United States
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Service

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Terrestrial Species Viability Evaluation for

The Uwharrie National Forest

Land and Resource Management Plan

Environmental Impact Statement

Contents

1.0 Introduction

This document describes the purpose, methods, and results of a species viability evaluation for the Environmental Impact Statement (EIS) alternatives developed for the Uwharrie National Forest Land and Resource Management Plan, National Forests in North Carolina. Species viability is assessed within the context of National Forest Management Act regulations to "provide for diversity of plant and animal communities based on the suitability and capability of the specific land area in order to meet overall multiple-use objectives."

2.0 Purpose

The purpose for conducting this species viability evaluation is to determine the degree to which ecological conditions on national forest system lands contribute to the long-term viability (for a 50-year planning horizon) of species at risk. More specifically, this evaluation provides an estimate of the likelihood that these species will persist on the Uwharrie NF for a given period of time.

2.1 Requirements in the National Forest Management Act (NFMA)

The 1982 planning regulations implementing the National Forest Management Act (NFMA) (36 CFR 219.19) require national forests to provide habitat in order "to maintain viable populations of existing native and desired non-native vertebrate species in the planning area." Additional direction (USDA Regulation 9500-4) extends this mandate to include vascular plants. Native species are species indigenous to the planning area. Desired non-native species are those species that are not indigenous to the planning area but are valued for the social, cultural, ecological, or economic value.

NFMA regulations define a viable population: "For planning purposes, a viable population shall be regarded as one which has the estimated numbers and distribution of reproductive individuals to insure its continued existence is well distributed in the planning area." The regulations direct that "habitat must be provided to support, at least, a minimum number of reproductive individuals and that habitat must be well distributed so that those individuals can interact with others in the planning area." The planning area is defined as the national forest system lands included in the Uwharrie National Forest proclamation boundary.

While the NFMA regulations focus on population viability, the Act itself does not contain an explicit requirement for "viability." Rather, it directs that management of national forests "provide for diversity of plant and animal communities based on the suitability and capability of the specific land area in order to meet overall multiple-use objectives." The regulation also contains language on diversity (36 CFR 219.26), and directs that "Forest planning shall provide for diversity of plant and animal communities and tree species consistent with the overall multiple-use objectives of the planning area." Thus, viability of individual species must be considered within the context of overall diversity of plant and animal species and the multiple-use objectives for the planning area. While invertebrates are not specifically addressed in the 1982 planning regulations, the Uwharrie NF evaluated these as part of this process.

3.0 Ecosystem Diversity

Ecosystem diversity is defined as the variety and relative extent of ecosystem types including their composition, structure, and processes (36 CFR 219.16). NatureServe's ecological systems (2004) were used as a starting point to define ecological systems on the Uwharrie NF. Ecological systems are groups of plant associations or "plant communities of definite floristic composition, presenting a uniform physiognomy, and growing in uniform habitat conditions" that occur in regions of similar physical conditions and biological potential (Flahault and Schroter 1910). Sites within ecological systems may be characterized by geologic formation, landform, aspect, and other physical attributes that interact to create unique environments controlled by temperature, moisture, and fertility.

An environmental variable-based model was used to map the potential extent of the ecological systems or plant associations on a 622,000 acre area centered on the Uwharrie NF (Appendix A). The existing extent of these systems was determined by intersecting map units from the environmental model with map units from the forest service vegetation database, (FSVEG) and evaluating how well the two classifications "fit". Through a collaborative effort by botanists, ecologists, and silviculturists, FSVEG forest types were cross-walked with their equivalent ecological systems by comparing descriptions of the individual classifications (Table 1). Information from the North Carolina Natural Heritage Program was used to map the extent of rare ecological systems. We identified the following 12 ecological systems that are roughly equivalent to The Nature Conservancy's "conservation targets" (NatureServe 2004, TNC 2003).

- Xeric Oak Forest
- Dry Oak-Hickory Forest
- Dry-mesic Oak-Hickory Forest
- Southern Piedmont Mesic Forest
- Southeastern Interior Longleaf Pine Woodland
- Shortleaf Pine-Oak Woodland
- Successional and planted Forests (Loblolly and Shortleaf pine)
- Streamside Forest
- Southern Piedmont Glades and Barrens
- Southern Piedmont Mafic Hardpan Woodland
- Piedmont Seepage Wetland
- Southern Piedmont / Ridge and Valley Upland Depression Swamp

The following table describes the results of intersecting the map of potential ecological systems and existing forest types and cross-walking type descriptions. The first column lists the NatureServe ecological system name and the second column lists the corresponding names of potential ecological system map units, i.e. "potential natural vegetation" on the Uwharrie NF. The last column lists the rules used to map the corresponding existing ecological system based on the match between FSVEG and NatureServe types. For example, there are approximately 1,660 acres on the Uwharrie NF where oak dominated FSVEG forest types occur in the driest modeled environments,

i.e, xeric oak. Map units where these two conditions intersect were labeled "Xeric Oak Forest" (see first table entry). However, the potential extent of Xeric Oak Forest as derived from environmental modeling is 2,990 acres, indicating a departure from the potential vegetation composition on 1,330 acres and a potential restoration opportunity.

Table 1: Relationship between NatureServe's ecological systems and potential and existing ecological systems on the Uwharrie NF

ECOLOCICAL SYSTEM (NatureServe 2004)	POTENTIAL ECOLOGICAL SYSTEMS on the Uwharrie NF - from environmental modeling - (approx. potential extent in acres)	EXISTING Forest Types cross-walked between Potential Ecological Systems and FSVeg Forest Type (FT) (existing extent in acres)
Southern Piedmont Dry Oak – (Pine) Forest	Xeric Oak Forest (2,990 ac.) Dry Oak-Hickory Forest (20,800 ac.) Dry-mesic Oak-Hickory Forest (11,060 ac.)	Xeric Oak potential intersecting with FSVEG FT *44,45,47,51-54,60* = (1,660 ac.) Dry Oak-Hickory potential intersecting with FSVEG FT *44,45,47,51-54,60* = (10,480 ac.) outside Streamside Forest Dry-mesic Oak-Hickory potential intersecting with FSVEG FT *44,45,47,51-54,60* = (5,914 ac.) outside Streamside Forest
Southern Piedmont Mesic Forest	Southern Piedmont Mesic Forest (1,220 ac.) = (Mesic / Alluvial Forests plus Hardwood Slope Forest environmental models)	Southern Piedmont Mesic Forest potential intersecting with FSVEG FT 50,55,56 = (1,076 ac.) outside Streamside Forest
Southeastern Interior Longleaf Pine Woodland	Southeastern Interior Longleaf Pine Woodland (7,560 ac.)	FSVEG FT 21 outside Streamside Forest = (2,300 ac.)
Southern Piedmont Glades and Barrens	Shortleaf Pine-Oak Woodland (92 ac.)	Shortleaf Pine-Oak Woodland potential (<20 ac.)
	UWNF Ecological Systems listed below were not derived from environmental modeling	
	Southern Piedmont Glades and Barrens (< 100 ac., 11 sites)	NC Natural Heritage Program Community Element Occurrences 2011 (< 100 ac., 11 sites)
Southern Piedmont Mafic Hardpan Woodland	Southern Piedmont Mafic Hardpan Woodland (17 ac., 6 sites)	NC Natural Heritage Program Community Element Occurrences 2011 (17 ac., 6 sites)
Piedmont Seepage Wetland	Piedmont Seepage Wetland (200+ ac., 19 sites)	NC Natural Heritage Program Community Element Occurrences 2011 (200+ ac., 19 sites) outside Streamside Forest
Southern Piedmont / Ridge and Valley Upland Depression Swamp	Southern Piedmont / Ridge and Valley Upland Depression Swamp (<40 ac., 9 sites)	NC Natural Heritage Program Community Element Occurrences 2011 (<40 ac., 9 sites)
Southern Piedmont Large Floodplain, Southern Piedmont Small Floodplain and Riparian Forest, Southern Piedmont Dry Oak – (Pine) Forests	Streamside Forest (6,800 ac.) One-hundred foot zone adjacent to perennial streams plus adjacent floodplain / alluvial soils. Perennial streams derived from 1:24,000 scale topographic maps plus hydrologically modeled streams below 19 acre catchment area (ESRI 2002)	Streamside Forest (6,800 ac.) One-hundred foot zone adjacent to perennial streams plus adjacent floodplain / alluvial soils. Perennial streams derived from 1:24,000 scale topographic maps plus hydrologically modeled streams below 19 acre catchment area (ESRI 2002)
Cultivated Forest, Semi-natural Forest	Successional and planted Forest (**acres are included in above types**)	Successional Forest (20,200 ac.) (**acres <u>not</u> included in above types**) Loblolly Pine (10,800 ac.) = FSVEG FT 31, 13 Shortleaf Pine (9,400 ac.) FSVEG FT 32, 12, 33, 16

[1/] See Appendix A for explanation of ecological modeling methods and results

In general, environmental modeling and geologic substrate facilitated the mapping of existing ecological systems on the Uwharrie NF by:

1. Separating oak-dominated FSVEG forest types 44 (Southern Red Oak -Yellow Pine – 1,043 ac.), 45 (Chestnut Oak-Scarlet Oak-Yellow Pine – 1,629 ac.), 47 (White Oak-Black Oak-Yellow Pine – 2,583 ac.), 51 (Post Oak-Black Oak – 14 ac.), 52 (Chestnut Oak – 716 ac.), 53 (White Oak-Red Oak-Hickory- 14,670 ac), 54 (White Oak – 292 ac.), 55 (Northern Red Oak – 155 ac.), and 60 (Chestnut

Oak-Scarlet Oak – 308 ac.) into ecological systems based upon temperature, moisture, and fertility (geology) gradients;

2. Separating pine-dominated FSVEG forest types 12 (Shortleaf Pine), 13 (Loblolly Pine-Hardwood), 16 (Virginia pine-Oak), 31 (Loblolly Pine), 32 (Shortleaf Pine), and 33 (Virginia Pine) into Successional Forest ecological systems or Southern Piedmont Mesic Forest ecological systems, and
3. Identifying pine-dominated FSVEG forest types that could potentially support Oak, Oak-Hickory or Longleaf Pine ecological systems.

Information developed in the following sections is used to evaluate and interpret the status of ecological systems on the Uwharrie NF. Each section is summarized in a subsection titled "***Evaluation***". Proposed plan components that provide for characteristics of ecosystem diversity that address these evaluations are listed in section 3.6.

3.1 Spatial Scales for Ecosystem Diversity

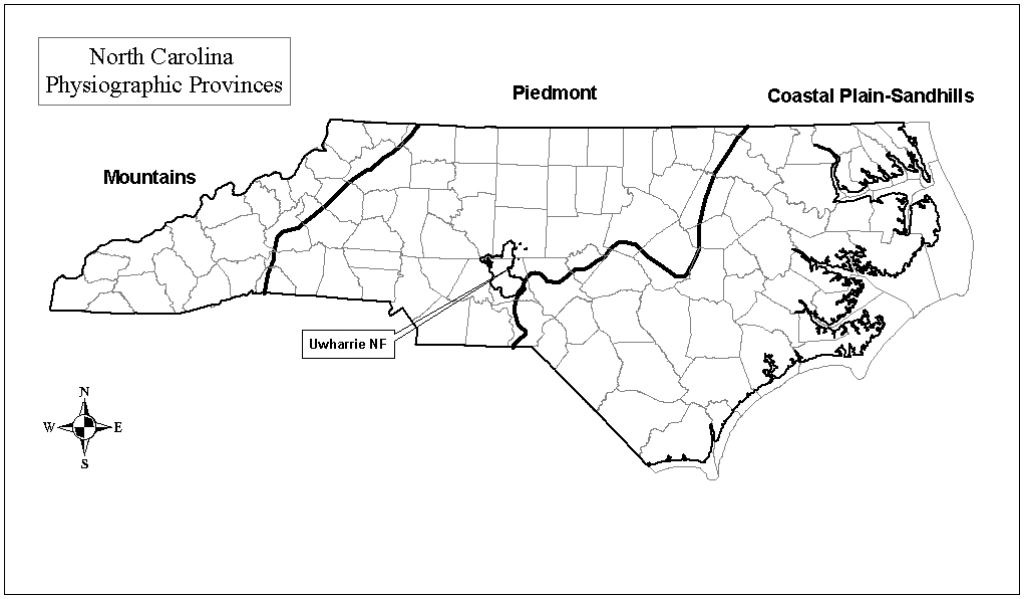
The spatial scales for considering ecosystem diversity on the Uwharrie NF were selected to address the administrative plan area and its role in the broader ecological context. Essentially we looked at ecological subsections from the National Hierarchical Framework of Ecological Units (USDA 1993) and at the landscape-level environmental model area for context and national forest roles in providing for ecosystem diversity. Ecological system characteristics on the Uwharrie NF were evaluated in detail to better understand opportunities and limitations for national forest lands to contribute to the sustainability of ecological systems.

The Uwharrie NF is located within the Southern Appalachian Piedmont Ecological Section, a broad area over 42 million acres in size that lies between the Coastal Plain and Blue Ridge Mountains. The proclaimed boundary of the Uwharrie NF is within a portion of the Sand Hills Ecological Section, and two Ecological Subsections within the Piedmont: the Carolina Slate Belt and Southern Triassic Uplands. No national forest land is managed within the Sand Hills Section, an area that is dominated by longleaf pine and pond pine ecological systems and very unlike the Uwharrie NF.

The Uwharrie NF is located within the North Carolina Piedmont ecoregion. The Piedmont region of NC is bounded on the east by the coastal plain and on the west by the Blue Ridge Mountains. The Piedmont is the most extensively modified of the state's regions as three centuries of intensive use eliminated most of the original natural habitats. Nearly the entire region has been farmed or timbered in the past, resulting in more than half of the area being in some stage of reforestation through the process of plant succession. The forest vegetation on the Piedmont is dominated by a mixture of oaks and hickories, with an understory of dogwood, red maple, sourwood, and black gum. The herbaceous flora is generally sparse and of relatively low diversity.

The NC Piedmont area provides the bounds on the area of analysis to evaluate the environmental context, opportunities, and limitations for national forest system lands to contribute to the diversity of native plant and animal communities.

Figure 1. Ecological Subregions in and adjacent to the Uwharrie National Forest in NC



In areas where forest cover is relatively high but ownership is highly fragmented, such as on the Uwharrie NF, it is anticipated that even marginal changes in forest cover may have disproportionate impacts on the connectivity of forested habitats (USDA 2002). The Uwharrie NF is approximately 51,000 acres in size and just a fraction of the total extent of the NC Piedmont region. Other federal land ownership within the NC Piedmont region includes the Pee Dee National Wildlife Refuge, approximately 8,400 acres, and Fort Bragg, approximately 160,700 acres.

The environmental model was used to approximate the extent of potential ecological systems on a 622,000 acre area bounded by the extent of 16 - USGS 7 ½ minute quadrangles centered on the Uwharrie NF (Figure 2). This area includes both National Forest System (NFS) lands and non-NFS lands and covers 497,440 acres within Montgomery, Randolph, Davidson, and Stanly counties (Table 2). The potential extent of ecological systems and the proportion of forested area on non-NFS lands was approximated using results of modeling (Appendix A) (Brown and Sheffield 2003) in order to evaluate the opportunities and limitations for NFS lands to contribute to the sustainability of ecological systems in the plan area (Table 2).

The Uwharrie NF includes about 10% of the total land but roughly 15% of the forested land within the analysis area. Similarly, the potential extent of at least four ecological systems is disproportionately greater on the Uwharrie NF, i.e. although the Uwharrie NF is only 15% of the total forest area, it could support nearly 30% of Xeric Oak Forests, 21% of Dry-mesic Oak-Hickory felsic Forests, 19% of Dry Oak-Hickory felsic Forests, and 18% of all Dry Oak-Hickory mafic Forests in the four-county modeled area. Potential for several ecological systems are also underrepresented on the Uwharrie NF including Southern Piedmont Mesic Forests, Streamside Forests, and Longleaf Pine Woodlands (Table 2).

Figure 2. Area of the environmental variable-based model (hatched) used to map potential ecological systems centered on the Uwharrie NF (shaded) and Montgomery, Davidson, Randolph, and Stanley Counties

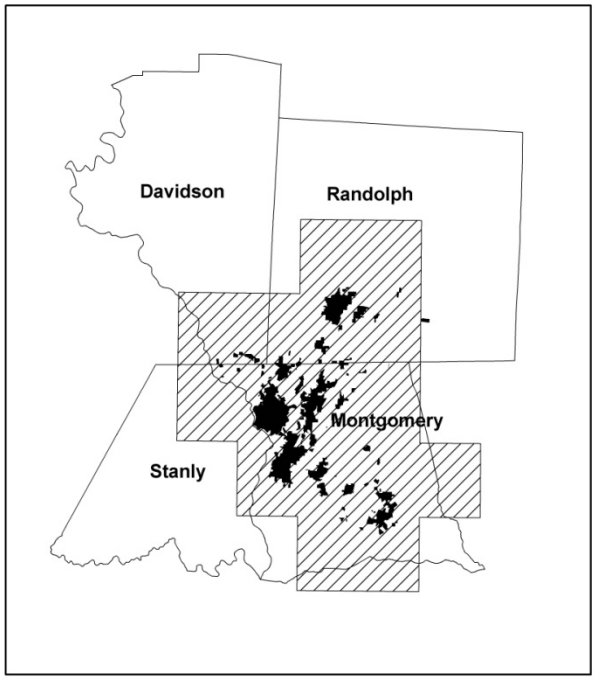


Table 2. Potential extent of ecological systems in the 4-county modeled area

Ecological System	UwhNF (approx. acres)	UwhNF % of Modeled Area	Total Modeled Area (acres)	Modeled Area by County			
				Davidson (acres)	Montgomery (acres)	Randolph (acres)	Stanly (acres)
Total area	**51,000**	**10.3%**	**497,440**	**41,720**	**239,130**	**159,320**	**57,270**
% forest [1/]	98%		67%	56%	78%	62%	43%
Xeric Oak Forest	2,990	30.9%	9,685	1,925	1,710	5,130	920
Dry Oak-Hickory	20,800	18.1%	114,976	11,625	37,690	53,790	11,870
Dry Mesic Oak-Hickory	11,060	21.6%	51,265	4,540	25,015	17,220	4,490
So.Piedmont Mesic	1,220	8.4%	14,530	580	9,550	2,280	2,120
Longleaf Pine Woodland	7,560	10.3%	73,321	0	73,141	180	0
Streamside Forest	6,800	9.7%	70,405	4,690	39,375	21,150	5,190
Total Forested	**50,430**	**15.1%**	**333,289**	**23,363**	**186,521**	**98,778**	**24,626**

[1/] Private land figures exclude forests on the Uwharrie NF

The proportion of forested land in the four county area (67% forested) surrounding the Uwharrie NF is higher than the 52% estimated in 2002 for the North Carolina Piedmont as a whole (USFS Forest Survey, Brown and Sheffield 2003). Montgomery County, where most of the Uwharrie NF is located, is about 80% forested, more than any other county in the 35-county Piedmont of North Carolina. The extent of forest land in the four county area during the past 20 years has been relatively static although has increased about 19% in Davidson County and decreased by nearly the same amount in Stanly County (Brown 1990, Hutchins 1984).

