanoke River floodplain as of the late 1970s (Lynch 1981); however, this epiphyte has been in serious decline in the northeastern part of the state in recent years, likely owing to air pollution, and thus the amount here and elsewhere in the floodplain needs to be documented.

The site is important for wildlife, such as for wintering Wood Ducks (*Aix sponsa*). Semi-aquatic mammals such as Northern River Otter (*Lontra canadensis*) and American Mink (*Mustela vison*) are present.

PROTECTION AND MANAGEMENT: The site lies in private ownership and is not protected. Like many swampy creeks in the lower half of the Coastal Plain, this one is heavily

impacted by the exotic alligator-weed (*Alternanthera philoxeroides*). There are a few methods to control this aggressive floating weed, and there is at least some chance that this species can be cut-back or eliminated. This natural area, like a few others in the lower portion of the floodplain, was not surveyed during the inventory. New surveys for wetland and semi-aquatic plants, such as the two rare species listed above, is greatly needed, to fully assess the importance of this natural area and its priority for protection.

NATURAL COMMUNITIES: Cypress—Gum Swamp (Brownwater subtype).

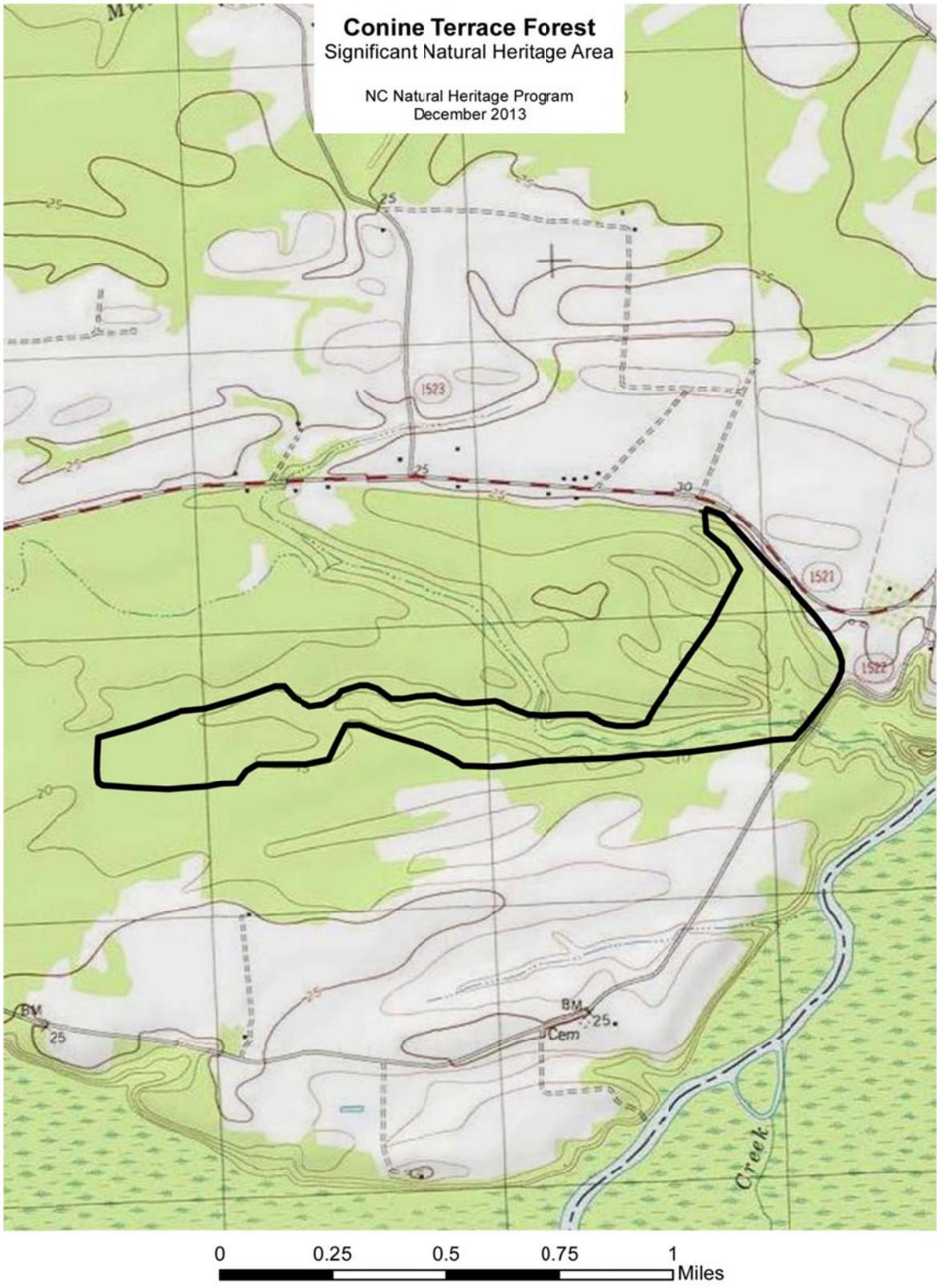
RARE PLANTS: Crowfoot sedge (*Carex crus-corvi*) (historical?), featherfoil (*Hottonia inflata*).

RARE ANIMALS: None known.

REFERENCES:

Lynch, J.M. 1972. Site report: Sweetwater Creek. University of North Carolina Botany class report.

Lynch, J.M. 1981. Roanoke River Preserve Design Project. N.C. Natural Heritage Program and the N.C. Nature Conservancy.


Conine Terrace Forest
Significant Natural Heritage Area
NC Natural Heritage Program
December 2013
1523
1521
1522
BM
25
BM
Cem
25
Creek
0
0.25
0.5
0.75
1
Miles

Roanoke River Inventory

CONINE TERRACE FOREST
Significant Natural Heritage Area

Site Significance:
Representational Value: Moderate (R4)
Collective Value: General (C5)
Quadrangle: Windsor South

Size: 170 acres
Ownership: private

SIGNIFICANT FEATURES: The occurrence of Dry-Mesic Oak—Hickory Forest (Coastal Plain subtype) is considered one of the better ones, though not among the top six, in the Coastal Plain; thus, the site receives a Moderate (R4) Representational Value rating. The occurrence of just one other natural heritage element – Mesic Mixed Hardwood Forest (Coastal Plain subtype, Swamp Island variant) – gives the site a General (G5) Collective Value rating.

LANDSCAPE RELATIONSHIPS: This small site lies just inside the poorly defined margin of the Roanoke River floodplain, about 0.6-mile north of Conine Island natural area. Devil's Gut is just under 3 miles to the south (across the river), whereas Jamesville Island/Warren Neck lies on the same (north) side of the river, but is about 3.35 miles farther to the east.

SITE DESCRIPTION: This narrow and small natural area is one of several similar ones – such as Bull Neck Swamp and Bluffs, Indian Woods/Broadneck Swamp, and Coniott Ridge —located well removed from the river, basically at the northern edge of the floodplain. Like several of these, its primary feature is a series of ridges and sloughs with about 15 feet of relief. The ridges are "floodplain islands" with a mosaic of several upland natural communities. Mesic Mixed Hardwood Forest (Coastal Plain subtype, Swamp Island variant) is the wetter of these. As is typical of the community, American beech (*Fagus grandifolia*) is present, and the locally uncommon bigleaf snowbell (*Styrax grandifolia*) is present in the shrub layer. The Dry-Mesic Oak—Hickory Forest on the terrace features rather xeric species for a floodplain island, such as post oak (*Quercus stellata*) and sourwood (*Oxydendrum arboreum*), in addition to the locally rare chinquapin (*Castanea pumila*). Silky camellia (*Stewartia malacodendron*) is also present on the terrace.

PROTECTION AND MANAGEMENT: This site lies in private, unprotected ownership. More than half of the original site, as first identified, was clear-cut and converted to loblolly pine plantations. Thus, the remainder of the natural area can be considered highly susceptible to timber harvest. Obtaining a conservation easement should be considered, as acquisition for protection does not seem to be likely, due to distance to other protected sites.

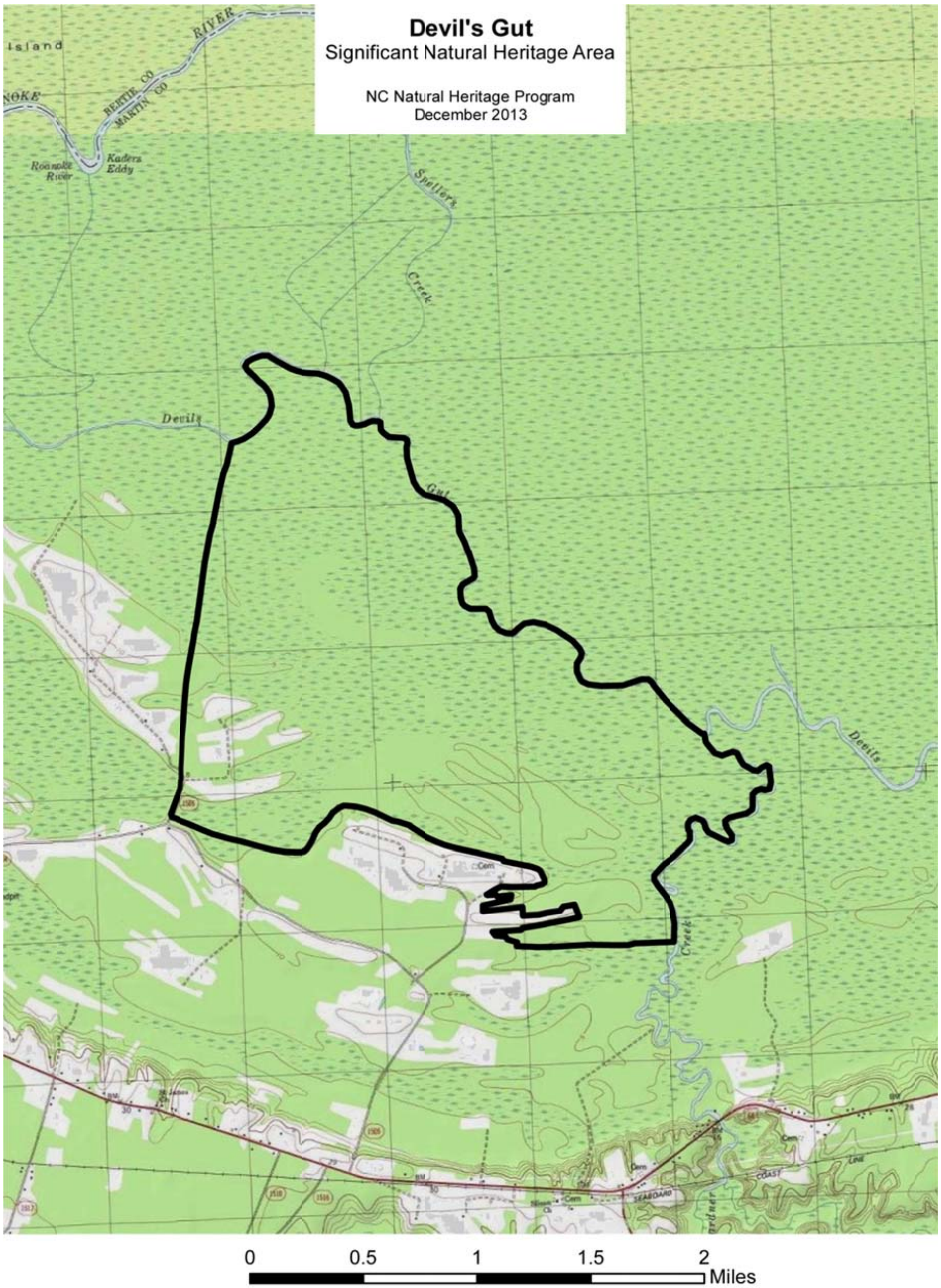
NATURAL COMMUNITIES: Mesic Mixed Hardwood Forest (Coastal Plain subtype, Swamp Island variant), Dry-Mesic Oak—Hickory Forest (Coastal Plain subtype).

RARE PLANTS: None known.

RARE ANIMALS: None known.

REFERENCES:

Schafale, M. 1992. Site Survey Report: Conine High Terrace Forest. N.C. Natural Heritage Program.


Devil's Gut
Significant Natural Heritage Area
NC Natural Heritage Program
December 2013
0
0.5
1
1.5
2
Miles

Roanoke River Inventory

DEVIL'S GUT
Significant Natural Heritage Area

Site Significance:
Representational Value: Very High (R2)
Collective Value: High (C3)
Quadrangle: Jamesville

Size: about 2,114 acres
Ownership: The Nature Conservancy

SIGNIFICANT FEATURES: The natural area likely contains the best example in the state of a Brownwater Bottomland Hardwoods (High subtype) natural community. In addition, the site contains among the best populations in the state for three moth species and one rare plant species; each of these five features gives the site a Very High (R2) Representational Value rating. The combination of three significant examples of natural communities, four rare moth species, one rare bat species, and a rare plant yield a High (C3) Collective Value site rating.

LANDSCAPE RELATIONSHIPS: Devil's Gut natural area lies over a mile back from the Roanoke River, in the southern part of the river's wide floodplain. Sweetwater Creek Swamp lies 2 miles up-river, to the west. The very large Conine Island natural area lies on the opposite (north) side of the river, about 1.3 miles to the northwest. Downriver, Jamesville Island/Warren Neck lie about 1.5 miles to the east.

SITE DESCRIPTION: Devil's Gut is a distributary creek that cuts across the large meander bend in the river northwest of Jamesville; a large "island," called Bull Run Island, lies to the north, whereas the Devil's Gut natural area lies immediately to the south of the creek. Though most of the natural area consists of an extensive backswamp with Cypress—Gum Swamp (Brownwater subtype) vegetation, the most ecologically significant features are located on the gentle floodplain ridges to the south of the main swamp forest. The primary community is Brownwater Bottomland Hardwoods (High subtype); this example is very mature and rather park-like and is dominated by oaks. Along the edge of Devil's Gut itself is a gentle natural levee – the Brownwater Levee Forest (Low Levee subtype).

The State Significantly Rare swamp panic grass (*Phanopyrum gymnocarpon*) occurs in the natural area, one of just three locales known for it in North Carolina. Detailed moth survey work by Steve Hall (1999) revealed 371 species, of which four are on the N.C. Natural Heritage Program's Significantly Rare list. These are an inchworm moth (*Anacamptodes cypressaria*), Lincoln Underwing (*Catocala lincolnana*), Marbled Underwing (*Catocala marmorata*), and a bird-dropping moth (*Cerma cora*). The State Special Concern Southeastern Myotis (*Myotis austroriparius*) has been mist-netted along Devil's Gut and at several sites on Bull Run Island. The natural area has at least 55 species of breeding birds (Lynch 1981); and fairly large mammals such as Black Bear (*Ursus americanus*), Bobcat (*Lynx rufus*), Northern River Otter (*Lontra canadensis*), and American Mink (*Mustela vison*) have been seen here.

PROTECTION AND MANAGEMENT: The entire natural area is owned by The Nature Conservancy and managed as the Devil's Gut Preserve. The eastern 50-55% of the Preserve is a Dedicated State Nature Preserve. In addition, The Nature Conservancy owns the entirely of Bull Run Island, though it is not dedicated. Bull Run Island was considered for inclusion with Devil's Gut as a larger site for this inventory; however, most of the site is a regenerating middle-aged swamp forest, having been mostly logged by rail several decades ago. The majority of the private lands surrounding Devil's Gut contain disturbances, and thus there seem to be few adjacent areas to add to the preserve. The floodplain ridges apparently remain in excellent condition, relatively free from exotic invasion. Thus, there are few if any management recommendations at the present time.

NATURAL COMMUNITIES: Brownwater Bottomland Hardwoods (High subtype), Brownwater Levee Forest (Low Levee subtype), Cypress—Gum Swamp (Brownwater subtype).

RARE PLANTS: Swamp panic grass (*Phanopyrum gymnocarpon*).

RARE ANIMALS: An inchworm moth (*Anacamptodes cypressaria*), Lincoln Underwing (*Catocala lincolnana*), Marbled Underwing (*Catocala marmorata*), a bird-dropping moth (*Cerma cora*), Southeastern Myotis (*Myotis austroriparius*); Watch List – a canebrake moth (*Acrapex relicta*), a cane moth (*Argillophora furcilla*), Kentucky Lichen Moth (*Cisthene kentuckiensis*), a wave (*Hypomecis longipectinaria*), a wave (*Idaea scintillularia*), Southeastern Cane Borer Moth (*Papaipema* new sp.), an owlet moth (*Properigea tapeta*), an owlet moth (*Tripudia flavofasciata*), an owlet moth (*Zanclognatha atrilineella*).

REFERENCES:

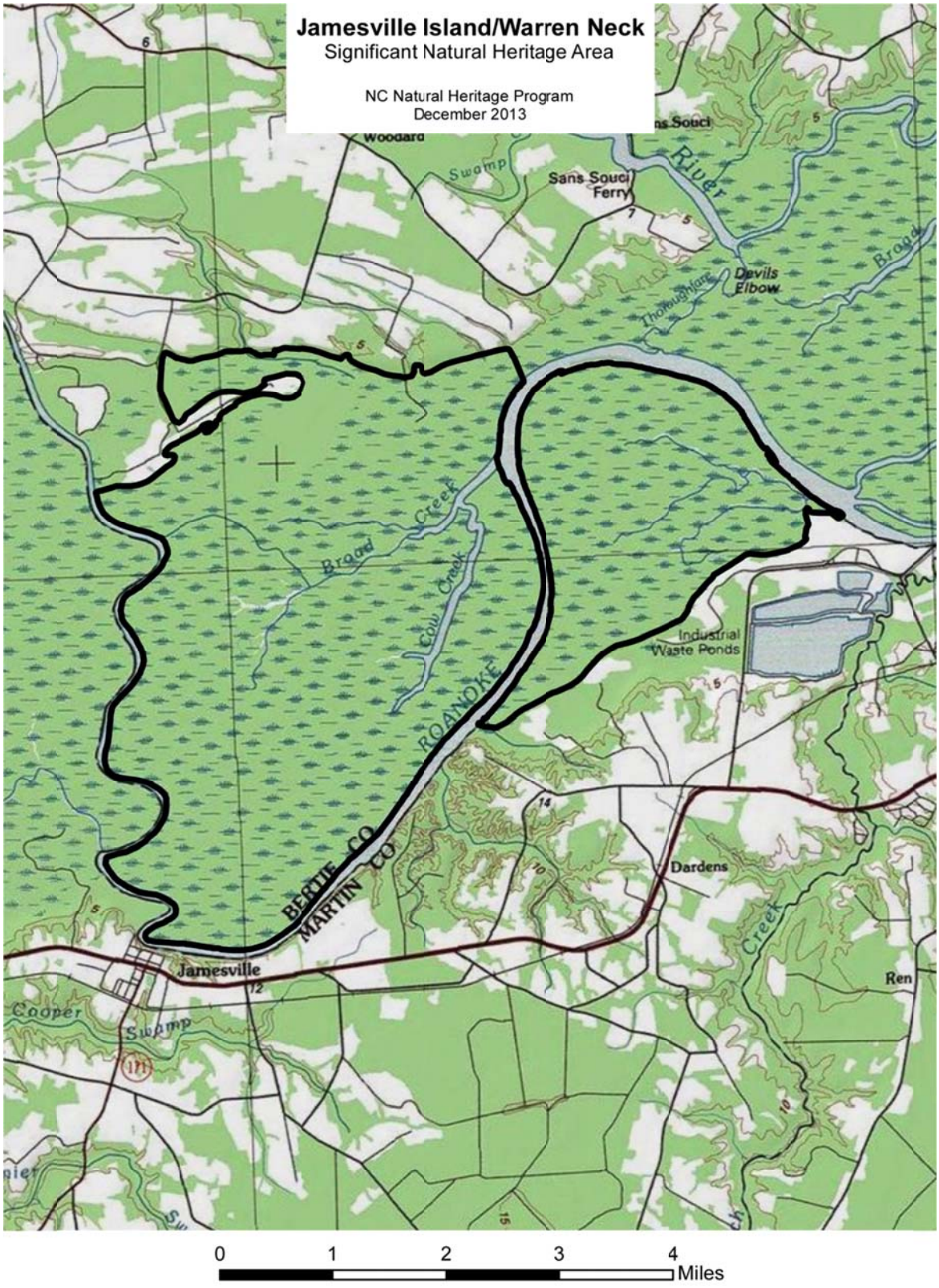
Berg, D. 1982. Roanoke River Swamp Report – Devil's Gut Natural Area. University of North Carolina botany class report.

Hall, S.P. 1999. Inventory of the Macro-Lepidoptera of the Devil's Gut Preserve. N.C. Natural Heritage Program.

Lynch, J.M. 1978. Site report: Devil's Gut Slough. N.C. Natural Heritage Program.

Roe, C. 1980. Devil's Gut – Roanoke River Natural Area. N.C. Natural Heritage Program.

Schafale, M. 1992. Notes on a visit to Devil's Gut Preserve. N.C. Natural Heritage Program.


Jamesville Island/Warren Neck
Significant Natural Heritage Area
NC Natural Heritage Program
December 2013
Woodard
Swamp
Sans Souci Ferry
River
Devils Elbow
Broad
Creek
Cow Creek
Industrial Waste Ponds
ROANOKE
BERTIE CO
MARTIN CO
Dardens
Jamesville
Cooper
Swamp
Creek
Ren
0
1
2
3
4
Miles

Roanoke River Inventory

JAMESVILLE ISLAND/WARREN NECK
Significant Natural Heritage Area

Site Significance:
Representational Value: Very High (R2)
Collective Value: General (C5)
Quadrangles: Windsor South, Woodard, Jamesville, Plymouth West

Size: about 12,290 acres
Ownership: The Nature Conservancy, U.S. Fish and Wildlife Service, private (easements), other private

SIGNIFICANT FEATURES: This very large natural area contains perhaps the most extensive Cypress—Gum Swamp (Brownwater subtype) in the state. This feature, as well as possibly the only currently known population in North Carolina for the State Special Concern yellow water-crowfoot (*Ranunculus flabellaris*), each yield a Very High (R2) Representational Value for the site. As these are the only two reported elements for the natural area, it receives a General (C5) Collective Value rating.

LANDSCAPE RELATIONSHIPS: Prior to the inventory, Jamesville Island (also known as "Broad Creek Neck") and Warren Neck were considered as separate sites by the N.C. Natural Heritage Program. However, as both contain very similar features, and as they are side-by-side across from each other (though on opposite sides of the Roanoke River), they have been incorporated into a single very large natural area. Devil's Gut natural area is located about 1.5 miles to the west; however, the also very large Roanoke River Delta Islands natural area lies directly east of Warren Neck, across the river on the Bertie County side.

SITE DESCRIPTION: The Roanoke River floodplain becomes increasingly swampier the farther downriver it flows, as natural levees are very low and do not hold back high water from overflowing the banks. In addition, the meander bends are quite wide, such that in some areas the majority of the swamp forest is located to the north of the river (i.e., Jamesville Island, roughly 9,225 acres) and in others it is to the south (i.e., Warren Neck, roughly 3,065 acres). Both sites are essentially roadless and essentially are wilderness areas due to the soil wetness. There is essentially no natural levee this far downriver, though a poorly-expressed one was noted by Schafale (1999) at Warren Neck; thus, practically all of the natural area is a huge extent of Cypress—Gum Swamp (Brownwater subtype). Though the usual two swamp canopy trees are dominant – water tupelo (*Nyssa aquatica*) and bald-cypress (*Taxodium distichum*), this lower section of the river has somewhat more blackwater input from tributary creeks, and thus swamp tupelo (*N. biflora*) also occurs in the canopy, at least at Warren Neck.

Because of the flooded nature of the site, some floating aquatic plants are present. Just back from the river on Jamesville Island is a population of the rare yellow water-crowfoot (*Ranunculus flabellaris*), discovered in 1999 (Schafale and Horton 1999) and assumed to still be extant. Of the three known records for the state, this is the only population considered to still be present. American frog's-bit (*Limnobium spongium*) is also present; however, the exotic parrot-feather (*Myriophyllum aquaticum*) is also present.

PROTECTION AND MANAGEMENT: The Nature Conservancy owns the southern 70% of the Jamesville Island portion of the natural area; the U.S. Fish and Wildlife Service owns the northeastern 10-15% of the Jamesville Island portion, as part of the Roanoke River National Wildlife Refuge. The northwestern 15-20% is in private ownership; fortunately, about half of this is protected as a Wetland Reserve Program easement to the U.S. Department of Agriculture's Natural Resources Conservation Service. At Warren Neck, the northern two-thirds of the site is a private easement held by The Nature Conservancy. The remainder, south of Middle Prong, is in private, unprotected ownership. Because of the very large acreage already in protected status, acquiring in fee or by easement adjacent unprotected lands is a low priority. Though there is parrot-feather in portions of the site, and the exotic invasive alligator-weed (*Alternanthera philoxeroides*) is likely present, for the most part these swampy areas are free from man-made disturbances.

NATURAL COMMUNITIES: Cypress—Gum Swamp (Brownwater subtype).

RARE PLANTS: Yellow water-crowfoot (*Ranunculus flabellaris*).

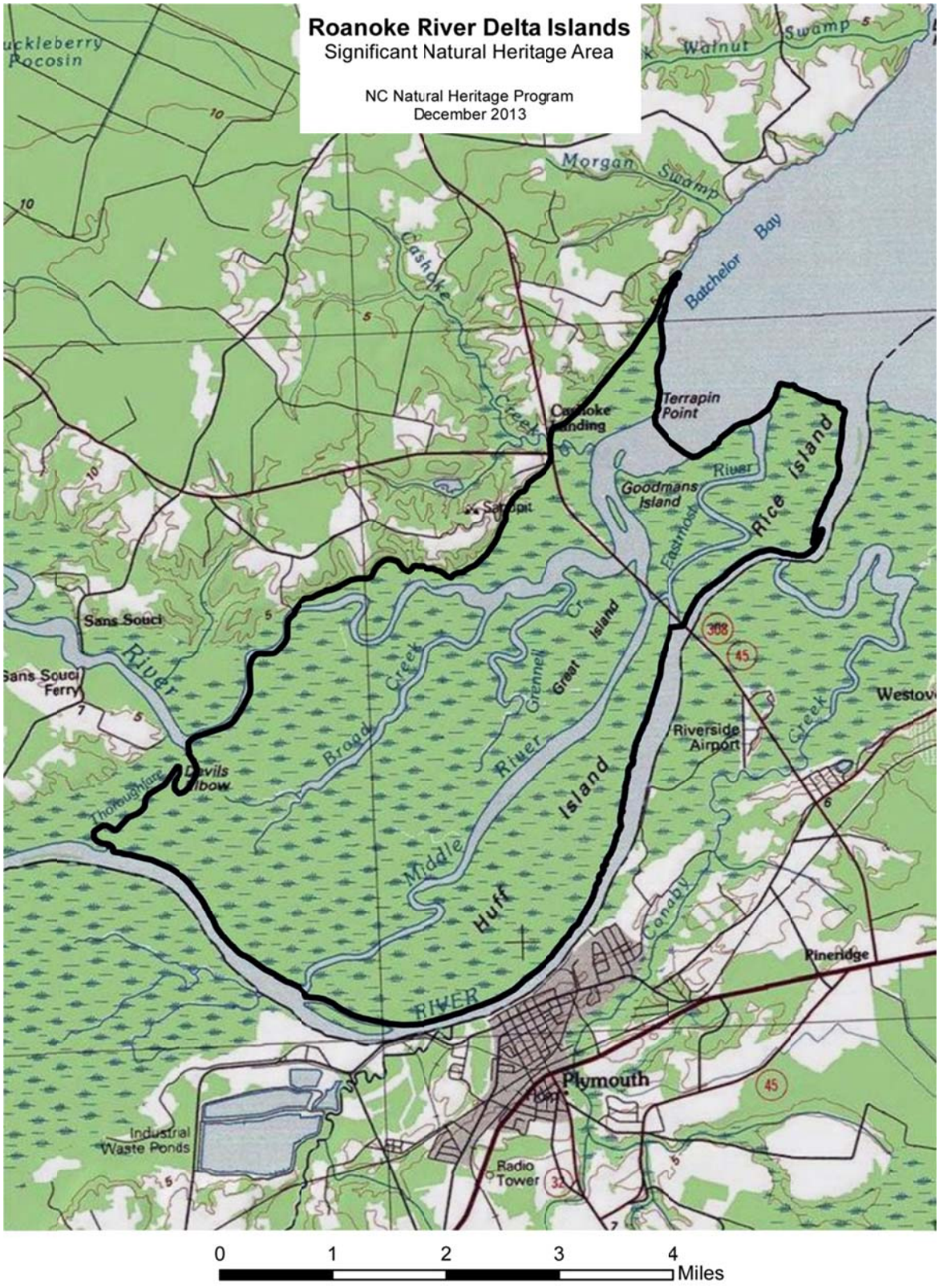
RARE ANIMALS: None known.

REFERENCES:

Lynch, J.M. 1981. Roanoke River Preserve Design Project. N.C. Natural Heritage Program and the N.C. Nature Conservancy.

Schafale, M. 1999. Site Survey Report: Roanoke River Warren Neck (Shingleton tract). N.C. Natural Heritage Program.

Schafale, M., and J. Horton. 1999. Site report: Broad Creek Neck (Jamesville Island). N.C. Natural Heritage Program.


Roanoke River Delta Islands
Significant Natural Heritage Area
NC Natural Heritage Program
December 2013
Buckleberry Pocosin
Walnut Swamp
Morgan Swamp
Batchelor Bay
Cashoke Creek
Cashoke Landing
Terrapin Point
Goodmans Island
Rice Island
Eastmost River
Sans Souci
Sans Souci Ferry
River
Broad Creek
Grennell Cr.
Great Island
Riverside Airport
Devils Elbow
Thoroughfare
Middle River
Island
Huff
Conaby Creek
Pineridge
RIVER
Plymouth
Industrial Waste Ponds
Radio Tower
0
1
2
3
4
Miles

Roanoke River Inventory

ROANOKE RIVER DELTA ISLANDS
Significant Natural Heritage Area

Site Significance:
Representational Value: Moderate (R4)
Collective Value: General (C5)
Quadrangles: Woodard, Westover, Plymouth West, Plymouth East

Size: about 11,140 acres
Ownership: U.S. Fish and Wildlife Service, The Nature Conservancy, private

SIGNIFICANT FEATURES: The site contains a fairly good example of Brownwater Bottomland Hardwoods (Swamp Transition subtype), which gives the natural area a Moderate (R4) Representational Value rating. This element, plus a Tidal Swamp (Cypress—Gum subtype) natural community, gives the site a General (C5) Collective Value rating.

LANDSCAPE RELATIONSHIPS: This is another very large natural area, with all of the site lying on the north (Bertie County) side of the Roanoke River. It lies at the mouth of the river, with Conaby Creek/Swan Bay Swamp flanking the river on the southeastern (Washington County) side. Jamesville Island/Warren Neck lies across the river to the southwest. The Cashie River Swamp natural area lies about 2 miles to the west, up the Cashie River, which flows through the northern part of the natural area and empties into Albemarle Sound, about 1.5 miles west of where the Roanoke River does.