Evaluation

Because of its small size relative to the NC Piedmont region, it would appear that the Uwharrie NF has very limited opportunities to contribute to the sustainability of ecological systems and the species they support. However, ecological systems on many private lands have greatly departed from their natural range of variation due to urban development, farming, and short-rotation timber production within these subregions. Still, unless the Uwharrie NF provides the majority of known occurrences of specific rare ecosystems or rare species throughout this subregion, its contribution to ecological sustainability will probably always be limited by its small size and fragmented condition (see section 3.5).

At a more local level focused on the plan area, the Uwharrie NF could contribute greatly to sustaining ecological systems and the species they support. This contribution is due primarily to the diversity of habitats available on the Uwharrie NF, the relative amount of intact forests that occur on mafic rock that support a variety of locally rare species, and the potential for restoration of rare ecological systems such as Southeastern Interior Longleaf Pine Woodlands. Future loss of forest acres to developed uses on private lands would likely make the Uwharrie NF's conservation contribution even more meaningful in the future.

3.2 Characteristics of Ecosystem Diversity

In order to evaluate ecological sustainability, we must identify the ecological processes, ecosystem composition, and structural characteristics that are important to the long term persistence of ecological systems on the Uwharrie NF. Three general characteristics are evaluated for each ecological system: (1) the abundance of each ecological system, i.e., the area supporting characteristic dominant vegetation of the system on ecologically appropriate sites, (2) forest density expressed in terms of percent overstory closure and size of canopy gaps, and (3) fire regime and its role in maintaining subcanopy and understory species composition and structure. Two additional characteristics are evaluated for specific ecological systems where they are important factors affecting composition and processes: (1) the abundance of non-native invasive species, and (2) hydrologic regime. All of these characteristics are measurable, have been significantly influenced by past management actions, and are subject to management control in the future. Therefore, they are important factors to consider when establishing (or evaluating) plan components. To quantify the status of these characteristics, the following indicators have been developed and specifically applied to each of the 12 ecological systems (Appendix B) where they are appropriate:

Key Factor	Indicator
Species Landscape Composition	*The percent of NFS acreage dominated by species characteristic of the ecological system on ecologically appropriate sites.* This indicator is used to evaluate the abundance and distribution of the system on the landscape, i.e., the proportion of the total acreage dominated by plant communities and species composition characteristic of ecological systems best adapted to the site, regardless of their successional stage.
Species Composition	*The percent of NFS acreage for a given ecological systems with less than 10% non-native invasives species (NNIS) cover.* This indicator is used to evaluate the degree of

	competition from non-native species and their effect on the long-term persistence of native species best adapted to the site.
Canopy Structure	*The percent of NFS acreage at the desired canopy closure for a given ecological system approximated by the number of acres thinned or having basal area reduced through natural disturbance within the last decade.* This indicator is used to evaluate the proportion of forests that have the structure, i.e., canopy closure that facilitates the development and maintenance of species characteristic of the system
Fire Regime	*The percent of NFS acreage prescribed burned on multiple occasions within the last 15, 20, or 30 years (time period specific to system) under appropriate conditions for a given ecological system.* This indicator is used to evaluate the condition of subcanopy and understory tree, shrub, herb, and grass species and the role of disturbance regimes that allow periodic perturbations to maintain canopy gaps and thin midcanopy trees to favor species best adapted to the site.
Hydrologic Regime	*The percent of NFS acreage within a given ecological system with unaltered natural hydrology (undrained)* . This indicator is used to evaluate the status of wetland systems, i.e., their ability to persist and provide conditions for wetland dependent species.

For each ecological system, benchmarks were developed for the appropriate indicator based on proportions of the optimal extent of the system on the landscape. Optimal extent is defined as the total potential acres that could be occupied by the ecological system. Four qualitative categories were used to rate each indicator: "Very Good", "Good", "Fair" and "Poor". An additional indicator rates the combined condition of each key factor on the same site and is used to evaluate departure from overall reference condition (see section 43.14.2). The qualitative categories are defined as follows:

- **Very Good:** The key factor (characteristic) is functioning at an ecologically desirable status, i.e., is self-maintaining and requires little management action.
- **Good:** The key factor is functioning within its natural range of variation and may require some management action.
- **Fair:** The key factor lies outside of its natural range of variation and requires management action. If unmanaged, the ecological system will be vulnerable to degradation.
- **Poor:** Allowing the key factor to remain in this condition for an extended period of time may make ecological system restoration or preventing species loss impractical or not economically feasible.

Category percentages vary by potential abundance (% of national forest acreage) of the ecological system (Table 3) on the Uwharrie NF. The benchmarks provide an important context to evaluate the current and desired conditions within each ecological system and can be used for monitoring progress related to the key factors. However, they may not necessarily be used as the desired condition itself. Given the climatic, cultural, and ecological changes that have occurred over time, it might not be possible to achieve "optimal" conditions.

Table 3. Values used to calculate benchmarks representing "very good", "good", "fair", and "poor" indicator condition. Percentages vary by potential abundance (% of national forest acreage) of an ecological system. Benchmarks are higher for indicators in rarer ecological systems, and lower for indicators in more common ecological systems. Benchmarks are also adjusted higher by 10-30% for the combined indicator used to evaluate departure from overall reference condition.

	Percent of "Optimal" extent of ecological systems			
Percent of national forest acreage potentially occupied by the ecological system	**"Very Good"**	**"Good"**	**"Fair"**	**"Poor"**
> 10% (i.e. oak-hickory and longleaf pine)	> 75%	55%-75%	30%-55%	< 30%
1% to 10% (i.e. mesic hardwoods)	> 85%	70%-85%	50%-70%	< 50%
< 1% (rare communities)	> 95%	85%-95%	70%-85%	< 70%

These benchmarks are based on expert opinion and standard percentages consistent with Region 8 guidelines. They should be viewed as coarse estimates, not hard thresholds, but as planning tools that are useful for assessing ecological outcomes and for evaluating management performance during monitoring of plan implementation.

3.3 Range of Variation

The historic range of variation is also a necessary context to evaluate current and desired conditions on the Uwharrie NF. The Forest Service Handbook (FSH) gives direction to evaluate natural variation of ecosystem characteristics (section 3.2) in the context of a reference period with relative climatic and ecological stability, i.e. the period of indigenous settlement, but prior to the influence of European-American settlement, (FSH 1909.12.43.13). These selected ecosystem characteristics serve as reference conditions for species analysis during planning.

It is difficult to accurately determine the historic range of variation in disturbance regimes in the ecologically diverse eastern United States. This is especially true in the highly fragmented land ownership of the Southern Piedmont where hurricanes, tornadoes, fire, insects, drought, and disease interacting with a 12,000+ year history of human disturbance (pre-settlement Native American influences, clearing for European settlements, historic agricultural use, and current urban sprawl) that has masked reference period vegetation patterns. Furthermore, unlike the western United States, few intact ecological systems at or near pre-European settlement conditions still exist in the Southern Piedmont to define and study reference conditions. However, we can approximate the abundance and distribution of ecological systems for a reference period prior to European settlement through the use of environmental modeling based on remnant vegetation and site features. We can also estimate other important ecological characteristics such as canopy closure and composition by evaluating current habitat requirements for plant communities or species in decline due to habitat loss or degradation. Finally, we can evaluate the disturbance processes that affect or have affected ecological systems in the Southern Piedmont and use ecological understanding of how the structure and composition of vegetation on the Uwharrie NF have been influenced by these disturbance regimes.

Disturbance processes

Hurricanes and Tornadoes: Over the 107-year period 1871 through 1977, a total of 651 tropical cyclones (tropical storms and hurricanes) of various intensities have been recorded over the Atlantic cyclone basin (NOAA 1978). A total of 257 or about 40 percent have crossed or passed immediately adjacent to the United States mainland. About 140 of these were of hurricane strength and 21 occurred in North Carolina. Eight of the hurricanes in North Carolina during this period were considered major hurricanes (≥ category 3) "capable of blowing large trees down" and therefore capable of altering the composition and structure of forests. Only Florida had a greater number (50) of hurricanes than North Carolina during this same period and 21 of these were considered major.

During the period from 1978 to 2005, 13 additional hurricanes have been recorded in North Carolina. Of the total 33 hurricanes recorded in North Carolina from 1871 to 2005, 11 (33 percent) have passed within 100 miles of the Uwharrie NF or were recorded as producing damage in the surrounding four county area. However, only three of these – Hazel, Hugo, and Fran were major hurricanes. Moderate damage (partial tree blowdown up to 10 acres in size) on the Uwharrie NF occurred from Hazel, Hugo, and Fran but was not widespread. The year 2005 was the most active year on record for hurricanes in the Atlantic cyclone basin.

Although hurricane frequency declines from coastlines to the interior Piedmont, tornadoes are more frequent in interior areas. Nearly 10 violent tornadoes per year have occurred over the last 100 years (Grazulis 1984) in the Piedmont region. Since 1950, 39 tornadoes (or about 4 per decade) have been recorded in the four counties surrounding the Uwharrie NF. Most of these were considered weak tornadoes (F0-F1) with winds less than 112 mph, but seven (nearly one per decade) were strong tornadoes (F2) with winds exceeding 112 mph. Damage on the Uwharrie NF has likely been greater from tornadoes, in the long term, than from hurricanes; damage to stands nearly 100 acres in size have been documented on the Uwharrie NF (Carter 2006) although this damage resulted in only partial loss of the tree overstory.

Insects: The Southern Pine Beetle (*Dendroctonus frontalis*) is the most destructive pine bark beetle in the southern United States. They are indigenous, occurring in small numbers, but populations are cyclic and occasionally increase dramatically to epidemic proportions over wide areas. Pine trees are killed singly, in small groups, or in large numbers over hundreds of acres. An epidemic cycle may last 3-5 years. Environmental factors and/or natural predators will eventually cause a population collapse, ending the epidemic.

Infestations can develop to epidemic levels when pine forests are stressed by crowded growing conditions or drought, trees are damaged from ice or wind, or when stands are considered biologically mature. Once beetle populations develop in weakened trees, they may spread to healthy trees that normally would resist attack. When beetle populations become large, they can successfully attack healthy, vigorous trees, resulting in widespread mortality. Natural enemies, including diseases, parasites, and predators, can

help maintain beetle populations at normal levels; however, these forces seem to have relatively little effect during epidemics. Most major outbreaks last from three to five years and occur in irregular cycles of about seven to 10 years.

Southern Pine Beetle activity on the Uwharrie NF has largely been confined to loblolly and shortleaf pine stands, but could impact all pine species in pine and mixed pine and hardwood forest types if populations increase to epidemic proportions. Southern pine beetle infestations can cause a shift in community composition in mixed pine-hardwood or pine-oak stands and a shift in forest-wide age-class distribution in pine dominated stands. Shade tolerant species such as blackgum, red maple, sourwood, and dogwood may increase in abundance in pine-hardwood stands and oaks are likely to become more dominant in mixed pine-oak stands. Pine dominated forests may experience a 30+% increase in seedling-aged stands (USDA 2003).

The most recent Southern Pine Beetle outbreaks on the Uwharrie NF occurred in the mid 1990's and in 2002. During the first infestation suppression actions were taken on approximately 120 acres over a 5-year period from 1992 to 1996. Monitoring by the Forest Service-Forest Health Protection Unit indicated low but increasing SPB populations from 2001 and 2002. The North Carolina Department of Forest Resources predicted the North Carolina Piedmont would have an increasing population trend in 2003, and possibly in 2004. In 2003, up to 5,000 acres of Southern Pine Beetle suppression treatments were authorized to suppress infestation on the Uwharrie NF.

Lightning Caused Fires: Lightning storms, which can lead to fire ignition in forests, are more frequent in the Southeast than in any other part of the United States. Historic records indicate an average lightning-caused wildfire interval of 2-3 (Cowell 1992) or 3-5 (Hughes 1966) years in the southeast coastal plain where fire compartments are large and lightning is frequent. A fire compartment is defined as an element of the landscape with continuous fuel and no natural firebreaks, such that an ignition in one part would be likely to burn the whole (Frost 1998). Fire danger may remain high in the Coastal Plain even when heavy rain is associated with lightning storms because of the drying effects in the commonly open-canopied pine savannas and their associated sandy, droughty soils (Juras 1997). In the Piedmont, the landscape is more frequently dissected by drainages that create fire compartments that may be too small to allow fires to burn large areas as frequently as they do in the coastal plain. Furthermore, fire danger in the more closed canopy forests of the Piedmont decreases as vegetation "greens up" during the summer season when lightning storm frequencies are at their maximum.

We might conclude that lightning caused fires, based on their lack of extensive documentation in the Piedmont, may have played an infrequent role in changing the composition and structure of terrestrial ecological systems on the Uwharrie NF prior to European settlement. However, this does not explain the persistence of longleaf pine woodlands or flora more adapted to open, prairie-like conditions that currently exist only on managed rights-of-way (roadsides, field margins, railway embankments, and power lines) on the Uwharrie NF. Some of these species are not widespread outside the Piedmont, and a few, such as Schweinitz's Sunflower, are restricted to the region (Barden

2002). The persistence of these species and of longleaf pine woodlands is evidence that presettlement conditions on the Uwharrie NF included more open landscapes than we see today.

Native American Caused Fire: There has been much debate on causes and effects of fire in the presettlement Piedmont (Juras 1997). However, the preponderance of anecdotal (Stewart 1963, Williams 1992), archeological (Dobyns 1966, 1983; Jacobs 1974), ecological (Delcourt and Delcourt 1997, 1998; Hamel and Buckner 1998), and meteorological evidence supports the conclusion that fire was a widespread occurrence in the pre-European landscape. Furthermore, more recent studies of "fire signatures" in Antarctic ice-cores indicate almost a 40% reduction in biomass burning emissions from about 1000 A.D. to 1700 A.D. and that from 1500 to 1700 A.D., regional human population variations are the most likely cause of these reduced emissions (Ferretti et.al. 2005). This is the time period when Native American populations severely declined as a result of Old World diseases brought by Europeans explorers.

It is likely that many of the Piedmont ecological systems developed under a regime of Native American-caused fires over a period of thousands of years. Native Americans have lived in the Piedmont region for 12,000 years and they burned the forest to improve hunting, to facilitate travel, and to clear fields for agriculture (Merrell 1989). The wealth of independent historical reports of large prairie-like openings suggests that they were an important component of the landscape in the Carolina Piedmont region and that these "prairies" were created or at least maintained by Native Americans using fire (Barden 1997, 2002).

Further evidence of the importance of Native American-caused fire may come from historical observation of actual fires. Most of these observations were made during the dormant season (Lawson et al. 1701) when lightning-caused fires are extremely uncommon. However, because early explorers primarily traveled along established trails through regions inhabited by Native Americans and probably extensively cultivated, their observations may give a false impression and exaggerate the importance of fires and frequency of openings in the broader landscape.

The documented presence of bison in the early historic record is also given as evidence of significant alteration of the forest ecosystems in the Southeast; a large-scale program of burning by Native Americans converting large tract of forests to grasslands, thereby providing habitat for this grazing species (Rostlund, 1957, 1960). An inspection of the archaeological and historic record, however, does not support this interpretation (Bass 2002). Of the thousands of archaeological sites representing the Native American occupation for the southeast and dating from at least 8,000 B.C. to the late historic period that have been excavated, only one bison specimen is attributable to this period and it was a bison horn covered in copper and undoubtedly a ceremonial object (Bass 2002).

Still, it is likely that the historical Carolina Piedmont had some prairies which were open medium to large-size gaps among the mixed oak forests we see today. These prairies were able to establish where abundant rainfall would otherwise lead to forest because of

droughty soil and frequent fire (Barden 2002). It is also likely that extensive clearings occurred along productive bottomlands and alluvial terraces following the wide use of maize as a staple crop during the period of maximum cultivation in the Mississippian Period (1,200 to 500 years B.P). In this period, there was extensive clearing for cropland and large settlements were created whose influence included the harvest of wood for fuel and building materials in peripheral areas (Delcourt et al. 1993). During this period, Native Americans used fires to annually burn cereal grasses, to burn basket grasses and nut trees every three years, and the grassy savanna hunting areas annually (Pyne 1997).

Williams (1992) estimated that the cleared land needed to support a person before European settlement ranged from about two acres to 30 to 40 acres for all cleared and burned land. Although Native American population levels prior to European settlement are still debated (Snedeker 2006), assuming that 6 million Indians were part of the eastern woodland culture, and each person represented 10 to 20 burned acres, then 60 million to 120 million acres would have been affected by clearing and burning (Williams 1992). This is about 22 to 44 percent of the cropland acreage farmed in the 31 Eastern States in 1990. Although these exact figures can be refuted (Snedeker 2006), they were presented by Williams (1992) to reflect the importance of Native American impacts on the landscape through the use of fire.

Regardless of the role of Native-American caused fire in the Piedmont, Frost (1998) makes the case that fire-adapted and fire-dependent species in the U.S. have evolved over a much longer period of time than humans have occupied North America. Therefore, lightening would have been responsible for most fires historically and for the fire adapted species we see today. As Frost (1998) explains: "*Since any dependency on fire must involve evolutionary time, it seems unlikely that any rare species in the U.S. were dependent upon Native American burning. Native Americans have occupied North America only since the last glaciation – a relatively short time in evolutionary terms. The remarkable adaptations of extreme frequent-fire species like longleaf pine and Venus's flytrap are unlikely to have appeared in the 10,000 years since the end of the Wisconsin glaciation, and would have taken hundreds of thousands of years to evolve during previous interglacial periods*…." however "*The relative importance of Native American fires should be expected to increase in topographically complex areas where fire compartments are smaller, and in regions with infrequent lightning ignitions".*

Although the adaptations of individual species are <u>not</u> likely the result of Native American burning, anthropogenic fire is very likely responsible for the sorting of species distributions and development of the plant communities (i.e. ecological systems) and distributions we know today. It is this distribution of communities that we address in this analysis for conservation planning, not only the adaptations of individual species.

As a result of Old World diseases brought by Europeans explorers, during the 16th and 17th Centuries, Native American populations severely declined. The Piedmont became "the object of emigration" in the mid-1700's as "the extent and fertility of the beautiful prairies became known" (Foote 1846). When these European settlers moved into the Piedmont, they settled the open areas first because they did not have to clear the land of

trees and converted the prairies to fields and pastures. By the 1800's the Piedmont prairie community, including the elk, had disappeared from the Carolina landscape (Barden 1997).

Historic Fire Frequency on the Uwharrie NF: Frost (1998) developed a map of the United States that represents fire frequency in the most fire-exposed parts of each landscape during the era of European settlement (a window ranging from around 1565 to around 1890) using a synthesis of physiographic factors such as topography and land surface form, along with fire compartment size, historical vegetation records, fire frequency indicator species, lightning ignition data, and remnant natural vegetation. Native American burning was included in the estimate. The fire return interval in the Piedmont is estimated between 7-12 years for the most fire-exposed parts of the landscape, especially flats, dry uplands, and south slopes. Portions of the land within this area are naturally protected from fire such as wet areas, sparsely vegetated areas with insufficient fuels to carry fire, and fire-sheltered sites such as north-facing slopes, coves, ravines, steep-sided stream valleys.

The fire return interval is more likely at the low end of Frost's Piedmont range for portions of the Uwharrie NF south of Lovejoy because fire compartments are larger due to more rolling topography and smaller streams and because of its proximity to the Sandhills Section where Frost estimates a higher fire frequency of 4-6 years. Fire compartments are smaller outside of this area because they are restricted by the Uwharrie Mountains, and other mountains such as Morris Mountain, Walker Mountain, and the Birkheads.

Evaluation

Hurricanes and tornadoes have and will continue to impact forests on the Uwharrie NF and result in shifts in species composition and stand structure. These periodic disturbances, unlike in areas of the Southeastern Coastal Plain, are not likely to result in widespread alteration of ecological systems or loss of the species they support because major storm incidence declines from coastlines to the interior Piedmont. Widespread damage would be even less likely in portions of ecological systems on the Uwharrie NF where composition, structure, and ecological processes are ranked as being in "good" to "very good" ecological condition. Forests in these conditions are more resilient than forests whose ecological characteristics are outside the natural range of variation. However, few acres have been ranked in these categories on the Uwharrie NF (Appendix B); and Forest Plan components should be developed that improve the current ecological condition of forest composition and structure would reduce risks to biodiversity.

Similarly, Southern Pine Beetle outbreaks have and will periodically cause damage to trees and result in shifts in species composition and stand structure on the Uwharrie NF. These outbreaks have the potential to develop into epidemic levels that could result in extensive damage to pines. Plan components have been developed that emphasize reducing overcrowded conditions in pine stands, managing for species best adapted to the site, and continuing the suppression of Southern Pine Beetle infestations using integrated pest management practices.

The influence of fire on the composition and structure of ecological systems on the Uwharrie NF has probably been greater than from any other source of disturbance. The extent of species and plant communities adapted to fire has been significantly reduced on the Uwharrie NF, and flora more adapted to open, prairie-like conditions currently exists only on managed rights-of-way. Plan components have been developed to emphasize reintroducing fire on the Uwharrie NF using fire return intervals appropriate to the ecological system, and restoration of plant communities that are fire-adapted such as Southeastern Interior Longleaf Pine Woodlands.

3.4 Current Condition and Trend of Ecosystem Characteristics and Status of Ecosystem Diversity

In this section the current condition of the selected ecosystem diversity characteristics (overstory composition, canopy structure, and subcanopy / structure and composition) are described and evaluated. The purpose of this evaluation is to determine:

1. The parts of the system that are functioning and will likely continue to function in a way that contributes to ecosystem resiliency and diversity over time.
2. Those parts that may need adjustment through future management actions.

The current condition of ecosystem characteristics for each ecological system is evaluated in Appendix B along with a full description of each ecological system.

Current Condition and Trend in Forest Type Composition

Approximately one-half of the approximately 51,000 acre Uwharrie NF is dominated by pine and about one-half is dominated by hardwoods (FSVEG). Loblolly pine and shortleaf pine are the most common pines; chestnut oak, white oak, and southern red oak are the most common hardwoods. There are 22 forest types on the Uwharrie NF identified in FSVEG. The most extensive forest types are white oak- red oak-hickory and loblolly pine and together they cover one-half of the Uwharrie NF. Other common types include (in order of decreasing importance): shortleaf pine, white oak-black oak-yellow pine, shortleaf pine-oak, longleaf pine, and chestnut oak-scarlet oak-yellow pine. Approximately 749 acres are non-forested openings or have not been inventoried to determine forest type.

Forests on the Uwharrie NF are older than forests on the surrounding private land. Approximately one-third of the Uwharrie NF forests are 40 years or less in age and about one-half are greater than 80 years in age (Figure 3). Hardwood dominated forest types are generally older than mixed pine-hardwood or pine dominated forest types. The most extensive older stands are mapped as white oak-red oak-hickory and they represent about 10% of the land base.

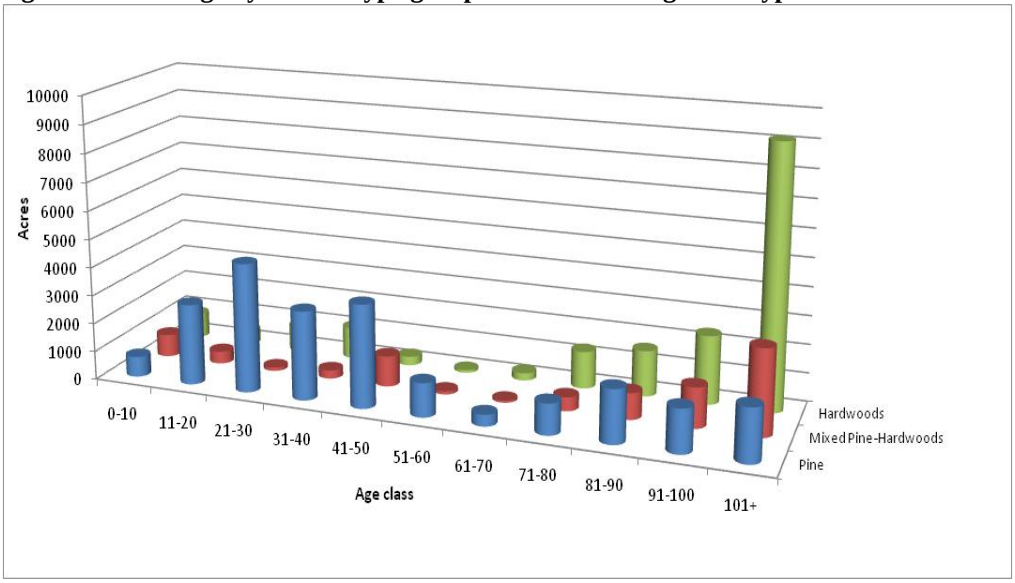
Table 4. Current Forest Composition on the Uwharrie National Forest.

Forest Type	Total
Longleaf Pine	2,605
Loblolly Pine	11,540

Forest Type	Total
Shortleaf Pine	8,232
Virginia Pine	370
Virginia Pine-Oak	93
Shortleaf Pine-Oak	1,964
Loblolly Pine-Hardwood	757
Southern Red Oak-Yellow Pine	1,042
Chestnut Oak-Scarlet Oak-Yellow Pine	1,837
Bottomland Hardwoods-Yellow Pine	540
White Oak-Black Oak-Yellow Pine	2,483
Post Oak-Black Oak	14
Chestnut Oak-Scarlet Oak	357
Chestnut Oak	687
White Oak-Red Oak-Hickory	15,994
White Oak	292
Northern Red Oak	83
Yellow Poplar-White Oak-Red Oak	1,002
Laurel Oak-Willow Oak	27
Yellow Poplar	53
Sweet Gum-Yellow Poplar	81
Elm-Ash-Sugarberry	11
not classified	717
Total Uwharrie NF Acreage	**50,782**

Overall, average-aged stands (age 50-70) on the Uwharrie NF are underrepresented while younger and older stands are over-represented. The large number of stands less than 50 years in age and the narrow range of average-aged stands is likely due to the period when active forest management began on the Uwharrie NF in 1961 – the year the Uwharrie NF was established. Since this time, about 8,200 acres of loblolly pine and about 3,500 acres of shortleaf pine have been planted and/or young stands have been acquired (Tables 5-6). This trend has decreased greatly in the past decade as silvicultural operations have moved towards increased thinning of existing stands and less regeneration harvest.

Figure 3. Stand age by Forest Type group within all management types



Along with the downward trend in timber harvest on the Uwharrie NF is a reduction of acres managed for loblolly pine or shortleaf pine that could support longleaf pine or oak-hickory forests. From 1966 to 1986, about 26% of land capable of supporting forests in the longleaf pine ecological system was managed for loblolly pine. This is evident by examining the percent of current loblolly pine stands 21-40 years old that occur on longleaf pine sites (Table 5). During this same period about 30% of land capable of supporting forests in oak-hickory ecological systems was managed for loblolly pine. Similarly, shortleaf pine was favored over longleaf pine and oak-hickory forests in these same ecological systems. A change in this trend is evident beginning in the 1990s (1-10 and 11-20 year age classes). Fewer regeneration areas were managed for loblolly pine, which is reflected in the small percentage of acres (0% to 1.1%) of potential longleaf or oak-hickory sites that are currently dominated by loblolly pine in the 1-10 year age-class (Table 5). During this same period shortleaf pine was still managed on sites more suitable for longleaf pine (43 acres) or oak-hickory forests (180 acres), but longleaf pine was planted on over twice as many acres as during the previous two decades.

Table 5. Trends in the preference of species managed on the Uwharrie NF from 1970 to 2010 evident from the age class distribution of loblolly and shortleaf pine forest types that occupy longleaf and oak-hickory sites.

Age Class (years)	Longleaf Pine sites		Oak-Hickory sites			Longleaf Pine sites		Oak-Hickory sites	
	Existing Forest Type (acres)		Existing Forest Type (acres)			Existing Forest Type (% of potential longleaf pine)		Existing Forest Type (% of potential oak-hickory)	
	Loblolly pine	Shortleaf pine	Loblolly pine	Shortleaf pine		Loblolly pine	Shortleaf pine	Loblolly pine	Shortleaf pine
1-10	0	43	83	180		0.0%	9.0%	1.1%	5.3%
11-20	96	117	747	1117		2.6%	13.4%	9.7%	14.1%
21-30	987	121	1520	1246		26.8%	13.8%	19.8%	15.8%
31-40	380	37	1680	834		10.3%	4.2%	21.8%	10.6%
0-20	96	196	830	1536		2.8%	18.8%	11.1%	18.3%
21-40	1367	158	3200	2080		38.7%	20.5%	43.1%	30.2%
41-50	1241	14	2077	138		33.7%	1.6%	27.0%	1.7%
51-60	383	22	712	53		10.4%	2.5%	9.3%	0.7%

Age Class (years)	Longleaf Pine sites		Oak-Hickory sites			Longleaf Pine sites		Oak-Hickory sites	
	Existing Forest Type (acres)		Existing Forest Type (acres)			Existing Forest Type (% of potential longleaf pine)		Existing Forest Type (% of potential oak-hickory)	
	Loblolly pine	Shortleaf pine	Loblolly pine	Shortleaf pine		Loblolly pine	Shortleaf pine	Loblolly pine	Shortleaf pine
61-70	113	32	200	52		3.1%	3.7%	2.6%	0.7%
71-80	59	147	128	652		1.6%	16.8%	1.7%	8.2%
81-90	107	158	257	1052		2.9%	18.0%	3.3%	13.3%
91-100	313	19	194	602		8.5%	2.2%	2.5%	7.6%
100+	7	130	91	1740		0.2%	14.8%	1.2%	22.0%
						100%	100%	100%	100%

Condition and Trend in Canopy Structure based on the extent of thinning

About 3,500 acres of thinning has occurred on the Uwharrie NF in the past 10 years; with approximately 70-75% occurring in loblolly pine stands, 20% in longleaf, and 10% in oak-hickory stands. During the last five years thinning activities have almost doubled.

Current Fire Frequency and trends in prescribed burning

Nearly 9,800 acres (about 20% of the Forest) have been prescribed burned at least once on the Uwharrie NF during the last 30 years (Table 6). About 2,800 acres have been burned more than once in the last 10 years and 5,200 acres have been burned more than once in the last 20 years. Over one-half of the acres burned were dominated by loblolly or shortleaf pine occurring on sites capable of supporting longleaf pine forests, oak-hickory, or other types. The most frequent burning has occurred on sites capable of supporting longleaf pine; about one-half was dominated by longleaf pine at the time of burning. About 40% of the potential acres that could support forests in the Southeastern Interior Longleaf Pine Woodland ecological system have been burned at least once in the last 30 years (Table 6). By contrast, only 13% of Oak-Hickory felsic Forest sites and about 11% of Xeric Oak sites have been burned during this period.

Table 6. Prescribed fire frequency from 1986 to 2006 on the Uwharrie NF within ecological systems (potential acres)

Ecological System	Potential acres	Prescribe fire frequency				
		at least once in last 30 years		> once in last 10 years	> once in last 15 years	> once in last 20 years
		acres	% of type	acres	acres	acres
Xeric Oak Forest	2,990	306	10.6	75	148	165
Shortleaf Pine-Oak Woodland	< 100	5	5.0	0	0	0
Southeastern Interior Longleaf Pine Woodland	7,560	3,316	40.0	1,310	1,783	2,162
Dry Oak-Hickory (felsic)	19,200	2,558	13.3	450	728	962
Dry Oak-Hickory (mafic)	2,200	387	17.5	19	176	209
Dry-mesic Oak-Hickory (felsic)	9,150	1,611	17.6	475	667	856
Dry-mesic Oak-Hickory (mafic)	820	134	16.3	16	76	85
Southern Piedmont Mesic Forest	1,220	204	22.2	52	87	97
Streamside Forests	6,800	1,265	18.3	380	569	681
Total for all types		9,786 [1/]	20.0	2,777	4,234	5,217

[1/] Over ½ of prescribed burning occurred in forests not at their "potential" but dominated by shortleaf and loblolly pine

Evaluation

The current **composition** of forests on the Uwharrie NF has departed to a large degree from what we have approximated and the literature has suggested for the pre-European settlement forest. Approximately one-half of the Uwharrie NF is dominated by pine and pine forest types but composition in many of these forests lies outside of the natural range of variation based on our ecological condition rating (Appendix B). Although fewer acres have been planted to "offsite" species during the last 10 years, over 7,800 acres (15%) of the Uwharrie NF is still dominated by young to mid-age loblolly pine on sites that are better adapted to oak-hickory forests or longleaf pine. Many of these forests are inherently more vulnerable to natural disturbance events (hurricane, tornadoes, single disease or insect epidemics, fast moving wildfire) because they are intensively managed, even-aged stands approaching monoculture conditions.

The current **structure** of forests on the Uwharrie NF is variable but mostly outside the historic range of variation. This is due primarily to the abundance of even-aged pine plantations on the Forest. Approximately 3,500 acres of pine have been thinned in the past 10 years and thinning activities have accelerated during the last 5 years. Although thinning is the first step in restoring composition and structure for potential ecological systems on these sites, this is just 14% of the total 22,000 acres of pine dominated stands on the Uwharrie NF.

The current **fire regime** on most of the Uwharrie NF is outside the historic range of variation. Only about 20% of the Uwharrie NF has been prescribed burned during the last 30 years and less than 10% has been burned more than once during this period. Although a significant proportion of some ecological systems have been burned on multiple occasions (e.g. longleaf pine) only 13% of the most extensive ecological system (Dry-Oak-Hickory felsic) on the Uwharrie NF has been burned during this period.

During the past 10 years there has been an increasing trend in management to improve the composition and structure of forests and increase the role of fire as an ecological process on the Uwharrie NF. Therefore, the 1986 Plan has allowed a shift away from activities that do not contribute to ecosystem resiliency and diversity (such as pine site conversion) and toward those that improve these key factors. However, under the existing plan guidance, the future trend in the ecological condition for most key factors is likely to remain poor to fair. This expectation is primarily because thinning and prescribed burning objectives are not high enough to reduce the backlog of forests needing management, and because there are no objectives for restoring native plant communities. Ecological systems would therefore continue to be vulnerable to degradation. This is especially true for those rare systems not mentioned in the 1986 Plan, such as Southern Piedmont Glades and Barrens, Shortleaf Pine-Oak Woodland, Southern Piedmont Mafic Hardpan Woodland, Piedmont Seepage Wetland, and Southern Piedmont / Ridge and Valley Upland Depression Swamps. In addition, ecological systems that have declined in the past, such as Southeastern Interior Longleaf Pine Woodlands, would show little improvement.