SITE DESCRIPTION: This natural area is composed of roughly four large islands – Great, Huff, Goodmans, and Rice. As expected, most of the natural area exists in cypress—gum swamp, but the N.C. Natural Heritage Program has classified this type as Tidal Swamp (Cypress—Gum subtype), rather than Cypress—Gum Swamp (Brownwater subtype). This lowest portion of the river does indeed experience some tidal action, though mostly from strong east or northeast winds pushing water up into the river from Albemarle Sound. In addition, many blackwater streams – those originating in the Coastal Plain and thus carrying little sediment load – empty into the lower part of the river. As a result, some areas contain more blackwater/pocosin-like vegetation than are found in the typical swamp farther up-river. Species such as swamp tupelo (*Nyssa biflora*), redbay (*Persea palustris*), and sweetbay magnolia (*Magnolia virginiana*) are locally numerous. There are even a few stands of the locally scarce Atlantic white cedar (*Chamaecyparis thyoides*). These latter places, which can be somewhat peaty, have been considered as Brownwater Bottomland Hardwoods (Swamp Transition subtype) natural community.

No rare plants are known from the natural area; however, this portion of the floodplain is the best habitat for Black Bears (*Ursus americanus*). Several rare aquatic species occur in the river within the site, though they are not treated as part of this terrestrial site.

PROTECTION AND MANAGEMENT: Great Island, which is bounded by The Thoroughfare, the Roanoke River, Middle River, and the Cashie River, is completely protected –

the eastern 70% by the U.S. Fish and Wildlife Service (Roanoke River National Wildlife Refuge) and the western portion by The Nature Conservancy. Huff Island, which lies east of Great Island and is bounded essentially by Middle River and the Roanoke River, also is completely protected, by The Nature Conservancy. Goodmans Island, located just northeast of Great Island, is bounded mainly by the Cashie River and Eastmost River, plus Albemarle Sound; it is completely protected by the U.S. Fish and Wildlife Service. Rice Island, lying east of Goodmans Island across Eastmost River, and bounded on the southeast by the Roanoke River and the north by Albemarle Sound, is privately owned and is not protected. As Rice Island is not accessible by land, threats to it are likely low. With a slow sea level rise and/or increasing salt water intrusion, protection of this island is not a high priority. Increased salinity and higher water levels, already seen farther eastward at places such as the lower Scuppernong River, will convert these swamp forests to fresh or slightly brackish marshes in a few decades: after 50 or more years there is the possibility that the site might go completely underwater.

NATURAL COMMUNITIES: Brownwater Bottomland Hardwoods (Swamp Transition subtype), Tidal Swamp (Cypress—Gum subtype).

RARE PLANTS: None known.

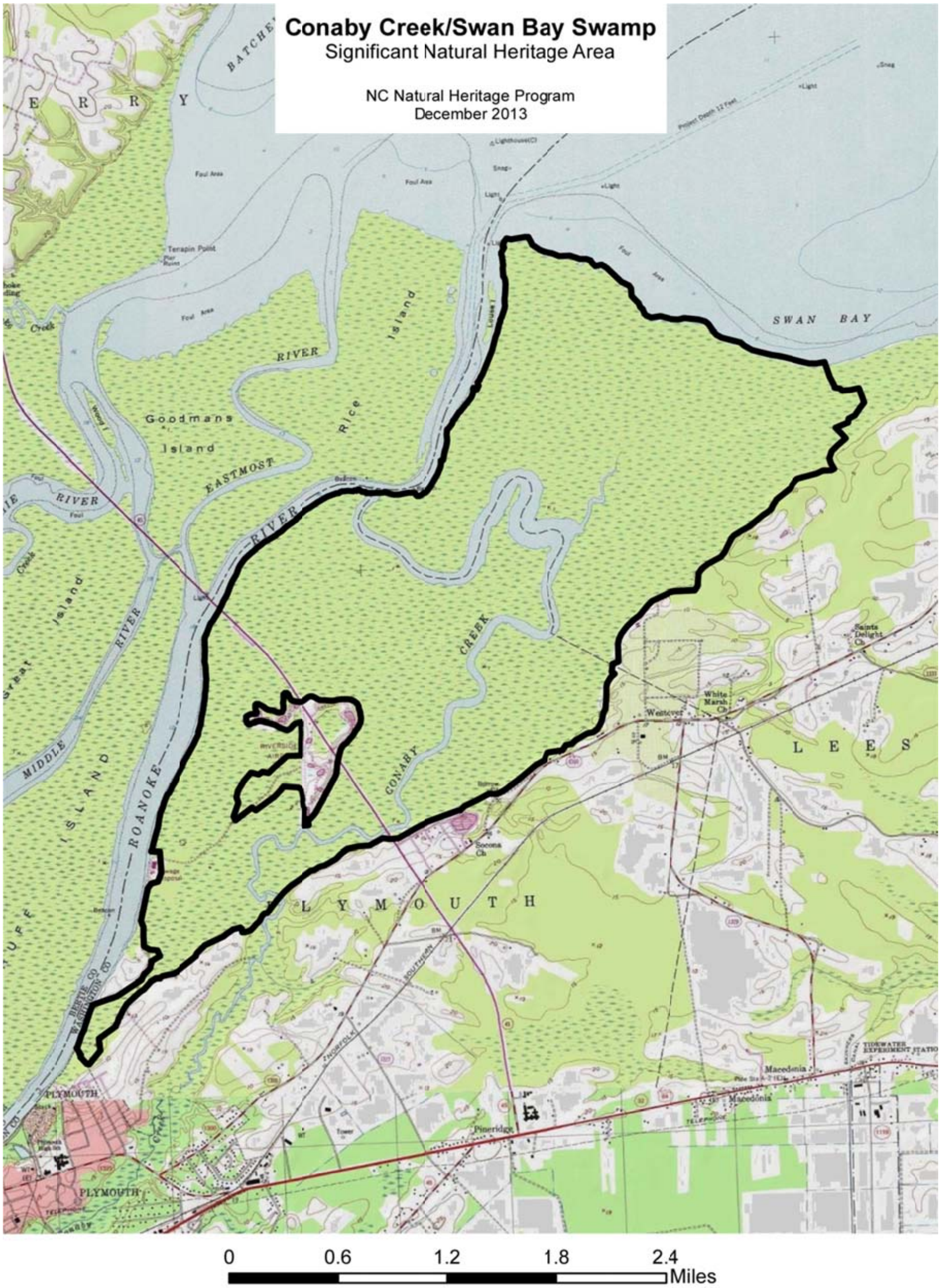
RARE ANIMALS: None known.

REFERENCES:

Lynch, J.M. 1981. Roanoke River Preserve Design Project. N.C. Natural Heritage Program and the N.C. Nature Conservancy.

Roe, C. 1984. Great Island and Goodman Island – Roanoke River Natural Area. N.C. Natural Heritage Program.

Tingley, C.A. 1985. An Ecosystematic Survey of Floodplain Vegetation at the Mouth of the Roanoke River. M.S. thesis, University of North Carolina – Chapel Hill.


Conaby Creek/Swan Bay Swamp
Significant Natural Heritage Area
NC Natural Heritage Program
December 2013
SWAN BAY
Goodmans Island
EASTMOST RIVER
Rice Island
ROANOKE RIVER
MIDDLE RIVER
CONABY CREEK
PLYMOUTH
LEES
Westover
White Marsh Ch
Socona Ch
Pineridge
Macedonia
Saints Delight
Terapin Point
0
0.6
1.2
1.8
2.4
Miles

Roanoke River Inventory

CONABY CREEK/SWAN BAY SWAMP
Significant Natural Heritage Area

Site Significance:
Representational Value: Moderate (R4)
Collective Value: Moderate (C4)
Quadrangle: Westover

Size: about 4,188 acres
Ownership: The Nature Conservancy, private

SIGNIFICANT FEATURES: The natural area contains three good examples of natural communities, as well as the Federally Endangered Red Wolf (*Canis rufus*) and the State Threatened Bald Eagle (*Haliaeetus leucocephalus*). The presence of the eagle nest and the wolf give the site a Moderate (R4) Representational Value. The collection of Nonriverine Swamp Forest (Mixed subtype), Peatland Atlantic White Cedar Forest, and Tidal Swamp (Cypress—Gum subtype), plus the two rare animals, give the site a Moderate (C4) Collective Value rating.

LANDSCAPE RELATIONSHIPS: This site is located at the southern end of the mouth of the Roanoke River. The very large Roanoke River Delta Islands natural area lies directly across the river, to the northwest. The small Conaby Swamp Natural Area, not located within the river floodplain, lies about 0.6-mile to the south-southwest**.**

SITE DESCRIPTION: This large natural area contains the southern portion of the Roanoke River floodplain, at the river mouth at Albemarle Sound. However, this portion of the floodplain has some tidal (wind) influence, as well as some blackwater and nonriverine influences. Thus, the natural communities here are quite different from that farther upriver, especially in terms of nonriverine communities. For example, though some Atlantic white cedar (*Chamaecyparis thyoides*) is found on Goodmans Island, in the Roanoke River Delta Islands site, Conaby Creek/Swan Bay Swamp contains the only known stands of this tree, enough for there to be a Peatland Atlantic White Cedar Forest community. This community and the Nonriverine Swamp Forest (Mixed subtype) community are found well away from the river front, which is dominated by the Tidal Swamp (Cypress—Gum subtype). The Nonriverine Swamp Forest contains patches of pond pines (*Pinus serotina*), common farther eastward in the Coastal Plain but rare in the river floodplain. This community also features other woody plants scarce in the Roanoke floodplain but very common eastward away from floodplains – sweetbay magnolia (*Magnolia virginiana*), redbay (*Persea palustris*), coastal sweet pepperbush (*Clethra alnifolia*), and titi (*Cyrilla racemiflora*), among many others. Such sites are underlain by peat deposits, reported as deep as 20 feet (Lynch 1981).

One of the first recorded Bald Eagle nests in the state, after the several decade hiatus in nestings owing to DDT poisoning, was found in the site in 1985. The nest was still active through 2009, the last year that the nest was surveyed. The Red Wolf, listed as Federally Endangered though as an experimental population, has been released by the U.S. Fish and Wildlife Service into the wild in Dare County in recent decades, and now over 100 individuals (with radio collars) roam the mainland of Dare, Tyrrell, Washington, Beaufort, and Hyde counties. Otherwise, there seems to

be little information on the animal species diversity of this wilderness area, which is mostly devoid of logging roads or other man-made access.

PROTECTION AND MANAGEMENT: The Nature Conservancy owns 692 acres in the northern part of the natural area, bordering Conaby Creek on the south and the Roanoke River on the west. This tract is leased to the N.C. Wildlife Resources Commission as part of their Bachelor Bay Game Land. There is a small tract between Albemarle Sound and The Nature Conservancy tract that is shown as owned by the State of North Carolina on the 2011 parcel data. However, it has apparently not been allocated to the Commission and perhaps not to any other state agency, and thus it should be considered as unprotected. The remainder of the natural area lies in private, unprotected ownerships. Because of the relative scarcity of white cedar stands remaining in the state, protection of the private portions of the site, by easements or acquisition, is a moderate priority. As the site is quite remote, little direct management is needed. However, owing to slight sea level rise and/or salt water encroachment, sites located along the margins of Albemarle Sound will lose trees over the next few decades, and more of this natural area is expected to become marshland.

NATURAL COMMUNITIES: Nonriverine Swamp Forest (Mixed subtype), Peatland Atlantic White Cedar Forest, Tidal Swamp (Cypress—Gum subtype).

RARE PLANTS: None known.

RARE ANIMALS: Red Wolf (*Canis rufus*), Bald Eagle (*Haliaeetus leucocephalus*).

REFERENCES:

Lynch, J.M. 1981. Roanoke River Preserve Design Project. N.C. Natural Heritage Program and the N.C. Nature Conservancy.

Tingley, C.A. 1985. An Ecosystematic Survey of Floodplain Vegetation at the Mouth of the Roanoke River. M.S. thesis, University of North Carolina – Chapel Hill.

PART II. LANDSCAPE ASSESSMENT

Stephen P. Hall
With Survey Contributions from J.Bolling Sullivan

Composite of Mississippi Kites and the Roanoke River at Camassia Slopes from photos by Stephen Hall

INTRODUCTION

NCNHP Landscape Inventories

In addition to its traditional focus on Significant Natural Heritage Areas (SNHAs) and occurrences of Natural Heritage Elements (EOs) – represented in Part I of this inventory -- the North Carolina Natural Heritage Program conducts analyses of the larger landscapes in which these features occur. Part II of this report presents an evaluation of the conservation needs of the entire landscape of the Lower Roanoke floodplain. Special emphasis is given to the need to protect or restore links between the SNHAs and EOs identified in Part I, but attention is also given to protecting the integrity of the entire landscape in its own right, as an entity just as vital for the protection of native biodiversity as the individual SNHAs and EOs.

The aims and methods are similar in both approaches: to identify specific areas meriting conservation based on the representativeness, quality, and viability of the native species and ecosystems they contain, as well as on the urgency with which these elements need protection. Whereas the site- and element-focused approach concentrates on identifying sites that have particularly high quality natural communities or populations of the most imperiled species, the landscape approach concentrates more on the overall extent of natural habitats, including those of lesser quality located outside the boundaries of the SNHAs. Equally important, it gives weight to the degree of interconnectedness between different areas within the landscape. In contrast to the traditional approach, which focuses on protecting species and communities in places where they are expected to persist indefinitely, the landscape approach focuses more on the dynamic nature of populations and ecosystems, particularly on the need for species to be able to move around, shifting their ranges as individuals and populations in response to environmental change.

These two approaches are highly complementary; by identifying and protecting individual sites and maintaining connections between them and to the wider world, we are attempting to achieve a balance between protecting the site-specific and dynamic values that are essential for protecting the state's natural heritage. As demonstrated by this investigation of the Lower Roanoke, the shared methodologies of these approaches allows them to be closely integrated and efficiently conducted at the same time. This combined approach is particularly well-suited for larger, eco-regional analyses, which are likely to play an ever more prominent role in future conservation planning.

Lower Roanoke as a Significant Landscape

The Lower Roanoke floodplain has been a key target for conservation for decades and now approximately 43,500 hectares (107,460 acres) are in some form of conservation protection. In some cases rare species such as wild hyacinth (*Camassia scilloides*) or Cerulean Warblers (*Setophaga cerulea*), or exemplary Natural Communities, such as Brownwater Levee Forests or Cypress-Gum Swamp Forests, were the targets of conservation. However, much of the conservation attention has been drawn to the Roanoke due to the expansiveness and high degree of interconnectedness of its habitats, i.e., its landscape integrity. For mobile species, such as

Cerulean Warblers, Mississippi Kites (*Ictinia mississipiensis*), Black Bears (*Ursus americanus*), or Zebra Swallowtail Butterflies (*Eurytides marcellus*), the ability to move freely around the entire expanse of the floodplain – in response to changes in habitat suitability or to recover from local extirpation caused by flooding or other disturbances – is critical to maintaining their populations within the area. The fact that each of the major habitat types within the Lower Roanoke floodplain is represented by a landscape-scale expanse, each with a high degree of interconnectivity, accounts for much of the overall biological richness of this area.

Goals of the Landscape Inventory

The overall goal of this inventory was to identify specific areas of land that possess a high degree of biological integrity, i.e., that match the expected conditions in undisturbed natural areas, or at least as undisturbed as currently can be found in the state. For landscape assessment, our evaluations are based on species that are susceptible to fragmentation of particular types of habitat: species that depend on large expanses of habitat and the ability to move freely within them. Over the course of just a few decades, these species are likely to vanish from tracts of habitat that become too small and/or isolated. Conversely, more of these species are likely to survive within larger, better-connected expanses of their habitat, i.e., areas that still possess a high degree of landscape integrity. Consequently, the more such species that are recorded within a given tract of habitat, the higher the estimated landscape integrity of that tract.

The goal for the landscape portion of the inventory, accordingly, was to conduct surveys for landscape sensitive species within given habitat types; identify concentrations of such species (Landscape Guilds); and estimate the degree of landscape integrity within a given tract of habitat based on the number of sensitive species it contains. With the exception of the peatland habitats located at the mouth of the river, all of the main habitat types found in the floodplain were evaluated. Brownwater habitats – those characterized by their possession of nutrient-rich alluvial deposits – were given special attention in the landscape inventory, just as they were for the site- and element-focused portion of the project. Information was additionally collected on other types of floodplain habitats, including swamp forests, canebrakes, and general bottomland hardwoods.

METHODS

NCNHP uses a survey-based, indicator-guild approach to identify and assess the functional integrity of landscapes (Hall 2008). The main goal of this analysis is the identification of Significant Natural Heritage Landscapes [1] (SHNLs). These are geographic units defined similarly to Significant Natural Heritage Areas, based on their possession of one or more occurrences of viable, high quality elements. The elements used in their definition differ, however: whereas SNHAs are based on occurrences (EOs) of Species Elements or Community Elements, SNHLs are based on occurrences of Landscape Guilds. These are collective elements composed of four or more animal species that are sensitive to fragmentation of a specific type of habitat. As with SNHAs, an SNHL is composed of one or more Guild Occurrences and is evaluated in terms of its importance for conservation according to the number, quality, and degree of imperilment of these elements.

This approach to landscape analysis, like that for SNHAs and elements, is highly dependent on the existence of survey data, covering a wide variety of taxa and habitats. In our previous analysis of the Northern Coastal Plain (Hall 2008, 2009), we compiled information from a number of different sources, including inventories conducted by NCNHP staff or by other researchers. In addition to mapping guild landscapes based on this information, we looked for significant gaps in previous surveys, in terms of both taxonomic, habitat, and areal coverage. For our purposes, gaps in animal surveys – particularly the species used to define the guilds – were given special attention.

For each such gap, representative areas were identified for inventory efforts. In the case of the Lower Roanoke floodplain, only a few such areas were identified since much of the floodplain has already been well-surveyed for birds (Lynch et al. 1994), bats (Clark 1999), reptiles and amphibians (Lamb et al. 1998), and Lepidoptera (Hall 1999b). Many of these inventories, however, were concentrated in the lower portion of the floodplain, primarily in the vicinity of the Devil's Gut Nature Conservancy Preserve and the Roanoke River National Wildlife Refuge. More poorly represented were animal species associated with the rich slopes, bottomlands, and levees that are some of the most important biological features of the Lower Roanoke.

Based on this preliminary analysis, several survey areas were identified for the upper reaches of the floodplain, including sites with well-developed brownwater habitats as indicated by Element Occurrence Records for both natural communities and rare plant species associated with these habitat types. Following reconnaissance visits made in the early spring, five sites were selected for intensive surveys. The location of these sites is shown in Figure 5 (also shown are previously surveyed sites at the Devil's Gut TNC Preserve and Bull Run Island).

[1] See Glossary (Appendix B) for a more detailed description of these terms.

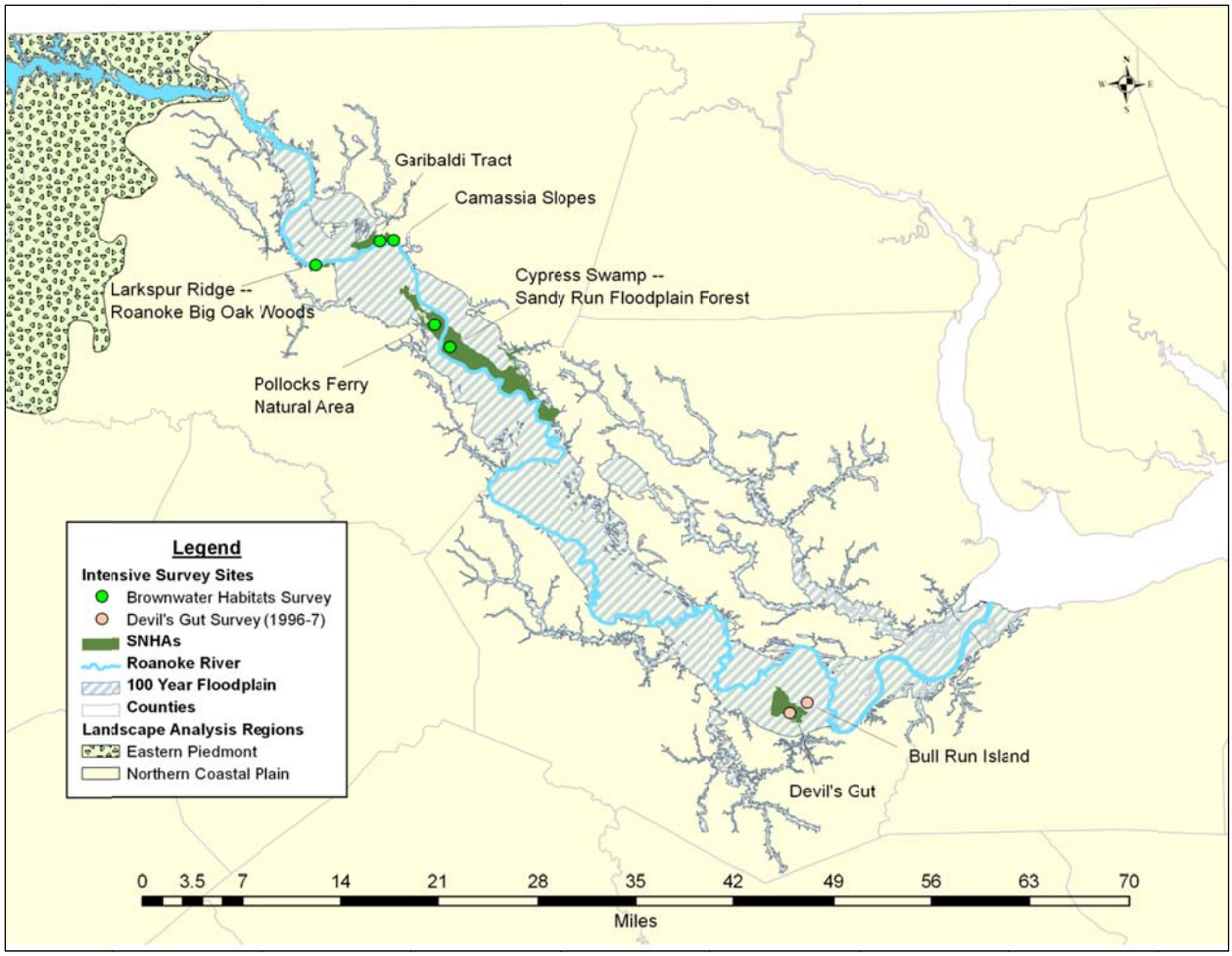


Figure 5. Intensive Survey Sites for Landscape Guilds

The chief objective of the landscape inventory was to record the presence of as many species belonging to the landscape guilds as possible, particularly those representing brownwater habitat types. The guild members represent a much broader set of species than the elements normally targeted in our inventories, and the landscape inventory amounts to a general survey of the terrestrial animals present within the study area. All Tetrapod classes of Vertebrates were covered, as well as the following orders of Insects: Lepidoptera (Moths and Butterflies), Odonata (Dragonflies and Damselflies), Orthoptera (Grasshoppers and Katydids), and Coleoptera (primarily Tiger Beetles).

Surveys for diurnal species – birds, reptiles and amphibians, butterflies, and other day-active insects – were conducted as a routine part of all site visits and served the dual purpose of identifying element species for site evaluation and guild members for landscape assessment. Most sites were visited just once or twice in order to spread the sampling effort over as many sites as possible. Insect sampling – particularly for nocturnal species – was conducted more intensively at the four sites chosen for detailed surveys.

RESULTS

Search Effort

Diurnal animals were surveyed during all 61 site visits m ade in this inventory and from all 25 of the sites visited. Surveys for nocturnal insects were done only at the four intensively sampled sites, with 59 samples obtained during the months of March, May, June, July, and September.[2] The overall results, summarized by taxa, are presented in Appendix A.

Guild Results

A total of 117 species belonging to 20 landscape guilds were recorded during the inventory, a summary of which is given in Table 9.

Table 9. Summary of Guild Member Records

Guild	Number of Species	Number of Sites
Canebrakes	9	28
Coastal Freshwater Marshes	1	1
Coastal Wet-Hydric Deciduous Forests	16	87
Dry-Xeric Mixed Forests, Woodlands, and Barrens	5	6
General Coastal Marshes	1	1
General Wet Hardwood Forests	8	44
General Wet-Mesic Hardwood Forests	13	88
General Mesic Hardwood Forests	4	7
General Wet-Dry Hardwood Forests	15	208
Rich Wet Hardwood Forests	5	12
Rich Wet-Mesic Hardwood Forests	8	29
Rich Wet-Dry Hardwood Forests	14	42
Sedge Mires	1	4
Semi-Natural Grasslands	3	5
Sparsely Settled Mixed Habitats	2	6
Wet Acidic Shrublands	2	3
Wet-Hydric Cypress Forests and Woodlands	10	28
Wet-Mesic Pine Woodlands	1	1
Wet-Xeric Longleaf Pine Woodlands/Ephemeral Pools	1	1

[2] For the majority of the trips to sample nocturnal insects, we were joined by Dr. J.B. Sullivan, a consulting entomologist. Thanks to his participation, we were able to sample more locations than we would have been able to do on our own.

Combined with records from previous studies (see Hall 2008, 2009), 11 of these guilds had sufficient concentrations of species within the floodplain to meet the threshold specifications for guild occurrences: observed number of species ≥ 25% of the expected number for the region. These guilds are described in Appendix C and their extent within the Roanoke floodplain is summarized in Table 10.

Table 10. Summary of Guild Occurrences

Guild	Total Acreage
Rich Wet Hardwoods Forests	20,418 ha (50,454 acres)
Rich Wet-Mesic Hardwood Forests	23,108 ha (57,100 acres)
Rich Wet-Dry Hardwood Forests	22,457 ha (55,493 acres)
General Wet Hardwood Forests	27,838 ha (68,788 acres)
General Wet-Mesic Hardwood Forests	32,5500 ha (80,432 acres)
Canebrakes (Atlantic Slope Subtype)	28,289 ha (69,905 acres)
Wet-Hydric Cypress Forests and Woodlands	37,803 ha (93,412 acres)
Coastal Wet-Hydric Deciduous Forests	65,595 ha (162,088 acres)
General Mesic Hardwood Forests	497 ha (1,228 acres)
General Wet-Dry Hardwood Forests	36,964 ha (91,340 acres)
Sparsely Settled Mixed Habitats	109,216 ha (269,878 acres)

Except for the General Mesic Hardwood Forests guild – which has two relatively small occurrences– all of the guilds are represented by single occurrences that extend over most of the floodplain. All of these occurrences, including the two small ones, contain populations of more than 50% of the expected number of guild members.

Lower Roanoke Landscape

Figure 6 illustrates the combined Guild Occurrences in the Lower Roanoke. A few occurrences – those of the Sparsely Settled Mixed Habitats and Canebrake Guilds – extend well outside the limits of the floodplain. All the others, however, are confined to the floodplain of the Roanoke or its tributaries or to the adjoining slopes. Within the floodplain, the majority of occurrences extend from the vicinity of Weldon in the fall zone to the vicinity of Jamesville, where the floodplain becomes dominated by permanently flooded swamps.

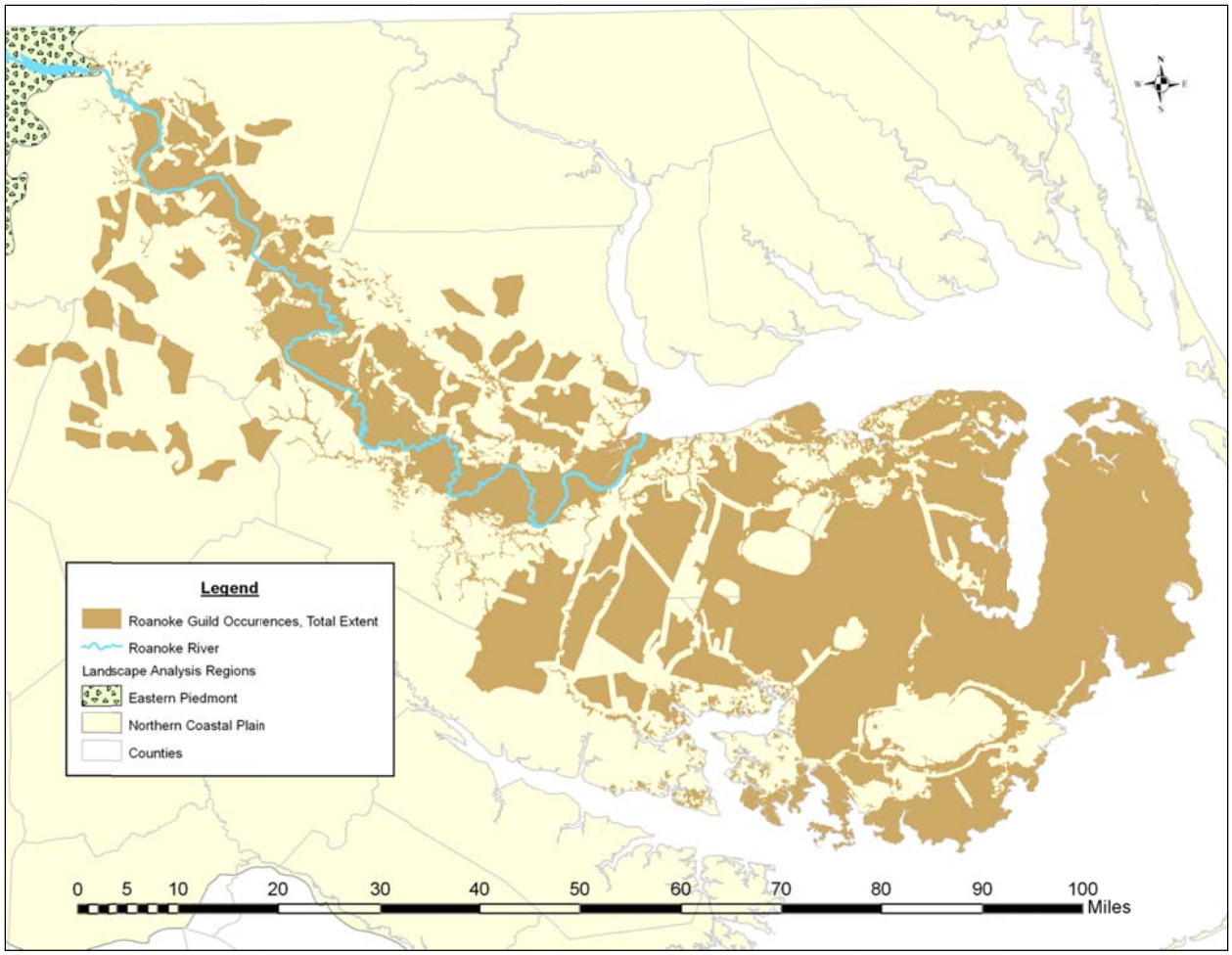


Figure 6. Total Extent of Guild Occurrences that Include the Roanoke Floodplain

This high degree of guild continuity within the floodplain and the sharp break in the number of guilds that cross out of the floodplain indicate that the Lower Roanoke floodplain can be identified as a distinct Significant Natural Heritage Landscape. Drawing a line around all overlapping and contiguous guild occurrences associated with the floodplain, but separating the SNHL at the gaps that only one or two of the guilds can cross (retaining the portions of those guilds located inside the Landscape), produces the map shown in Figure 7. The resulting landscape unit covers 130,199 ha (321,728 acres). Excluding the Sparsely Settled Mixed Habitat guild occurrence – which contains agricultural and silvicultural lands – the remainder represents most of the natural habitats still left in the Lower Roanoke floodplain.[3] This expanse of natural habitats covers a total of 77,319 ha (191,059 acres), 59% of the area covered by all the guild occurrences combined.