Proposed plan components would improve the ecological conditions over the existing rankings, however, it will be a long-term process to achieve fair conditions for some of the ecological systems.

The current ecological condition for most indicators on the Uwharrie NF is only "poor" to "fair" (Table 7). Only four of the 12 ecological systems have "good" ratings for species composition, only one system has a "good" rating for canopy structure, and no ecological system has a "good" rating for subcanopy/understory composition and structure for fire processes. These low ratings are partially due to the ranking methodology used which calculates benchmarks relative to the potential (optimal) extent of an ecological system.

As indicated previously, given the climatic, cultural, and ecological changes that have occurred over time, it might not be possible to achieve "optimal" conditions and therefore benchmark levels could be adjusted downward. However, it is not likely that this would change the results of the evaluation of ecosystem diversity needs because roughly one-third of the forests on the Uwharrie NF are dominated by species that are not best suited for the site, e.g. loblolly pine on upland oak or longleaf pine sites. In addition, thinning and prescribed fire, although used increasingly in recent years to reduce canopy closure and midcanopy cover, have not been sufficient to achieve historic vegetation conditions. The fragmented ownership condition of the Uwharrie NF also contributes to the low ecological condition ratings by increasing the complexity of implementing management practices such as prescribed burning and timber harvest. This may further indicate the need to adjust the levels estimated for the potential extent of ecological systems.

Table 7. Current ecological condition rankings for Ecological systems on the Uwharrie NF

Ecological System	Species Composition	Canopy Structure	Fire Regime	Hydro. Regime
Southern Interior Longleaf Pine Woodland	Poor	Poor	Poor	N/A
Xeric Oak Forest	Poor	Fair	Poor	N/A
Dry Oak-Hickory Forest	Good	Fair	Poor	N/A
Dry-mesic Oak-Hickory Forest	Good	Fair	Poor	N/A
Mesic Forest	Poor	Fair	Fair	N/A
Streamside Forest (directly influenced by alluvial processes)	Poor	Fair	Poor	Good
Streamside Forest (not directly influenced by alluvial processes)	Fair	Fair	Poor	N/A
Successional Forest (Shortleaf and Loblolly)	Poor	Fair	Poor	N/A
Shortleaf Pine-Oak Woodland	Poor	Poor	Poor	N/A
Glades and Barrens	unknown	unknown	Poor	N/A
Mafic Hardpan Woodland	Fair	Poor	Poor	N/A
Upland Depression Swamp	Good	Good	N/A	Fair
Piedmont Seepage Wetlands	Fair	Fair	N/A	Fair

3.5 – Risks to Selected Characteristics of Ecosystem Diversity

The following threats or stresses have been identified for ecological systems and the diversity of native plant and animal species on the Uwharrie NF:

1) Habitat vulnerability: Sun-loving species that were once more widespread in open woodland habitats that currently exist only on managed rights-of-way (roadsides, railway embankments, power lines, or field margins) are at risk from damage due to mowing during the improper season or herbicide use. This could lead to

reduced viability or total loss of populations. The federally endangered Schweinitz's Sunflower falls into this risk category.

2) Altered fire regime: Disruption of natural, historical fire return intervals, fire intensity, severity, and extent in ecological systems that changes the composition, structure and abundance of characteristic, fire-influenced species and communities. This includes communities and rare species that occur in nearly all of the ecological systems on the Uwharrie NF.

3) Direct and indirect habitat disturbance: This threat includes primarily disturbance from unmanaged recreation (unauthorized roads in the OHV area and cross-country equestrian use) and risks from adjacent private land, i.e., wildfires originating from private land.

4) Altered conditions for insect infestations: This threat includes the risk of total loss of forests that are stressed by crowded growing conditions, (canopy closure outside its natural range of variation).

5) Competition for resources: This process includes the displacement of native species by non-native, invasive species that are capable of out-competing native species and communities for resources such as light, nutrients, and water. This threat is primarily a concern in Mesic Forests and where wildlife openings have been planted to non-native, and at times, invasive species.

Many of these threats are directly caused or at least aggravated by the fragmented ownership of the Uwharrie NF. There are over 60 separate land parcels or patches on this 51,000 acre Forest of which only 25% (15 total) are greater than 500 acres in size. These larger patches are further fragmented by internal private land holdings. The largest contiguous patch (no private in holdings) of national forest system lands is located in the Pekin area and is only 4,200 acres in size but due to its irregular configuration it has a 30-mile perimeter with private lands. Furthermore, ownership fragmentation on the Uwharrie NF only worsens the effect of the decrease in natural fire compartment size within the proclamation boundary (Langley 2000) and increases the difficulty in restoring pre-settlement vegetation patterns.

The greatest uncertainty in this risk assessment is from the unpredictability of how natural disturbances (hurricanes, tornadoes, natural lightening fire ignition, drought, and climate change) may interact. A prolonged drought could increase the risk of a pine beetle epidemic which, given a natural lightening fire ignition, could lead to widespread loss of forest cover. Widespread loss of forest cover could also result from a severe hurricane in the interior Piedmont. Although these natural disturbances are beyond our control, the suggested plan components should lessen these impacts especially if land acquisition and land consolidation occurs. Furthermore, those species more adapted to open conditions may, in fact, benefit from these uncertain disturbances.

3.6 Recommended Forest Plan Components

Based on the evaluation of spatial scales, existing conditions, range of variability, condition of ecological characteristics, and risks, the following plan components are

recommended to be part of the framework that would provide for characteristics of ecosystem diversity on the Uwharrie NF:

Recommended Desired Conditions:

- Woodlands and open forests with small canopy gaps, interspersed with glades and Piedmont prairies, occupy portions of the forest where they occurred historically. These forests contain mixed ages with old trees and old forest conditions.
- Plant communities more common in the past are reestablished on appropriate sites across the forest. Examples include longleaf pine woodlands, shortleaf pine woodlands, and oak-hickory forests.
- Non-native invasive species are at low levels that do not interfere with native plant reproduction and distribution. New outbreaks are not spreading.
- There is increasing evidence of prescribed fire used to restore the structure, composition and ecosystem processes in ecological systems.
- Biological diversity is evident across the forest, and is further enhanced by a system of botanical special areas. Rare plant communities are represented in this system.
- Regenerating hardwoods are evident following disturbances in tree canopies (canopy gaps) in multi-age deciduous forests and mixed pine-hardwood forests.
- The forest is in a healthy condition. Most trees are in good health, well-formed, and with little evidence of widespread insect and/or disease damage. A healthy forest includes some dead and dying trees as well as den trees that contribute to wildlife habitat. A healthy forest also contains patches of disturbance that provide habitat components desired by a variety of wildlife, and space and light for young trees ("regeneration").
- Ephemeral pools, ponds, swamps, seeps, bogs, and other wetlands are frequent throughout the Forest and conditions are secure for animals such as amphibians that use these habitats for reproducing.
- Streamsides are dominated by native riparian vegetation.
- Bogs and seeps are maintaining or increasing their size through natural hydrologic processes.
- Ecological conditions (composition, structure, fire regime) are improving. Canopy closures are approaching the following levels:

Table 8. Desired canopy closures within Ecological Systems

Ecological System	Desired Canopy Closure
Southern Interior Longleaf Pine Woodland	25%-60%
Xeric Oak Forest	60%-80%
Dry Oak-Hickory Forest	60%-80%
Dry-mesic Oak-Hickory Forest	60%-90%
Mesic Forest	80%-100%
Streamside Forest	60-80%, 80%-100%
Successional Forest	60-80%
Shortleaf Pine-Oak Woodland	25%-60%
Glades and Barrens	5%-25%
Mafic Hardpan Woodland	25%-60%
Upland Depression Swamp	60%-100%

Ecological System	Desired Canopy Closure
Seepage Wetlands	25%-100%

Recommended Objectives:

- Maintain 2,200 acres of existing longleaf pine as pine woodlands.
- Implement restoration activities each year on an average 200 acres of oak-hickory and 100 acres of longleaf pine on sites where they occurred historically. (This would amount to restoration activities on a minimum of 4,500 acres over the fifteen year planning period.)

Table 9. Restoration objectives for Ecological Systems

Ecological System	Total Acres restored in 15 years
Southern Interior Longleaf Pine Woodland	[1/] 1,500
Xeric Oak Forest	0
Dry Oak-Hickory Forest	[2/] 2,000-2,380
Dry-mesic Oak-Hickory Forest	[2/] 1,000-1,150
Mesic Forest	0
Streamside Forest	0
Successional Forest (Shortleaf pine) On potential Longleaf sites On potential Oak-Hickory sites	 0 0
Successional Forest (Loblolly pine) On potential Longleaf sites On potential Oak-Hickory sites	 0 0
Glades and Barrens	0
Mafic Hardpan Woodland	0
Upland Depression Swamp	0
Seepage Wetlands	0

[1/] existing loblolly and shortleaf pine stands on longleaf pine sites > 40 years in age
[2/] existing loblolly and shortleaf pine stands on oak-hickory sites > 50 years in age outside Wilderness areas

- Over the planning period, relocate at risk populations of Schweinitz's sunflower adjacent to roads or railroads to sites more appropriate for long-term maintenance of the populations.
- Thin stands of trees as needed to maintain room for growth and to discourage insect and disease infestation. Thin an average of 400 acres per year, or approximately 6,000 over the fifteen-year planning period.

Table 10. Projected application of the thinning objective

Ecological System	Approximate acres thinned in 15 years
Southern Interior Longleaf Pine Woodland	[1/] 375
Xeric Oak Forest	0
Dry Oak-Hickory Forest	[2/] 225
Dry-mesic Oak-Hickory Forest	[2/] 150
Mesic Forest	0
Streamside Forest	[3/] 950
Successional Forest (Shortleaf pine) On potential Longleaf sites	[4/] 200

Ecological System	Approximate acres thinned in 15 years
On potential Oak-Hickory sites	1,075
Successional Forest (Loblolly pine)	[4/]
On potential Longleaf sites	1,150
On potential Oak-Hickory sites	1,850
Glades and Barrens	0
Mafic Hardpan Woodland	0
Upland Depression Swamp	0
Seepage Wetlands	0

[1/] all existing longleaf pine > 50 years in age,
[2/] 5% of all oak forests > 80 years in age outside the wilderness
[3/] only loblolly and shortleaf stands < 50 years in age outside the wilderness and more than 30 ft. from streams
[4/] 2/3s of all loblolly or shortleaf pine stands > 20 years in age outside the wilderness not planned for restoration to longleaf pine or oak-hickory

- Apply prescribed fire to an average of 3,000 to 6,000 acres per year.

Table 11. Recommended Fire Return Interval for Ecological Systems

Ecological System	Average Fire Return Interval
Southern Interior Longleaf Pine Woodland	3-5 years
Xeric Oak Forest	5-7 years
Dry Oak-Hickory Forest	5-7 years
Dry-mesic Oak-Hickory Forest	7-20 years
Mesic Forest	12-20 years
Streamside Forest	12-20 years
Successional Forest (Shortleaf and Loblolly)	
On potential Longleaf sites	3-5 years
On potential Oak-Hickory sites	5-7 years
Shortleaf Pine-Oak Woodland	3-5 years
Glades and Barrens	5-7 years
Mafic Hardpan Woodland	3-5 years
Upland Depression Swamp	Ignitions should originate outside these areas - interval dependent upon seasonal and yearly water fluctuations
Seepage Wetlands	Ignitions should originate outside these areas - interval dependent upon seasonal and yearly water fluctuations

Table 12. Projected application of prescribed burning objective

Ecological System	Average annual (acres)	Total in 15 years (acres)
Southern Interior Longleaf Pine Woodland	350-800	[1/] 3,200
Xeric Oak Forest	50-200	[2/] 1,200
Dry Oak-Hickory Forest	350-900	[2/] 5,500
Dry-mesic Oak-Hickory Forest	150-400	[2/] 2,500-4800
Streamside Forest	50-200	[3/] 1,500-4000

Ecological System	Average annual (acres)	Total in 15 years (acres)
Successional Forest (Shortleaf pine)		[4/]
On potential Longleaf sites	50-150	600
On potential Oak-Hickory sites	350-800	4,500
Successional Forest (Loblolly pine)		[4/]
On potential Longleaf sites	300-800	3,000
On potential Oak-Hickory sites	350-900	5,000
Shortleaf Pine-Oak Woodland	20	[5/] 90
Glades and Barrens	15	100
Mafic Hardpan Woodland	10	30
Upland Depression Swamp	No target	No target
Seepage Wetlands	No target	No target

[1/] all current longleaf pine PLUS 1,500 acres restoration
[2/] all current oak forests burned at least once – PLUS all current oak forests > 50 years in age outside the wilderness
[3/] all current mesic or streamside forest burned at least once – PLUS all mesic or streamside forest > 70 years in age outside the wilderness
[4/] all loblolly or shortleaf pine forest burned at least once – PLUS all loblolly or shortleaf pine forest > 20 years in age outside the wilderness
[5/] all potential Shortleaf Pine-Oak Woodland

- Each year treat an average of 100 acres to eliminate non-native invasive plants.

Recommended Guidelines:

- When implementing prescribed burning, at least every third entry should be a growing season burn, and fire should be allowed to burn in a mosaic pattern.
- Emphasize thinning in predominantly pine stands where the stem density is so high that it presents a risk of southern pine beetle infestation or where dying trees are creating high risk of catastrophic wildfire.
- Vegetation should not be cut, and mechanized ground disturbing equipment should not be used within 33 feet of a perennial stream unless needed for riparian wildlife habitat, stream channel stability, or to provide access for recreation or stream crossings. If portions of trees felled in the streamside forest fall into the 33-foot no-cut zone, that portion within 33 feet of the perennial stream should not be removed.
- A 33-foot no-mechanized equipment zone should serve as protective strips along each side of all intermittent streams. It may consist of understory vegetation. Refer to North Carolina Division of Forest Resources *Forestry Best Management Practices Manual* for additional guidance.
- Following extensive damage to trees from wind, water, insects or disease, restoration activities should restore the ecological system appropriate to the site.
- The following priority should be used to select areas for treating non-native invasive plants:
    - Schweinitz's sunflower habitat management areas;
    - Botanical special areas;
    - Streamside Forest;

    - General Forest
- New ground disturbing activities should be located away from rare Ecological Systems (Glades and Barrens, Mafic Hardpan Woodland, Depression Swamps, and Seepage Wetlands) to avoid direct and indirect impacts to surface soil erosion or displacement and alteration of natural hydrologic functioning.
- New occurrences of rare Ecological Systems (Glades and Barrens, Mafic Hardpan Woodland, Depression Swamps, and Seepage Wetlands) should be documented with a GPS or similar technology, and coordinates entered in a GIS.
- All bogs, swamps, and wetlands should be protected from all activities that would alter natural hydrologic function.

3.7 Assessing effects of Forest Plan alternatives on viability

Ecological condition rankings for individual ecological systems are difficult to quantify into the future. A more appropriate way to look at the change in ecological systems is to project the change in acreage and general quality of the ecological system. Table 13 shows existing acreage and projected short and long term acreage for each ecological system under Alternatives A, B and C. While an increased acreage in desired ecological systems (i.e. longleaf pine woodland, oak-hickory types) is a positive change for species that depend on those systems, it is also important to note that while other systems are not increasing, the quality of the system is improving in terms of the ecological indicators. Appendix B gives a brief description of how implementing Alternatives B or C would change the ecological condition ranking in terms of species composition, canopy closure, and fire regime.

Table 13. Short and long term effects on ecological systems under each alternative.

Ecological System	Existing Ecological condition ranking [1]	Existing Acreage	Restored in 15 yrs	Thinned in 15 yrs	Prescribed Burning in 15 yrs	End of 1st decade	End of 3rd decade	End of 1st decade	End of 3rd decade
			Alt B and C management			Alternative A		Alternatives B & C	
Xeric oak	Fair	19,624	0	0	1200	19,624	19,624	22,096	24,934
Dry oak-hickory	Fair		2,000-2,380	225	5,500				
Dry-mesic oak-hickory	Fair		1,000-1,150	150	2,500-4,800				
Southern Piedmont mesic	Fair	1,076	0	0	no target	1,076	1,076	1,076	1,076
Southeastern interior longleaf pine woodland	Poor	2,308	1,500	375	3,200	2,308	2,308	3,352	6,214
Shortleaf pine-oak woodland	Poor	<20	0	0	30	<20	<20	<20	<20
Successional Forest (Shortleaf)	Poor	9,397				9,397	9,397	8,301	6,109
On longleaf sites			0	200	600				
On oak-hickory sites			0	1075	3,500				
Successional Forest (Loblolly)	Poor	10,798				10,798	10,798	9,597	6,089
On longleaf sites			0	1150	3,000				
On oak-hickory sites			0	1850	4,000				
Streamside forest	Poor to Fair	6,800	0	950	1,500-4,000	6,800	6,800	6,800	6,800
Southern Piedmont glades and barrens	unknown	<100	0	0	<100	<100	<100	<100	<100
Southern Piedmont mafic hardpan	Poor	17	0	0	30	17	17	17	17

Ecological System	Existing Ecological condition ranking [1]	Existing Acreage	Restored in 15 yrs	Thinned in 15 yrs	Prescribed Burning in 15 yrs	End of 1st decade	End of 3rd decade	End of 1st decade	End of 3rd decade
			Alt B and C management			Alternative A		Alternatives B & C	
woodland									
Piedmont seepage wetland	Fair	200	0	0	200	200	200	200	200
Southern Piedmont/ Ridge and valley upland depression swamp forest	Good	<40	0	0	no target	78	78	78	78

[1] Projected long-term ecological condition rankings are discussed in Appendix B for each ecological system.

4.0 Species Diversity

4.1 Ecosystem Context for Species

Ecological conditions that provide for ecosystem diversity are the context for the evaluation of species diversity. The spatial scales for considering ecosystem diversity on the Uwharrie NF were selected to address the administrative plan area and its role in the broader ecological context (Section 3.1). The North Carolina Piedmont area provided the upper bounds on the area of analysis to evaluate and understand the environmental context and opportunities and limitations for NFS lands to contribute to the diversity of native plant and animal species. These ecological subregions include the geographic ranges and habitats of federally listed threatened and endangered species, sensitive species and locally rare species (36 CFR 219.10(b)(2)) that occur or could occur on the Uwharrie NF. The following analysis is used to determine if additional species-specific plan components may be necessary to sustain species diversity in addition to those identified for maintaining ecosystem diversity.

4.2 Identification and Screening of Species

As directed (FSH 1909.12.43.2)), we have identified 82 federally threatened (T), and endangered (E) species, sensitive (S) species, and locally rare (LR) species whose ranges include the Uwharrie NF plan area. They were identified using the following: (a) proposed, threatened, or endangered species under the federal Endangered Species Act (b) the Regional Forester's Sensitive Species list, (c) species identified as locally rare on the Uwharrie NF by Forest Service biologists. The U.S. Fish and Wildlife Service Birds of Conservation Concern were also considered according to Forest Service Policy, however they were addressed separately in section 4.6.

4.2.1 Federally Listed Species

There are six species listed by the Department of Interior, U.S. Fish and Wildlife Service as threatened or endangered whose ranges include the Uwharrie NF plan area. They are the red wolf, eastern cougar, red-cockaded woodpecker, smooth coneflower, Schweinitz's Sunflower, and Michaux's Sumac. The red wolf and eastern cougar have been extirpated from the Southern Piedmont and the Uwharrie NF due to human persecution, hybridization and lowered prey numbers in the 1800's. The smooth

coneflower and Michaux's sumac are not known to occur on the Uwharrie NF. The red-cockaded woodpecker and Schweinitz's sunflower have been documented on the Uwharrie NF, however the red-cockaded woodpecker has not been seen on the Uwharrie NF since 1979.

4.2.2 Sensitive Species

Sensitive species are species that are identified on the Regional Forester's Sensitive Species List. Forest Service policy directs that the viability of sensitive species be considered in all planning on national forest system lands (FSM 2670.22). There are 17 sensitive species whose ranges include the Uwharrie NF plan area. They include one mammal, three birds, 11 vascular plants and two nonvascular plants.

4.2.3 Locally Rare Species

Locally rare species are those for which management actions may be needed or desirable to achieve ecological or other multiple-use objectives. Locally rare species are determined by reviewing state ranked species S1 or S2 that may occur on the Uwharrie NF. Forest Service biologists reviewed the NC Natural Heritage Program's List of Rare Animal Species of North Carolina (NCDENR 2008) and the NC Natural Heritage Program's List of Rare Plant Species (NCDENR 2010) to determine which species meet the requirements for locally rare on the Uwharrie NF. We identified 58 locally rare species that may occur in the Uwharrie NF plan area. They include two mammals, one bird, two reptiles, three amphibians, seven insects, 42 vascular plant species and one nonvascular plant species.

4.3 Information Collection

Information on habitat relationships, threats, distribution, status, quality of information, and the relationship of the Uwharrie NF to contribute to conservation was collected and synthesized for each of the species considered TES&LR species following the above screening process. Information for these species and their habitat associations is summarized in table 14 and in the tables in Appendix C.

Table 14. Habitat relationships and key ecosystem characteristics important to sustain threatened, endangered, sensitive, and locally rare species on the Uwharrie NF.

On UWNF	Scientific Name (Common Name)	Habitat relationship - Ecological system or other habitat features (G-rank)[1/]	Key ecological characteristics
Threatened or Endangered Birds			
no, historic	*Picoides borealis* (Red-cockaded woodpecker)	Southeastern interior longleaf pine woodland (G2) or other southern yellow pine woodlands	species composition, canopy structure (open), midcanopy structure (open), fire return interval
Threatened or Endangered Mammals			
no, extirpated	*Canis rufus* (Red wolf)	a variety of coniferous, mixed, or deciduous forests & woodlands	species composition, canopy structure (closed)
no, extirpated	*Puma concolor cougar* (Eastern cougar)	a variety of coniferous, mixed, or deciduous forests & woodlands	species composition, canopy structure (closed)
Threatened or Endangered Vascular Plants			
no	*Echinacea laevigata* (Smooth coneflower)	Southern Piedmont glades and barrens (G2?) over mafic or calcareous substrate	canopy structure (open), geologic substrate
yes	*Helianthus schweinitzii* (Schweinitz's sunflower)	Southeastern interior longleaf pine woodlands (G2), Southern Piedmont glades and barrens (G2?), Xeric oak woodlands (G2G4), roadsides,	canopy structure (open or with gaps), fire return interval

On UWNF	Scientific Name (Common Name)	Habitat relationship - Ecological system or other habitat features (G-rank)[1/]	Key ecological characteristics
		and rights-of-ways	
no	*Rhus michauxii* (Michaux's sumac)	Southern Piedmont hardpan woodlands (G2) on mafic slates	geologic substrate, canopy structure (open)
Sensitive Bird Species			
no	*Aimophila aestivalis* (Bachman's sparrow)	Southeastern interior longleaf pine woodland (G2), and open fields	canopy structure (open), fire return interval
yes	*Haliaeetus leucocephalus* (Bald eagle)	a variety of coniferous, mixed, or deciduous forests & woodlands near large bodies of water for nesting	canopy structure, i.e, presence of supercanopy trees
no	*Lanius ludovicianus migrans* (Migrant loggerhead shrike)	fields, pastures, wildlife fields, and wildlife openings	canopy structure, i.e. treeless
Sensitive Mammal Species			
yes	*Myotis leibii* (Eastern small-footed bat)	a variety of coniferous, mixed, or deciduous forests & woodlands with structures or caves	species composition and canopy structure (species capable of providing long-lived snags), hydrologic function
Sensitive Vascular Plant Species			
no	*Acmispon helleri* (Carolina birdfoot-trefoil)	Xeric oak woodlands (G2G4), and roadsides	canopy structure (open or with gaps)
yes	*Amorpha schwerinii* (Piedmont Indigo-bush)	Dry oak-hickory forests (felsic) (G4G5), Dry-mesic oak-hickory forests (felsic) (G4G5), Xeric oak forests (G2G4), Southern Piedmont mesic forests (G3G4)	Unknown; reproductive and establishment biology is poorly understood
no	*Berberis canadensis* (American barberry)	Southern Piedmont mafic hardpan woodlands (G2), and Xeric oak forests over calcareous rock (G2?)	canopy structure (open), geologic substrate, fire return interval
yes	*Carex impressinervia* (Ravine sedge)	Southern Piedmont mesic forests (G3G4), and Streamside forests (G2G4)	canopy structure (closed), competition from non-native invasive species
no	*Danthonia epilis* (Bog oatgrass)	Piedmont seepage wetlands around rock outcrops (G2G3)	hydrologic function
yes	*Eurybia mirabilis* (Piedmont aster)	Southern Piedmont mesic forests (G3G4)	competition from non-native invasive species
yes	*Fothergilla major* (Large witch-alder)	Dry oak-hickory forests (felsic) (G4G5), Dry-mesic oak-hickory forests (felsic) (G4G5), Xeric oak forests (G2G4), Southern Piedmont mesic forests (G3G4) and Piedmont seepage wetlands (G2G3)	species composition
no	*Heuchera caroliniana* (Carolina alumroot)	Dry-mesic oak-hickory forests (felsic) (G4G5) and Southern Piedmont mesic forests (G3G4)	canopy structure (closed)
no	*Lindera subcoriacea* (Bog spicebush)	Piedmont seepage wetlands (G2G3), Southern Piedmont / Ridge and Valley upland depression swamps (G1)	hydrologic function
no	*Solidago plumosa* (Yadkin river goldenrod)	mafic rock outcrops adjacent to rivers in Streamside forests (G2G4 – G?)	geologic substrate, hydrologic function
yes	*Symphyotrichum georgianum* (Georgia aster)	Southern Piedmont glades and barrens (G2?), Southern Piedmont mafic hardpan woodlands (G2), Xeric oak woodland (G2G4) , roadsides	canopy structure (open), fire return interval
Sensitive Nonvascular Plant Species			
no	*Scopelophila cataractae* (Agoyan cataract moss)	Mines, copper-rich soils	mineral (copper)
yes	*Xanthoparmelia monticola* (a rock-shield lichen)	Southern Piedmont glades and barrens (G2?) on mafic exposed substrate	canopy structure (open), geologic substrate
Locally Rare Bird Species			
no	*Accipiter striatus* (Sharp-shinned hawk)	a variety of coniferous, mixed, or deciduous forests & woodlands	canopy structure, i.e. a forest or woodland. key characteristics unknown
Locally Rare Mammal Species			
no	*Myotis austroriparius* (Southeastern myotis)	buildings, hollow trees, forages near water in Streamside forests (G2G4 – G?)	species composition and canopy structure (species capable of providing long-lived snags), hydrologic function
yes	*Condylura cristata pop. 1* (Star-nosed mole)	Piedmont seepage wetlands (G2G3), Streamside forests (G2G4), Southern Piedmont / Ridge and Valley upland depression swamps (G1)	understory structure i.e. downed woody debris on forest floor, hydrologic function
Locally Rare Reptile and Amphibian Species			
yes	*Ambystoma talpoideum* (Mole salamander)	Piedmont seepage wetlands (G2G3), Streamside forests (G2G4), Southern Piedmont / Ridge and Valley upland depression swamps (G1), and fishless ponds	hydrologic function

On UWNF	Scientific Name (Common Name)	Habitat relationship - Ecological system or other habitat features (G-rank)[1/]	Key ecological characteristics
no	*Ambystoma tigrinum tigrinum* (Eastern tiger salamander)	Piedmont seepage wetlands (G2G3), Streamside forests (G2G4), Southern Piedmont / Ridge and Valley upland depression swamps (G1), and fishless ponds	hydrologic function
no	*Ophisaurus attenuatus* (Slender glass lizard)	a variety of coniferous, mixed, or deciduous woodlands and fields near streams & ponds	canopy structure (open)
no	*Heterodon simus* (Southern hognose snake)	a variety of coniferous, mixed, or deciduous woodlands, usually in areas with sandy soils	canopy structure (open); soils i.e. sandy soils
no	*Micrurus fulvius* (Eastern coral snake)	a variety of coniferous, mixed, or deciduous woodlands, usually in areas with sandy soils	canopy structure (open); soils i.e. sandy soils
	Locally Rare Insect Species		
no	*Acronicta albarufa* (Barrens daggermoth)	Southern Piedmont glades and barrens (G2?), Dry oak-hickory forests (felsic) (G4?),	species composition
no	*Heterocampa varia* (A notodontid moth)	xeric pine-oak sandhills usually dominated by blackjack oak	species composition
no	*Hyperstrotia aetheria* (A noctuid moth)	xeric pine-oak sandhill woodlands	canopy structure (open), species composition
no	*Amblyscirtes alternata* (Dusky roadside-skipper)	open grassy pine flatwoods and sandhill ridges with *Gymnopogon ambiguus* (broadleaf beardgrass)	canopy structure (open), species composition
no	*Euphyes bimacula* (Two-spotted skipper)	Streamside forests (G2G4), Piedmont seepage wetlands (G2G3), sedge areas near wet woods	canopy structure (open), species composition, hydrologic function
no	*Satyrium edwardsii* (Edwards' hairstreak)	sandy or rocky woodlands usually with black oak	canopy structure (open), species composition, geologic substrate,
no	*Cicindela patruela* (Northern barrens tiger beetle)	sandy soils in open pine or pine-oak woodlands	canopy structure (open), species composition, soils i.e. sandy soils
	Locally Rare Vascular Plant Species		
yes	*Anemone berlandieri* (Southern Anemone)	Southern Piedmont glades and barrens (G2?) in thin, circumneutral soils around rock outcrops	geologic substrate, canopy structure (open)
no	*Arabis missouriensis* (Missouri rockcress)	Southern Piedmont glades and barrens (G2?) in thin, circumneutral soils around rock outcrops	geologic substrate, canopy structure (open)
no	*Baptisia alba var alba* (Thick-pod white wild indigo)	Southern Piedmont glades and barrens (G2?), Southern Piedmont mafic hardpan forests (G2), Xeric oak woodlands (G2G4), and roadsides	canopy structure (open or with gaps), fire return interval
no	*Baptisia australis var. aberrans* (Prairie blue wild indigo)	Southern Piedmont glades and barrens (G2?), Southern Piedmont mafic hardpan woodlands (G2), and Xeric oak forests over calcareous rock (G2?)	canopy structure (open), geologic substrate, fire return interval
no	*Callitriche terrestris* (Terrestrial water-starwort)	Seeps with moist soils from perennial or ephemeral streams in Dry-mesic oak-hickory forest over mafic rock (G2G3)	hydrologic function, geologic substrate
yes	*Cardamine dissecta* (Dissected toothwort)	Southern Piedmont mesic forests (G3G4)	species composition, canopy structure (closed)
no	*Carex bushii* (Bush's sedge)	Open wet areas, Piedmont seepage wetlands (G2G3)	hydrologic function
no	*Celastrus scandens* (American bittersweet)	Southern Piedmont mesic forests (G3G4)	species composition, canopy structure (closed)
yes	*Cirsium carolinianum* (Carolina thistle)	Southern Piedmont glades and barrens (G2?), Southern Piedmont mafic hardpan forests (G2), Xeric oak forests (G2G4), Southeastern interior longleaf pine woodlands (G2), and Dry-mesic oak-hickory forest over mafic or calcareous rock (G2G3)	canopy structure (open), geologic substrate, fire return interval
yes	*Collinsonia tuberosa* (Piedmont horsebalm)	Southern Piedmont mesic forests (G3G4), Streamside forests (G2G4), and Dry-mesic oak-hickory forests over calcareous or mafic substrates (G2G3)	geologic substrate, canopy structure (closed or with gaps)
yes	*Desmodium fernaldii* (Fernald's Tick-trefoil)	Southeastern interior longleaf pine woodlands (G2), Dry oak-hickory forest (felsic) (G4?)	canopy structure (partially open), fire return interval
no	*Dichanthelium annulum* (Ringed witchgrass)	Southern Piedmont glades and barrens (G2?), and Dry oak-hickory forests (mafic) on calcareous substrates (G2G3)	geologic substrate
yes	*Dichanthelium boreale*	Xeric oak woodlands (G2G4)	canopy structure (open or with gaps), fire

On UWNF	Scientific Name (Common Name)	Habitat relationship - Ecological system or other habitat features (G-rank)[1/]	Key ecological characteristics
	(Northern witch grass)		return interval
no	*Dodecatheon meadia var. meadia* (Eastern shooting star)	Southern Piedmont mesic forests (G3G4), Southern Piedmont glades and barrens (G2?), rocky Dry-mesic oak-hickory forest (mafic) (G2G3)	geologic substrate, canopy structure (open to partially open)
no	*Echinacea purpurea (*Purple coneflower)	Southern Piedmont glades and barrens (G2?) over mafic or calcareous substrate	canopy structure (open), geologic substrate
no	*Gillenia stipulata* (American ipecac)	Dry oak-hickory forests (mafic) (G2?) and Xeric oak forests on mafic rock (G2?), Dry-mesic oak-hickory forests (mafic) (G2G3)	geologic substrate, canopy structure (open or with gaps)
no	*Helenium brevifolium* (Littleleaf sneezeweed)	Piedmont seepage wetlands (G2G3)	hydrologic function
yes	*Helianthus laevigatus* (Smooth sunflower)	Southeastern interior longleaf pine woodlands (G2), Dry oak-hickory forests (felsic) (G4G5), Dry-mesic oak-hickory forests (felsic) (G4G5), and roadsides	canopy structure (open) and fire return interval
no	*Hexalectris spicata* (Crested coralroot)	Xeric oak forests (G2?), Dry oak-hickory forests (mafic) (G2?), and Dry-mesic oak-hickory forests (mafic) (G2G3)	geologic substrate, canopy structure (closed or with gaps)
no	*Liatris aspera* (Rough Blazing Star)	Southern Piedmont glades and barrens (G2?), Southern Piedmont mafic hardpan woodlands (G2), and Xeric oak woodlands over calcareous rock (G2?)	canopy structure (open), geologic substrate, fire return interval
no	*Lilium canadense ssp. editorum* (Red Canada lily)	Piedmont seepage wetlands (G2G3)	hydrologic function
yes	*Matelea decipiens* (Glade milkvine)	Southern Piedmont glades and barrens over mafic rock (G2?), and Southern Piedmont mafic hardpan woodlands (G2), and Xeric oak forests over calcareous rock (G2?)	geologic substrate, canopy structure (open), fire return interval
yes	*Parthenium auriculatum* (Glade wild quinine)	Southern Piedmont mafic hardpan woodlands (G2)	geologic substrate, canopy structure (open), fire return interval
no	*Pellaea wrightiana* (Wright's cliffbrake)	Southern Piedmont glades and barrens over calcareous rock (G2?) with seepage	geologic substrate, canopy structure (open), hydrologic function
no	*Plantago cordata* (Heartleaf plantain)	slate-bottomed perennial stream beds in Streamside forests (G?)	hydrologic function
no	*Polygala senega* (Seneca Snakeroot)	Southern Piedmont glades and barrens (G2?), Southern Piedmont mafic hardpan woodlands (G2), and Xeric oak woodlands over mafic or calcareous rock (G2G3)	canopy structure (open), geologic substrate, fire return interval
yes	*Pseudognaphalium helleri* (Heller's rabbit tobacco)	Southeastern interior longleaf pine woodlands (G2), Southern Piedmont glades and barrens (G2?) over mafic rock, Xeric oak woodlands (G2G4), Southern Piedmont mafic hardpan woodlands (G2)	geologic substrate (?), fire return interval, canopy structure (open)
yes	*Quercus austrina* (Bluff oak)	river bluffs and levees of brown water streams in Streamside forests over mafic rock (G?)	hydrologic function, geologic substrate
yes	*Ruellia purshiana* (Pursh's wild-petunia)	Dry-mesic oak-hickory forests (mafic) (G2G3)	geologic substrate, fire return interval
no	*Salvia azurea* (Azure Sage)	Southeastern interior longleaf pine woodlands (G2)	canopy structure (open), fire return interval
yes	*Sedum glaucophyllum* (Cliff Stonecrop)	Southern Piedmont glades and barrens (G2?)	geologic substrate, open habitat
no	*Silphium terebinthinaceum* (Prairie rosinweed)	Southern Piedmont mafic hardpan woodlands (G2), and Southern Piedmont glades and barrens over mafic rock (G2?)	geologic substrate, fire return interval, canopy structure (open)
yes	*Smilax hugeri (*Huger's Carrion-flower)	Southern Piedmont mesic forests (G3G4)	species composition, canopy structure (closed)
no	*Solidago radula* (Western rough goldenrod)	Southern Piedmont mafic hardpan woodlands (G2), and Southern Piedmont glades and barrens (G2?)	geologic substrate, fire return interval, canopy structure (open)
no	*Solidago rigida var. glabrata* (Southeastern bold goldenrod)	Southern Piedmont glades and barrens over mafic, ultramafic, or calcareous rock (G2?), and Southern Piedmont mafic hardpan woodlands (G2)	geologic substrate, canopy structure (open)
no	*Stachys sp. 1* (a Hedge nettle)	sandy alluvium in Streamside forests (G2G4?)	hydrologic function