[3] Some natural habitats may be present in the excluded areas of the Sparsely Settled Mixed Habitats Guild.

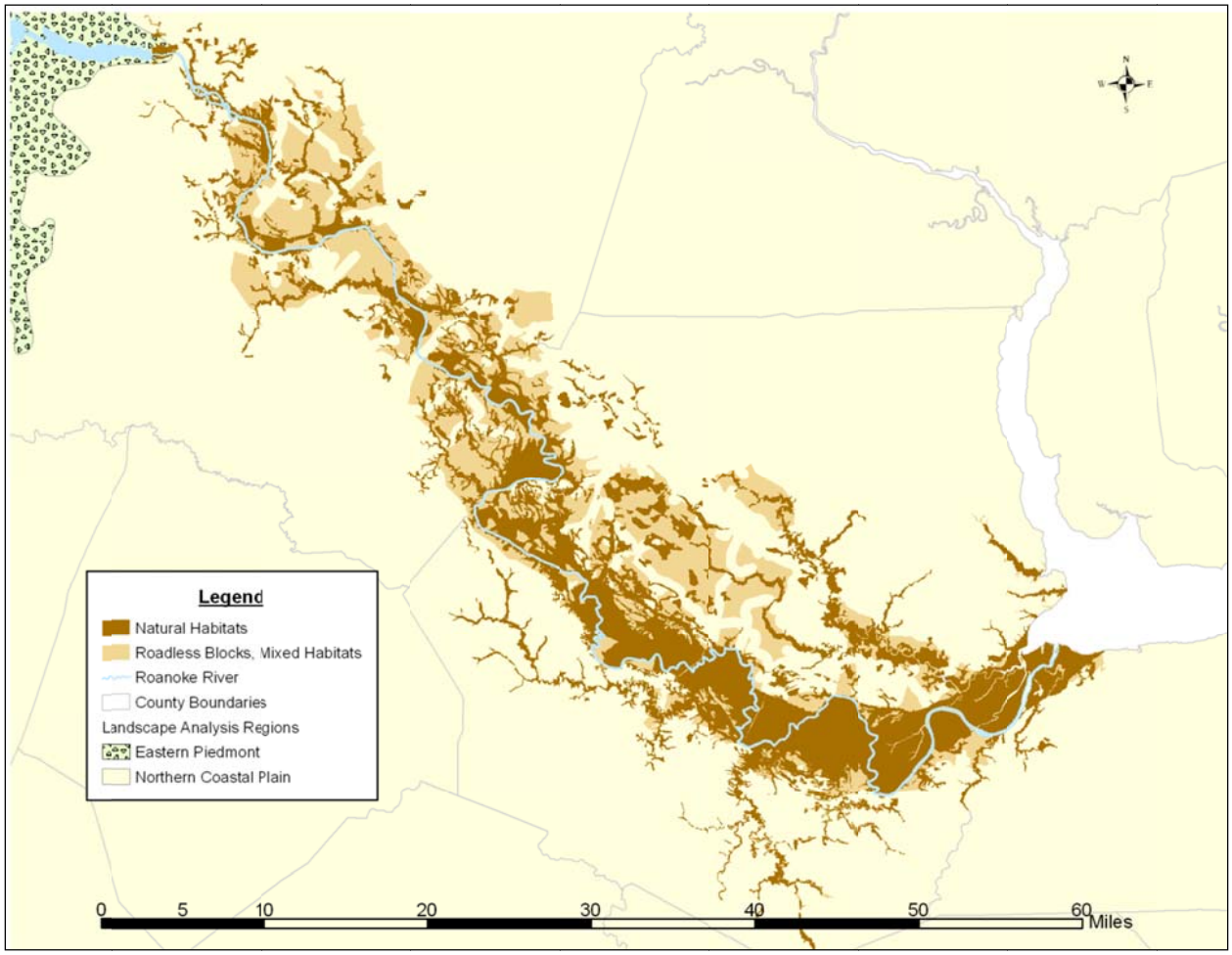


Figure 7. Lower Roanoke Significant Natural Heritage Landscape

Intersection of Landscapes, Sites, and Protected Areas

As shown in Figure 8, all of the Significant Natural Heritage Areas located within the Roanoke SNHL are connected by one or more of the guild occurrences.[4] These connecting areas enhance the value of the SNHAs, both by adding species that require larger areas of habitat than are present within any one SNHA and by increasing their long-term viability in face of environmental disturbances. In turn, the presence of high quality natural areas enhances the value of the landscapes: they often correspond to the most resistant areas of habitat within the landscape, having withstood the tests of time in maintaining their native biodiversity, and represent important sources of recolonization following a disturbance.

Individually, the guilds vary in terms of their overall extent and degree of connectedness within the SNHL. Consequently, they also vary in terms of the SNHAs that they connect and in the

[4] Short gaps between some of the units are all believed to be crossable by guild members.

strength of these connections. The following section describes these features for the five groups of habitats listed in Table 10. Information is also included on the extent to which these landscapes occur within lands managed for biodiversity conservation.

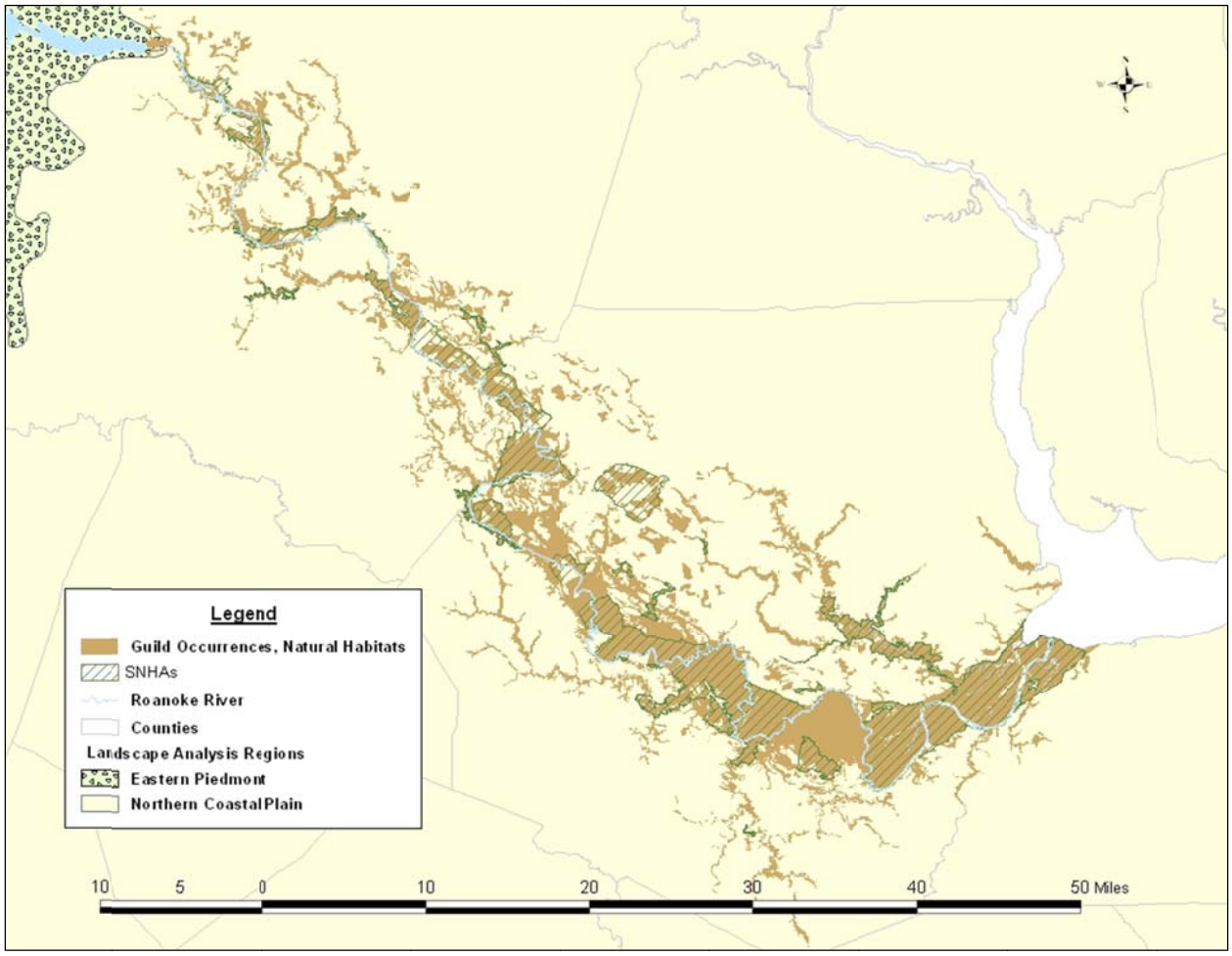


Figure 8. Overlap between Combined Guild Occurrences and Significant Natural Heritage Areas

Rich Habitats

Guilds associated with nutrient-rich habitats were main targets of this inventory and include the Rich Wet Hardwood Forests, Rich Wet-Mesic Hardwood Forests, and Rich Wet-Dry Hardwood Forests guilds. Members of these guilds are more directly associated with the plant species that require rich soils than to the soil conditions per se (see Appendix C for a more detailed description and species lists). The three guilds differ primarily in terms of their tolerance for flooding or droughts. In the Lower Roanoke floodplain, the occurrences of these guilds largely coincide, although elsewhere in the state there are significant areas where they do not overlap.

Figure 9 shows the combined occurrences for the three guilds. All three share the levee forests and bottomlands and Rich Wet-Mesic Hardwood Forests guild and Rich Wet-Dry Hardwood Forests guild further overlap on the narrow area of adjoining slopes that possess rich soils. Table

11 provides data on the spatial extent of the occurrences as well as their intersection with SNHAs and conservation lands.

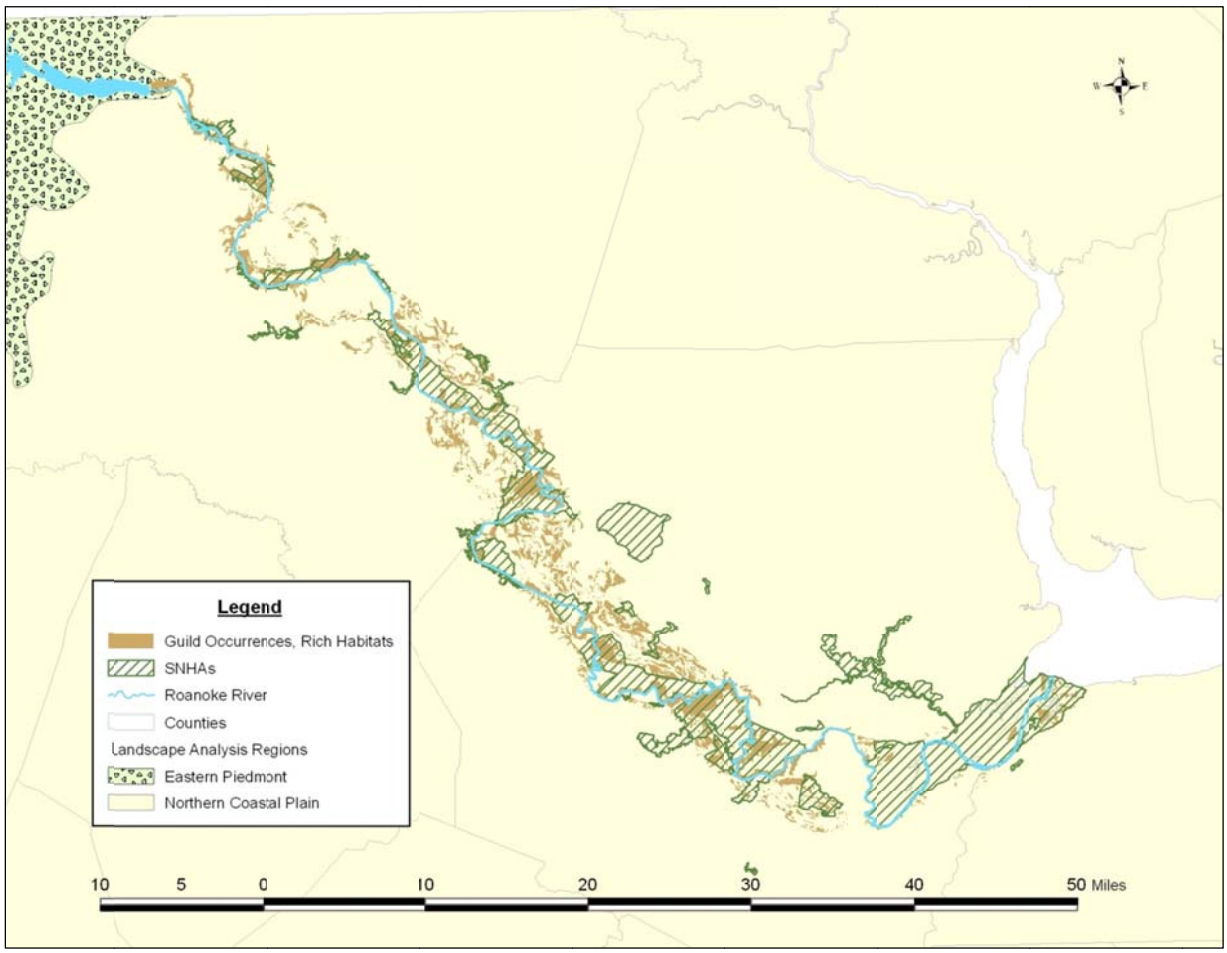


Figure 9. Intersection of Guild Occurrences and SNHAs, Rich Habitats Group

Table 11. Spatial Extent and Areal Relationships, Rich Habitat Guilds

Combined Occurrences (% of SNHL Natural Habitats)	Area Inside SNHAs (% of Combined Occurrences)	Area Inside Conservation Lands (% of Combined Occurrences)
23,108 ha (30%)	9,503 ha (41%)	6,659 ha (29%)

Only single, large occurrences were identified for each of these guilds. All of their members can fly and the occurrence separation distances for unsuitable habitat – i.e., widths of inhospitable habitat that are too wide for the members to normally cross[5] – are 2 km for the Rich Wet-Dry Hardwood Forests guild and 4 km for the other two guilds. Currently, no gaps of over 2 km exist

[5] Guilds are often composed of a mixture of species differing in movement capabilities. In determining separation distances, we use a rule that favors the species most susceptible to habitat fragmentation: separation between guild occurrences is determined by widths of inhospitable habitat or barriers to movement that at least 10% of the guild members cannot normally cross.

for these habitats from the fall line to the vicinity of Jamesville, where deeply flooded swamps occupy most of the floodplain. Connections become very thin, however, at the big bend in the river where Caledonia and Odum Correctional Institutions are located on opposite sides of the river. Only narrow strips of natural habitat remain along the river within both of these institutions, with the rest consisting of cultivated lands or dense pine plantations.

Unlike guilds that make use of blackwater habitats, the guilds in this group are essentially isolated within the Lower Roanoke floodplain, cut off from the Piedmont by the large reservoirs upstream and from other areas of rich habitats in the Coastal Plain by intervening areas of blackwater or acidic upland habitats. The landscape integrity of these guilds is nonetheless quite high within the Roanoke floodplain itself: the occurrences of all three guilds contain greater than 75% of the expected number of species for this region, which we interpret as indicating excellent landscape integrity.

Over 40% of the area included within the combined occurrences for these guilds falls within Significant Natural Heritage Areas. The habitats in these intersecting areas is likely to be especially important for guild members that require mature, high quality habitats, such as Cerulean Warblers (*Setophaga cerulea*), which prefer to nest in mature stands of levee forest. This groups also includes species associated with the rich herb and shrub layers characteristic of these habitats, including Asimina Webworm Moth (*Omphalocera munroei*), Four-spotted Angle (*Trigrammia quadrinotaria* complex), Hop Vine Moth (*Hypena humuli*), Mayapple Borer (*Papaipema rutila*), Pettit's Sallow (*Pyreferra pettiti*), Promiscuous Angle (*Macaria promiscuata*), and Zebra Swallowtail (*Eurytides marcellus*). All of these species probably take a long time to recover from disturbance events, such as major storms or clear-cutting, that remove the forest canopy. However, most of the species associated with trees -- which includes the majority of the members of these guilds -- can make use of younger stands that would not qualify as element occurrences. For these species, the 59% of the guild habitats not included in the SNHAs may be just as important as the 41% that is included.

Currently, 29% of the habitats mapped for these guilds are located within areas managed for biodiversity conservation, including state game lands, federal wildlife refuges, private conservation preserves, and areas with conservation easements (see Figure 10). The remaining 71%, including areas within unprotected SNHAs, is open to multiple uses, including conversion to agriculture or silviculture.

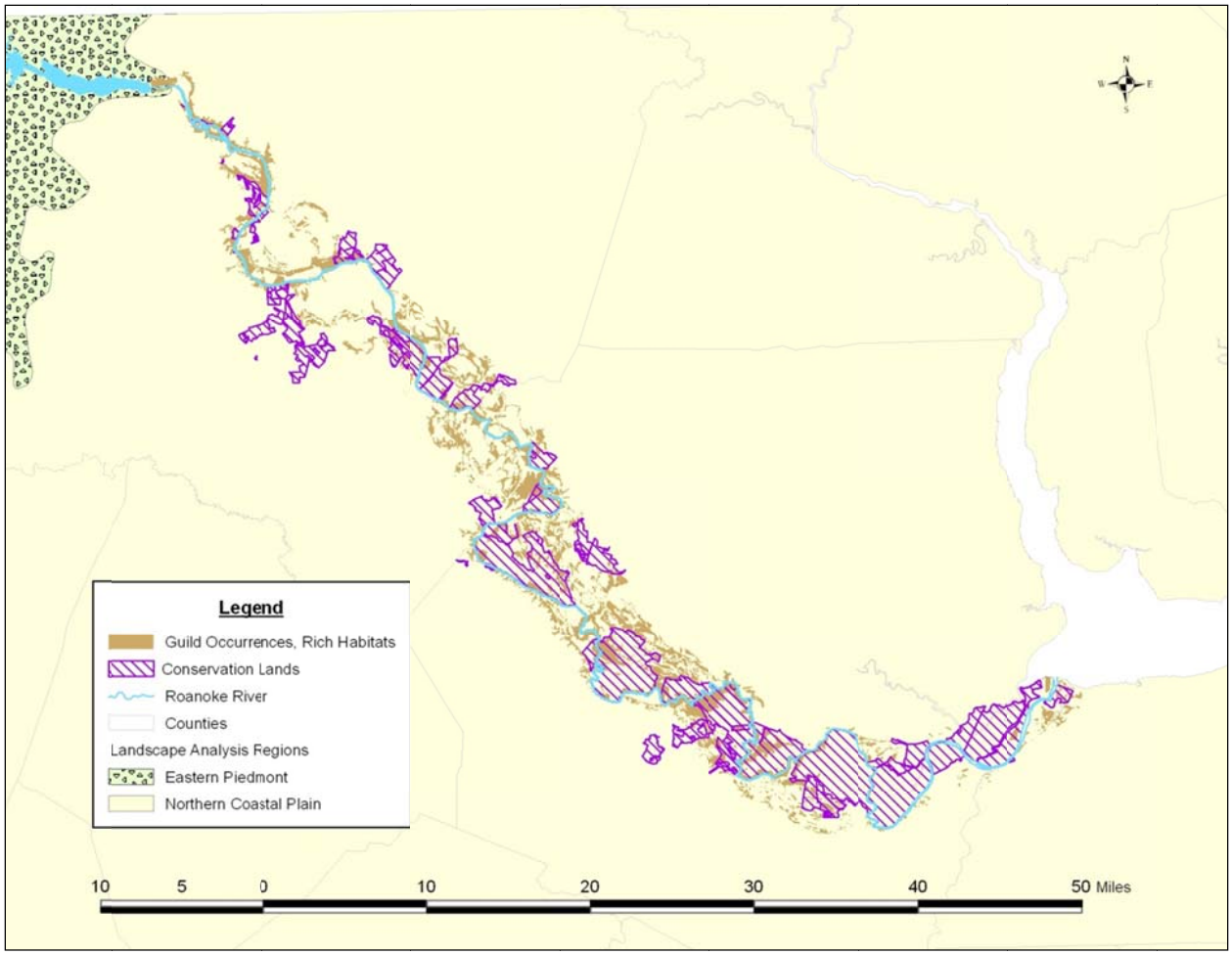


Figure 10. Intersection of Guild Occurrences and Conservation Lands, Rich Habitats Group

General Floodplain Hardwoods

The three guilds in this group -- the General Wet Hardwood Forests, General Wet-Mesic Hardwood Forests and Canebrakes guilds – are all associated with the moist-to-wet habitats typical of floodplains but occur in areas of nutrient-rich soils as well as areas of nutrient-poor, acidic floodplains along blackwater rivers and streams. Within the Lower Roanoke floodplain, the occurrences of these three guilds overlap strongly with those of the Rich Soil guilds along the main floodplain of the Roanoke, but also extend up the adjoining tributaries and wet flats that do not receive any deposits of nutrient-rich sediments (Figure 11). Additionally, the Canebrakes guild makes some use of the peatland habitats located at the mouth of the river and the full extent of the occurrence for that guild includes the vast area of peatland habitats extending farther east on the Albemarle-Pamlico Peninsula.

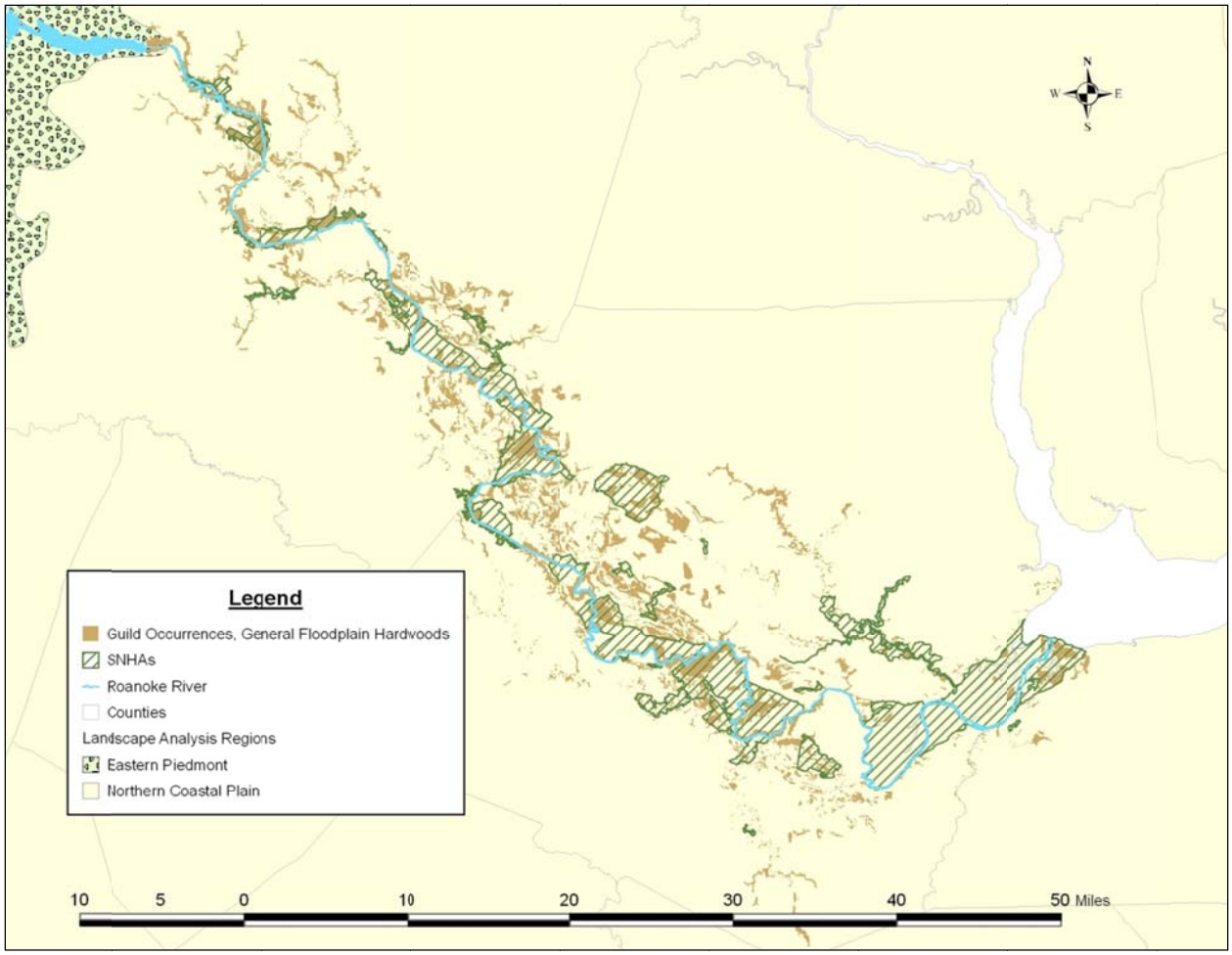


Figure 11. Intersection of Guild Occurrences and SNHAs, General Floodplain Hardwoods Group

Table 12. Spatial Extent and Areal Relationships, General Floodplain Hardwoods Guilds

Combined Occurrences (% of SNHL Natural Habitats)	Area Inside SNHAs (% of Combined Occurrences)	Area Inside Conservation Lands (% of Combined Occurrences)
34,631 ha (45%)	11,251 ha (32%)	7,546 ha (22%)

As in the previous group of guilds, only single large occurrences were identified for these three guilds within the Lower Roanoke floodplain. All members of these guilds are capable of flight and the occurrence separation distance for unsuitable habitat is 2 km for all three guilds. No gaps of over 2 km exist for these habitats from the fall line to the vicinity of Jamesville, where deeply flooded swamps (not used by this group of guilds) cover most of the floodplain. As in the previous group, connections become very thin at the big bend in the river where Caledonia and Odum Correctional Institutions are located.

Unlike the Rich Habitats Group, which are strongly confined to the main floodplain of the Roanoke, the extension of the General Floodplain Hardwoods guild into the blackwater tributaries of the Roanoke, make them far less isolated, with connections potentially being made

to the adjoining river basins via short overland gaps between headwater streams. As in the Rich Habitat Guilds, however, the large reservoirs upstream block the penetration of these guilds into the Piedmont, areas of which these guilds occupy elsewhere within the state.

The landscape integrity of these guilds is again quite high: the occurrences of all three guilds in this group contain greater than 75% of the expected number of species for this region, indicating excellent landscape integrity. The Roanoke occurrence for the Canebrake guild may, in fact, be one of the most important globally for this guild: in terms of the number of species recorded, including several that are nearly endemic to eastern North Carolina (also occurring in adjoining areas of Virginia), the Roanoke floodplain is rivaled only by the Croatan National Forest, the most intensively studied habitat for Canebrake species in the state. One member of this guild, *Leucania calidior* (Cane Wainscot), has not been recorded so far anywhere else in North Carolina, including the Croatan (J.B. Sullivan, pers. comm.) Two of the first three specimens of *Loscopia roblei* (Roble's Cane Borer) were collected at Devil's Gut (Hall 1999b) and are included in the paratypes for this species (Mikkola et al. 2009). This species and another as yet undescribed species of cane-borer (Apameine genus 2, species 3) are believed to be endemic to northeastern North Carolina and a small portion of adjoining southeastern Virginia.

Only a few members of these guilds appear to be associated with mature trees or well-developed herb and shrub layers. These include Kentucky Warblers (*Geothlypis formosus*) and Appalachian Browns (*Satyrodes appalachia*), Northern Pearly-eyes (*Enodia anthedon)*, and some of the seep-inhabiting dragonflies. For these species, the 32% of the guild occurrences that intersect SNHAs may be important. For the rest, however, younger second-growth stands located within the remaining78% may be just as suitable.

Only a small portion – 22% – of the habitats used by this group are located within lands managed for biodiversity conservation (see Figure 12). Whether or not the remaining 78% contains high quality habitats, these areas nonetheless play an important role in safeguarding refuges for the members of this guild from major disturbances, particularly those associated with human activities. Consequently, more areas of this habitat should be targeted for some form of conservation.

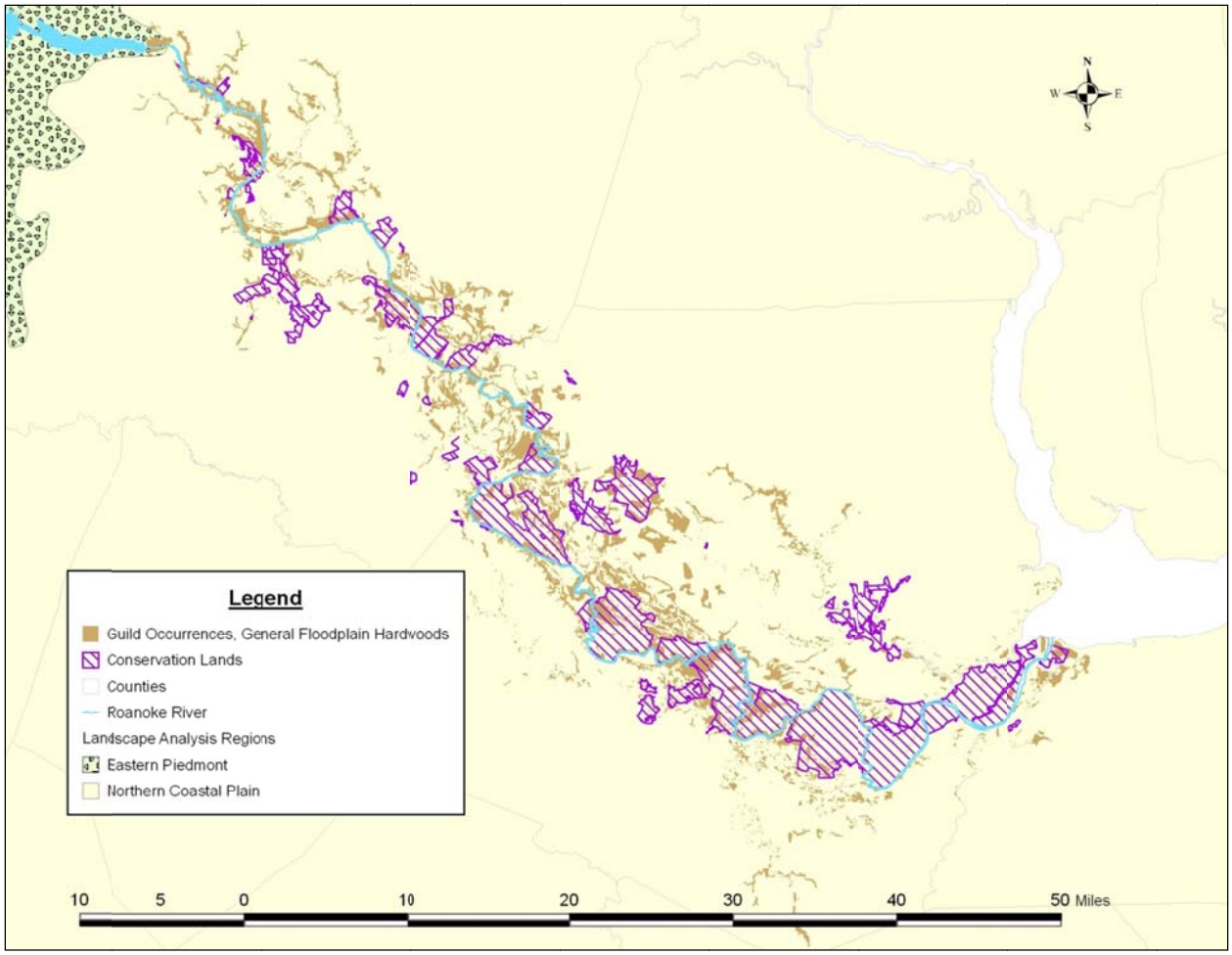


Figure 12. Intersection of Guild Occurrences and Conservation Lands, General Floodplain Hardwoods Group

Swamps and General Floodplain Forests

The two guilds included in this group – the Wet-Hydric Cypress Forests and Woodlands guild and the Coastal Wet-Hydric Deciduous Forests guild – are distinguished from the preceding groups by their extensive occurrence within frequently to permanently flooded swamps, including those dominated by bald cypress (*Taxodium distichum*) rather than hardwoods. The Wet-Hydric Cypress Forests and Woodlands guild is essentially confined to stands of cypress.[6] The Coastal Wet-Hydric Deciduous Forests guild makes use of swamps as well as the same habitats as the floodplain hardwoods guilds described previously. The combined occurrences of these two guilds is shown in Figure 13.