On UWNF	Scientific Name (Common Name)	Habitat relationship - Ecological system or other habitat features (G-rank)[1/]	Key ecological characteristics
yes	*Stewartia ovata* (Mountain camellia)	Southern Piedmont mesic forests (G3G4) especially with beech and rhododendron	species composition, canopy structure (closed)
no	*Symphyotrichum laeve var. concinnum* (Smooth blue aster)	Southern Piedmont mafic hardpan woodlands (G2), and Southern Piedmont glades and barrens (G2?) or Xeric oak woodlands over mafic rock (G2G3)	geologic substrate, fire return interval, canopy structure (open or with gaps)
yes	*Tradescantia virginiana* (Virginia spiderwort)	Southern Piedmont mesic forests (G3G4) over mafic rock	canopy structure (closed), geologic substrate
no	*Tridens chapmanii* (Chapman's redtop)	Shortleaf pine-oak woodlands (G2), Xeric oak forests (G2G4), Southeastern interior longleaf pine woodlands (G2), and roadsides	canopy structure (open or with gaps)
yes	*Trifolium reflexum* (Buffalo Clover)	Southern Piedmont glades and barrens (G2?), Xeric oak woodlanda (G2G4)	canopy structure (open), fire return interval
yes	*Viola walteri* (Prostrate Blue Violet)	Southern Piedmont mesic forest (G3G4)	species composition, canopy structure (closed)
Locally Rare Nonvascular Plant Species			
no	*Weissia sharpii* (A moss)	Cedar oak bluffs, cedar barrens, Southern Piedmont glades and barrens over mafic rock (G2?), roadsides	geologic substrate
Birds of Conservation Concern			
no	*Asio flammeus* (Short-eared Owl (nb))	Fields, savannas and woodlands near water	Canopy structure
yes	*Caprimulgus vociferus* (Whip-poor-will)	Open woodlands and early successional forests	Canopy structure
yes	*Sitta pusilla* (Brown-headed Nuthatch)	Southeastern interior longleaf pine woodlands (G2)	Canopy structure
no	*Cistothorus platensis* (Sedge Wren)	Grasslands, savannas and marshes	Canopy structure
yes	*Hylocichla mustelina* (Wood Thrush)	Deciduous or mixed forests with dense canopy and well developed understory	Canopy structure
yes	*Vermivora pinus* (Blue-winged Warbler)	Edges of pastures, woodlands, streams, and swamps	Canopy structure
yes	*Dendroica discolor* (Prairie Warbler)	Early successional forests	Canopy structure
no	*Dendroica cerulea* (Cerulean Warbler)	Mature mesic hardwood forest with developed shrub layer	Canopy structure
yes	*Oporornis formosus* (Kentucky Warbler)	Mid-successional forests with open canopy and developed ground cover	Canopy structure
no	*Euphagus carolinus* (Rusty Blackbird (nb))	Moist pine forests and wooded edges of small permanent water bodies	Canopy structure

[1/] G-rank of ecological system: combined ranks from plant associations within the ecological system.

G1 = CRITICALLY IMPERILED, generally 5 or fewer occurrences and/or very few remaining acres or very vulnerable to elimination throughout it range due to other factor(s).
G2 = IMPERILED, generally 6-20 occurrences and/or few remaining acres or very vulnerable to elimination throughout its range due to other factor(s).
G3 = VULNERABLE, generally 21-100 occurrences. Either very rare and local throughout its range or found locally, even abundantly, within a restricted range or vulnerable to elimination throughout it range due to specific factors.
G4 = APPARENTLY SECURE, uncommon, but not rare (although it may be quite rare in parts of its range, especially at the periphery). Apparently not vulnerable in most of its range.
G5 = SECURE, common, widespread, and abundant (though it may be quite rare in parts of its range, especially at the periphery). Not vulnerable in most of its range.
G? = UNRANKED, status has not yet been determined.

Modifies and Rank Ranges

? = uncertainty about the rank in the range of 1 either way on the 1-5 scale. For example, a G2? Rank indicates that the rank is thought to be a G2, but could be a G1 or G3.
G#G# = greater uncertainty about a rank is expressed by indicating the full range of ranks which may be appropriate. For example, a G2G4 rank indicates the rank could be a G2, G3, or G4.
Q = questionable taxonomy. It modifies the degree of imperilment and is *only* used in cases where the type would have a less imperiled rank, if it were not recognized as a valid type (i.e., if it were combined with a more common type).

4.4 Species Groups and Surrogate Species

Species groups were used as an evaluation and analysis tool to improve planning efficiency and for development of management strategies. Species were grouped according to their habitat needs, limiting factors, threats, and specific habitat elements. Many species occur in multiple groups.

Where possible, species groups were associated with ecological systems. Some groups are directly related to specific systems. Other groups may be more closely related to some ecological systems than others, but may be associated with multiple systems. Some groups may occur in any of the systems. The list of species groups and the ecological systems with which they are associated are listed in Table 15. All TES&LR species considered in this viability evaluation can be grouped into one or more of the six categories.

Table 15. Habitat groups for the threatened, endangered, sensitive, and locally rare terrestrial species on the Uwharrie NF and the ecological systems with which they are associated.

Species Habitat Group	Associated Ecological System	Species
1. Open Mafic Substrate- Rare communities on mafic or calcareous substrates requiring open canopy conditions	Southern Piedmont Glades and Barrens, Streamside Forests, Dry and Dry-Mesic Oak-Hickory Forest, Xeric Oak Forest, Southern Piedmont Mafic Hardpan Woodland	Smooth coneflower
		Michaux's sumac
		Eastern small-footed bat
		American barberry
		Yadkin river goldenrod
		rock-shield lichen
		Slender glass lizard
		Sharp-shinned hawk
		Barrens daggermoth
		Edwards' hairstreak
		Southern Anemone
		Missouri rockcress
		Prairie blue wild indigo
		Carolina thistle
		Ringed witchgrass
		Eastern shooting star
		Purple coneflower
		American ipecac
		Crested coralroot
		Rough Blazing Star
		Glade milkvine
		Glade wild quinine
		Wright's cliffbrake
		Seneca Snakeroot
		Heller's rabbit tobacco
		Bluff oak
		Pursh's wild-petunia
		Cliff Stonecrop
		Prairie rosinweed
		Western rough goldenrod
		Southeastern bold goldenrod
		Smooth blue aster
		Prostrate Blue Violet
		Weissia sharpii
		Blue-winged warbler
		Whip-poor-will
2. Open Felsic Substrate - Sun-loving species that occur in woodlands and openings	Southeastern Interior Longleaf Pine Woodland, Dry and Dry-Mesic Oak-Hickory Forest, Xeric Oak Forest, Shortleaf Pine-Oak Woodland	**Schweinitz's sunflower**
		Red-cockaded woodpecker
		Bachman's sparrow
		Migrant loggerhead shrike
		Eastern small-footed bat

Species Habitat Group	Associated Ecological System	Species
		Carolina birdfoot-trefoil
		Piedmont Indigo-bush
		Large witch-alder
		Georgia aster
		Agoyan cataract moss
		Slender glass lizard
		Southern hognose snake
		Eastern coral snake
		Sharp-shinned hawk
		Barrens daggermoth
		A notodontid moth
		A noctuid moth
		Dusky roadside-skipper
		Northern barrens tiger beetle
		Thick-pod white wild indigo
		Bush's sedge
		American bittersweet
		Fernald's Tick-trefoil
		Northern witch grass
		Smooth sunflower
		Heller's rabbit tobacco
		Azure Sage
		Chapman's redtop
		Buffalo Clover
		Prostrate Blue Violet
		Short-eared owl
		Sedge wren
		Prairie warbler
		Brown-headed nuthatch
3. Closed Mesic Forests - Mesic forests or microhabitats within mesic forests	Southern Piedmont Mesic Forest, Dry-Mesic Oak Forest and Streamside Forest	Eastern small-footed bat
		Piedmont Indigo-bush
		Ravine sedge
		Piedmont aster
		Carolina alumroot
		Southeastern myotis
		Dissected toothwort
		Piedmont horsebalm
		Huger's Carrion-flower
		a Hedge nettle
		Mountain camellia
		Virginia spiderwort
		Cerulean warbler
		Kentucky warbler
		Wood thrush
4. Rare Wetlands - Rare wetland species that depend on wetlands or water for most of their life cycle	Piedmont Seepage Wetland, Southern Piedmont / Ridge and Valley Upland Depression Swamp	Bog oatgrass
		Large witch-alder
		Bog spicebush
		Star-nosed mole
		Mole salamander
		Eastern tiger salamander
		Two-spotted skipper
		Bush's sedge
		Littleleaf sneezeweed
		Red Canada lily
		Heartleaf plantain
5. Wetlands or Semi-Permanent Ponds - Species that require wetlands or water for only a portion of their	Piedmont Seepage Wetland, Southern Piedmont / Ridge and Valley Upland Depression Swamp	Eastern tiger salamander
		Slender glass lizard
		Terrestrial water-starwort

Species Habitat Group	Associated Ecological System	Species
lifecycle		Rusty blackbird
6. Open Water	All ecological system	Bald eagle

Instead of choosing one species as a surrogate or "indicator" species for the group, the species habitat group will be considered further in the planning process to evaluate if plan components for ecological systems would be sufficient to sustain the species they contain.

4.5 Evaluation of Species Diversity

Plan components for ecosystem diversity identified in section 3.6 should satisfy most species diversity objectives on the Uwharrie NF. Thinning, prescribed burning, and ecosystem restoration objectives would improve and maintain habitat conditions and habitat connections for the species habitat groups and would maintain suitable habitat that is not currently occupied but has a likelihood of being occupied in the future by species identified as TES & LR species.

Table 16. Comparison of alternatives by management of species habitat groups.

Species Habitat Group	Management of Species Habitat Group	
	Alt. A	Alt. B &C
1. Open Mafic Substrate - Rare communities on mafic or calcareous substrates requiring open canopy conditions	Alternative A allows for some management in oak-hickory forests, however it does not encourage efforts that would maintain existing oak-hickory woodlands or open canopy conditions to restore oak-hickory woodlands. This alternative would not lead to increased or improved habitat for the rare species associated with open mafic substrate.	Alternatives B and C propose restoration activities on 200 acres annually of oak-hickory habitat. Suitable habitat for sun-loving species would be improved to a greater degree compared to Alternative A. Alternatives B and C also propose twice as much prescribed burning as Alt. A (6,000 compared to 3, 000), which would increase suitable habitat for species associated with mafic-substrate as well as improve habitat for species that occur on rock outcrops
2. Open Felsic Substrate – Sun-loving species that occur in woodlands and openings	Alternative A provides protection for one rare species that occurs within this habitat group within special interest areas. Implementation of Alt. A would not lead to increased or improved habitat for the federally endangered Schweinitz's sunflower or the 21 sensitive and locally rare species associated with oak-hickory woodlands or Piedmont longleaf pine woodlands.	Alternatives B and C have specific objectives for the restoration of Schweinitz's sunflower habitat, which is a federally listed species in this habitat group. The proposed increase in prescribed burning would help to restore and maintain this habitat. Implementation of Alts. B and C would lead to increased or improved habitat for the federally endangered Schweinitz's sunflower and the 21 sensitive and locally rare species associated with oak-hickory woodlands or Piedmont longleaf pine woodlands.

Species Habitat Group	Management of Species Habitat Group	
	Alt. A	Alt. B &C
3. Closed Mesic Forests – Mesic forests or microhabitats within mesic forests	Alt. A does not have specific goals or activities associated with closed mesic hardwood forests that would have impacts to this habitat group. Implementation of this alternative would not restrict available habitat for the fourteen sensitive and locally rare species associated with closed mesic forests. Four rare plant species have known occurrences within special interest areas of closed mesic hardwoods.	Alternatives B and C do not have specific goals or activities associated with closed mesic hardwood forests that would have impacts to this habitat group. Implementation of this alternative would not restrict available habitat for the fourteen sensitive and locally rare species associated with closed mesic forests. Seven rare plant species have known occurrences within special interest areas of closed mesic hardwoods.
4. Rare wetlands – Rare communities in wetlands	Four wetlands with a total of 33 acres are protected as special interest areas.	Eight wetlands with a total of 66 acres are protected as special interest areas. Alt. B would protect rare wetlands to a greater extent than Alt. C by proposing to limit horseback riding to a designated trail system.
5. Wetlands or Semi-permanent ponds – Species that require wetlands or water for a portion of their lifecycle	Semi-permanent ponds would be protected through adherence to state best management practices. There are no known occurrences of rare plant species in this habitat group. Two rare wildlife species have the potential to be impacted by ground disturbance and sedimentation attributed to horseback riding.	Semi-permanent ponds would be protected through adherence to state best management practices. There are no known occurrences of rare plant species in this habitat group. Two rare wildlife species have the potential to be impacted by ground disturbance and sedimentation attributed to horseback riding under Alt. C. Alt B proposes to eventually limit horseback riding to a designated trail system which would effectively limit disturbance in wetlands and permanent ponds.
6. Open Water – Permanent lakes and ponds	Open water habitat will persist in its current condition under Alt. A.	Open water habitat will persist in its current condition under Alts. B and C.

Individual species listed in Table 15 are associated with a species group which can be associated with one or more ecological systems. Table 16 compares how the alternatives differ in terms of management of species habitat groups. Alternatives B and C propose increasing open habitat conditions and prescribe burning, both of which would increase the quality and quantity of habitat for open mafic substrate species, open felsic substrate species, and rare wetland species in the short term and over the long term.

4.6 Species Specific Plan Component Recommendations

The Uwharrie NF provides habitat for several TES&LR species and is at the center of the range and supports multiple populations of one Federally-listed species – the Schweinitz's sunflower. Therefore, although the Uwharrie NF represents only a portion

of the Piedmont, its contribution to the viability of these species may be considerable. For example:

- documented occurrences of two sensitive species and one locally rare species on the Uwharrie NF account for 45% or more of the total occurrences in the Piedmont; they are:
    - *Xanthoparmelia monticola* (100% of 1 occurrence) G2?, S2?
    - *Cirsium carolinianum* (45% of 20 occurrences) G5, S2
    - *Amorpha schwerinii* (45% of 80 occurrences) G3G4, S3
- documented occurrences of one sensitive species and two locally rare species on the Uwharrie NF account for 25-40% of the total occurrences in the two subsections; they include:
    - *Carex impressinervia* (31% of 16 occurrences) G2, S1
    - *Helianthus laevigatus* (31% of 74 occurrences) G4, S2
    - *Dichanthelium boreale* (40% of 5 occurrences) G5, S1

Additional plan components are needed to contribute to the diversity of several native plant and animal species on the Uwharrie NF:

- Species within the rare community and open woodlands habitat groups, and
- Species with less than five documented occurrences on the Uwharrie NF.

Most rare communities (those on mafic or calcareous substrates or in wetland conditions) are imbedded within broader ecological systems and will therefore benefit from management in those systems following plan components directed at improving composition, structure, and ecological processes. Rare communities have a disproportionately large number of documented TES&LR species but because of their small size or because they are often difficult to recognize, they are often overlooked or misidentified in the field. Therefore, beyond provisions providing characteristics of ecosystem diversity, the following program management emphasis is needed to help ensure self-sustaining rare species populations within rare communities:

Program management emphasis:

- Coordinate with the NC Natural Heritage Program in providing field training to identify rare Ecological Systems (Glades and Barrens, Mafic Hardpan Woodlands, Depression Swamps, and Seepage Wetlands) for all District employees especially Forester's, Forest Technicians, and other Resource Technicians at least every 3 years.