[6] In other areas of the state, this guild also makes use of stands of Pond Cypress (*T. ascendens*), including those associated with seasonally dry Cypress Savannas.

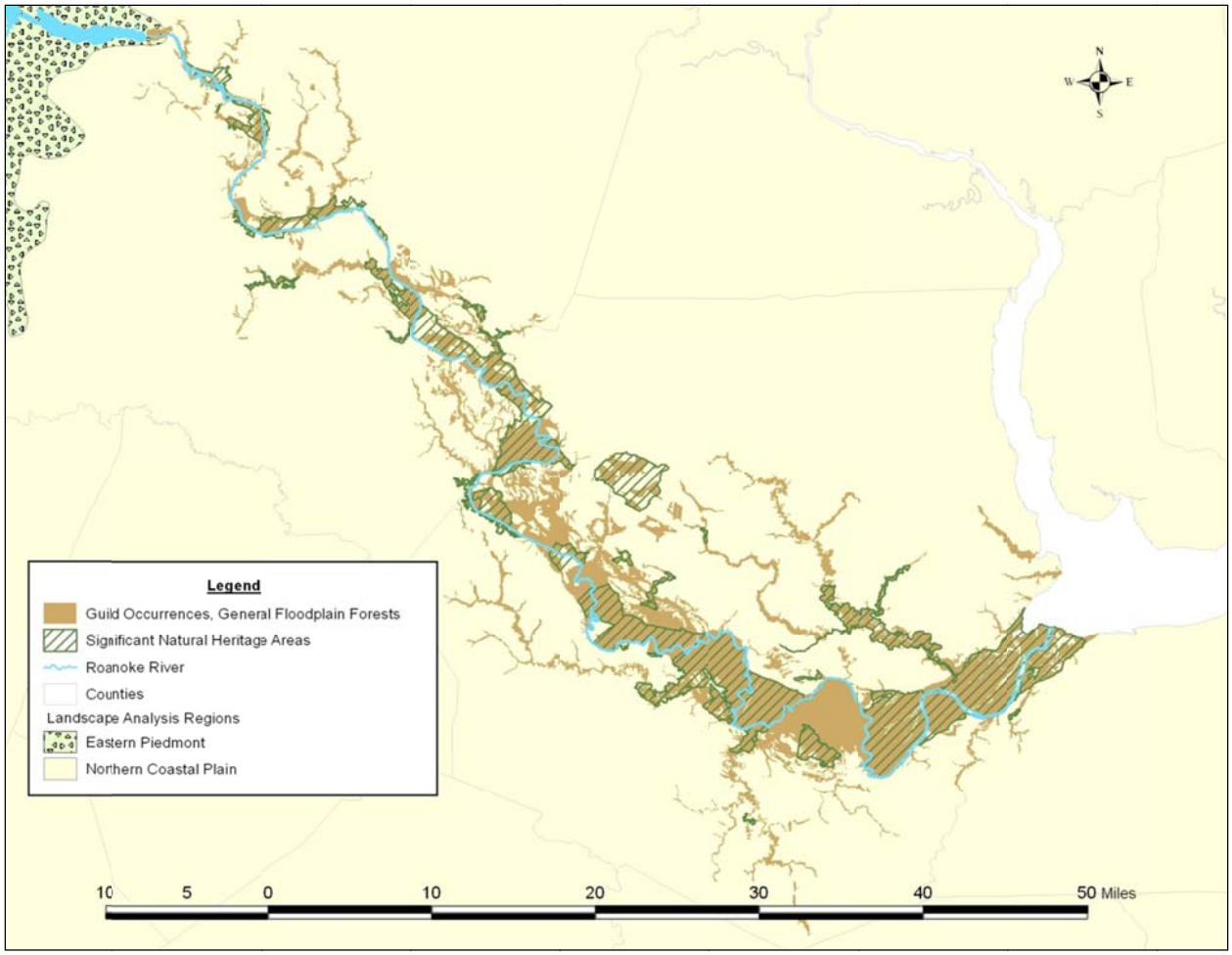


Figure 13. Intersection of Guild Occurrences and SNHAs, Swamps and General Floodplain Forests Group

Table 13. Spatial Extent and Areal Relationships, Swamps and General Floodplain Forests

Combined Occurrences (% of SNHL Natural Habitats)	Area Inside SNHAs (% of Combined Occurrences)	Area Inside Conservation Lands (% of Combined Occurrences)
65,595 ha (85%)	32,406 ha (49%)	27,298 ha (42%)

Single large occurrences exist for both guilds within the Lower Roanoke floodplain. The occurrence separation distance for unsuitable habitat is 2 km for the Wet-Hydric Cypress Forests and Woodlands guild and 4 km for the Coastal Wet-Hydric Deciduous Forests guild, and no gaps greater than 2 km exist for these habitats from the fall line all the way to the mouth of the river. As in the previous habitat groups, however, the connections become very thin at the big bend in the river where Caledonia and Odum Correctional Institutions are located.

Similarly to the Floodplain Hardwoods Group, guilds in this group make use of blackwater floodplains as well as brownwater, and are potentially connected to the adjoining river basins by their headwater streams. The large reservoirs upstream from the fall line, however, block their direct penetration into the Piedmont. Given the extensive amount of this habitat within the

Lower Roanoke SNHL itself, however, the landscape integrity of these occurrences is quite high: occurrences of both guilds in this group contain greater than 75% of the expected number of species for this region, indicating excellent landscape integrity.

Several members of the Coastal Wet-Hydric Deciduous Forests guild are associated with mature stands of their habitat. Wood Ducks (*Aix sponsa*), Rafinesque's Big-eared Bats (*Corynorhinus rafinesquii macrotis*), Southeastern Myotis (*Myotis austroriparius*), and Prothonotary Warblers (*Protonotaria citrea*) are all cavity-nesting species and require the presence of trees large and old enough to have substantial amounts of dead wood. Additionally, Mississippi Kites (*Ictinia mississippiensis*) prefer tall trees for nesting. For these species, the extent and connectivity of high quality stands plays a significant role in maintaining their presence within the area, so the 49% of the occurrence for this guild contained within SNHAs is highly meaningful. On the other hand, most of the species in these two guilds – including most, if not all, of the species in the Wet-Hydric Cypress Forests and Woodlands guild – make use of younger second-growth stands. For those species, the habitats outside the SNHAs may be just as important as those inside.

Due to the large amount of swamp habitat that is included within the Roanoke River National Wildlife Refuge, along with other areas managed for the conservation of biodiversity, a relatively high proportion – 42% -- of the area covered by these two guilds receives some degree of protection (see Figure 14).

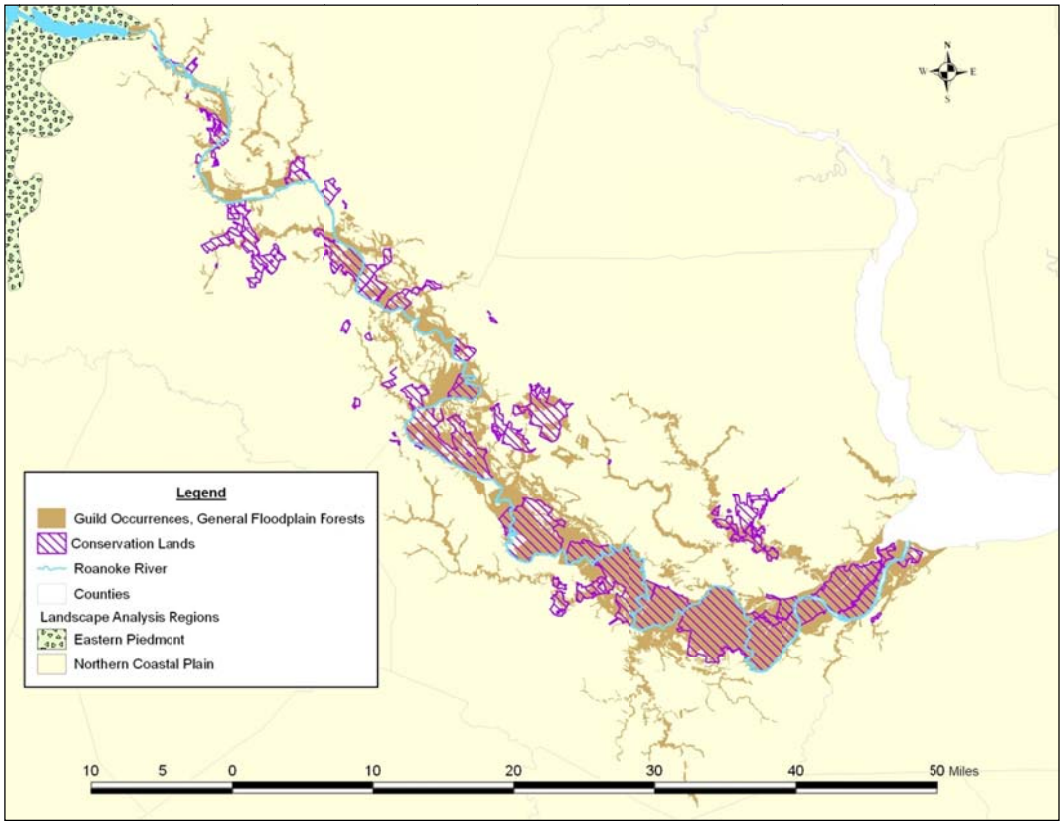


Figure 14. Intersection of Guild Occurrences and Conservation Lands, Swamps and General Floodplain Forests Group

Mesic Slopes and Floodplain Ridges

This group consists of just a single guild that is associated primarily with the cool, moist slopes that adjoin floodplains rather than the floodplains themselves. All of the guild members are completely terrestrial and generally intolerant of flooding; within the floodplain, only seldom-flooded ridges are occupied, possibly only on a temporary basis. Combined, these habitats cover about 3,580 ha, or just 5% of the natural habitats in the SNHL.

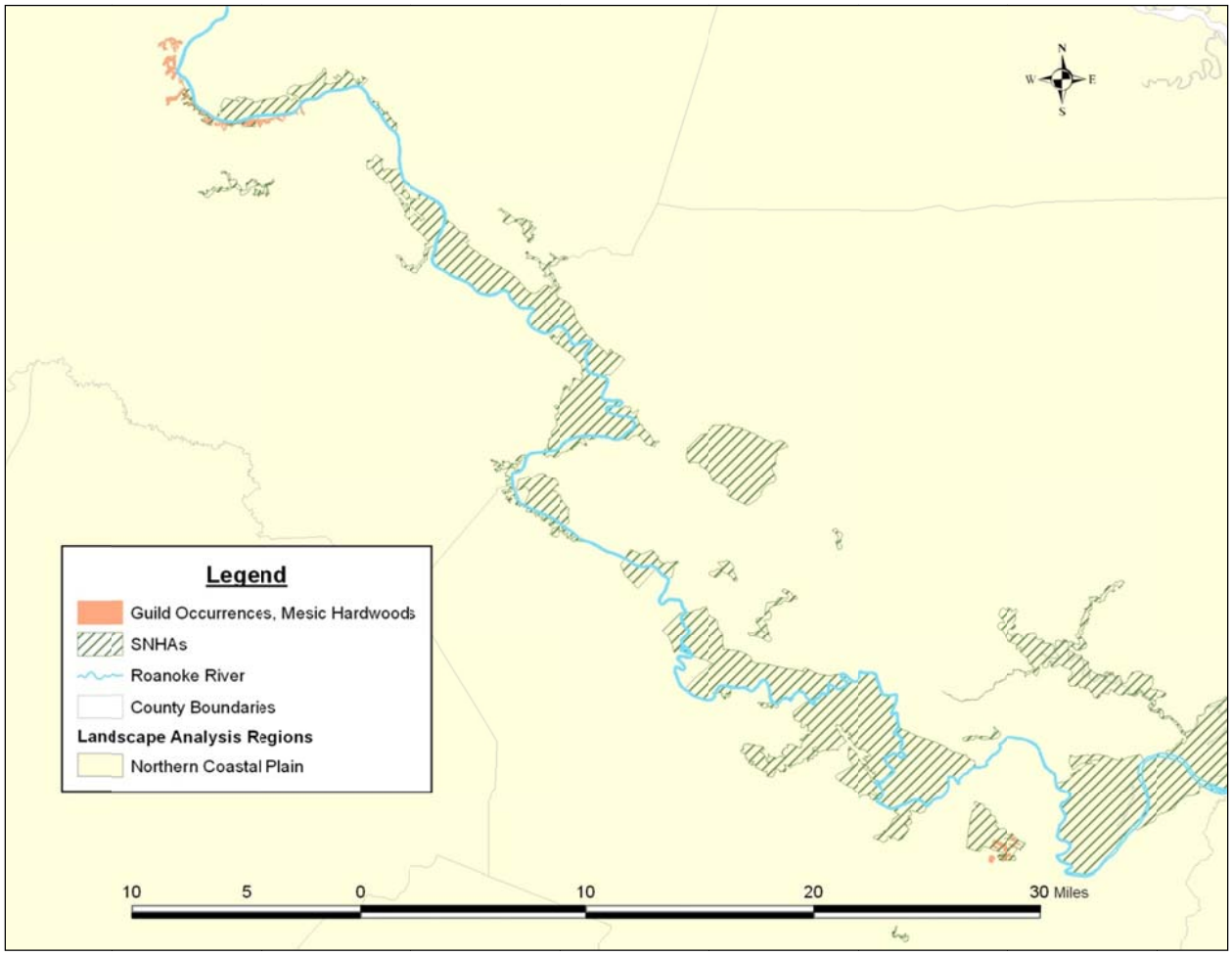


Figure 15. Intersection of Guild Occurrences and SNHAs, Mesic Slopes and Floodplain Ridges Group

Table 14. Spatial Extent and Areal Relationships, Mesic Slopes and Floodplain Ridges

Combined Occurrences (% of SNHL Natural Habitats)	Area Inside SNHAs (% of Combined Occurrences)	Area Inside Conservation Lands (% of Combined Occurrences)
497 ha (0.6%)	204 ha (41%)	142 ha (29%)

The majority of the members of this guild are small, non-flying reptiles and amphibians, including Eastern Worm Snake (*Carphophis amoenus*), Ringneck Snake (*Diadophis punctatus*),

Atlantic Coast Slimy Salamander (*Plethodon chlorobryonis*), and Smooth Earth Snake (*Virginia valeriae*). For these species, the occurrence separation distance for unsuitable habitat is 1 km, with the river itself acting as a major barrier to movements. Unlike the General Mesic Hardwood Forests guild or the two Rich Habitat guilds that make use of mesic slopes but also the extensive connections made between slope habitats via the floodplain, connections for this guild are made primarily via the slopes.[7] Within these slope habitats, there are several gaps of 5-10 km separating the units, making the habitat for this guild the most fragmented of any identified within the floodplain.

Compared to the other guilds, relatively few members of this guild were recorded and only two small, widely separated occurrences were identified. Nonetheless, both occurrences contain 57% and 67% of the expected guild members, respectively, and probably more areas of habitat are actually occupied. Several extensive areas of slope forests were not surveyed for this guild, including the largest area of these habitats located along the western side of the Roanoke floodplain in the vicinity of Hamilton.

All seven of the members of this guild require good quality habitat conditions. In addition to the small reptiles and amphibians, which need abundant logs and a diverse community of detritivores, the two Lepidopteran members feed on witch-hazel (*Hamamelis virginiana*), a shrub that requires moist, shaded conditions. None of these species are likely to survive a major blow-down or clear-cutting of the canopy and probably require a lengthy period to recolonize following these events. It is probably no accident, therefore, that a relatively high proportion of the guild occurrences are included within SNHAs, i.e., within good quality habitats. Also probably not a coincidence, both occurrences have substantial portions located on protected conservation lands (see Figure 16).

[7] Rarely-flooded floodplain ridges are included as habitat for this guild, but most examples are represented by small, isolated "islands" of habitat surrounded by more frequently flooded bottomlands and swamps.

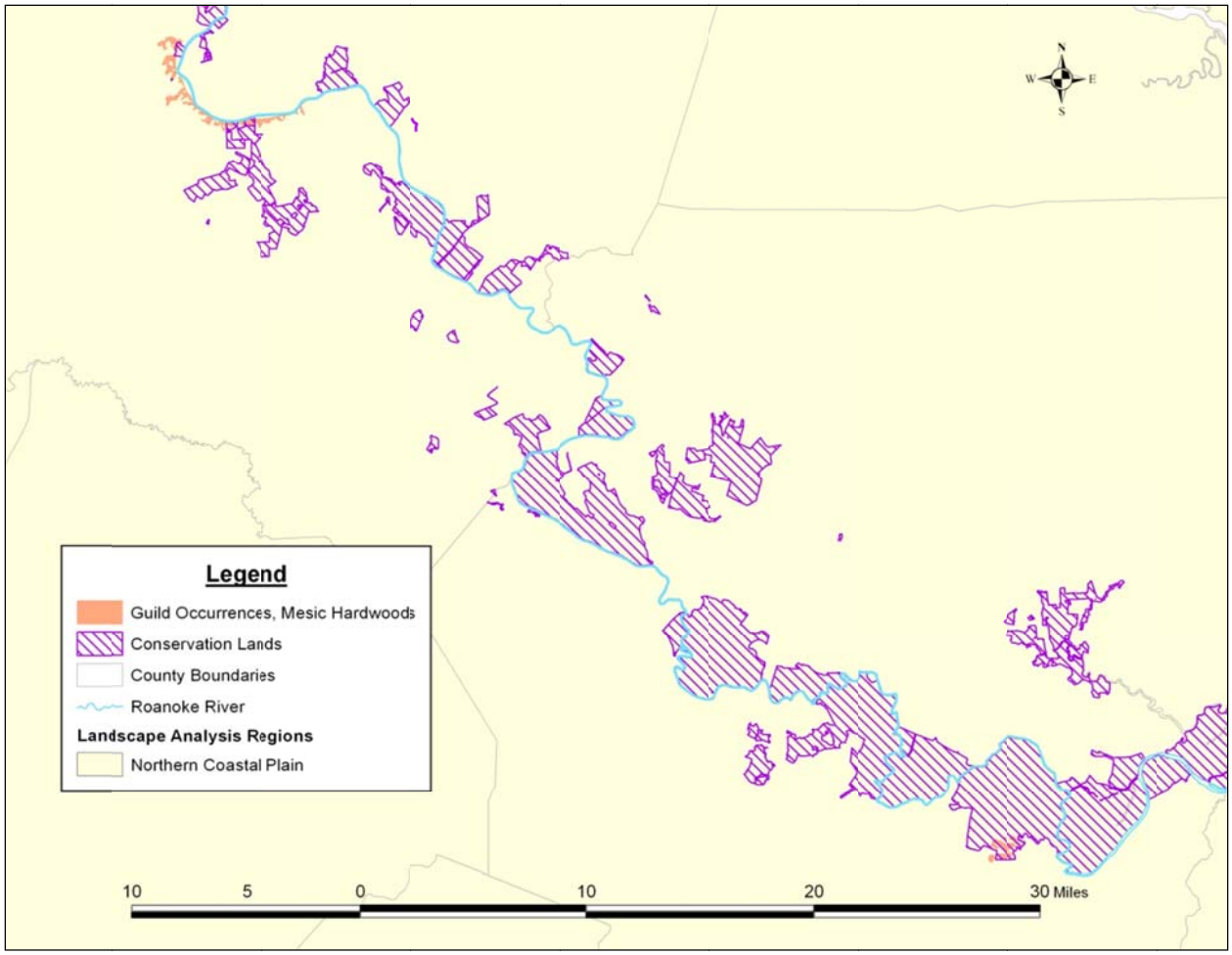


Figure 16. Intersection of Mesic Slopes and Floodplain Ridges Guild Occurrences and Conservation Lands

General Habitats

The occurrences of the two guilds associated with the most generalized habitats are shown in Figure 17. Members of the General Wet-Dry Hardwood Forests guild range from dry uplands to bottomlands, making at least some use of swamp forests at least during the drier periods of the year. Members of the Sparsely Settled Mixed Habitats guild make use of all of those habitats but also range into agricultural fields and tree plantations. Although habitat generalists, the species composing this guild – primarily wide-ranging carnivores – do best in areas with only a low level of human activity or occupation, typically areas with few roads, especially paved roads with heavy traffic.

Not surprisingly, the combined occurrences of these guilds have the largest acreage of any of the five habitat groups, covering almost the entire expanse of the SNHL. The General Wet-Dry Hardwood Forests guild includes most of the natural habitats within the SNHL with the exception of the deep swamps. The large areas of roadless habitats composing the occurrence of

Sparsely Settled Mixed Habitats guild also overlaps most of the other guild occurrences, particularly within the floodplain, where there is little permanent human settlement, roads included.

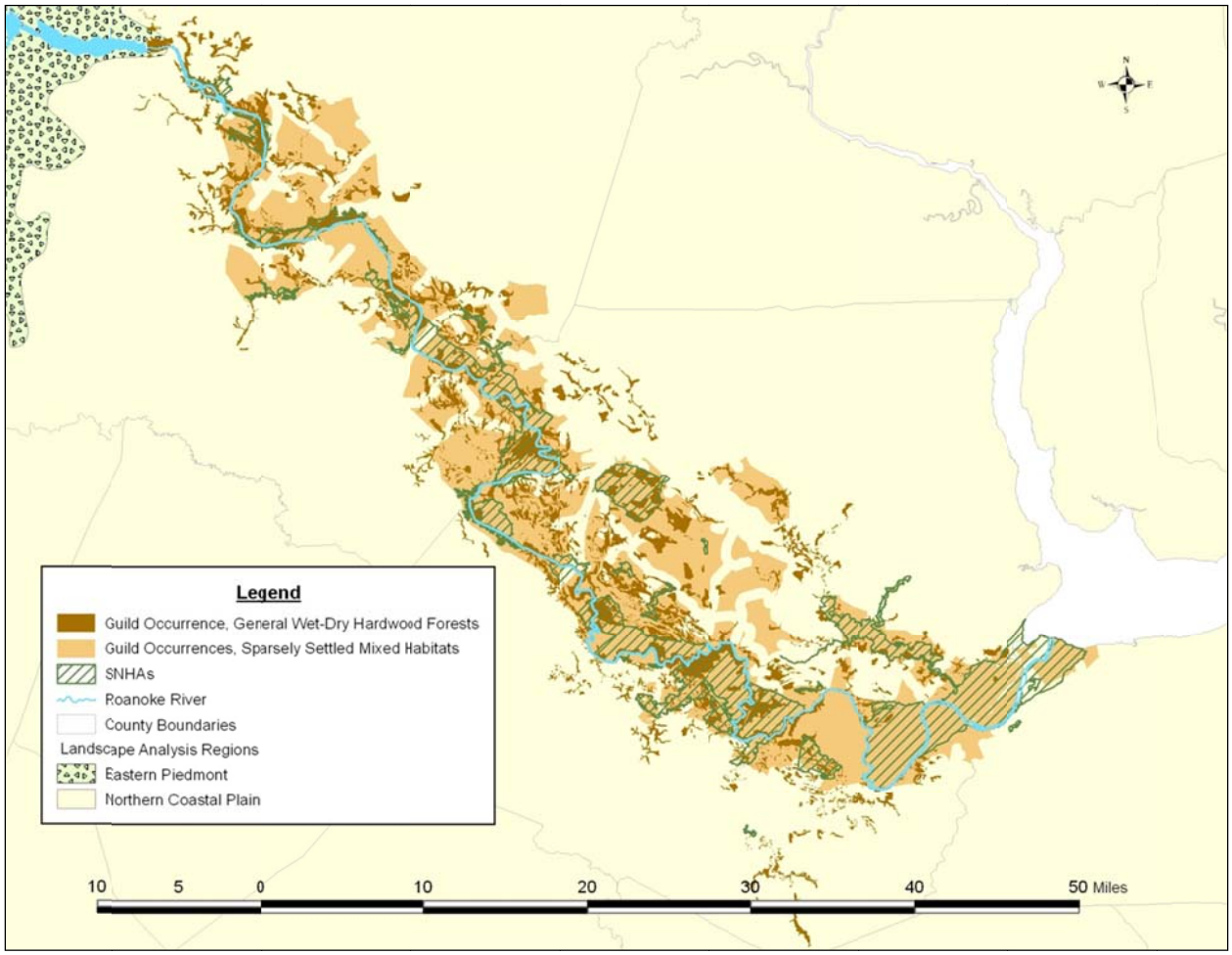


Figure 17. Intersection of Guild Occurrences and SNHAs, General Habitats Group

Table 15. Spatial Extent and Areal Relationships, General Habitats

Combined Occurrences (% of total SNHL)	Area Inside SNHAs (% of Combined Occurrences)	Area Inside Conservation Lands (% of Combined Occurrences)
122,030 ha (94 %)	36,005 ha (30%)	34,753 ha (28%)

Only single large occurrences were identified for both guilds. The occurrence separation distance for unsuitable habitat is 1 km for both guilds, based on their inclusion of ground-dwelling amphibians and reptiles. This limitation is made up for, however, by the broad range of habitats that these guild members treat as "suitable." For both of these guilds, there are no significant gaps in habitat from Weldon, on the fall line, to the vicinity of Plymouth near the mouth of the river. Greater than 75% of the expected guild members were recorded for each of the two guild occurrences, indicating excellent landscape integrity.

The maturity and quality of natural habitats, beyond the need for minimal human intrusion, is not too critical for the Sparsely Settled Mixed Habitat guild. In contrast, virtually the entire membership of the General Wet-Dry Hardwood Forests guild is considered sensitive to habitat quality. Eleven of the species are neo-tropical migrant, forest-interior songbirds, which, along with Eastern Whip-poor-wills (*Antrostomus vociferus*), prefer tracts of mature hardwoods. Five species forage or nest mainly on the ground and mainly inhabit areas with good quality forest-floor communities located under a hardwood canopy. Two species, White-breasted Nuthatches (*Sitta carolinensis*) and Hairy Woodpeckers (*Picoides villosus*), prefer large trees for both foraging and nesting. For these species, the portion of their guild occurrence that intersects areas included within SNHAs is important. For the General Wet-Dry Hardwood Forests guild by itself, 29% of its occurrence area is included within SNHAs, a somewhat lower percentage than for some of the other groups of guilds, probably due to its inclusion of upland habitats located outside the floodplain of the Roanoke.

A large area, but only 28% of the combined occurrences for these guilds, is contained within lands managed for biodiversity conservation (see Figure 18). Several species in these guilds, however, are game animals, including Wild Turkey (*Meleagris gallopavo*), Bobcat (*Lynx rufus*), Long-tailed Weasel (*Mustela frenata*), and American Black Bear (*Ursus americanus*). On many of the conservation lands, hunting is permitted and the protection given to these species is not absolute. However, populations of all these species are managed, with hunting regulated to prevent any significant decline in numbers. More importantly, these preserves protect the habitats of these species from development and the most extractive forms of agriculture and silviculture.

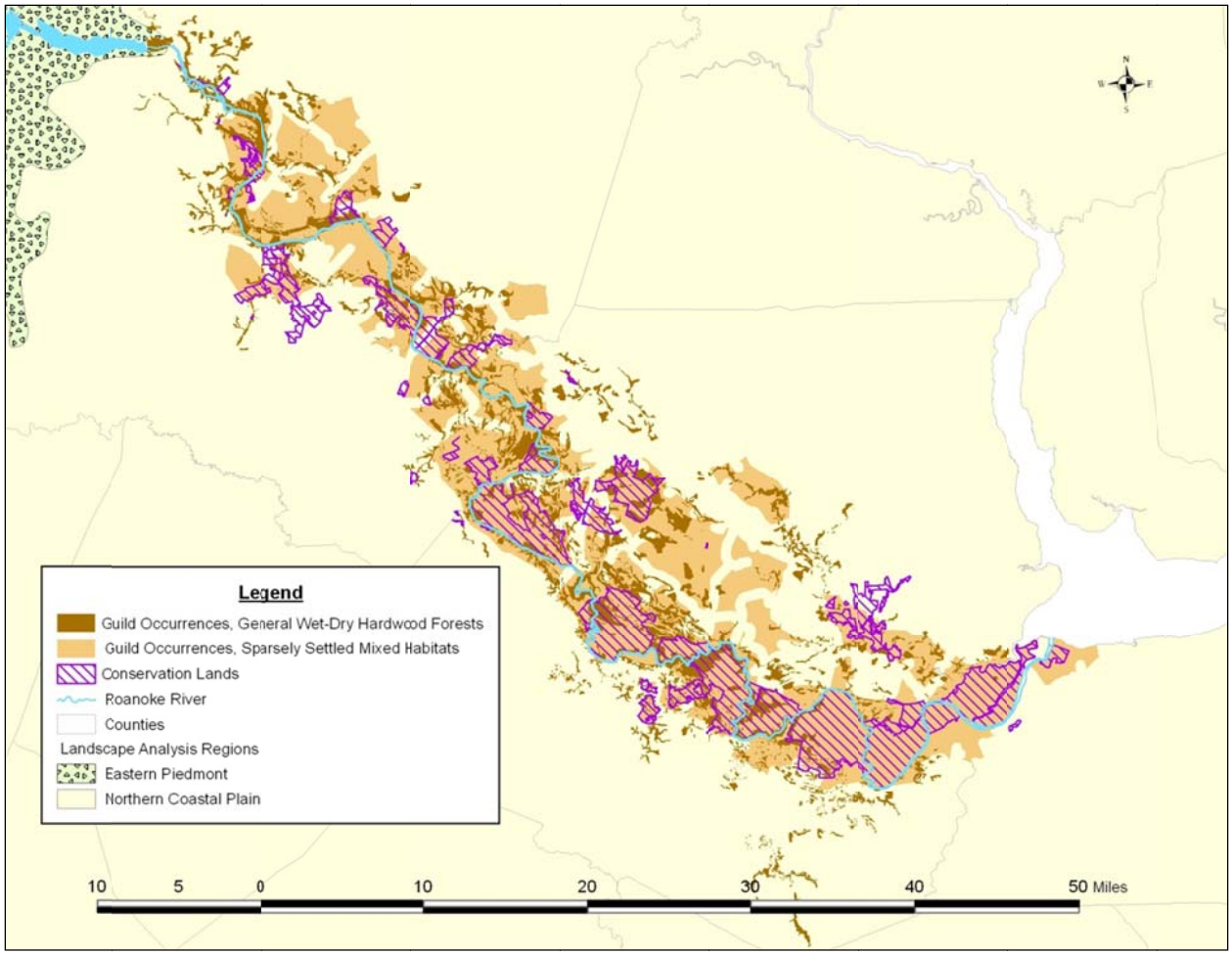


Figure 18. Intersection of Guild Occurrences and Conservation Lands, General Habitats Group

DISCUSSION

Combined Landscape Value of the Lower Roanoke SNHL

The Lower Roanoke SNHL has a high degree of landscape integrity for all the guilds associated with floodplain habitats, including the brownwater habitats that were the particular targets of this survey. For a number of species, e.g., Cerulean Warblers and Cane Wainscots, the quality of the habitat is important, but for all species considered, habitat extensiveness and degree of connectedness across the floodplain are also critical in explaining their continued presence within the area. In assessing the value of the SNHL as a whole, it is not only the quality and landscape integrity of any one habitat that is important, but also the combined quality and integrity of all the habitat types present within the landscape. It is not just the current state of the Roanoke environment that we should consider, but also its prospects for long-term viability.

Anderson et al. (2012) identified both a high degree of landscape/habitat *complexity* and a high degree of landscape *integrity* as keys to an ecosystem's ability to resist and recover from environmental disturbances as well as to adapt to environmental change, including those related to climate. Stated in terms of the landscape guilds used in our analysis, each guild represents a different set of environmental factors, including microclimates, moisture regimes, soils, disturbance regimes, and biotic (including with humans) interactions. The greater the diversity of such factors in a given area, the greater the range of opportunities for organisms to make adjustments in response to either temporary or long-term changes. The fact that each guild represented on the map (Figure 18) occupies a landscape that still possesses a high degree of landscape integrity indicates that their habitats are both widespread and that the organisms using them are able to travel freely enough within them to maintain their presence, even in the face of frequent local extirpations.

The Natural Heritage Program uses a numerical approach to assess combined landscape significance, developed for use in our Conservation Planning Tool (CPT).[8] In this raster-based analysis, the number of guilds overlapping a given pixel is summed, weighted by the degree of imperilment (S-rank) of the guild and the degree of landscape integrity for the individual occurrence. The output of this analysis is illustrated in Figure 19. Values are scaled where 1 indicates a threshold degree of conservation significance and 10 indicates the highest degree of significance within the state.

[8] See http://portal.ncdenr.org/web/cpt/cpt-report. We would like to thank John Amoroso, Division of Parks and Recreation, and Allison Weakley, NCNHP, for their help in preparing this map.

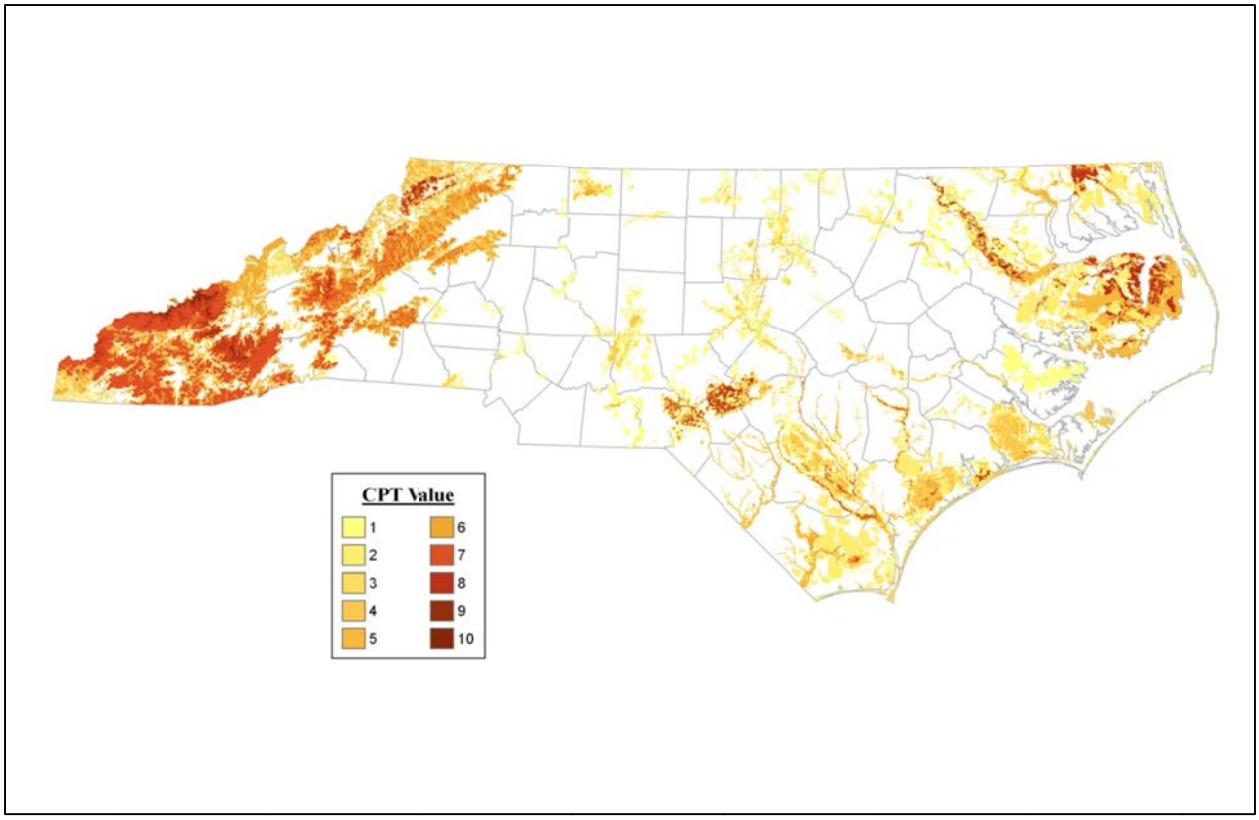


Figure 19. Weighted Sum of Guild Occurrences, Statewide

As shown, the Lower Roanoke SNHL includes an extensive area of high density landscape values, outweighing any other floodplain in the state -- brownwater, blackwater, Piedmont, or Mountains. It also has one of the highest ratings for any landscape unit in the Coastal Plain overall and one of the highest anywhere east of the Mountains. The concentration of guilds associated with rich soil habitats alone makes it one of the most significant landscapes in the state. The extensiveness and concentration of values for this set of guilds is unmatched anywhere else in the Coastal Plain or Piedmont and rivals or exceeds the combined value of rich soil landscapes in most areas of the Mountains apart from the Amphibolite range. As described in the Results, the Lower Roanoke appears to be one of the most significant landscapes globally for the Canebrake Guild, rivaled in North Carolina only by occurrences in the Croatan National Forest.

Based on this analysis, the Lower Roanoke floodplain meets Anderson et al.'s criteria as a "resilient site for conservation," having enough landscape/habitat complexity and landscape integrity to allow natural ecosystems, if not their current complement of species, to persist into the future. There also appears to be sufficient resiliency within the floodplain to allow at least some degree of persistence in the face of a likely increase in frequency and severity of storms and droughts over the next century.

On the other hand, a large part of the floodplain towards the mouth of the river is likely to become inundated by rising sea levels. Areas that are currently occupied by peatland habitats may disappear completely and cypress-gum swamp forests are likely to be displaced by

freshwater marshes. In turn, some of the areas now occupied by floodplain hardwoods are likely to be displaced by swamp forests, as the water table rises. In short, most, if not all, of the landscape guilds within the floodplain are likely to experience some loss of habitat area, losses that cannot be compensated by expansion upstream into the Piedmont, especially with the reservoirs blocking the way. Furthermore, increases in human exploitation of the forests – for instance for biofuels production – could exacerbate those effects.

While the existing landscape integrity of the Lower Roanoke will help it weather most expected impacts, an active conservation strategy needs to be developed, aimed as much at maintaining the extensiveness and connectedness of natural habitats as at preserving high biodiversity value within individual sites.

Conservation Strategy

In order to effectively conserve the biodiversity of the Lower Roanoke floodplain, the entire SNHL should be a focal area for conservation efforts, recognizing the landscape needs of the species and ecosystems it supports. The SNHL is analogous to Significant Natural Heritage Areas, in that regard. The conservation strategy for SNHAs, however, is directed towards bringing them into some form of complete protection, i.e., dedicated management as natural areas. SNHLs are generally too large for that option; large portions are always likely to remain in private ownership and to be managed for multiple uses, including resource extraction. Instead, landscape conservation from its early roots (e.g., Harris 1984) has recognized the need to co-exist with multi-use land management, particularly where the levels of human uses have not precluded a high level of landscape integrity, as in the case of the Lower Roanoke SNHL. That strategy does not exclude forms of protection but emphasizes the role of persuasion, forming working relationships with land owners, local and state governments, and conservation organizations. It also relies heavily on building public support for these efforts through education.

Land Protection

Outright protection is likely to play only a limited role in conserving guild occurrences in the Lower Roanoke SHNL, but there are two cases where its use is appropriate: 1) as part of the protection aimed at SNHAs, and 2) as special case protection aimed at securing key links in the landscape.

LANDSCAPE CONSERVATION THROUGH PROTECTION OF SNHAS. The habitats used by the guilds are not restricted to the high quality examples found within SNHAs, but the SNHAs frequently contain a substantial proportion of these habitats and their protection contributes to the overall conservation of guild occurrences. Guild members that require areas of high quality habitats in addition to landscape integrity especially benefit from the protection given to SNHAs.

Figure 20 shows the intersection between the combined guild occurrences within natural habitats, existing conservation lands, and currently unprotected areas of SNHAs. Bringing the remaining

areas of the SNHAs into conservation would, in fact, do a lot to preserve landscape integrity within the floodplain; along with the existing conservation lands, the addition of these areas would protect large tracts of nearly continuous habitat along the entire length of the floodplain.

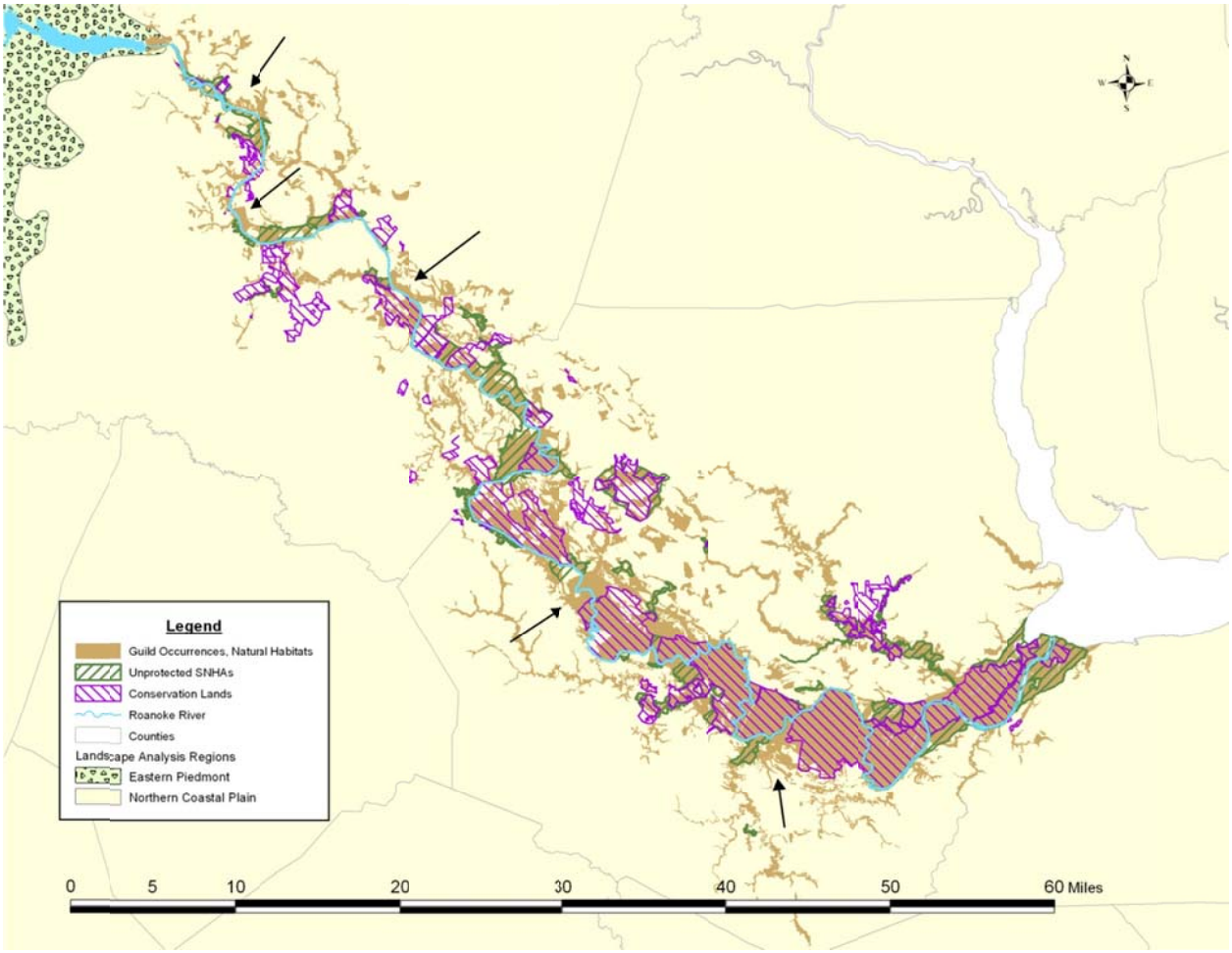


Figure 20. Intersection of Combined Guild Occurrences and Unprotected Areas of SNHAs

Several substantial areas of guild occurrences – indicated by arrows – would, however, still be left out on one or both sides of the river (along with at least a few complete gaps in habitat, which will be discussed in the next section). In some cases, the excluded areas represent tracts of younger stands managed for timber production, where it may be most appropriate to work out management agreements with the landowners to maintain their contribution to landscape integrity (see Land Management Agreements below). In a number of cases, however, areas with apparently mature stands were left out of SNHAs primarily because they have not yet been inventoried. Whereas delineation of the guild occurrences was done mainly through use of aerial photography, only limited use of this information is allowed in the delineation of SNHAs. Areas falling within this category, consequently, should at the very least be high priority targets for the next round of inventories conducted within the floodplain (see also Areas for Further Study in Part I).

Currently, only Species, Communities, and Animal Assemblages are treated as elements and used to define and evaluate SNHAs. Landscape Guilds, however, capture aspects of ecological viability and a range of species not directly covered by the standard elements. Use of the guilds to evaluate connectivity to other areas of suitable habitat, including other SNHAs, would be of particular use in evaluating the significance of SNHAs: those that intersect high quality guild occurrences in particular have a better chance of recovering from environmental disturbances. The greater the number of guilds intersecting a given SNHA, the higher their overall chances of survival and recovery of their entire biota, hence the higher the priority that should be given to its protection.

While some of the areas contained within Guild Occurrences would not qualify as SNHAs, areas of habitat that are used by multiple guilds or guilds that are declining or imperiled within the state should be considered as high priorities for conservation. Figure 21 shows the results of the CPT analysis previously discussed, centered on the Lower Roanoke floodplain and including only the highest value combined guild occurrences -- those scoring 8 or higher on the CPT scale.

In terms of effective conservation, landscape units located in between existing conservation lands should be the primary concern. Figure 22 focuses on a series of SNHAs located in the upper portion of the floodplain. Although these SNHAs are among the most significant in the entire floodplain, containing some of the richest soils in the region and a large number of the species and communities associated with them, none are likely to be viable as isolated units. As linked together by high quality landscape units, however, they do have a great deal of viability; floods, storm events, or other disturbance affecting a part of this network can be restored by recolonization from less affected sites.

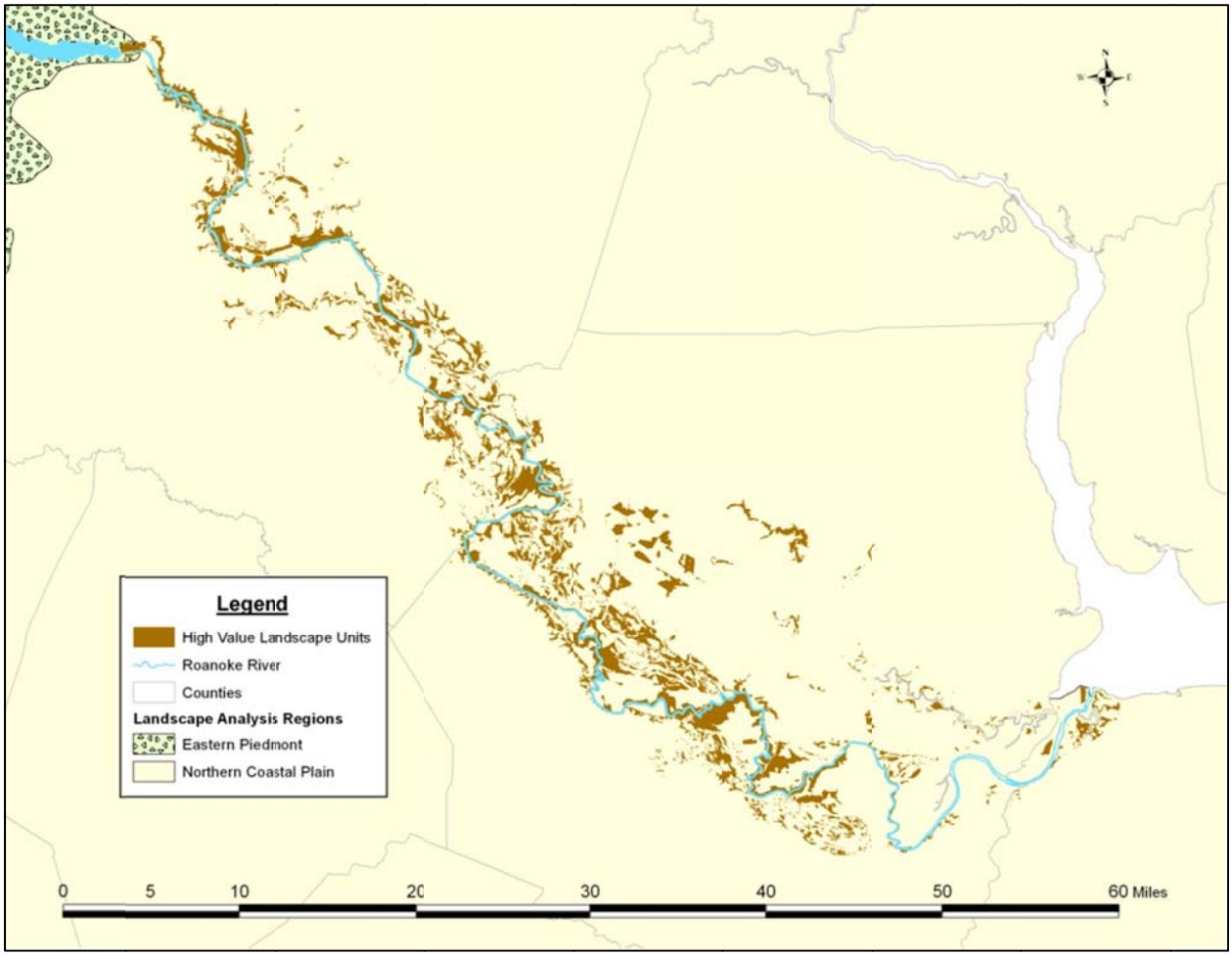


Figure 21. Combined Guild Occurrences with High Conservation Value

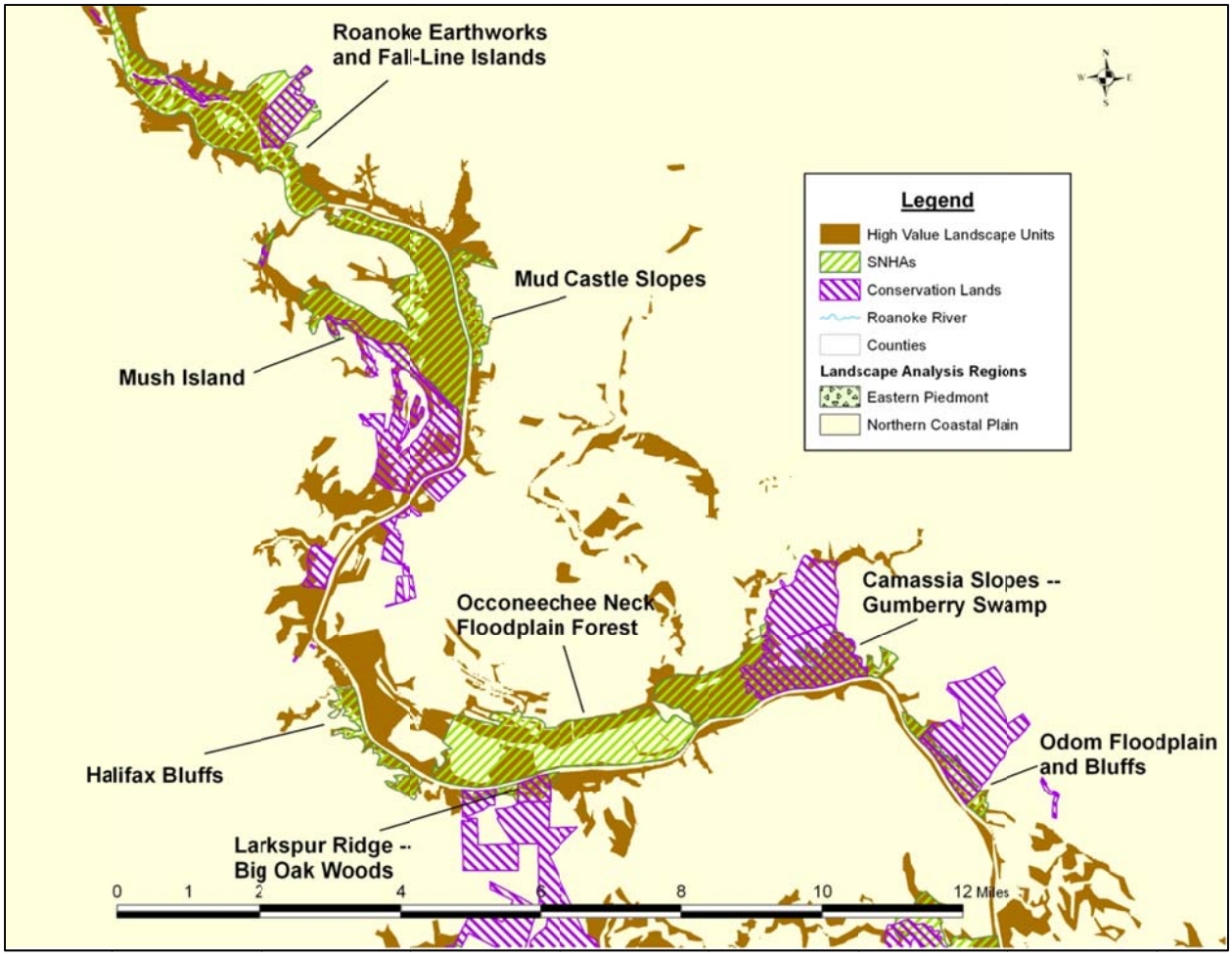


Figure 22. High Value Landscape Units and Conservation Lands in the Upper Floodplain

PROTECTION OF KEY LANDSCAPE LINKS. At the opposite extreme from identifying well-connected networks of high quality sites, landscape analysis also highlights areas where habitat loss and fragmentation have left only narrow, degraded strips of habitat or virtually no natural habitat at all, requiring species to traverse at least short distances of unsuitable habitat. None of these areas would meet the standards for SNHAs based on the quality of the natural communities or presence of imperiled species. Nonetheless, the viability of the entire landscape, SNHAs included, may depend on the preservation of these key links, including restoration where necessary.

For most (8 out of 11) of the guilds found in the Lower Roanoke floodplain, gaps in habitat of 2 km or more are considered to pose major obstacles to movements. Figure 23 shows the location of gaps this wide or wider between existing conservation lands and unprotected SNHAs (intended for conservation) within the main floodplain of the Roanoke. While some of these gaps still contain broad strips of guild habitat, the absence of any current or intended protection makes them vulnerable to becoming landscape bottlenecks in the future.

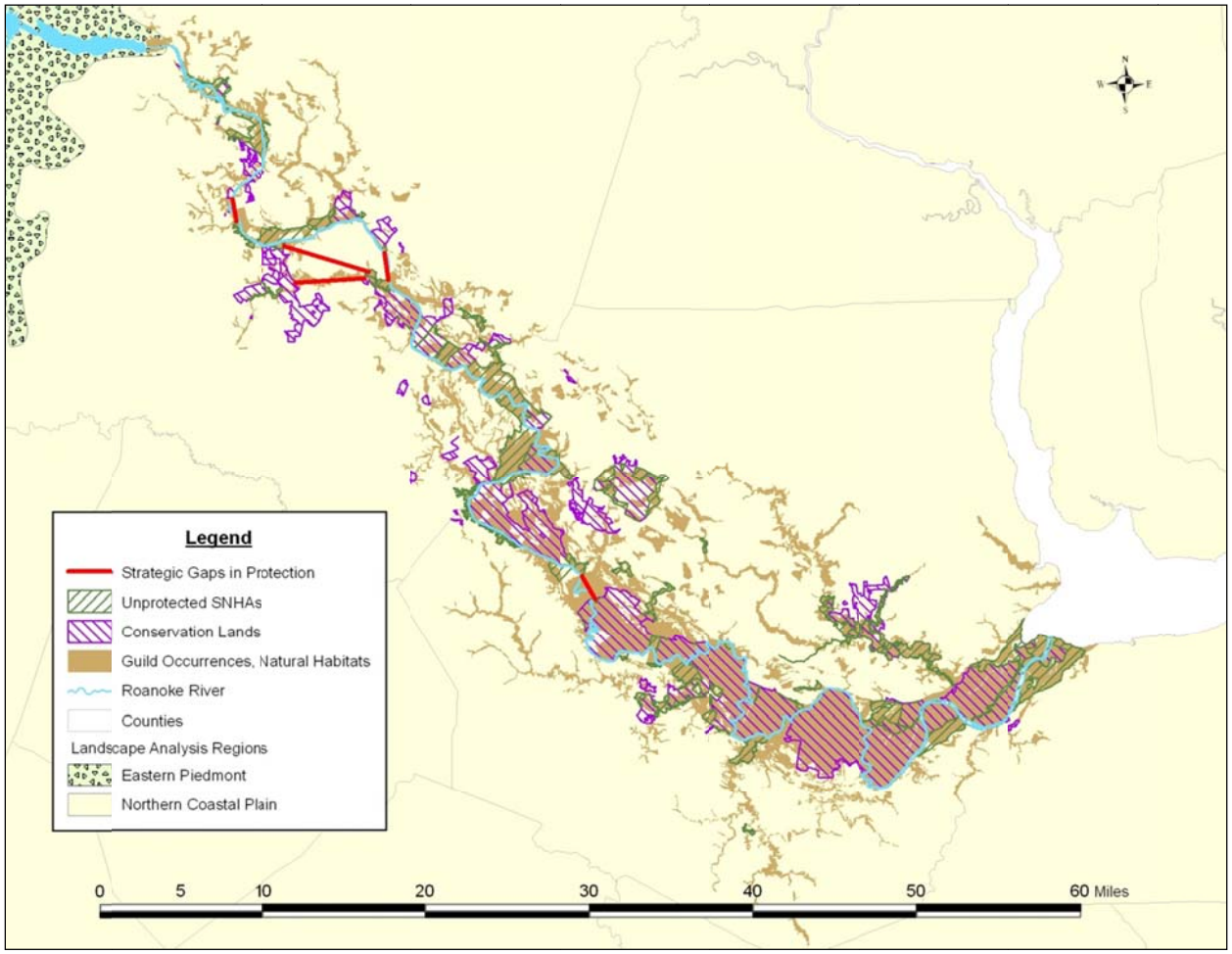


Figure 23. Gaps in Protected Connectivity

Three of the gaps actually appear to have developed into bottlenecks. As shown in Figure 24, the large area of cultivated fields located at the Caledonia and Odom State Correctional Institutions, together with adjoining areas of pine plantations, have greatly restricted the amount of natural forests within this section of the floodplain. On the north bank of the river, natural habitats have been reduced to a 200-500 m wide strip running along an approximately 5 km section of the river. On the south side – almost all within the Caledonia State Correctional Institution – natural habitats have been reduced to a strip less than 200 m at its widest, running along the 11 km river frontage of the Correctional Institution. Although we have treated these strips of habitat – particularly on the north side – as still providing connections for the floodplain guilds, these connections are probably tenuous at best (these areas were not included in the current survey and the actual habitat quality is unknown).

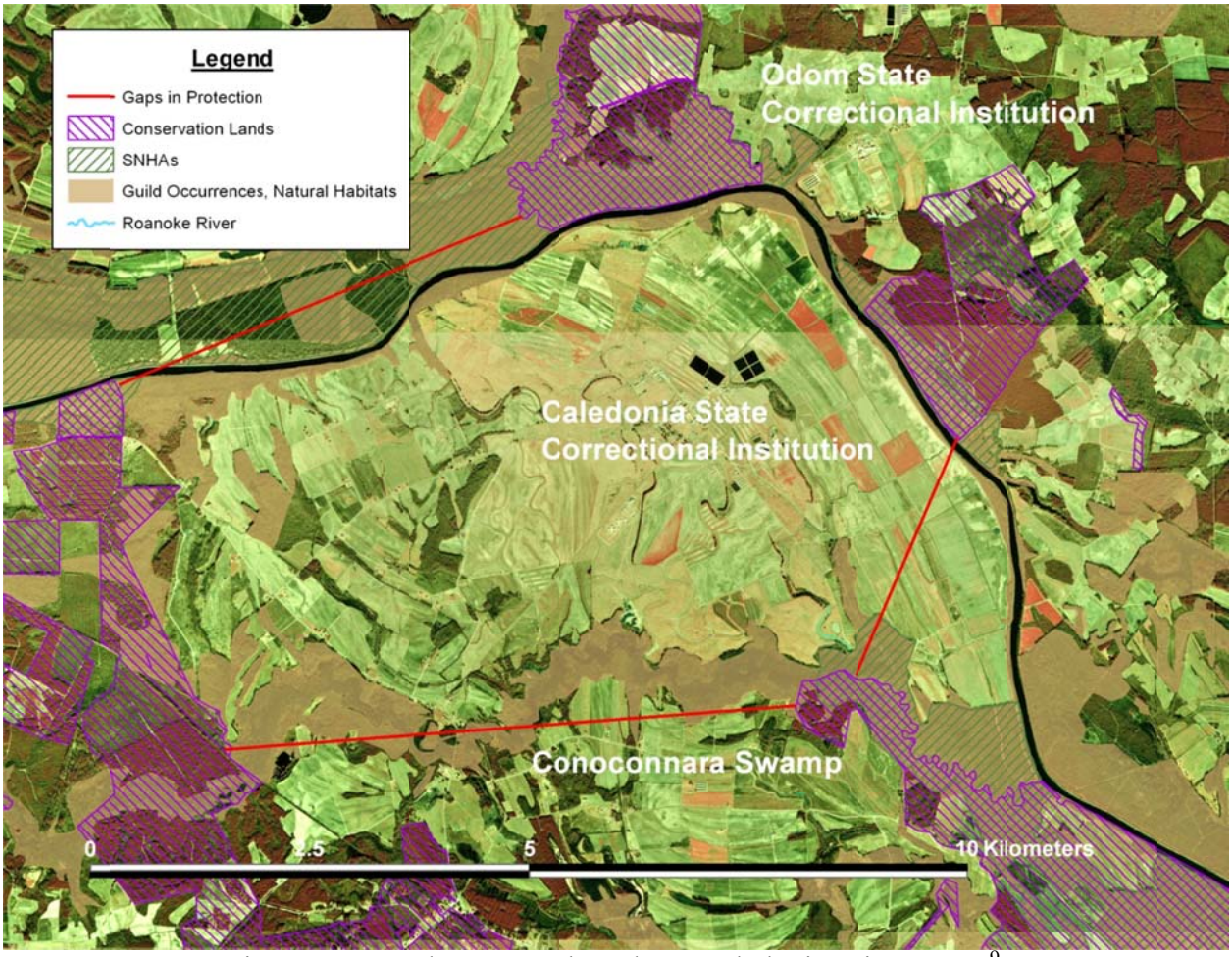


Figure 24. Landscape Bottlenecks at Caledonia Prison Farm[9]

Connections between the upstream and downstream portions of the floodplain are also assumed to exist along Conoconnara Swamp, a 600-700 m strip of natural forests that crosses the Roanoke floodplain just south of the Caledonia State Correctional Institution. This strip itself represents a

[9] Land cover is illustrated using 1998 Color Infrared Aerial photos. Agricultural fields (in winter) have a pale tan to green color signature. Pine stands show up as red, hardwoods as dark green or brown.

bottleneck, however. Although the lower portion of the Conoconnara floodplain lies within the Roanoke River Wetlands Game Land and the upper portion is included within the Tillery Game Land, a stretch of about 7 km in the middle section is located on privately owned lands and is closely bordered by cultivated fields on both sides. Even in the portion included within the Tillery Game Land, connections are made via a few scattered stands of forest habitats that occur between the headwaters of the swamp and the Roanoke. Again, any connections that exist along this route are probably tenuous and – lacking full protection – may be easily severed.