Plan components for ecosystem diversity should especially benefit species in the Woodlands habitat group (open felsic substrate group). Species in this group are sun-loving and have declined in the past due to competition from other vegetation; competition that should be reduced following ecosystem diversity objectives for prescribed burning and thinning. However, some of these species are at risk because they are found primarily in roadside habitats prone to mowing or herbicide damage or in Southeastern Interior Longleaf Pine Woodlands that have significantly declined from historic levels. The following additional provisions, beyond those for providing characteristics of ecosystem diversity, are needed to ensure self-sustaining populations of

Schweinitz's sunflower. These objectives and guidelines would also ensure the continued presence and restoration of other open felsic woodland habitat species including Georgia aster, smooth sunflower, and Heller's rabbit tobacco:

Desired Condition

- Schweinitz's sunflower is restored throughout the plant's historical range across the forest.

Objectives

- Restore or reintroduce 5 to13 subpopulations of Schweinitz's sunflower in woodlands or openings in forests over the next fifteen years.
- Over the planning period, relocate at risk populations of Schweinitz's sunflower adjacent to roads or railroads to sites more appropriate for long-term maintenance of the populations.
- Create prairie-like openings of ½ to 2 acres in size within longleaf pine and oak-hickory restoration areas that are within the Schweinitz's sunflower Habitat Management Area.

Standard

- Roadside banks shall not be mowed before flowering and seed development where TES&LR species occur.

TES&LR species that have been documented on less than five sites on the Uwharrie NF could occur in all five species habitat groups. Although these species will benefit from plan components for ecosystem diversity, their risk of extirpation is aggravated by their extreme rarity and small population size. Therefore, the following monitoring provisions are needed to ensure self-sustaining species populations for these very rare species:

Monitoring

- Monitoring Question: "What are the trends in the condition of element occurrences on the Forest?"
- Performance Measure: Documented condition and extent of occurrence.
- Likely implementation process would be to visit documented locations of TE&S species having less than five known occurrences on the on the Uwharrie NF as a first priority.

4.7 U.S. Fish and Wildlife Service Birds of Conservation Concern

The U.S. Fish and Wildlife Service (USFWS) Migratory Bird Office created the list of Birds of Conservation Concern (BCS) to fulfill a 1988 mandate to *"identify species, subspecies, and populations of all migratory nongame birds that, without additional conservation actions, are likely to become candidates for listing under the Endangered Species Act (ESA) of 1973(USFWS 2008)."* This list was reviewed and 13 species were identified as either occurring on, having suitable habitat on or migrating through the Uwharrie NF. Three of these bird species were already identified as TES&LR species bringing the total number species for consideration to 10 (Table 18). These species were considered separately from TES&LR using breeding bird survey data for the Uwharrie NF.

Table 18. USFWS Birds of Conservation Concern Status and Temporal Trend on the Uwharrie NF

Birds of Conservation Concern	Status Global/NC	Habitat Association	Breeding Bird Survey occurrences on the Uwh NF	Temporal Trend on Uwh NF
Asio flammeus (Short-eared Owl (nb))	G5/SUB, S3N	fields, savannas and woodlands near water	0	—
Caprimulgus vociferus (Whip-poor-will)	G5/S5B	open woodlands and early successional forests	2	stable
Sitta pusilla (Brown-headed Nuthatch)	G5/S5	open longleaf pine forests	3	stable
Cistothorus platensis (Sedge Wren)	G5/SUB, S4N	grasslands, savannas and marshes	0	—
Hylocichla mustelina (Wood Thrush)	G5/S5B	deciduous or mixed forests with dense canopy and well developed understory	222	stable to declining
Vermivora pinus (Blue-winged Warbler)	G5/S2B	edges of pastures, woodlands, streams and swamps	3	declining
Dendroica discolor (Prairie Warbler)	G5/S5B, S1N	early successional forests	64	stable to declining
Dendroica cerulea (Cerulean Warbler)	G4/S2B	mature mesic hardwood forest with developed shrub layer	0	—
Oporornis formosus (Kentucky Warbler)	G5/S4B	mid successional forests with open canopy and developed ground cover	27	stable to declining
Euphagus carolinus (Rusty Blackbird (nb))	G4/S3N	moist pine forests and wooded edges of small permanent water bodies	0	—

Breeding bird survey data from 1997 to 2008 was used to determine the temporal trends of these species. This information was collected at stationary listening points throughout the Uwharrie NF during late spring each year. It is important to note that this type of breeding season data is not likely to capture information regarding migratory birds that may be wintering in or migrating through the Uwharrie NF during other times of the year.

Increased restoration activities under Alternatives B and C of the proposed plan would improve habitat for the birds of conservation concern listed in Table 18. For the six birds that occur on the Uwharrie NF, implementation of Alternatives A, B, or C would either slow the rate of decline or stabilize local populations.

4.8 Viability Outcomes

A viability outcome was determined for each of the species identified during the species viability evaluation process. A range of five viability outcome levels was developed to facilitate the comparison of species viability under each alternative in forest plan revision. The viability outcome should be thought of as an index of the capability of the environment to support population abundance and distribution, but not as an actual prediction of population occurrence, size, density or other demographic characteristics. A viability outcome is a judgment, based on scientific information found in the literature and from discussion with taxonomic experts, and it does not make a yes-or-no determination of viability. It is important to note that the concept of ecological conditions, distribution and quality must be based on the knowledge of the species distributional range and life history.

The following 'outcomes' were used to evaluate the viability of individual species based primarily on availability and quality of habitat in the short term (10 years), and long term (30 years) for each alternative:

- **Outcome A**: Habitat (including known sites) is of sufficient quality, abundance and distribution to allow species to stabilize in a pattern similar to reference distribution.
- **Outcome B**: Habitat (including known sites) is of sufficient quality, abundance and distribution to allow species to stabilize in a pattern similar to reference distribution with some limitations on biological functions and species interactions.
- **Outcome C**: Habitat (including known sites) is the minimum quality, abundance and distribution to allow species to stabilize in a pattern highly altered from reference distribution with major limitations on biological functions and species interactions. Loss of any sites that provide linkage could result in habitat insufficient to support stable populations of the species.
- **Outcome D**: Habitat (including known sites) is insufficient to support stable populations of the species.
- **Outcome E**: Information is insufficient to determine an outcome.

Table 17. Species Viability Outcomes.

Species	Habitat Group	Alt. A		Alt. B		Alt. C	
		2021	2041	2021	2041	2021	2041
Picoides borealis (Red-cockaded woodpecker)							
Canis rufus (Red wolf)							
Puma concolor cougar (Eastern cougar)							
Echinacea laevigata (Smooth coneflower)	1	D	D	C	C	C	C
***Helianthus schweinitzii* (Schweinitz's sunflower)**	**2**	**C**	**C**	**B**	**A**	**B**	**A**
Rhus michauxii (Michaux's sumac)	1	D	D	C	C	C	C
Aimophila aestivalis (Bachman's sparrow)	2	D	D	D	C	D	C
Haliaeetus leucocephalus (Bald eagle)	6	A	A	A	A	A	A
Lanius ludovicianus migrans (Migrant loggerhead shrike)	2	B	B	B	B	B	B
Myotis leibii (Eastern small-footed bat)	**1,2,3**	B	B	B	B	B	B
Acmispon helleri (Carolina birdfoot-trefoil)	2	D	D	C	C	C	C
***Amorpha schwerinii* (Piedmont Indigo-bush)**	**2,3**	**B**	**B**	**B**	**A**	**B**	**A**
Berberis canadensis (American barberry)	1	D	D	C	C	C	C
***Carex impressinervia* (Ravine sedge)**	**3**	**C**	**C**	**B**	**B**	**C**	**C**
Danthonia epilis (Bog oatgrass)	4	D	D	C	B	D	C
***Eurybia mirabilis* (Piedmont aster)**	**3**	**D**	**D**	**C**	**C**	**D**	**D**
***Fothergilla major* (Large witch-alder)**	**2,4**	**C**	**C**	**B**	**B**	**B**	**B**
Heuchera caroliniana (Carolina alumroot)	3	D	D	C	C	C	C
Lindera subcoriacea (Bog spicebush)	4	D	D	C	B	C	B
Solidago plumosa	1	C	C	C	C	C	C

Species	Habitat Group	Alt. A		Alt. B		Alt. C	
		2021	2041	2021	2041	2021	2041
(Yadkin river goldenrod)							
***Symphyotrichum georgianum* (Georgia aster)**	**2**	**C**	**C**	**B**	**B**	**B**	**B**
Scopelophila cataractae (Agoyan cataract moss)	2	D	D	D	C	C	C
***Xanthoparmelia monticola* (a rock-shield lichen)**	**1**	**D**	**D**	**C**	**C**	**C**	**C**
Myotis austroriparius (Southeastern myotis)	1,3	C	C	C	B	C	B
***Condylura cristata pop. 1* (Star-nosed mole)**	**4**	C	C	C	B	C	B
***Ambystoma talpoideum* (Mole salamander)**	**4**	**C**	**C**	**C**	**B**	**C**	**B**
Ambystoma tigrinum tigrinum (Eastern tiger salamander)	4,5	C	C	C	B	C	B
Ophisaurus attenuatus (Slender glass lizard)	1,2,5	C	C	C	B	C	B
Heterodon simus (Southern hognose snake)	2	C	C	B	A	B	A
Micrurus fulvius (Eastern coral snake)	2	C	C	B	A	B	A
Accipiter striatus (Sharp-shinned hawk)	1,2	B	B	B	B	B	B
Acronicta albarufa (Barrens daggermoth)	1,2	B	B	B	B	B	B
Heterocampa varia (A notodontid moth)	2	B	B	B	B	B	B
Hyperstrotia aetheria (A noctuid moth)	2	C	C	C	B	C	B
*Amblyscirtes alternata (*Dusky roadside-skipper)	2	C	C	C	B	C	B
Euphyes bimacula (Two-spotted skipper)	4	C	C	C	C	C	C
Satyrium edwardsii (Edwards' hairstreak)	1	C	C	C	B	C	B
Cicindela patruela (Northern barrens tiger beetle)	2	C	C	C	B	C	B
***Anemone berlandieri* (Southern Anemone)**	**1**	**C**	**C**	**C**	**B**	**C**	**B**
Arabis missouriensis (Missouri rockcress)	1	D	D	C	C	C	C
Baptisia alba var alba (Thick-pod white wild indigo)	2	D	D	C	C	C	C
Baptisia australis var. aberrans (Prairie blue wild indigo)	1	D	D	C	C	C	C
Callitriche terrestris (Terrestrial water-starwort)	5	D	D	D	D	D	D
***Cardamine dissecta* (Dissected toothwort)**	**3**	D	D	C	B	C	C
Carex bushii (Bush's sedge)	2,4	D	D	C	B	C	C
Celastrus scandens (American bittersweet)	2	D	D	C	C	C	C
***Cirsium carolinianum* (Carolina thistle)**	**1**	**C**	**C**	**B**	**B**	**B**	**B**
***Collinsonia tuberosa* (Piedmont horsebalm)**	**3**	**D**	**D**	**C**	**C**	**D**	**D**
***Desmodium fernaldii* (Fernald's Tick-trefoil)**	**2**	D	D	C	C	C	C
Dichanthelium annulum (Ringed witchgrass)	1	D	D	C	C	C	C
***Dichanthelium boreale* (Northern witch grass)**	**2**	**D**	**D**	**C**	**C**	**C**	**C**
Dodecatheon meadia var. meadia (Eastern shooting star)	1	D	D	C	C	C	C

Species	Habitat Group	Alt. A		Alt. B		Alt. C	
		2021	2041	2021	2041	2021	2041
*Echinacea purpurea (*Purple coneflower)	1	D	D	C	C	C	C
Gillenia stipulata (American ipecac)	1	D	D	C	B	C	B
Helenium brevifolium (Littleleaf sneezeweed)	4	D	D	C	B	C	C
***Helianthus laevigatus* (Smooth sunflower)**	**2**	**C**	**C**	**B**	**B**	**B**	**B**
Hexalectris spicata (Crested coralroot)	1	D	D	C	C	C	C
Liatris aspera (Rough Blazing Star)	1	D	D	C	C	C	C
Lilium canadense ssp. editorum (Red Canada lily)	4	D	D	C	C	D	C
***Matelea decipiens* (Glade milkvine)**	**1**	**D**	**D**	**C**	**C**	**C**	**C**
***Parthenium auriculatum* (Glade wild quinine)**	**1**	**D**	**D**	**C**	**B?**	**C**	**B?**
Pellaea wrightiana (Wright's cliffbrake)	1	D	D	C	C	C	C
Plantago cordata (Heartleaf plantain)	4	D	D	D	D	D	D
Polygala senega (Seneca Snakeroot)	1	D	D	C	C	C	C
***Pseudognaphalium helleri* (Heller's rabbit tobacco)**	**1,2**	**D**	**C**	**C**	**B**	**C**	**B**
***Quercus austrina* (Bluff oak)**	**1**	**D**	**D**	**C**	**C**	**C**	**C**
***Ruellia purshiana* (Pursh's wild-petunia)**	**1**	**D**	**D**	**C**	**C**	**C**	**C**
Salvia azurea (Azure Sage)	2	D	D	C	C	C	C
***Sedum glaucophyllum* (Cliff Stonecrop)**	**1**	**D**	**D**	**C**	**C**	**C**	**C**
Silphium terebinthinaceum (Prairie rosinweed)	1	D	D	C	C	C	C
***Smilax hugeri* (Huger's Carrion-flower)**	**3**	**C**	**C**	**C**	**C**	**C**	**C**
Solidago radula (Western rough goldenrod)	1	D	D	C	C	C	C
Solidago rigida var. glabrata (Southeastern bold goldenrod)	1	D	D	C	C	C	C
Stachys sp. 1 (a Hedge nettle)	3	D	D	D	C	D	C
***Stewartia ovata* (Mountain camellia)**	**3**	**C**	**C**	**C**	**C**	**C**	**C**
Symphyotrichum laeve var. concinnum (Smooth blue aster)	1	D	D	C	C	C	C
***Tradescantia virginiana* (Virginia spiderwort)**	**3**	**D**	**D**	**C**	**C**	**D**	**D**
Tridens chapmanii (Chapman's redtop)	2	D	D	C	C	C	C
***Trifolium reflexum* (Buffalo Clover)**	**2**	**D**	**D**	**C**	**C**	**C**	**C**
***Viola walteri* (Prostrate Blue Violet)**	**1,2**	**D**	**D**	**C**	**C**	**C**	**C**
Weissia sharpii (moss species)	1	D	D	C	C	C	C
Asio flammeus (Short-eared Owl (nb))	2	C	C	C	B	C	B
Caprimulgus vociferus (Whip-poor-will)	1	C	C	C	B	C	B
Sitta pusilla (Brown-headed Nuthatch)	2	C	C	C	B	C	B
Cistothorus platensis (Sedge Wren)	2	C	C	C	B	C	B

Species	Habitat Group	Alt. A		Alt. B		Alt. C	
		2021	2041	2021	2041	2021	2041
Hylocichla mustelina (Wood Thrush)	3	B	B	B	B	B	B
Vermivora pinus (Blue-winged Warbler)	2	C	C	C	B	C	B
Dendroica discolor (Prairie Warbler)	2	C	C	C	B	C	B
Dendroica cerulea (Cerulean Warbler)	3	C	C	B	B	B	B
Oporornis formosus (Kentucky Warbler)	3	C	C	B	B	B	B
Euphagus carolinus (Rusty Blackbird (nb))	5	C	C	B	B	B	B

*Viability was not evaluated for the red wolf and the eastern cougar as those are species that have been extirpated from the Uwharrie NF.

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Appendix A. Mapping Ecological Systems and Potential Plant Communities on the Uwharrie National Forest: First Approximation

Introduction

The purpose of this mapping effort is to quantify the distribution and abundance of potential plant communities relative to environments on the Uwharrie National Forest in order to provide a mid-level map useful for Forest Planning. Ecological systems are defined by groups of plant associations occurring in regions of similar physical conditions and biological potential (NatureServe 2004). There are numerous ecological systems on the Uwharrie NF. Sites within ecological systems may be characterized by geologic formation, landform, aspect and other physical variables that combine to form environments of varying temperature, moisture, and fertility, which are suitable to support characteristic species and forests. Using NatureServe ecological systems as a framework, we have developed a map of potential plant communities using environmental variable-based models that we believe can provide insight on the "capability" of land and can assist land managers and planners in implementing ecosystem management policies.

Methods

Map Area

The mapped area consists of a 16-USGS quad area centered on the Uwharrie NF. This area includes the following 1:24,000 scale quads: Asheboro, Badin, Biscoe, Candor, Eleazer, Farmer, Handy, Harrisville, Highrock, Lovejoy, Morrow Mountain, Mt. Gilead East, New London, Seagrove, Star, and Troy.