Given the strategic importance of these connectors, a high priority should be given to their protection. In the case of the two correctional institutions, easements or management agreements should be sought, protecting and/or restoring a strip of native forests along the river's edge. Ideally, the strip should be wider than 100 m, providing at least some buffer from edge effects. In the case of Conoconnara Swamp, direct purchase of the existing riparian corridor should be considered in addition to easements and management agreements.

Preservation of these links would help protect the landscape integrity of nearly all the guilds that occur within the Lower Roanoke floodplain and should be considered a high priority. Many other smaller gaps exist, however, that also act as barriers to some of the guilds, particularly the Mesic Hardwood Forests guild and others that contain a substantial number of flightless mammals, reptiles, and amphibians. For these guilds, gaps in habitat of only 1 km may act as major barriers, as may the river and major roads. Although probably too numerous to bring into direct protection, certain areas should be given at least some priority, particularly where four-lane highways – acting as almost absolute barriers to movements for some of these species – cross the floodplain.

Fortunately, the Lower Roanoke is crossed by only five roads, only two of which are four-lanes in width: I-95 at Roanoke Rapids and US 13/17 at Williamston. At these highways, safe passages are essentially restricted to bridge crossings and only where there is at least some dry land left along the banks beneath the bridges – ideally without any riprap or concrete obstacles – and where there are areas of natural vegetation located close by on either side. These conditions appear to be met at least at the I-95 bridge crossing, particularly on the south side of the river where the Roanoke Canal Trail passes beneath the bridge. Safe passages are found on the north side of the US 13/17 crossing, where the road crosses an extensive area of the floodplain included within the Roanoke River National Wildlife Refuge. On the south side, however, a gap of about 500 m of cleared lands is located adjoining the bridge crossing. While that is barely enough to qualify as a connector for some of the guilds with separation distances of only 1 km, it is fragile enough to consider as a priority for conservation protection, spanning the gap between the Conoho Neck Swamp and Sweetwater Creek Swamp SNHAs.

Land Management Agreements

Even if all current SNHAs – as traditionally defined – were brought into conservation, large areas of habitat used by guild members would still be left out, as shown in Figure 25. Just considering natural habitats, only 52% of the acreage would be covered, leaving out younger stands of natural forests and stands that have not yet been inventoried, including a large amount of the landscape units identified as having particularly high value in the CPT analysis. For the wide-ranging predators composing the Sparsely-Settled Mixed Habitat guild, all of the large roadless blocks consisting of agricultural and silvicultural lands would be left out completely – areas that are heavily managed fall entirely outside of the definition of natural areas under the state's Nature Preserves Act.

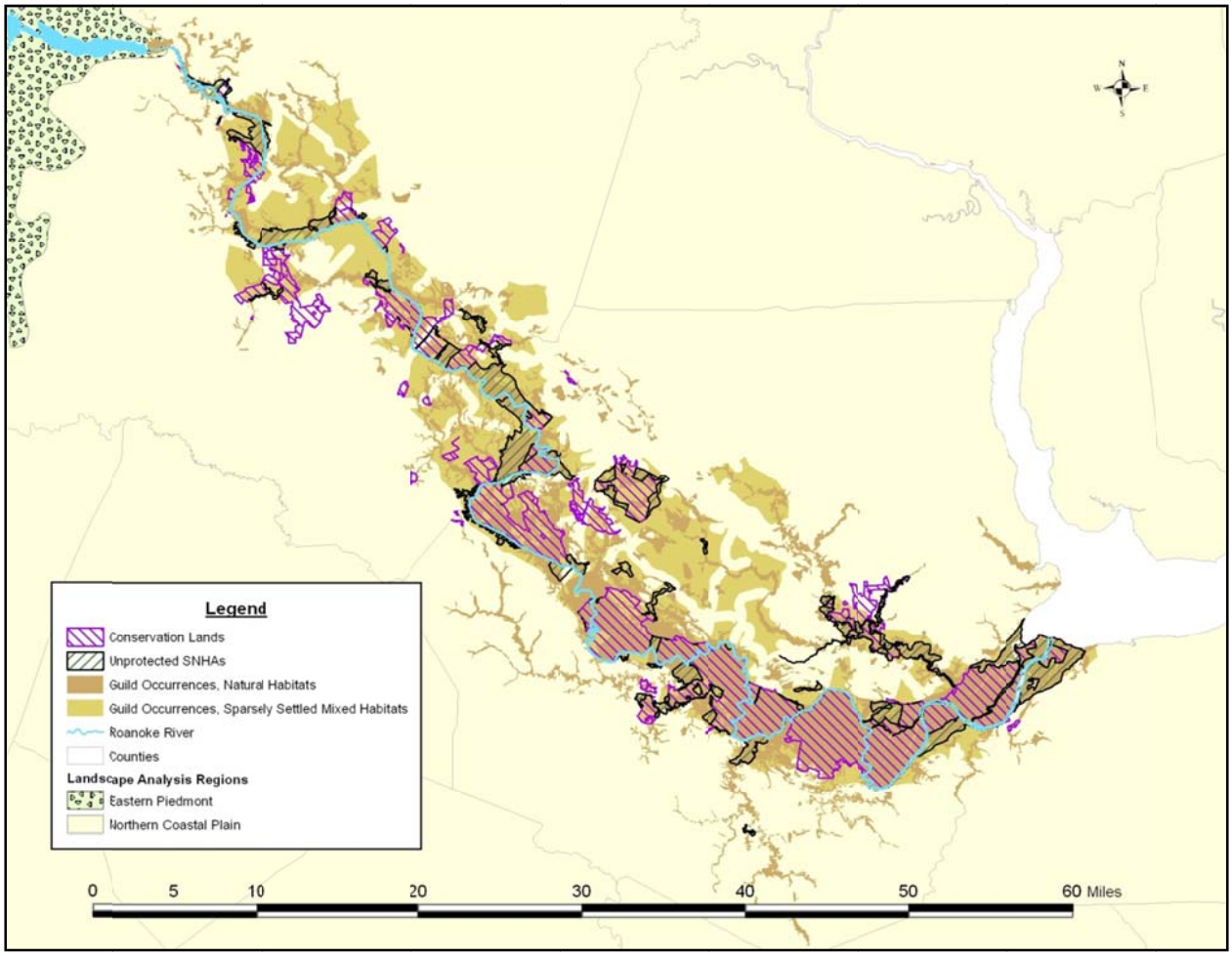


Figure 25. Intersection of Guild Occurrences and Conservation Lands

All of these excluded areas contribute to the quality and viability of the floodplain's ecosystems, but permanent protection is not an option for most of them; the majority is likely to remain in multiple use management, including agriculture and silviculture. Not all areas within the landscape need to be brought into permanent protection, however. Many of the guild members use second growth habitats, colonizing stands even after clear-cutting once they reach a certain

stage of maturity. Areas in between occupied habitats need only be crossable, not necessarily permanently inhabitable. For many of the guild members, clear-cuts, minimally cultivated areas, tree farms, or even developed areas do not pose absolute barriers to movement, at least if the gaps between natural areas are not too wide.

The existing high level of landscape integrity seen among nearly all of the guilds in the Lower Roanoke floodplain indicates that the current spatial pattern and intensity of land uses is compatible with our conservation goals for the landscape. Current conditions are not likely to continue, however. Disturbance events such as storms, floods, droughts, and fire are all predicted to increase in frequency, severity, and scope over the coming decades. The overall area occupied by forests in the floodplain is likely to decrease as the result of higher water levels, particularly in areas near the mouth of the river. New pressures may be placed on natural lands with a growing demand for biofuels; more non-farm acres are likely to be devoted to fuel production and fewer stands of trees may survive to the stage at which guild members could inhabit them.

To offset some of these changes, land management agreements with property owners may help retain some of the traditional patterns of land use. For working lands that intersect the guild occurrences, agreements should seek to maintain current uses and acreages of production as much as possible. For lands managed for timber production, the period between harvests should ideally be maintained or lengthened, allowing stands of hardwoods to mature and to serve at least as temporary habitat for guild members. Timber harvests should also ideally be systematically rotated among stands, ensuring that not all will be cut at one time within a given area and that at least some stands can serve not only as connectors, but also as suitable habitat for guild members.

Although in some cases, incentives may be available to the landowners, these agreements can also be purely voluntary, following the model of the Registry Agreements used to protect SNHAs by the Natural Heritage Program.[10] Wherever possible, agreements should be made with conservation agencies or organizations that have land holdings adjoining the areas covered by these agreements.

Government and Public Involvement

Landscapes are typically too vast and cross too many property and jurisdictional boundaries for any one conservation organization or landowner to conserve by themselves; joint efforts involving multiple parties, including federal, state, and local governments are needed, as is the support by an informed public. The challenge with regard to landscape conservation is reach a general agreement that the natural landscape is, in fact, an integrated resource greater than the sum of all its myriad parts. Within that perspective, conservation has to be seen as more than just the protection of individual preserves, communities, or species, but rather the integrity of the entire system.

[10] NHP Registry Agreements are currently applicable only where the habitat is maintained in a natural state.

For the Lower Roanoke floodplain, this is most easily seen with respect to land use decisions that affect the entire landscape, the most profound of which has been the creation of the flood control reservoirs located above the fall-line. The pervasive effects of changes to the natural flood regime on native species and ecosystems were discussed in Part I under Changes in Natural Resources since the 1970s. Less well-discussed have been the impacts to landscape integrity resulting from the increased human intrusion and exploitation of the floodplain, the main objective of flood control itself. It was, in fact, the regular occurrence of vast floods that was responsible for keeping the Lower Roanoke floodplain in a largely unfragmented state, which we have noted has played a critical role in maintaining the viability of its highly disturbance-dependent ecosystems.

While permanent human settlement itself remains fairly low within the floodplain, vast areas have now been cleared for agricultural or silvicultural uses, all accompanied by the construction of a greater extent of paved roads. More and more, the natural forests of the floodplain are being constricted to just those areas that still receive regular flooding, occupying an increasingly narrow strip along the steepest bluffs and lowest terraces adjoining the river itself. The cost has been a loss of resistance and resilience to environmental disturbances, natural as well as man-made. Over the long run, there is an even greater cost due to a decreased ability for species to adapt to environmental change, which depends upon their populations being able to spread out over large areas of varied habitats. While new adaptations may still arise within small, isolated populations, they are unlikely to spread if the connections between them have been severed.

The single most important action that could be taken to preserve the biodiversity of the Lower Roanoke would be to return the flood regime to a more natural state, allowing more extensive flooding during the winter and spring and reducing the duration of flooding during the rest of the growing season. This would not only support populations of species adapted to that pattern of flooding, but it would also help reduce the impacts of habitat fragmentation that affect an even larger proportion of the species inhabiting the floodplain.

Information Needs

Most of the guilds have now been surveyed well enough to identify their occurrences and determine their current levels of landscape integrity. Only the General Mesic Hardwood Forests guild still needs to be surveyed to determine if more guild occurrences are present along the valley rim.

At least for the immediate future, additional landscape analysis in this area should concentrate on the connections of the Roanoke floodplain to the larger set of natural habitats beyond its limits. In contrast to the work that has been done within the main valley of the Roanoke, the tributary streams have been scarcely surveyed at all. Given their role in providing connections across the region, they deserve more attention, both to determine their individual conservation needs and to assess their role in connecting areas across the Coastal Plain or into the Piedmont.

Figure 26 shows some of the tributaries likely to play the most significant role as connectors: those that provide links between river basins or, in the case of Sweetwater Creek/Hardison Mill Creek with the non-riverine swamps and peatlands located on the Albemarle-Pamlico Peninsula.

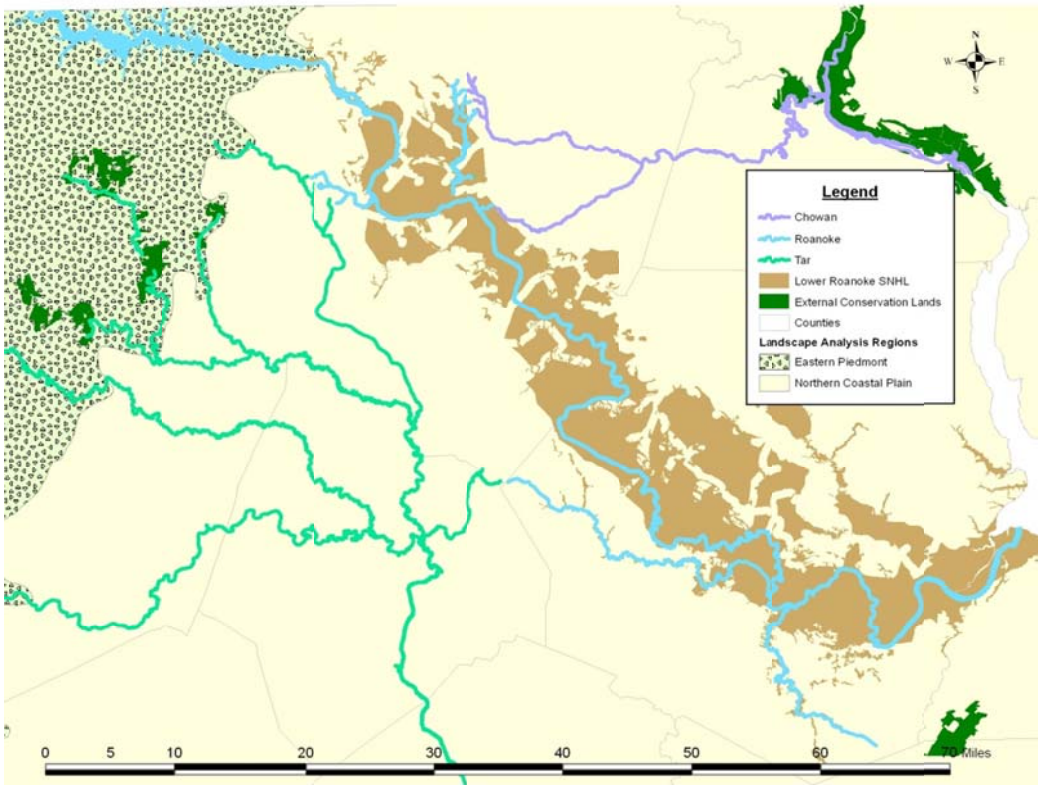


Figure 26. Interbasin Connectors

If viable, these connections provide some of the only routes left for species to move from south to north across the state, most of the interbasin uplands having long been converted to agriculture or silviculture or have major highways or cities situated along their length. Similarly, they may also provide some of the most important routes linking the Outer Coastal Plain to the Piedmont, which in the case of the Roanoke are largely blocked by the reservoirs located just above the Fall-line.

Given the potential importance of these connectors, especially in helping maintain the resilience of species populations and ecosystems in the face of major environmental changes, the tributary streams of the Roanoke should be considered high priority targets for the next round of NHP inventories. The principal aim of such inventories would be to assess landscape integrity over the entire region.

Prognosis, Monitoring, and Adaptive Management

Significant Natural Heritage Areas (SNHAs) and Landscapes (SNHLs) represent our best guesses as to where our native biodiversity is likely to persist into the future. The continued presence of species that need high quality and/or extensive areas of habitat over which to roam provide evidence that these areas have withstood the test of time and are likely to continue to do so. The results of the Inventory of the Lower Roanoke floodplain, therefore, strongly support that this is one of the best places in the state to make significant investments in conservation, as has been done by The Nature Conservancy, U.S. Fish and Wildlife Service, and the North Carolina Wildlife Resources Commission (TNC 2005). Especially based on the landscape analysis, we predict that floodplain ecosystems of the Lower Roanoke are likely to survive for a longer period than those of any other floodplain system in the Coastal Plain, Piedmont, or Mountains of North Carolina, even in the face of major environmental changes.

That does not mean, however, that we expect no loss of biodiversity within the next few decades. Changes to the Lower Roanoke ecosystems have already been documented with respect to past land use practices, including timber harvest, agricultural development, and changes in the flood regime and sediment deposition resulting from the creation of the reservoirs upstream (Pearsall et al. 2005; TNC 2005). As documented in our study (see Part I), several rare plants may be succumbing to the smothering effects of exotic invasives, and the Cerulean Warbler may be on the verge of extirpation from the Lower Roanoke floodplain due to a number of factors.

Still other impacts loom on the horizon, including one that has been only recently recognized: the exotic Emerald Ash Borer (*Agrilus planipennis*) has just been discovered in North Carolina this past year and is already widespread in Virginia. This species has already destroyed tens of millions of ash (*Fraxinus* spp.) trees in the north, where it first appeared in 2002 and threatens not only the trees themselves but a number of insects that feed solely or primarily on ash (Wagner 2007). Given the severity of this threat, its geographic scope, and its frequency, the populations of ash and ash-feeding species are likely to be extirpated everywhere, similarly to the fate of the American chestnut and its associated species. Within the Lower Roanoke, there are four ash-feeding insects that are likely to be affected, three within the Rich Wet-Dry Hardwood Forests guild. If those species are lost – all of which have been recorded in the floodplain – that

guild will decline by 19%, resulting in a substantial drop in our estimate of landscape integrity for that guild.[11]

Other guilds may suffer similar declines – i.e., through species' extirpations -- due to environmental changes. Increased droughts, particularly if accompanied by extreme heat waves and catastrophic fires, are likely to have severe and widespread impacts to the General Mesic Hardwood Forests guild, which already appears to have reduced landscape integrity due to habitat fragmentation. Increased intensity of storms and flash flood events – coupled with the prolonged growing-season flooding now the norm due to the pattern of water releases from the reservoirs upstream – may have major impacts on the remaining population of Cerulean Warblers and other species associated with old-growth stands of levee and bottomland hardwoods. Species in the Rich and General Wet-Mesic Hardwood Forests guilds may be affected by both increased droughts and increased flooding, particularly if they occur in quick succession.

More generally, all of the guilds will be affected by reductions in overall size of the Lower Roanoke SNHL. Higher water levels are likely to claim a large portion of the floodplain at the lower end of the river. Loss of agricultural and silvicultural lands in the Outer Coastal Plain could also put pressure to develop additional lands for those purposes farther inland, including areas within the Lower Roanoke floodplain. Changes in the wood-products industry, particularly resulting from the development of chip mills and the growing demand for biofuels, may also alter current silvicultural practices, and may result in an effective reduction in habitat and in the connectivity between the remaining areas of natural forest.

The timing, severity, and geographic scope of all of these potential impacts are extremely hard to predict. Prior to 2002, probably no one would have expected that the Emerald Ash Borer – an ecologically innocuous species in its native Asia – would become such a scourge in North America. Especially given these uncertainties, we do not have enough information to predict how much land is actually needed for conservation, or the degree of connectivity between conserved areas, habitat diversity, and quality.

The surveys we have conducted in the Lower Roanoke floodplain provide a baseline against which changes in the distribution and abundance of landscape- and habitat- quality-sensitive species can be evaluated. Similar surveys will need to be repeated periodically but could target particular species, such as the Cerulean Warbler or Waved Sphinx Moth (an ash-feeding species), or particular areas of concern. They could be timed to follow large disturbances or large changes in land-use, particularly where substantial amounts of habitat become lost or fragmented.

With respect to changes in landscape integrity, the main signal would be permanent extirpation of species from the floodplain, i.e., reduction in the number of species expected under good landscape conditions, particularly those we have already documented as occurring in the

[11] The remaining guild members are likely to be affected by the secondary effects of the loss of ash, but should otherwise survive. The entire guild may need to be re-defined as a consequence, since not all guild members react the same way to the habitat loss and fragmentation caused by the Emerald Ash Borer.

floodplain. Hopefully, extirpations will still take decades to occur, in which case we may be able to use evidence of declining populations to modify our conservation strategies before they result in irrevocable losses. This approach to conservation is termed Adaptive Management, and has already been recommended for protecting or restoring the Lower Roanoke from the impacts of the changes to the flood regime (Pearsall et al. 2005; TNC 2005).

In addition to the focal species and habitats identified for monitoring in the TNC Conservation Plan, the guilds should be considered as a tool for monitoring changes at the landscape level. This would give increased attention to the importance of maintaining connectivity, both within the floodplain and to other large areas of natural habitat in adjoining regions. Although the Lower Roanoke floodplain is a high conservation priority in itself, a major lesson from landscape conservation biology is that no area should be treated solely as an island, where both its local and global importance can only diminish over time. Instead, the Lower Roanoke should be treated as a keystone component of much larger system that has a better chance of resisting, rebounding from, and adapting to environmental changes over the long run.

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APPENDIX A. ANIMAL SURVEY RESULTS, 2012

TAXON	Species	Number of Sites
MAMMALS		
	Canis latrans (Coyote)	6
	Castor canadensis (American Beaver)	5
	Didelphis virginiana (Virginia Opossum)	2
	Glaucomys volans (Southern Flying Squirrel)	2
	Lontra canadensis (Northern River Otter)	2
	Lynx rufus (Bobcat)	1
	Marmota monax (Woodchuck)	4
	Mephitis mephitis (Striped Skunk)	2
	Neovison vison (American Mink)	1
	Odocoileus virginianus (White-tailed Deer)	15
	Ondatra zibethicus (Common Muskrat)	1
	Procyon lotor (Northern Raccoon)	13
	Scalopus aquaticus (Eastern Mole)	7
	Sciurus carolinensis (Eastern Gray Squirrel)	11
	Sylvilagus floridanus (Eastern Cottontail)	5
	Urocyon cinereoargenteus (Common Gray Fox)	2
	Ursus americanus (American Black Bear)	5
	Vulpes vulpes (Red Fox)	1
BIRDS		
	Actitis macularius (Spotted Sandpiper)	1
	Aix sponsa (Wood Duck)	3
	Ammodramus savannarum (Grasshopper Sparrow)	4
	Anhinga anhinga (Anhinga)	2
	Archilochus colubris (Ruby-throated Hummingbird)	14
	Ardea alba (Great Egret)	4
	Ardea herodias (Great Blue Heron)	8
	Baeolophus bicolor (Tufted Titmouse)	22
	Bombycilla cedrorum (Cedar Waxwing)	1
	Branta canadensis (Canada Goose)	2
	Buteo jamaicensis (Red-tailed Hawk)	5
	Buteo lineatus (Red-shouldered Hawk)	15
	Cardinalis cardinalis (Northern Cardinal)	24
	Cathartes aura (Turkey Vulture)	13
	Catharus ustulatus (Swainson's Thrush)	1
	Chaetura pelagica (Chimney Swift)	7

TAXON	Species	Number of Sites
	Charadrius vociferus (Killdeer)	2
	Coccyzus americanus (Yellow-billed Cuckoo)	13
	Colaptes auratus (Northern Flicker)	2
	Colinus virginianus (Northern Bobwhite)	5
	Contopus virens (Eastern Wood-pewee)	16
	Coragyps atratus (Black Vulture)	11
	Corvus brachyrhynchos (American Crow)	21
	Corvus ossifragus (Fish Crow)	5
	Cyanocitta cristata (Blue Jay)	17
	Dendroica coronata -- n.br. (Yellow-rumped Warbler)	1
	Dryocopus pileatus (Pileated Woodpecker)	19
	Dumetella carolinensis (Gray Catbird)	3
	Empidonax virescens (Acadian Flycatcher)	19
	Eremophila alpestris (Horned Lark)	3
	Geothlypis formosa (Kentucky Warbler)	9
	Geothlypis trichas (Common Yellowthroat)	11
	Haliaeetus leucocephalus (Bald Eagle)	4
	Hirundo rustica (Barn Swallow)	3
	Hylocichla mustelina (Wood Thrush)	14
	Icteria virens (Yellow-breasted Chat)	4
	Icterus spurius (Orchard Oriole)	4
	Ictinia mississippiensis (Mississippi Kite)	6
	Lanius ludovicianus ludovicianus (Loggerhead Shrike)	1
	Limnothlypis swainsonii (Swainson's Warbler)	9
	Megaceryle alcyon (Belted Kingfisher)	6
	Melanerpes carolinus (Red-bellied Woodpecker)	20
	Melanerpes erythrocephalus (Red-headed Woodpecker)	1
	Meleagris gallopavo (Wild Turkey)	18
	Mimus polyglottos (Northern Mockingbird)	1
	Mniotilta varia (Black-and-white Warbler)	2
	Molothrus ater (Brown-headed Cowbird)	16
	Myiarchus crinitus (Great Crested Flycatcher)	18
	Nyctanassa violacea (Yellow-crowned Night-heron)	1
	Pandion haliaetus (Osprey)	1
	Parkesia motacilla (Louisiana Waterthrush)	14
	Parula americana (Northern Parula)	19
	Passerina caerulea (Blue Grosbeak)	9
	Passerina cyanea (Indigo Bunting)	14
	Phalacrocorax auritus (Double-crested Cormorant)	2
	Pheucticus ludovicianus (Rose-breasted Grosbeak)	1

TAXON	Species	Number of Sites
	Picoides pubescens (Downy Woodpecker)	21
	Picoides villosus (Hairy Woodpecker)	10
	Pipilo erythrophthalmus (Eastern Towhee)	7
	Piranga olivacea (Scarlet Tanager)	10
	Piranga rubra (Summer Tanager)	19
	Poecile carolinensis (Carolina Chickadee)	23
	Polioptila caerulea (Blue-gray Gnatcatcher)	20
	Progne subis (Purple Martin)	4
	Protonotaria citrea (Prothonotary Warbler)	17
	Quiscalus quiscula (Common Grackle)	7
	Regulus calendula (Ruby-crowned Kinglet)	1
	Scolopax minor (American Woodcock)	2
	Seiurus aurocapilla (Ovenbird)	16
	Setophaga caerulescens (Black-throated Blue Warbler)	4
	Setophaga citrina (Hooded Warbler)	15
	Setophaga discolor (Prairie Warbler)	6
	Setophaga dominica (Yellow-throated Warbler)	18
	Setophaga pinus (Pine Warbler)	12
	Setophaga ruticilla (American Redstart)	11
	Sialia sialis (Eastern Bluebird)	4
	Sitta carolinensis (White-breasted Nuthatch)	19
	Sitta pusilla (Brown-headed Nuthatch)	2
	Spinus tristis (American Goldfinch)	15
	Spizella passerina (Chipping Sparrow)	7
	Spizella pusilla (Field Sparrow)	4
	Stelgidopteryx serripennis (Northern Rough-winged Swallow)	1
	Strix varia (Barred Owl)	6
	Sturnella magna (Eastern Meadowlark)	1
	Sturnus vulgaris (European Starling)	1
	Thryothorus ludovicianus (Carolina Wren)	24
	Toxostoma rufum (Brown Thrasher)	1
	Troglodytes aedon (House Wren)	1
	Turdus migratorius (American Robin)	4
	Tyrannus tyrannus (Eastern Kingbird)	4
	Vireo flavifrons (Yellow-throated Vireo)	18
	Vireo griseus (White-eyed Vireo)	22
	Vireo olivaceus (Red-eyed Vireo)	25
	Zenaida macroura (Mourning Dove)	10
	Zonotrichia albicollis (White-throated Sparrow)	4

TAXON	Species	Number of Sites
LIZARDS		
	Anolis carolinensis (Green Anole)	2
	Eumeces fasciatus (Common Five-lined Skink)	2
	Eumeces laticeps (Broadhead Skink)	1
	Scincella lateralis (Ground Skink)	9
SNAKES		
	Agkistrodon piscivorus (Cottonmouth)	1
	Carphophis amoenus (Eastern Worm Snake)	4
	Coluber constrictor (Eastern Racer)	7
	Elaphe obsoleta (Rat Snake)	2
	Opheodrys aestivus (Rough Green Snake)	1
	Storeria dekayi (Brown Snake)	1
	Virginia valeriae (Smooth Earth Snake)	1
TURTLES		
	Chelydra serpentina (Common Snapping Turtle)	1
	Chrysemys picta (Painted Turtle)	1
	Pseudemys concinna (Eastern River Cooter)	4
	Sternotherus odoratus (Common Musk Turtle)	1
	Terrapene carolina (Eastern Box Turtle)	8
	Trachemys scripta (Slider)	4
SALAMANDERS		
	Ambystoma opacum (Marbled Salamander)	2
	Amphiuma means (Two-toed Amphiuma)	1
	Desmognathus auriculatus (Southern Dusky Salamander)	2
	Eurycea cirrigera (Southern Two-lined Salamander)	2
	Plethodon chlorobryonis (Atlantic Coast Slimy Salamander)	1
FROGS		
	Acris crepitans (Northern Cricket Frog)	11
	Bufo americanus (American Toad)	1
	Bufo fowleri (Fowler's Toad)	7
	Bufo terrestris (Southern Toad)	1
	Gastrophryne carolinensis (Eastern Narrowmouth Toad)	4
	Hyla chrysoscelis (Cope's Gray Treefrog)	16
	Hyla cinerea (Green Treefrog)	2
	Hyla gratiosa (Barking Treefrog)	1
	Hyla squirella (Squirrel Treefrog)	9
	Pseudacris crucifer (Spring Peeper)	3
	Pseudacris feriarum (Upland Chorus Frog)	5
	Rana catesbeiana (Bullfrog)	3
	Rana clamitans (Green Frog)	10

TAXON	Species	Number of Sites
	Rana palustris (Pickerel Frog)	1
	Rana sphenocephala (Southern Leopard Frog)	12
DRAGONFLIES AND DAMSELFLIES		
	Anax junius (Common Green Darner)	6
	Argia apicalis (Blue-fronted Dancer)	6
	Argia sedula (Blue-ringed Dancer)	2
	Basiaeschna janata (Springtime Darner)	1
	Calopteryx maculata (Ebony Jewelwing)	4
	Celithemis eponina (Halloween Pennant)	1
	Cordulegaster bilineata (Brown Spiketail)	3
	Enallagma signatum (Orange Bluet)	2
	Epiaeschna heros (Swamp Darner)	11
	Epitheca princeps (Prince Baskettail)	1
	Erythemis simplicicollis (Eastern Pondhawk)	17
	Gomphaeschna furcillata (Harlequin Darner)	1
	Gomphus exilis (Lancet Clubtail)	2
	Gomphus hybridus (Cocoa Clubtail)	4
	Gomphus lividus (Ashy Clubtail)	1
	Hetaerina titia (Smoky Rubyspot)	2
	Lestes sp.	1
	Libellula auripennis (Golden-winged Skimmer)	1
	Libellula axilena (Bar-winged Skimmer)	3
	Libellula cyanea (Spangled Skimmer)	4
	Libellula incesta (Slaty Skimmer)	4
	Libellula luctuosa (Widow Skimmer)	8
	Libellula pulchella (Twelve-spotted Skimmer)	1
	Libellula semifasciata (Painted Skimmer)	2
	Libellula vibrans (Great Blue Skimmer)	12
	Macromia sp. (River Cruiser sp.)	1
	Nasiaeschna pentacantha (Cyrano Darner)	2
	Pachydiplax longipennis (Blue Dasher)	10
	Pantala flavescens (Wandering Glider)	1
	Pantala hymenaea (Spot-winged Glider)	2
	Perithemis tenera (Eastern Amberwing)	2
	Plathemis lydia (Common Whitetail)	20
	Stylurus amnicola (Riverine Clubtail)	3
	Sympetrum vicinum (Autumn Meadowhawk)	1
	Tramea lacerata (Black Saddlebags)	4

TAXON	Species	Number of Sites
GRASSHOPPERS AND KATYDIDS		
	Arphia sulphurea	9
	Atlanticus americanus	7
	Atlanticus monticola	1
	Chortophaga viridifasciata	10
	Conocephalus brevipennis	2
	Conocephalus fasciatus	2
	Conocephalus strictus	3
	Dichromorpha viridis	9
	Dissosteira carolina	5
	Hippiscus ocelote	1
	Melanoplus bivittatus	1
	Melanoplus differentialis	1
	Melanoplus nr. tepidus	1
	Melanoplus scudderi	2
	Metaleptea brevicornis	2
	Microcentrum retinerve	3
	Montezumina modesta (Modest Katydid)	1
	Neoconocephalus triops	1
	Orchelimum erythrocephalum	1
	Orphulella pelidna	2
	Pardalophora phoenicoptera	1
	Paroxya atlantica	1
	Paroxya clavuliger	1
	Pyrgocorypha uncinata	1
	Schistocerca alutacea	1
	Schistocerca americana	4
	Scudderia cuneata	1
	Spharagemon bolli	1
	Syrbula admirabilis	2
BUTTERFLIES		
	Abaeis nicippe (Sleepy Orange)	15
	Amblyscirtes aesculapius (Lace-winged Roadside-Skipper)	2
	Amblyscirtes carolina (Carolina Roadside-Skipper)	2
	Ancyloxypha numitor (Least Skipper)	10
	Anthocharis midea (Falcate Orangetip)	2
	Asterocampa celtis (Hackberry Emperor)	5
	Asterocampa clyton (Tawny Emperor)	4
	Atalopedes campestris (Sachem)	5
	Atlides halesus (Great Purple Hairstreak)	1

TAXON	Species	Number of Sites
	Battus philenor (Pipevine Swallowtail)	8
	Calycopis cecrops (Red-banded Hairstreak)	10
	Celastrina ladon complex	2
	Celastrina neglecta (Summer Azure)	11
	Cercyonis pegala (Common Wood-Nymph)	1
	Chlosyne nycteis (Silvery Checkerspot)	6
	Colias eurytheme (Orange Sulphur)	9
	Cupido comyntas (Eastern Tailed-Blue)	19
	Cyllopsis gemma (Gemmed Satyr)	14
	Danaus plexippus (Monarch)	1
	Enodia anthedon (Northern Pearly-eye)	4
	Enodia creola (Creole Pearly-eye)	1
	Enodia portlandia (Southern Pearly-eye)	6
	Epargyreus clarus (Silver-spotted Skipper)	12
	Erynnis horatius (Horace's Duskywing)	6
	Erynnis juvenalis (Juvenal's Duskywing)	3
	Erynnis zarucco (Zarucco Duskywing)	1
	Euphyes vestris (Dun Skipper)	11
	Euptoieta claudia (Variegated Fritillary)	11
	Eurytides marcellus (Zebra Swallowtail)	17
	Feniseca tarquinius (Harvester)	2
	Hermeuptychia hermes sosybius (Carolina Satyr)	20
	Hylephila phyleus (Fiery Skipper)	6
	Junonia coenia (Common Buckeye)	18
	Lerema accius (Clouded Skipper)	10
	Libytheana carinenta (American Snout)	10
	Limenitis archippus (Viceroy)	5
	Limenitis arthemis astyanax (Red-spotted Purple)	12
	Megisto cymela (Little Wood-Satyr)	7
	Nymphalis antiopa (Mourning Cloak)	4
	Panoquina ocola (Ocola Skipper)	3
	Papilio glaucus (Eastern Tiger Swallowtail)	14
	Papilio palamedes (Palamedes Swallowtail)	2
	Papilio polyxenes asterias (Black Swallowtail)	7
	Papilio troilus (Spicebush Swallowtail)	16
	Phoebis sennae eubule (Cloudless Sulphur)	13
	Phyciodes tharos (Pearl Crescent)	22
	Pieris rapae (Cabbage White)	6
	Poanes viator zizaniae (Broadwinged Skipper)	1
	Poanes zabulon (Zabulon Skipper)	14

TAXON	Species	Number of Sites
	Polygonia comma (Eastern Comma)	10
	Polygonia interrogationis (Question Mark)	19
	Pompeius verna (Little Glassywing)	3
	Pyrgus communis (Common Checkered-Skipper)	5
	Pyrisitia lisa (Little Yellow)	5
	Satyrium calanus (Banded Hairstreak)	1
	Satyrodes appalachia (Appalachian Brown)	11
	Speyeria cybele (Great Spangled Fritillary)	1
	Staphylus hayhurstii (Hayhurst's Scallopwing)	1
	Strymon melinus (Gray Hairstreak)	6
	Thorybes bathyllus (Southern Cloudywing)	1
	Vanessa atalanta rubria (Red Admiral)	13
	Vanessa cardui (Painted Lady)	2
	Vanessa virginiensis (American Lady)	18
MOTHS		
	Abagrotis alternata (Greater Red Dart Moth)	3
	Achatia distincta (Distinct Quaker Moth)	1
	Achatodes zeae (Elder Shoot Borer Moth)	2
	Acrapex relicta	1
	Acronicta americana (American Dagger Moth)	3
	Acronicta clarescens (Clear Dagger Moth)	1
	Acronicta haesitata (Hesitant Dagger Moth)	3
	Acronicta impleta (Yellow-haired Dagger Moth)	1
	Acronicta inclara complex (Unclear Dagger Moth)	2
	Acronicta interrupta (Interrupted Dagger Moth)	1
	Acronicta laetifica (Pleasant Dagger Moth)	4
	Acronicta lobeliae (Greater Oak Dagger Moth)	2
	Acronicta longa (Long-winged Dagger Moth)	1
	Acronicta modica (Medium Dagger Moth)	1
	Acronicta morula (Ochre Dagger Moth)	1
	Acronicta retardata (Retarded Dagger Moth)	3
	Acronicta vinnula (Delightful Dagger Moth)	1
	Actias luna (Luna Moth)	4
	Adoneta spinuloides (Purple-crested Slug Moth)	3
	Agrotis ipsilon (Ipsilon Dart Moth)	4
	Aletia oxygala (Lesser Wainscot Moth)	1
	Allagrapha aerea (Unspotted Looper Moth)	1
	Allotria elonympha (False Underwing Moth)	2
	Alypia octomaculata (Eight-spotted Forester Moth)	2

TAXON	Species	Number of Sites
	Amolita obliqua (Oblique Grass Moth)	2
	Amphipyra pyramidoides (Copper Underwing Moth)	4
	Anacamptodes defectaria (Brown-shaded Gray Moth)	5
	Anacamptodes pergracilis (Cypress Looper Moth)	4
	Anacamptodes vellivolata (Large Purplish Gray Moth)	2
	Anavitrinelia pampinaria (Common Gray Moth)	5
	Anicla infecta (Green Cutworm Moth)	3
	Anisota stigma (Spiny Oakworm Moth)	1
	Anorthodes tarda (Slowpoke Moth)	4
	Antheraea polyphemus (Polyphemus Moth)	2
	Apameine new genus 2 sp. 2	1
	Apameine new genus 2 sp. 3	1
	Apantesis nais (Nais Tiger Moth)	2
	Apantesis phalerata (Harnessed Tiger Moth)	3
	Apantesis vittata (Banded Tiger Moth)	4
	Apatelodes torrefacta (Spotted Apatelodes Moth)	1
	Apoda biguttata (Shagreened Slug Moth)	1
	Argillophora furcilla	3
	Arugisa latiorella (Common Arugisa Moth)	3
	Arugisa lutea (Common Arugisa Moth)	4
	Athetis miranda (Miranda Moth)	1
	Atteva punctella (Ailanthus Webworm Moth)	2
	Autographa precationis (Common Looper Moth)	1
	Automeris io (Io Moth)	2
	Baileya australis (Small Baileya Moth)	2
	Baileya levitans (Pale Baileya Moth)	2
	Balsa labecula (White-blotched Balsa Moth)	1
	Balsa malana (Many-dotted Appleworm Moth)	1
	Balsa tristrigella (Three-lined Balsa Moth)	1
	Bellura gortynoides (White-tailed Diver Moth)	1
	Bellura obliqua (Cattail Borer Moth)	1
	Besma quercivoraria (Oak Besma Moth)	4
	Bleptina caradrinalis (Bent-winged Owlet Moth)	6
	Bleptina inferior	2
	Bomolocha abalienalis (White-lined Bomolocha Moth)	2
	Bomolocha baltimoralis (Baltimore Bomolocha Moth)	6
	Bomolocha manalis (Flowing-line Bomolocha Moth)	4
	Bomolocha madefactilis (Gray-edged Bomolocha Moth)	1
	Caenurgia chloropha (Vetch Looper Moth)	1
	Caenurgina crassiuscula (Clover Looper Moth)	1

TAXON	Species	Number of Sites
	Calledapteryx dryopterata (Brown Scoopwing Moth)	5
	Callopistria floridensis (Florida Fern Moth)	1
	Caripeta aretaria (Southern Pine Looper Moth)	1
	Catocala amatrix (Sweetheart Underwing Moth)	1
	Catocala andromedae (Andromeda Underwing Moth)	1
	Catocala carissima (Carissima Underwing Moth)	1
	Catocala clintoni (Clinton's Underwing Moth)	2
	Catocala connubialis (Connubial Underwing Moth)	1
	Catocala grynea (Woody Underwing Moth)	1
	Catocala ilia (Ilia Underwing Moth)	1
	Catocala lacrymosa (Tearful Underwing Moth)	1
	Catocala mira (Wonderful Underwing Moth)	2
	Catocala nebulosa (Clouded Underwing Moth)	2
	Catocala neogama (Bride Underwing Moth)	1
	Catocala obscura (Obscure Underwing Moth)	1
	Catocala orba (Orb Underwing Moth)	1
	Catocala piatrix (Penitent Underwing Moth)	1
	Catocala robinsoni (Robinson's Underwing Moth)	1
	Catocala ultronia (Ultronia Underwing Moth)	2
	Celiptera frustulum (Black Bit Moth)	1
	Cepphis decoloraria (Dark Scallop Moth)	3
	Cerastis tenebrifera (Reddish Speckled Dart Moth)	1
	Ceratomia undulosa (Waved Sphinx Moth)	3
	Charadra deridens (Laugher Moth)	1
	Chlorochlamys chloroleucaria (Blackberry Looper Moth)	1
	Chloropteryx tepperaria (Angle-winged Emerald Moth)	4
	Chytolita morbidalis (Morbid Owlet Moth)	2
	Chytolita petrealis (Stone-winged Owlet Moth)	4
	Chytonix palliatricula (Cloaked Marvel Moth)	3
	Cisseps fulvicollis (Yellow-collared Scape Moth)	7
	Cissusa spadix (Black-dotted Brown Moth)	1
	Cisthene packardii (Packard's Lichen Moth)	4
	Cisthene plumbea (Lead-colored Lichen Moth)	5
	Citheronia regalis (Regal Moth)	1
	Clemensia albata complex (Little White Lichen Moth)	3
	Clemensia n. sp. -- dingy, Coastal Plain	4
	Clemensia n. sp. -- white	5
	Cleora sublunaria (Double-lined Gray Moth)	1
	Clostera inclusa (Angle-lined Prominent Moth)	2
	Colobochyla interpuncta (Yellow-lined Owlet Moth)	2

TAXON	Species	Number of Sites
	Comachara cadburyi (Cadbury's Lichen Moth)	1
	Copivaleria grotei (Grote's Sallow Moth)	1
	Cossula magnifica (Pecan Carpenterworm Moth)	1
	Crambidia lithosioides (Dark Gray Lichen Moth)	1
	Crambidia pallida complex (Pale Lichen Moth)	4
	Crambidia uniformis (Uniform Lichen Moth)	5
	Crocigrapha normani (Norman's Quaker Moth)	1
	Cryptothelea gloverii	1
	Ctenoplusia oxygramma (Sharp-stigma Looper Moth)	1
	Cutina albopunctella	1
	Cutina aluticolor	4
	Cutina arcuata	2
	Cutina distincta (Distinguished Cypress Owlet Moth)	1
	Cyclophora myrtaria (Waxmyrtle Wave Moth)	2
	Cyclophora packardi (Packard's Wave Moth)	4
	Cycnia tenera (Delicate Cycnia Moth)	6
	Darapsa myron (Virginia Creeper Sphinx Moth)	2
	Dasychira manto (Manto Tussock Moth)	1
	Dasychira meridionalis memorata	1
	Dasychira tephra (Tephra Tussock Moth)	1
	Dasychira vagans vagans	2
	Datana angusii (Angus's Datana Moth)	3
	Datana contracta (Contracted Datana Moth)	2
	Datana drexelii (Drexel's Datana Moth)	2
	Datana integerrima (Walnut Caterpillar Moth)	3
	Datana ministra (Yellow-necked Caterpillar Moth)	2
	Desmia funeralis (Grape Leaffolder Moth)	2
	Dichorda iridaria (Showy Emerald Moth)	3
	Digrammia continuata (Curve-lined Angle Moth)	1
	Digrammia gnophosaria (Hollow-spotted Angle Moth)	4
	Digrammia ocellinata (Faint-spotted Angle Moth)	1
	Disclisioprocta stellata (Somber Carpet Moth)	1
	Drepana arcuata (Arched Hooktip Moth)	1
	Dryocampa rubicunda (Rosy Maple Moth)	3
	Dyspteris abortivaria (Badwing Moth)	2
	Dyspyralis nigella	2
	Dyspyralis puncticosta (Spot-edged Dyspyralis Moth)	3
	Eacles imperialis (Imperial Moth)	3
	Ectropis crepuscularia (Small Engrailed Moth)	5
	Egira alternans (Alternate Woodling Moth)	1

TAXON	Species	Number of Sites
	Elaphria chalcedonia (Chalcedony Midget Moth)	2
	Elaphria cornutinus	2
	Elaphria georgei (George's Midget Moth)	1
	Elaphria grata (Grateful Midget Moth)	5
	Elaphria versicolor (Variegated Midget Moth)	3
	Emarginea percara (Beloved Emarginea Moth)	1
	Epimecis hortaria (Tulip-tree Beauty Moth)	3
	Erastria cruentaria (Thin-Lined Erastria Moth)	5
	Eubaphe mendica (Beggar Moth)	4
	Euchaetes egle (Milkweed Tussock Moth)	2
	Euchlaena amoenaria (Deep Yellow Euchlaena Moth)	5
	Euchlaena irraria (Least-marked Euchlaena Moth)	1
	Euchlaena obtusaria (Obtuse Euchlaena Moth)	5
	Euchlaena pectinaria (Forked Euchlaena Moth)	3
	Eulithis diversilineata (Lesser Grapevine Looper Moth)	3
	Eulithis gracilineata (Greater Grapevine Looper Moth)	5
	Eumicremma minima (Everlasting Bud Moth)	2
	Eupithecia miserulata (Common Eupithecia Moth)	5
	Eusarca confusaria (Confused Eusarca Moth)	5
	Eutrapela clemataria (Curve-toothed Geometer Moth)	5
	Exelis pyrolaria (Fine-lined Gray Moth)	2
	Faronta diffusa (Wheat Head Armyworm Moth)	1
	Feltia herilis (Master's Dart Moth)	1
	Fulgoraecia exigua (Planthopper Parasite Moth)	1
	Gabara sp.	1
	Galgula partita (Wedgling Moth)	4
	Glena cribrataria (Dotted Gray Moth)	1
	Glenoides texanaria (Texas Gray Moth)	5
	Gluphisia septentrionalis (Common Gluphisia Moth)	2
	Grammia parthenice intermedia	3
	Grammia virgo (Virgin Tiger Moth)	2
	Gueneria similaria	1
	Halysidota harrisii (Sycamore Tussock Moth)	2
	Halysidota tessellaris (Banded Tussock Moth)	4
	Haploa clymene (Clymene Moth)	4
	Harrisimemna trisignata (Harris's Three-spot Moth)	1
	Helicoverpa zea (Corn Earworm Moth)	2
	Hemaris thysbe (Hummingbird Clearwing Moth)	1
	Hemeroplanis scopulepes (Variable Tropic Moth)	1
	Heterocampa biundata (Wavy-Lined Heterocampa Moth)	3

TAXON	Species	Number of Sites
	Heterocampa guttivitta (Saddled Prominent Moth)	4
	Heterocampa obliqua (Oblique Heterocampa Moth)	4
	Heterocampa subrotata (Small Heterocampa Moth)	2
	Heterocampa umbrata (White-blotched Heterocampa Moth)	1
	Heterophleps triguttaria (Three-spotted Fillip Moth)	4
	Himella intractata (Intractable Quaker Moth)	1
	Holomelina aurantiaca (Orange Holomelina Moth)	5
	Holomelina opella (Tawny Holomelina Moth)	3
	Homophoberia apicosa (Black Wedge-spot Moth)	5
	Horisme intestinata (Brown Bark Carpet Moth)	3
	Hydriomena pluviata (Sharp Green Hydriomena Moth)	1
	Hypagyrtis esther (Esther Moth)	2
	Hypagyrtis unipunctata (One-spotted Variant Moth)	5
	Hyparpax aurora (Pink Prominent Moth)	1
	Hypena humuli (Hop Vine Moth)	2
	Hypenodes fractilinea (Broken-line Hypenodes Moth)	3
	Hyperaeschra georgica (Georgian Prominent Moth)	1
	Hyperstrotia pervertens (Dotted Graylet Moth)	2
	Hyperstrotia secta (Black-patched Graylet Moth)	1
	Hyperstrotia villificans (White-lined Graylet Moth)	1
	Hyphantria cunea (Fall Webworm Moth)	2
	Hypomecis longipectinaria	2
	Hypoprepia fucosa (Painted Lichen Moth)	5
	Hypoprepia miniata (Scarlet-winged Lichen Moth)	3
	Hypsoropha hormos (Small Necklace Moth)	3
	Hypsoropha monilis (Large Necklace Moth)	1
	Idaea demissaria (Red-Bordered Wave Moth)	1
	Idaea obfusaria (Rippled Wave Moth)	2
	Idaea scintillularia (Diminutive Wave Moth)	1
	Idia aemula (Common Idia Moth)	5
	Idia americalis (American Idia Moth)	5
	Idia denticulalis (Toothed Idia Moth)	1
	Idia diminuendis (Orange-spotted Idia Moth)	1
	Idia forbesi	5
	Idia julia	4
	Idia lubricalis (Glossy Black Idia Moth)	5
	Idia rotundalis (Rotund Idia Moth)	5
	Idia scobialis (Smoky Idia Moth)	2
	Iodopepla u-album (White-eyed Borer Moth)	3
	Isa textula (Crowned Slug Moth)	2

TAXON	Species	Number of Sites
	Isochaetes beutenmuelleri (Spun Glass Slug Moth)	1
	Isogona tenuis (Thin-lined Owlet Moth)	5
	Isoparce cupressi (Bald Cypress Sphinx Moth)	1
	Itame pustularia (Lesser Maple Spanworm Moth)	3
	Lacinipolia implicata (Implicit Arches Moth)	1
	Lacosoma chiridota (Scalloped Sack-bearer Moth)	2
	Lagoa crispata (Black-waved Flannel Moth)	1
	Lambdina pellucidaria (Yellow-headed Looper Moth)	1
	Laothoe juglandis (Walnut Sphinx Moth)	2
	Lapara coniferarum (Southern Pine Sphinx Moth)	2
	Lascoria ambigualis (Ambiguous Moth)	5
	Ledaea perditalis (Lost Owlet Moth)	3
	Leucania adjuta (Adjutant Wainscot Moth)	5
	Leucania calidior (Cane Wainscot)	2
	Leucania inermis (Unarmed Wainscot Moth)	1
	Leucania linda (Linda Wainscot Moth)	1
	Leucanopsis longa (Long-streaked Tussock Moth)	4
	Leuconycta diphteroides (Green Leuconycta Moth)	1
	Lithacodes fasciola (Yellow-shouldered Slug Moth)	4
	Lithacodia muscosula (Large Mossy Lithacodia Moth)	5
	Lithacodia musta (Small Mossy Lithacodia Moth)	2
	Lithacodia sp. 2	2
	Lithophane patefacta (Dimorphic Pinion Moth)	1
	Lochmaeus bilineata (Double-lined Prominent Moth)	4
	Lochmaeus manteo (Variable Oakleaf Caterpillar Moth)	4
	Lomographa vestaliata (White Spring Moth)	3
	Lophosis labeculata (Stained Lophosis Moth)	2
	Lytrosis unitaria (Common Lytrosis Moth)	1
	Macaria aemulataria (Common Angle Moth)	4
	Macaria aequiferaria (Woody Angle Moth)	9
	Macaria bicolorata (Bicolored Angle Moth)	3
	Macaria multilineata (Many-lined Angle Moth)	2
	Macaria promiscuata (Promiscuous Angle Moth)	2
	Macaria transitaria (Blurry Chocolate Angle Moth)	3
	Macrochilo hypocritalis (Twin-dotted Macrochilo Moth)	4
	Macrochilo litophora (Brown-lined Owlet Moth)	5
	Macrurocampa marthesia (Mottled Prominent Moth)	2
	Malacosoma americanum (Eastern Tent Caterpillar Moth)	2
	Malacosoma disstria (Forest Tent Caterpillar Moth)	3
	Maliattha synochitis (Black-dotted Lithacodia Moth)	1

TAXON	Species	Number of Sites
	Marathyssa basalis (Light Marathyssa Moth)	1
	Marathyssa inficita (Dark Marathyssa Moth)	1
	Megalographa biloba (Bilobed Looper Moth)	1
	Megalopyge opercularis (Southern Flannel Moth)	1
	Melanolophia canadaria (Canadian Melanolophia Moth)	6
	Melanolophia signataria (Signate Melanolophia Moth)	1
	Melanomma auricinctaria (Gold-lined Melanomma Moth)	1
	Metalectra discalis (Common Fungus Moth)	5
	Metalectra quadrisignata (Four-spotted Fungus Moth)	4
	Metalectra richardsi (Richards' Fungus Moth)	4
	Metarranthis duaria (Ruddy Metarranthis Moth)	1
	Metarranthis homuraria (Purplish Metarranthis Moth)	3
	Misogada unicolor (Drab Prominent Moth)	4
	Mocis texana (Texas Mocis Moth)	1
	Morrisonia confusa (Confused Woodgrain Moth)	1
	Nadata gibbosa (White-dotted Prominent Moth)	5
	Natada nasoni (Nason's Slug Moth)	2
	Nedra ramosula (Gray Half-spot Moth)	3
	Nematocampa resistaria (Horned Spanworm Moth)	3
	Nemoria bistriaria (Red-fringed Emerald Moth)	3
	Nemoria elfa (Cypress Emerald Moth)	3
	Nemoria saturiba	2
	Nephelodes minians (Bronzed Cutworm Moth)	2
	Nerice bidentata (Double-toothed Prominent Moth)	2
	Nigetia formosalis (Thin-winged Owlet Moth)	5
	Noctua pronuba (Large Yellow Underwing Moth)	4
	Nola clethrae (Sweet Pepperbush Nola Moth)	2
	Nola triquetrana (Three-spotted Nola Moth)	1
	Ochropleura implecta (Flame-shouldered Dart Moth)	1
	Ogdoconta cinereola (Common Pinkband Moth)	5
	Olceclostera angelica (Angel Moth)	2
	Oligia modica (Black-banded Brocade Moth)	1
	Oligocentria lignicolor (White-streaked Prominent Moth)	2
	Oligocentria semirufescens (Red-washed Prominent Moth)	3
	Omphalocera munroei (Asimina Webworm Moth)	3
	Oreta rosea (Rose Hooktip Moth)	4
	Orgyia detrita (Fir Tussock Moth)	1
	Orgyia leucostigma (White-marked Tussock Moth)	4
	Orthodes crenulata (Rustic Quaker Moth)	4
	Orthonama centrostrigaria (Bent-line Carpet Moth)	5

TAXON	Species	Number of Sites
	Orthonama obstipata (Gem Moth)	5
	Orthosia alurina (Gray Quaker Moth)	1
	Orthosia hibisci (Speckled Green Fruitworm Moth)	1
	Orthosia rubescens (Ruby Quaker Moth)	1
	Paectes abrostoloides (Large Paectes Moth)	3
	Paectes oculatrix (Eyed Paectes Moth)	2
	Paleacrita vernata (Spring Cankerworm Moth)	1
	Palthis angulalis (Dark-spotted Palthis Moth)	5
	Palthis asopialis (Faint-spotted Palthis Moth)	5
	Pangrapta decoralis (Decorated Owlet Moth)	1
	Panopoda carneicosta (Brown Panopoda Moth)	3
	Panopoda rufimargo (Red-lined Panopoda Moth)	2
	Panthea furcilla (Eastern Panthea Moth)	1
	Paonias excaecatus (Blind-eyed Sphinx Moth)	2
	Papaipema araliae (Aralia Shoot Borer Moth)	1
	Papaipema baptisiae (Indigo Stem Borer Moth)	1
	Papaipema rutila (Mayapple Borer Moth)	1
	Parallelia bistriaris (Maple Looper Moth)	6
	Parasa indetermina (Stinging Rose Caterpillar Moth)	1
	Patalene olyzonaria puber	2
	Peridea angulosa (Angulose Prominent Moth)	4
	Pero hubneraria (Hubner's Pero Moth)	1
	Petrophora divisata (Common Petrophora Moth)	1
	Phalaenophana pyramusalis (Dark-banded Owlet Moth)	5
	Phalaenostola eumelusalis (Dark Phalaenostola Moth)	4
	Phalaenostola larentioides (Black-banded Owlet Moth)	4
	Phalaenostola metonalis (Pale Phalaenostola Moth)	2
	Phigalia strigataria (Small Phigalia Moth)	1
	Phoberia atomaris	1
	Phosphila miselioides (Spotted Phosphila Moth)	3
	Phyprosopus callitrichoides (Curve-lined Owlet Moth)	1
	Plagodis fervidaria (Fervid Plagodis Moth)	1
	Plathypena scabra (Green Cloverworm Moth)	5
	Platysenta mobilis (Mobile Groundling Moth)	1
	Platysenta sutor (Cobbler Moth)	2
	Platysenta vecors (Dusky Groundling Moth)	2
	Platysenta videns (White-dotted Groundling Moth)	3
	Pleuroprucha insulsaria (Common Tan Wave Moth)	5
	Plusiodonta compressipalpis (Moonseed Moth)	2
	Polia detracta (Disparaged Arches Moth)	1

TAXON	Species	Number of Sites
	Polygrammate hebraeicum (Hebrew Moth)	2
	Probole alienaria (Alien Probole Moth)	1
	Probole amicaria (Friendly Probole Moth)	2
	Prochoerodes transversata (Large Maple Spanworm Moth)	4
	Protapamea danieli	2
	Protoboarmia porcelaria (Porcelain Gray Moth)	5
	Protolampra brunneicollis (Brown-collared Dart Moth)	3
	Pseudaletia unipuncta (Armyworm Moth)	4
	Pseudeustrotia carneola (Pink-barred Lithacodia Moth)	2
	Pseudoplusia includens (Soybean Looper Moth)	3
	Pseudothyris sepulchralis (Mournful Thyris Moth)	1
	Ptichodis herbarum (Common Ptichodis Moth)	1
	Pyrrharctia isabella (Isabella Tiger Moth)	4
	Quandara brauneata	4
	Raphia abrupta (Abrupt Brother Moth)	2
	Redectis pygmaea (Pygmy Redectis Moth)	4
	Redectis vitrea (White-spotted Redectis Moth)	4
	Renia adspergillus (Speckled Renia Moth)	6
	Renia discoloralis (Discolored Renia Moth)	6
	Renia factiosalis (Sociable Renia Moth)	4
	Renia flavipunctalis (Yellow-spotted Renia Moth)	2
	Renia fraternalis (Fraternal Renia Moth)	4
	Renia n. sp. nr. discoloralis	1
	Renia nemoralis (Chocolate Renia Moth)	1
	Renia salusalis	1
	Renia sobrialis (Sober Renia Moth)	1
	Rivula propinqualis (Spotted Grass Moth)	7
	Rivula stepheni (Stephen's Grass Moth)	3
	Schinia arcigera (Arcigera Flower Moth)	3
	Schinia rivulosa (Ragweed Flower Moth)	1
	Schizura ipomoeae (Morning-glory Prominent Moth)	4
	Schizura leptinoides (Black-blotched Schizura Moth)	3
	Schizura unicornis (Unicorn Caterpillar Moth)	3
	Schrankia macula (Black-spotted Schrankia Moth)	5
	Scolecocampa liburna (Deadwood Borer Moth)	5
	Scoliopteryx libatrix (Herald Moth)	1
	Scopula limboundata (Large Lace-border Moth)	7
	Sericaglaea signata (Variable Sallow Moth)	1
	Spaelotis clandestina (Clandestine Dart Moth)	1
	Spargaloma sexpunctata (Six-spotted Gray Moth)	2

TAXON	Species	Number of Sites
	Sphinx kalmiae (Laurel Sphinx Moth)	1
	Spilosoma congrua (Agreeable Tiger Moth)	3
	Spilosoma latipennis (Pink-legged Tiger Moth)	1
	Spilosoma virginica (Virginian Tiger Moth)	2
	Spodoptera frugiperda (Fall Armyworm Moth)	4
	Spodoptera ornithogalli (Yellow-striped Armyworm Moth)	4
	Spragueia leo (Common Spragueia Moth)	1
	Stiriodes obtusa (Obtuse Yellow Moth)	4
	Symmerista albifrons (White-headed Prominent Moth)	1
	Synchlora aerata (Wavy-lined Emerald Moth)	3
	Tarachidia candefacta (Olive-shaded Bird-dropping Moth)	1
	Tetanolita floridana (Florida Tetanolita Moth)	5
	Tetanolita mynesalis (Smoky Tetanolita Moth)	5
	Thioptera nigrofimbria (Black-bordered Lemon Moth)	6
	Thysanopyga intractata (Black-dotted Ruddy Moth)	4
	Tolype notialis (Small Tolype Moth)	1
	Tornos abjectarius	1
	Tornos scolopacinarius (Dimorphic Gray Moth)	1
	Trigrammia quadrinotaria complex (Four-spotted Angle Moth)	2
	Tripudia flavofasciata	2
	Tripudia rectangula	1
	Urodus parvula (Bumelia Webworm Moth)	2
	Urola nivalis (Snowy Urola Moth)	1
	Vaxi critica (Straight-lined Argyria Moth)	3
	Xanthorhoe ferrugata (Red Twin-Spot Moth)	4
	Xanthotype attenuaria	2
	Xanthotype rufaria (Rufous Geometer Moth)	1
	Zale buchholzi	1
	Zale galbanata (Maple Zale Moth)	2
	Zale horrida (Horrid Zale Moth)	1
	Zale intenta	1
	Zale lunata (Lunate Zale Moth)	2
	Zale minerea (Colorful Zale Moth)	3
	Zale obliqua (Oblique Zale Moth)	2
	Zale phaeocapna (Phaeocapna Zale Moth)	3
	Zale squamularis (Gray-banded Zale Moth)	1
	Zanclognatha atrilineella	1
	Zanclognatha cruralis (Early Zanclognatha Moth)	5
	Zanclognatha gypsalis	1

TAXON	Species	Number of Sites
	Zanclognatha jacchusalis	2
	Zanclognatha laevigata (Variable Zanclognatha Moth)	2
	Zanclognatha lituralis (Lettered Zanclognatha Moth)	3
	Zanclognatha martha	1
	Zanclognatha obscuripennis (Dark Zanclognatha Moth)	3
	Zanclognatha ochreipennis (Wavy-lined Zanclognatha Moth)	1
	Zanclognatha protumnusalis	2
	Zanclognatha theralis	2
TIGER BEETLES		
	Cicindela punctulata	5
	Cicindela repanda	1
	Cicindela sexguttata	5
SPIDERS		
	Antrodiaetus unicolor (Folding-door Spider)	1
	Latrodectus variolus (Northern Black Widow)	1
	Sphodros sp. (a Purseweb Spider)	1
LAND SNAILS		
	Anguispira fergusoni (Coastal-plain Tigersnail)	3
	Haplotrema concavum (Gray-foot Lancetooth)	9
	Mesodon thyroidus (White-lip Globe)	11
	Mesomphix perlaevis (Fragile Button)	3
	Neohelix albolabris (Whitelip)	1
	Philomycus carolinianus (Carolina Mantleslug)	5
	Stenotrema barbatum (Bristled Slitmouth)	1
	Succinea unicolor (Squatty Ambersnail)	1
	Triodopsis hopetonensis (Magnolia Threetooth)	3
	Ventridens ligera (Globose Dome)	7
	Xolotrema caroliniense (Blunt Wedge)	6

APPENDIX B. GLOSSARY OF LANDSCAPE TERMS

General Terms

Indicator Guild – a group of species that react in similar ways to a particular type of environmental event. Following Verner's (1984) definition of Management Guilds, the response to a change in the environment is measured over the whole guild, for example, a reduction in the overall number of guild members present within a particular area following a disturbance.

Landscape Integrity – the capacity for a particular expanse of habitat to support populations of movement-dependent species. Such species need to move around within their habitats in response to changing environmental conditions, especially to rebuild their populations following severe disturbances. Landscape Integrity involves both the overall extent of the suitable habitat as well as the ability of species to move throughout its expanse. Landscape Integrity is reduced or eliminated due to both loss and fragmentation of habitats.

Natural Heritage Terms

Landscape Guild – a special type of Indicator Guild, composed of species that are sensitive to fragmentation of a particular type of habitat. At least four such species must be identified for a particular habitat type in order to define a Landscape Guild. Guild habitats are typically composed of one or more types of Natural Communities, with each combination unique to a particular guild. Landscape Guilds are treated here as a special type of Natural Heritage Element, whose occurrences are used to evaluate particular areas for conservation action.

Landscape Guild Occurrence – a specific expanse of habitat – a single block or multiple patches -- occupied by Landscape Guild. Guild Occurrences are equivalent to the Occurrences of other types of Natural Heritage Elements: they must be of practical conservation value, meeting minimum specifications for viability.

Landscape Guild Occurrence Rank – a measure of the quality or viability of a Landscape Guild Occurrence. This measure – reflecting Landscape Integrity of a particular expanse of habitat – is given by the ratio of the observed number of Guild Members within a particular Guild Occurrence to the number of species expected within a given region of the state. Only Guild Occurrences that possess 50% of more of their expected species are currently used in NHP conservation evaluations.

Significant Natural Heritage Landscape – an area of ground of conservation interest, defined by the documented presence of one or more Landscape Guild Occurrences. SNHLs are equivalent to Significant Natural Heritage Areas except in the type of NHP Element used in their definition. The boundaries of an SNHL are drawn around all overlapping and contiguous Occurrences of Landscape Guilds in a given area. They are separated from other SNHLs by major gaps in habitat or by barriers that most of the guilds cannot cross.

APPENDIX C. DESCRIPTION OF LANDSCAPE GUILDS

Canebrakes Guild

Description:

Landscape-dependent species associated with canebrakes

Guild Members:

Acrapex relicta (Relict Cane Moth)
Amblyscirtes carolina (Carolina Roadside-Skipper)
Apameine, New Genus 2, Species 2 (an Undescribed Cane Borer)
Argillophora furcilla (Silver Fork Cane Moth)
Enodia portlandia (Southern Pearly-eye)
Leucania calidior (Cane Wainscot)
Papaipema sp. 3 (an Undescribed Cane Borer)

Habitat:

Statewide: Most of the members of this guild are associated with cane (*Arundinaria* spp.), either feeding directly on it, as in the case of the Lepidopteran species, or nesting and foraging within the dense cover provided by canebrakes, as in the case of Swainson's Warbler (which in some areas is adopting Privet thickets as an alternative habitat). Across most of the state, cane-containing habitats used by this guild are associated primarily with wet soils, including blackwater and brownwater levees and bottomlands as well as peatlands and non-riverine wet flats. In the Mountains, habitats additionally include slopes occupied by hill cane (*Arundinaria appalachiana*), although a different subtype of this guild occurs in that region of the state. While cane itself is adapted to frequent to occasional fire, most of the species in this guild do not survive a fire on site. Instead, they must recolonize recently burned areas from sites that escaped the fire, requiring a metapopulation structure in order to survive within a given landscape. The same may be true with respect to areas that are subject to periodic, prolonged flooding, although cane itself may not survive floods that last more than a few days.

Lower Roanoke Floodplain: Within most of the floodplain, cane occurs primarily within stands of levee- and bottomland-hardwoods and is excluded from deeply flooded swamps. At the mouth of the river, there are also areas of peatlands that may provide additional habitat for this guild.

Occurrence Delineation:

Habitat Mapping: Occurrences within the Lower Roanoke floodplain are mapped as coinciding with those of the General Wet Hardwood Forests Guild.

Separation Distances: Based on the Cane-Feeding Moths EO Specs Group. The separation distance is 2 km for unsuitable habitat, with unsuitable habitat consisting of non-forested habitats, large bodies of water, and tracts of dry upland woodlands.

Coastal Wet-Hydric Deciduous Forests Guild

Description:

Landscape-dependent species associated with all types of deciduous forests growing in Coastal Plain floodplains and non-riverine wet flats

Guild Members:

Aix sponsa (Wood Duck)
Catocala amatrix (Sweetheart Underwing)
Corynorhinus rafinesquii macrotis (Rafinesque's Big-eared Bat - Coastal Plain subspecies)
Epiaeschna heros (Swamp Darner)
Eurycea cirrigera (Southern Two-lined Salamander)
Gomphaeschna antilope (Taper-tailed Darner)
Ictinia mississippiensis (Mississippi Kite)
Libellula axilena (Bar-winged Skimmer)
Myotis austroriparius (Southeastern Myotis)
Olceclostera angelica (Angel Moth)
Protonotaria citrea (Prothonotary Warbler)
Pseudotriton montanus (Eastern Mud Salamander)
Setophaga americana (Northern Parula)

Habitat:

Statewide: This guild is defined solely for the Coastal Plain, where its members make use of permanently flooded swamp forests composed of cypress and tupelos as well as stands of bottomland and levee hardwoods. They also use similar wet-to-hydric communities growing on inter-basin flats and natural lake shorelines. Most of the members of this guild – all of the Vertebrates and Odonates – are associated with the structural features of this combination of habitats rather than the composition of the stands. The two requirements of these species are a forest canopy and the presence of abundant pools or slow-moving streams. The few Lepidoptera included in this guild are associated with plants that occur in both bottomland hardwoods and swamp forests, including cottonwoods (*Populus* spp.) and ashes (*Fraxinus* spp.); only those species found in the entire range of habitats are treated as guild members.

Lower Roanoke Floodplain: In the Lower Roanoke, habitats consist primarily of riverine swamps and floodplain hardwoods. Only one example is included of a non-riverine swamp forest, located at the Roquist Pocosin along one of the tributaries of the Roanoke.

Occurrence Delineation:

Habitat Mapping: Occurrences of this guild are mapped by combining the habitats used by the General Wet Hardwood Forests Guild and the Wet-Hydric Cypress Forests and Woodlands Guild.

Separation Distances: Based on the Terrestrial Plethodontid Salamanders, Hylid Frogs and Ranid Frogs EO specs groups. Separation distances for unsuitable

habitat are 3 km for unsuitable habitat for the salamanders and 5 km for the two frogs; we split the difference and use 4 km for unsuitable habitat. Unsuitable habitat includes non-forested habitats, large bodies of water, and tracts of dry upland woodlands. Four-lane highways are considered to be essentially impassible barriers to movement for the amphibian members of this guild.

General Mesic Hardwood Forests Guild

Description:

Landscape-dependent species associated with hardwood stands and heath thickets growing on mesic slopes

Guild Members:

Acronicta hamamelis (Witch Hazel Dagger)
Dasylophia thyatiroides (Gray-patched Prominent)
Nola triquetrana (Three-spotted Nola)
Virginia valeriae (Smooth Earth Snake)

Habitat:

Statewide: Members of this guild are drought- and/or heat-sensitive species that are restricted to hardwood forests growing on cool, moist slopes, typically with north- or east-facing exposures or located in steep-sided ravines. Soil moisture is a key factor but nutrient content or soil pH are relatively unimportant; soils can range from acidic to circumneutral to basic. Although these habitats are often located adjacent to the floodplains of larger streams and rivers, members of this guild are relatively flood-intolerant; although they may venture out into the floodplains during dry periods, they do not maintain any permanent populations in areas exposed to frequent flooding. Similarly, they may range out into drier habitats during wet periods but survive prolonged droughts or severe heat waves only in cool, mesic refugia on the slopes they typically occupy.

Lower Roanoke Floodplain: Habitat in the Lower Roanoke floodplain includes the slopes rimming the main floodplain as well as some of the steeper slopes along the valleys of the tributary streams. At least some of the guild members also occur on rarely-flooded ridges located out in the floodplain.

Occurrence Delineation:

Habitat Mapping: Habitat for this guild includes stands of hardwood forests - distinguished by their brown color signature on color infrared, leaf-off photographs -- growing on the slopes rimming the main floodplain are included. Slopes along the edges of the blackwater tributaries are also included, especially where they are steep and either north- or east-facing.

Separation Distances: Based on the Small Colubrid Snakes and Terrestrial Plethodontid Salamanders EO Specs Groups. The separation distance is 1 km for unsuitable habitat, with unsuitable habitats consisting of non-forested lands, including developed areas and

agricultural fields. Some types of non-hardwood forests are also treated as unsuitable, especially pine plantations, peatlands, and drier upland communities, including sandhills. Four-lane highways are treated as absolute barriers to movement, as are rivers and lakes.

General Wet Hardwood Forests Guild

Description:

Landscape-dependent species associated with hardwood forests growing on floodplains and non-riverine wet flats, on both nutrient-rich and poor sites

Guild Members:

Acronicta betulae (Birch Dagger)
Catocala lincolnana (Lincoln Underwing)
Cepphis decoloraria (Dark Scallop Moth)
Euchlaena amoenaria (Deep Yellow Euchlaena)
Hypomecis longipectinaria (Broadly Pectinate Hypomecis)
Parkesia motacilla (Louisiana Waterthrush)

Habitat:

Statewide: Habitat for this guild consists of hardwood forests growing in areas subject to annual to frequent short-term flooding. Most examples are associated with floodplains but also include natural lake shorelines, non-riverine wet flats, and to a smaller extent, upland depressions in the Piedmont. This guild is more generalized than the Rich Wet Hardwood Forests Guild, with which it overlaps, in that it has no particular association with sediment types or soil pH. In the Coastal Plain in particular this guild covers blackwater as well as brownwater floodplains. Many of the guild members are tied more to structural features of the habitat rather than to the composition of the vegetation. For these species, the presence of pools and other standing water, wet soils, and a humid microclimate are the primary habitat factors. For other species, the association is more with the plant species tied to floodplain conditions, including river birch (*Betula nigra*), American hornbeam (*Carpinus americana*), willow oak (*Quercus phellos*), and, in the Coastal Plain, laurel oak (*Quercus laurifolia*). Several species of bottomland hawthorns (*Crataegus* spp.) are important for several members of this guild as are several herbaceous species, such as lizardtail (*Saururus cernuus*), clearweed (*Pilea pumila*), false-nettle (*Boehmeria cylindrica*), river oats (*Chasmanthium latifolium*), sedges (*Carex* spp.), and other wetland graminoids. All members of this guild need to be able to cope with frequent, if short-term flooding. Unlike floodplain plants, however, members of this guild may not survive the flooding on site, but may instead need to recolonize recently flooded areas from sites located beyond the high water mark. On the other hand, most members of this guild are unlikely to be drought-tolerant, especially if the plants they depend upon are affected by prolonged dry conditions. Open, sunny conditions created by clearcutting or hurricane damage may lead to temporary loss of habitat for this guild. Species associated with herbaceous plants may be especially affected.

Lower Roanoke Floodplain: Along the Lower Roanoke, occurrences of this guild include hardwood stands across the entire width of the main floodplain, excluding only deeply flooded swamps.

Occurrence Delineation:

Habitat Mapping: Habitat units for this guild consist of all stands of hardwood forests growing within the floodplain of the Roanoke and its tributaries, as determined by the 100 year floodplain map created by the NC Flood Hazard Mapping Program. Hardwood stands were identified based on the 1998 Color Infrared Photographs that were taken during the leaf-off period. On these photographs, stands of hardwoods have a light brown color signature. Within brownwater floodplain, the only conspicuous evergreen species -- which have a red color signature -- are Loblollly Pines (Pinus taeda), which are a natural component of infrequently-flooded bottomlands and levees.

Separation Distances: Based on the Forest and Woodland Geometridae EO specs group. The separation distance is 2 km for unsuitable habitat, with unsuitable habitat consisting of non-forested habitats, large bodies of water, and tracts of dry upland woodlands.

General Wet-Dry Hardwood Forests Guild

Description:

Landscape-dependent species associated with general hardwood forests, ranging from dry ridge tops to wet floodplains

Guild Members:

Ambystoma opacum (Marbled Salamander)
Coccyzus americanus (Yellow-billed Cuckoo)
Meleagris gallopavo (Wild Turkey)
Picoides villosus (Hairy Woodpecker)
Polioptila caerulea (Blue-gray Gnatcatcher)
Setophaga citrina (Hooded Warbler)
Sitta carolinensis (White-breasted Nuthatch)
Vireo flavifrons (Yellow-throated Vireo)

Habitat:

Statewide: Members of this guild are associated with the full range of hardwood forests in North Carolina. Currently, the guild is restricted to vertebrates, particularly those that appear to be affected by urbanization, i.e., that are frequent and abundant in natural stands but scarce in developed areas. Guild members are associated primarily with the physical features of hardwood forests rather than with a specific composition of plant species. The main requirements are for closed canopy forests composed of moderately mature trees. Soil types can vary from nutrient-rich to poor; moisture regimes can vary

from dry to wet.

Lower Roanoke Floodplain: Habitat in the Lower Roanoke floodplain includes the entire set of floodplain hardwoods as well as the adjoining mesic slopes and upland stands extending well beyond the limits of the floodplain.

Occurrence Delineation:

Habitat Mapping: Occurrences for this guild in the Lower Roanoke floodplain include the set of habitats mapped for the General Wet-Mesic Hardwood Forests Guild plus adjoining stands of drier, upland hardwoods. Only stands that are dominated by hardwoods are included, i.e., with a minimum amount of the red color signature of pines in the color-infrared aerial photos. Stands less than 250 ha in area are excluded as are strips of habitat less than 100 m wide, unless buffered by other types of natural habitats or by stands of pine.

Separation Distances: Based on the Ambystomatid Salamander EO Specs group and the individual EO specifications for the Eastern Box Turtle. The separation distance is 1 km for unsuitable habitat, with unsuitable habitats consisting of nonforested lands, including developed areas and agricultural fields. Four-lane highways are treated as absolute barriers to movement, as are large rivers and lakes.

General Wet-Mesic Hardwood Forests Guild

Description:

Landscape-dependent species associated with hardwood stands growing on floodplains and mesic slopes

Guild Members:

Acronicta laetifica (Pleasant Dagger)
Baileya ophthalmica (Eyed Baileya)
Colocasia flavicornis (Yellowhorn Moth)
Dasychira tephra (Tephra Tussock Moth)
Enodia anthedon (Northern Pearly-eye)
Polygonia comma (Eastern Comma)
Pseudacris feriarum (Upland Chorus Frog)
Somatochlora filosa (Fine-lined Emerald)
Somatochlora linearis (Mocha Emerald)
Somatochlora tenebrosa (Clamp-tipped Emerald)
Zale phaeocapna (Phaeocapna Zale)

Habitat:

Statewide: Habitat for this guild consists of hardwood forests growing on wet-to-moist soils, ranging from bottomland and levee forests in river floodplains to mesic stands

located in narrower ravines or on valley and mountain slopes. In the Piedmont and Mountains, forests associated with wet flats or upland depressions are included in this guild; in the Coastal Plain, non-riverine wet flats are included in other guilds. Members of this guild are tolerant of a wide range of soil pH. They are also tolerant of at least the occasional, short-term flooding characteristic of bottomlands but also the well-drained soil conditions present on the slopes. The majority of the members of this guild are tied more to habitat structure than they are to the composition of the vegetation; moist conditions and a closed canopy of hardwoods meet their basic needs. However, there are several Lepidoptera included in this guild whose larvae feed primarily on certain plants associated with wet to mesic habitats, including ironwood (*Carpinus caroliniana*), American hazelnut (*Corylus americanus*), nannyberry (*Viburnum prunifolium*) and wild raisins (*Viburnum cassinoides* and *V. nudum*). A few herbaceous species are also used, such as toothworts (*Cardamine* spp.), members of the Nettle family (Urticaceae), and wet-mesic graminoids such as river oats (*Chasmanthium latifolium*).

Lower Roanoke Floodplain: Habitat includes levee forests and bottomland hardwoods, along with the mesic mixed hardwoods characteristic of the adjoining slopes. Due to the rich alluvial deposits on the slopes, species characteristic of bottomland habitats often occur much farther upslope than on nutrient-poor slopes.

Occurrence Delineation:

Habitat Mapping: Occurrences of this guild combine habitats mapped for the General Wet Hardwood Forests Guild and General Mesic Hardwood Forests Guild.

Separation Distances: Based on the Hylid Frogs, Satyrine Butterflies, and Euphyes, Poanes, Other Wetland Skippers EO specs groups. The separation distance in that group is 2 km for unsuitable habitat, with unsuitable habitats consisting of non-forested habitats, large bodies of water, and tracts of dry upland woodlands (e.g. sandhills). Four-lane highways are considered to represent essentially impassible barriers to movement for Amphibians but not for the other members of this guild.

Rich Wet Hardwood Forests Guild

Description:

Landscape-dependent species associated with rich alluvial hardwood forests

Guild Members:

Halysidota harrisii (Sycamore Tussock Moth)
Hypena humuli (Hop Vine Moth)
Misogada unicolor (Drab Prominent)
Zale galbanata (Maple Zale)

Habitat:

Statewide: Species in this guild are associated with hardwood-dominated forests growing on rich, alluvial floodplains. The nutrient-rich soils characteristic of these habitats are deposited by rivers and larger streams flowing down from the Mountains or Piedmont; in the Coastal Plain, this guild is restricted to brownwater river floodplains. Guild members are not directly dependent on the rich soils themselves, however, but rather on the plant species that are restricted to these habitats, including sycamore (*Platanus occidentalis*), box-elder (*Acer negundo*), eastern cottonwood (*Populus deltoides*), stinging nettle (*Urtica* spp.), and wood nettle (*Laportea canadensis*). These habitats depend on the alluvial deposition caused by frequent -- typically at least annual -- overbank flooding. Guild members, consequently, must be able to cope with periods of inundation and flood scouring. Unlike floodplain plants, however, members of this guild may not survive the flooding on site, but may instead need to recolonize recently flooded areas from sites located beyond the high water mark. Most members of this guild are unlikely to be drought-tolerant, especially if the plants they depend upon are affected by prolonged dry conditions. Open, sunny conditions created by clearcutting or hurricane damage may lead to temporary loss of habitat for this guild. Species associated with herbaceous plants may be especially affected, as is the one vertebrate member of this guild, the Cerulean Warbler, which in the Coastal Plain depends on the presence of mature trees growing close to the riverbank.

Lower Roanoke Floodplain: Alluvial deposits extend across most of the floodplain; in the upper portion -- upstream from Williamston -- alluvial soils extend all the way up to the crest of the slopes bounding the floodplain. Although most of the plant species that provide direct habitat for this guild are typically found on levees and located close to river and stream banks, levee forest habitats themselves extend well inland from the river within the Roanoke floodplain. Consequently, occurrences of the Rich Wet Hardwood Forests Guild are mapped across the width of the floodplain, including all stands of hardwoods except for deeply flooded swamps.

Occurrence Delineation:

Habitat Mapping: Within the floodplain of the Roanoke itself, occurrences for this guild coincide with those for the General Wet Hardwood Forests Guild. They do not, however, extend up into the floodplains of the blackwater tributaries of the Roanoke.

Separation Distances: Based on the Forest, Woodland, and Scrub Noctuidae EO Specs group. The separation distance for unsuitable habitat is 4 km, with unsuitable habitat consisting of non-forested habitats, large bodies of water, floodplains of blackwater streams and rivers, and dry upland woodlands.

Rich Wet-Dry Hardwood Forests Guild

Description:

Landscape-dependent species associated with hardwood forests generally associated with rich soils, including both wet and dry varieties

Guild Members:

Acronicta morula (Ochre Dagger)
Asterocampa celtis (Hackberry Emperor)
Bomolocha abalienalis (White-lined Bomolocha)
Catocala residua (Residua Underwing)
Ceratomia undulosa (Waved Sphinx)
Isogona tenuis (Thin-lined Owlet Moth)
Lochmaeus bilineata (Double-lined Prominent)
Nerice bidentata (Double-toothed Prominent)
Sphinx kalmiae (Laurel Sphinx)

Habitat:

Statewide: Species in this guild are associated with a wide variety of rich soil types, ranging from wet, alluvial soils to dry-to-xeric upland soils weathered from mafic or calcareous rock substrates. Guild members are not directly dependent on the rich soils themselves, however, but rather on the plant species that are restricted to these habitats, including shagbark hickories (*Carya ovata* and *C. carolinae-septentrionalis*), ashes (*Fraxinus* spp.), elms (*Ulmus* spp.), hackberries (*Celtis* spp.), basophilic maples (*Acer floridanum* , *A. leucoderme*, *A. saccharum*), eastern redbud (*Cercis canadensis*), hop-hornbeam (*Ostrya virginiana*), basswoods (*Tilia* spp.), hop-tree (*Ptelea trifoliata*) , and ninebark (*Physocarpus opulifolius*). While members of this guild are able to make use of floodplain habitats, at least in some years, they are likely to be less able to cope with flood events than members of either the Rich Wet Hardwood Forests Guild or Rich Wet-Mesic Hardwood Forests Guild. On the other hand, they are likely to be more drought-resistant and in some areas can survive in upland habitats located well beyond areas affected by flooding.

Lower Roanoke Floodplain: Along the Lower Roanoke, rich soil habitats are restricted to the floodplain and lower slopes; no upland areas of marl or mafic substrates are located within the vicinity.

Occurrence Delineation:

Habitat Mapping: Habitats occupied by this guild are virtually the same as those of the Rich Wet-Mesic Hardwood Forests Guild, i.e., including all stands of hardwood forests growing on the floodplain and slopes.

Separation Distances: Based on the Asterocampa Butterflies, Forest and Woodland Geometridae, Forest and Woodland Hairstreaks, and Notodontidae EO Specs Groups. The separation distances for unsuitable habitat is 2 km, with unsuitable habitat consisting of non-forested habitats, large bodies of water, floodplains and adjoining slopes of blackwater streams and rivers, and acidic upland woodlands.

Rich Wet-Mesic Hardwood Forests Guild

Description:

Landscape-dependent species associated with hardwood forests growing on wet-to-moist rich soils

Guild Members:

Baileya australis (Small Baileya)
Catocala nebulosa (Clouded Underwing)
Catocala piatrix (Penitent Underwing)
Omphalocera munroei (Asimina Webworm Moth)
Trigrammia quadrinotaria complex (Four-spotted Angle)

Habitat:

Statewide: Habitats used by this guild include both rich floodplains and mesic slopes associated with mafic or calcareous substrates. Members of this guild are not directly dependent on the rich soils themselves but rather on the plant species that are restricted to these habitats, including black walnut (*Juglans nigra*), bitternut (*Carya cordiformis*), common pawpaw (*Asimina triloba*), buckeyes (*Aesculus* spp.), mayapple (*Podophyllum peltatum*), and trilliums (*Trillium* spp.). Members of this guild may have some abilities to cope with frequent flooding. Unlike members of the Rich Wet Hardwood Forests Guild, however, this guild occupies at least some habitats that are rarely, if ever, flooded. Consequently, they may be better able to survive and recolonize sites following a major flood event than the species more strongly restricted to the floodplains.

Lower Roanoke Floodplain: Along the Lower Roanoke, the richness of the slopes adjoining the floodplain is due to the same alluvial deposits that make the floodplain itself so rich. No mafic or calcareous substrates exist within the general vicinity (at least close to the surface), and no areas beyond the rim wall of the floodplain are included as habitat.

Occurrence Delineation:

Habitat Mapping: Occurrences for this guild include the same habitats as those used by the General Wet-Mesic Hardwood Forests Guild but do not extend up the valleys of the blackwater tributaries.

Separation Distances: Based on those of the Forest, Woodland, and Scrub Noctuidae and Catocala Moths, Large Mobile Species EO Specs groups. The separation distance for unsuitable habitat is 4 km, with unsuitable habitat including non-forested habitats, large bodies of water, floodplains and adjoining slopes of blackwater streams and rivers, and dry upland woodlands.

Sparsely Settled Mixed Habitats Guild

Description:

Landscape-dependent species associated with large roadless areas and low intensity of human intrusion

Guild Members:

Canis rufus (Red Wolf)
Lynx rufus (Bobcat)
Sistrurus miliarius (Pigmy Rattlesnake)

Habitat:

Statewide: Members of this guild are primarily wide-ranging carnivores with few specific habitat requirements. All occur at low population densities and are highly vulnerable to human disturbance. Concentrations of these species are now limited to large areas of open or forested habitat that have only a low level of human activity, especially areas that are not penetrated to any significant extent by paved roads. Within these tracts, both natural and semi-natural habitats can be used, including large farms and tree plantations.

Lower Roanoke Floodplain: The frequent flooding has, at least in the past, limited the intensity of human developments within the Roanoke floodplain. Only a few cities or large towns exist along its length and relatively few roads cross the floodplain. In addition to the large tracts of largely undisturbed floodplain forests, the vast agricultural fields and tree farms are also mainly roadless and are used by several of the species in this guild for foraging.

Occurrence Delineation:

Habitat Mapping: Rather than use vegetation cover, habitat units were defined primarily on the basis of distance from roads. Buffers of 500 meters were first created along all mapped primary and secondary roads and the resulting polygon then subtracted from a polygon representing the overall project region, leaving behind blocks of “roadless” habitats. Concentrations of guild member records were associated with blocks greater than or equal to 3,000 acres which were

selected as the basic habitat units for guild occurrences.

Separation Distances: Based on EO specifications for rattlesnakes. The separation distance is 1 km for unsuitable habitat, with unsuitable habitats consisting of primarily of urbanized areas. Four-lane highways are treated as absolute barriers to movement, as are large lakes and swift rivers.

Wet-Hydric Cypress Forests and Woodlands Guild

Description:

Landscape-dependent species associated with stands of bald and pond cypress

Guild Members:

Anacamptodes cypressaria (Small Cypress Looper)
Anhinga (Anhinga)
Cutina albopunctella (White-spotted Cutina)
Cutina arcuata (Arcuate Cutina)
Inscudderia walkeri (Walker's Cypress Katydid)
Lithophane abita (Cypress Pinion)
Nemoria elfa (Cypress Emerald)

Habitat:

Statewide: Nearly all of the species in this guild feed solely on cypress, including bald cypress (*Taxodium distichum*) and pond cypress (*T. ascendens*); one species is also included in this guild that is strongly associated with water tupelo (*Nyssa aquatica*) and swamp blackgum (*Nyssa biflora*). Habitats include cypress dominated river swamps -- both brown- and blackwater -- old mill ponds and oxbows, non-riverine swamps, and cypress savannas. With only a couple of possible exceptions, members of this guild are tolerant of permanently flooded conditions.

Lower Roanoke Floodplain: In the Lower Roanoke floodplain, occurrences of this guild are associated primarily with riverine swamp forests and semi-permanent impoundments. Only one example is included of a non-riverine swamp forest, located at the Roquist Pocosin along one of the tributaries of the Roanoke. Although cypress also occurs along the levees, it is fairly sparse in those habitats, which were not included within the occurrences for this guild.

Occurrence Delineation:

Habitat Mapping: Habitat was mapped based on color infrared photos taken during the leaf-off period. Due to the presence of standing water, the color signature for swamp habitats is blackish or dark green. In addition to swamps located along the main stem of the Roanoke, habitat for this guild extends up into the blackwater tributaries.

Separation Distances: Based on the Cypress or Cedar Associated Geometridae EO specs group. The separation distance is 2 km for unsuitable habitat, with

unsuitable habitats consisting of non-forested habitats, large bodies of water, and tracts of dry upland woodlands.

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