Field Data

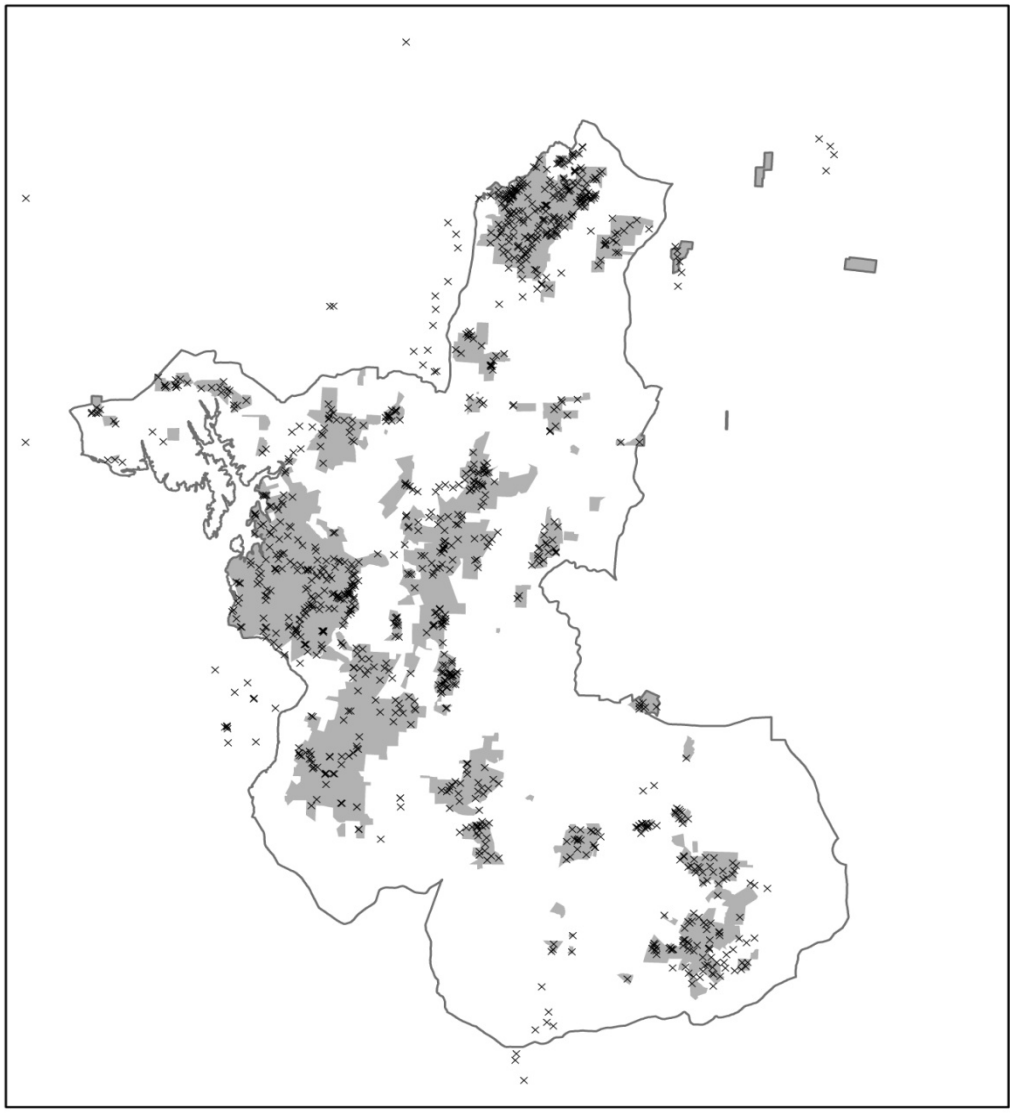
Much of the vegetation field data was obtained in 2004 from a U.S. Forest Service (USFS) contract with Alan and Allison Weakley. The contract included: 1) collection of species presence and abundance data from reference sites used to characterize all major and important minor plant community types on the Forest, 2) the collection of location data, (latitude & longitude) on a larger number of areas to identify the range of sites that support or could potentially support plant community types on the Uwharrie NF, and 3) location data for rare plant species. After visiting a sample of the Weakley's field sites, additional field data were obtained during the summer of 2005 by Gary Kauffman (USFS botanist) and Steve Simon (USFS plant ecologist). They collected additional location data for community types and / or potential community types to augment information on site potential across the Forest. All vegetation plots were located using a global positioning system (GPS).

Grouping of Plant Communities

The 15 common plant community types identified by the Weakley's were logically grouped into eight ecological systems/plant community groups by comparing field classifications and descriptions to those described by NatureServe (2004). Some of these groups are combinations of NatureServe ecological systems while other groups split

ecological systems into their component plant associations. These groups, and the field plots associated with each, are shown on Figure A-1.

Figure A- 1. Location of vegetation field data points (x) on the Uwharrie National Forest (outlined) (shaded areas are administered by the USFS)



Database Creation and Model Application

Application of the environmental variable-based plant community models required development of a spatial database for the study area. Source data were acquired from U.S. Geological Survey 10-m resolution DEMs. Edge matching and smoothing procedures were applied to all DEMs using the ArcGrid GIS to produce a seamless grid of elevations for the entire study area. This elevation grid was processed using algorithms from various sources (Table A-2) to produce estimates of derived terrain and environmental variables; e.g. aspect, slope gradient, landform index.

Table A-2: Variables used in the Uwharrie Plant Community Model's 1st Approximation (12/28/2005)

Elevation	Elevation above sea level in feet derived from a 10 meter DEM with sinks filled. Source: ESRI
Aspect	Beers transformation of land surface aspect from azimuth (0-360) to cosine representation [0.00-2.00]. (Beers et.al. 1966). Source: TopoMetrix (1999)
Solar radiation	A pseudo-solar radiation derived from shaded relief represented by values ranging from 0 to 255, with 0 representing the darkest areas and 255 the brightest. The azimuth angle of the light source is set on 200 and the angle set at 45. Source: ESRI (solar radiation = HILLSHADE (elevation-grid, 200, #,shade).
Slope steepness	The percent rise in elevation from the adjacent land area. Calculated as the maximum rate of change in z value from each 10 m grid cell. Source: ESRI.
Surface curvature profile	The curvature of the ground surface in the direction of slope. Source: ESRI
Surface curvature planiform	The curvature of the ground surface perpendicular to the slope direction. Source: ESRI
Landform Index (LFI)	An index of landform shape (site protection) and macro-scale landform. Larger number = more concave shape, more protected landform. From: *McNab, W.H. 1996. Classification of local- and landscape-scale ecological types in the Southern Appalachian Mountains. Environmental Monitoring and Assessment 39:215-229.* Source: TopoMetrix
Terrain shape index	The average curvature of the ground surface. A positive curvature indicates that the surface is upwardly convex. Source: ESRI
Relative Slope position	A measure of the cell position along a slope in relationship to the nearest ridge and drainage. Relative slope position (Wilds 1996) uses (1) a threshold level of flow accumulation to represent slope bottom, (2) the difference between mean elevation and highest elevation in a moving window to represent ridges, and (3) flowlength to calculate distance. Values range from 0 to 1: ridges = 1, valley bottoms = 0. Source: Stephanie Wilds
Topographic Relative Moisture Index (TRMI)	Based on the weighted scalar developed by Parker (1982). TRMI combines aspect, slope, slope configuration (curvature) and relative slope position. Source: Stephanie Wilds
Distance to Stream	Euclidian distance to the nearest modeled stream, regardless of stream order. Source: ESRI

GIS was used to assign each vegetative plot to the appropriate cell in the DEMs. Environmental variables were determined for each plot by merging the location with the 10-m resolution digital elevation and environment grids. In total, 11 grids were merged with an ARC point coverage that contained approximately 1100 plot locations. A database was created that included the plot number, plant community type (Weakley's), plant community group, and the 11 environmental characterization variables listed above.

Vegetation and Environment Relationships

We selected logistic regression for developing models to predict the probability of occurrence of plant communities in differing environments. We used ordinary multiple logistic regression to determine environmental variables associated with the presence or absence of the eight plant community groups at field sample plot locations. Both presence and absence data characterized environmental limits of occurrence. Model accuracy was evaluated using several standard measures of logistic regression performance, which included classification tables, receiver operating characteristic (ROC) curves, and selection of probability cut points using sensitivity and specificity.

Each of the eight logistic plant community models was applied to the DEMs representing environmental, variables. The resulting eight map layers represent the probability of occurrence, ranging from zero to one, of each plant community group in each 10-m (33-foot, 0.2 acre) cell of the DEM grid for the 16-quad, 660,000 - acre mapped area. Typically, the centers of areas of highest probabilities were at sample plot locations, where environmental data were obtained to generate the plant community group model. Clusters of cells where the plant community group was classified as present represent regions of probabilities.

Incorporating geologic formation, a surrogate for fertility, into model predictions

One of our interests in this mapping effort was to determine the historic distribution of longleaf pine plant communities across the Forest in order to address plant community restoration opportunities. Additional effort was made in the field to examine forests at the edge of the current distribution of longleaf pine on the Forest and surrounding areas. The relationship between longleaf pine, soil type, and geologic formation was evaluated at field locations where longleaf pine was found and in map features where longleaf pine was described in the USFS continuous inventory of stand condition (FSVEG) GIS coverage. It was clear from this analysis that longleaf pine almost never occurs in areas with high base rocks, i.e. mafic areas, and that it is most often associated with only 1 soil type – the Herndon series. The map area was therefore divided into two model sections using the break between the metamudstone – metaargillite geologic formation and the felsic metavolcanic geologic formation to define the western extent of longleaf pine, and the pattern of Herndon soil map unit abundance to define the northern extent of longleaf pine. We refer to the two model sections as the northwest section and the southeast section.

Creating a single map of plant community groups

Mapping of plant community groups involved combining individual models to form a single GIS coverage and establishing a boundary in the transition area between adjacent plant community groups. The boundaries often are broad and usually support more than one system. We used the stacking order feature in ArcGrid to resolve classification conflicts in areas where multiple plant community groups were predicted. All plant community group models were arranged in vertical sequence from highest, on top of the stack, to lowest predictive power. Themes in ArcGrid at the top of the stack take

precedence over those below, so in areas of overlap, the upper themes in descending order obstruct the view of those below. Using an iterative process, stacking order and probability cut points were adjusted until the pattern of plant community groups appeared reasonable and closely matched classifications made at field plots. The minimum map unit was set at 1 acre. This process was used twice – once for the southeast section with all eight-plant community groups being included, and once for the northwest section with only seven plant community groups being included, i.e. the longleaf pine model was not included in the northwest section. A single map of plant community groups was created by joining together the northwest and southeast sections.

Results

We identified eight common plant community groups on the Uwharrie NF that could be modeled using environmental variables and four rare plant communities that we represented by points based on field inventories. The map of plant community groups is an approximation of the distribution and abundance of pre-settlement plant communities (potential natural vegetation). Statistics and significant variables associated with development of the models are presented in Table A-3. The areas under the ROC curves all exceed 0.70, which suggests the models have acceptable to excellent discrimination capability (Hosmer and Lemeshow 2000). The high ROC values of most logistic models suggest that ecological systems described by NatureServe, some of which were combined or disaggregated for this study, are associated with sites having unique environmental characteristics.

The map of potential vegetation illustrates the strong influence of topography on the distribution of site potentials and plant species on the forest. For example, Xeric Oak communities that are characterized by chestnut oak dominance (NatureServe) are mapped only on exposed ridges, especially at higher elevations; dry oak-hickory characterized by southern red oak is distributed along the convex portions of hillsides and low ridges and occur adjacent to Dry-mesic oak-hickory in the concave draws. Similarly, shortleaf pine-oak is distributed predominantly on steep slopes with a southerly exposure while mesic hardwood slopes are on more protected steep slopes. Finally, alluvial and mesic forests are mapped along streams and toe slopes and longleaf pine occupies topography similar to dry-oak hickory but is restricted primarily to the southeastern portion of the Forest.

Discussion

This map of potential natural vegetations is a mid-level map for use in forest planning and should therefore be evaluated in the context of the intended analysis application and the management decision the data and analysis are intended to support, e.g. ecological sustainability analysis. This evaluation should consider the needs of the desired level of precision (i.e., the level of thematic detail) with the desired level of accuracy and should provide the basis for evaluating the level of uncertainty that is acceptable to support particular management decisions at the forest planning level.

Map units were further divided by incorporating important differences in soil chemistry that may affect site fertility. The Wynot, Enon, and Cullen soils formed in clayey residuum weathered from mafic rocks or mixed mafic and felsic crystalline rocks are less

acidic than other more common soils on the Forest. This characteristic was used to differentiate between the "basic" oak hickory communities that could likely support chalk maple, shagbark hickory, redbud, and cedar and those oak-hickory communities where these species are not likely to occur. This was done only for those areas where soil mapping was complete and map units digitized, i.e. lands administered by the USFS on the Uwharrie National Forest.

Table A-3 – Environmental variables included in plant community group models

Environmental variable	Xeric Oak	SL Pine-Oak	Dry Oak-Hick.	D.mesic Oak-Hick.	Mesic HW slope	Mesic-Alluvial	Small Stream	Longleaf Pine
Elevation	2 +	3 -	-	-	2 -	2 -	4 +	-
Aspect	4 -	-	5 +	4 +	5 -	-	-	5 +
Solar radiation	-	-	4 -	-	-	6 -	2 +	6 -
Slope steepness	-	-	-	5 +	1 +	1 -	5 +	2 -
Surface curvature profile	-	-	-	-	-	-	-	-
Surface curvature planiform	-	-	-	-	4 -	-	-	-
Terrain shape index	-	-	-	-	-	-	-	-
Landform index	3 +	2 +	6 -	2 -	-	4 +	-	1 -
Relative slope position	-	-	3 +	3 -	-	5 +	3 -	7 -
Terrain moisture index	-	1 -	1 -	-	3 +	-	-	3 -
Distance to stream	1 +		2 -	1 -	-	3 -	1 -	4 -
ROC	0.97	0.99	0.82	0.77	0.92	0.94	0.93	0.84

Whole numbers in columns indicate the relative level of importance of significant variables in each plant community group model and sign of the coefficient. ROC, or receiver operating characteristic, is a plot of sensitivity over 1 minus specificity: sensitivity is a measure of accuracy of predicting on occurrence and specificity is a measure of predicting nonoccurrence. A model with an area under the ROC curve > 0.7 is considered to have acceptable discrimination capability; models with ROC values > 0.8 are considered to be excellent (Hosmer and Lemeshow 2000).

Table A-4 – Plant community groups on the Uwharrie National Forest and Vicinity

Plant Community Group	Total area		Federal land	
	no. acres	*percent*	*no. acres*	*percent*
Xeric Oak Forest	20,500	3.3	3,050	6.0
Shortleaf Pine-Oak Woodland	172	0.04	94	0.2
Dry Oak-Hickory	217,800	35.0	21,480	41.9
Dry-mesic Oak-Hickory	188,400	30.3	16,200	31.6
Mesic Hardwood Slope	3,655	0.6	44	0.3
Small Stream Forest	1,915	0.3	140	0.3

Alluvial & Mesic Forest	50,480	8.1		2,560	5.0
Longleaf Pine Woodland	138,600	22.3		7,700	15.1
Total	621,600			51,270	8.2

Table A-5. Point data used to develop Uwharrie Plant Community models

PLANT COMMUNITY GROUP MAP UNIT	ECOLOGICAL SYSTEM	PLANT COMMUNITY (Weakley')	Weakley's field plots	Simon/ Kauffman Plots 1/	Total Data Pts. 2/
Xeric Oak Forest	Southern Piedmont Dry Oak-(Pine) Forest	Piedmont Monadnock Forest	45	195	240
Shortleaf Pine-Oak Woodland	Southern Piedmont Dry Oak-(Pine) Forest	Shortleaf Pine-Oak Savanna	6	0	6
Dry Oak-Hickory Forest	Southern Piedmont Dry Oak-(Pine) Forest	Dry Oak-Hickory	96	124	240
		Dry Basic Oak-Hickory	16		
Dry-Mesic Oak-Hickory Forest	Southern Piedmont Dry Oak-(Pine) Forest	Dry-Mesic Oak-Hickory	55	140	221
		Dry-Mesic Basic Oak-Hickory	26		
Mesic Hardwood Slope Forest	Southern Piedmont Mesic Forest	Basic Mesic Forest	6	20	26
Mesic and Alluvial Forest	Southern Piedmont Mesic Forest	Mesic Mixed Hardwood Forest	9	143	182
	Southern Piedmont Large Floodplain Forest	Piedmont Alluvial Forest	27		
		Piedmont Bottomland Forest	1		
		Piedmont Levee Forest	2		
Small Stream Forest	Southern Piedmont Small Floodplain and Riparian Forest	Piedmont Small Stream Forest	22	47	70
		Piedmont/Coastal Plain Heath	1		
Longleaf Pine Woodland	Southeastern Interior Longleaf Pine Woodland	Piedmont Longleaf Pine Forest	20	66	89
		Piedmont LL Pine Seepage Bog	3		
NOT MODELED					
Represented by points	Southern Piedmont Glades and Barren	Basic Piedmont Bluff Glades	1	1	19
Represented by points	Southern Piedmont Mafic Hardpan Woodland	Xeric Hardpan Forest	8	1	9
Represented by points	Southern Piedmont/Ridge and Valley Upland Depression Swamp	Upland Depression Swamp Forest	6	2	11
Represented by points	Southern Piedmont Seepage Wetland	Piedmont Boggy Streamhead	6	5	50

1/ field plots (GPS and veg. Type), GPS and veg. Type derived from soils (alluvial only), NC Heritage community EOs, and extrapolations. 2/ includes additional data points from NC Natural Heritage Program Community Element Occurrences

Appendix B. Ecological System descriptions and ecological condition evaluations

Format of write-up

Derivation: The data source used to define the reference condition.
Environment: Topographic setting, slope position and steepness, soil drainage class and texture, geologic substrate, temperature-moisture-fertility relative to other types.
Disturbance regime: Natural disturbance processes and fire regime.
Abundance and distribution on the Uwharrie NF: The approximate number of acres that could occur on the UWNF derived from environmental modeling, total existing acres, and primary location.
Potential abundance relative to potential in the surrounding 4 counties: The proportion of the potential acres on the UWNF relative to potential acres within Montgomery, Randolph, Stanley, and Davidson counties.
Composition and structure (reference condition): A description of the overstory, midcanopy, and understory tree, shrub, and herb structure (canopy closure and gap size) and composition (dominant and characteristic species) based primarily on NatureServe (2004) and/or Schafale and Weakley (1990). Species common and scientific names are listed in **Table 2** following all descriptions. These descriptions are considered an approximation of composition and structure before European settlement and include the effects of natural and Indian-caused disturbances such as fire.

Ecological condition benchmarks within the potential extent of this system: format described in section 43.12. For this analysis, the potential extent is considered optimal.

Southeastern Interior Longleaf Pine Woodland

Derivation: Piedmont Longleaf Pine Forest (Schafale and Weakley 1990). Southeastern Interior Longleaf Pine Woodland Ecological System (NatureServe 2004).
Environment: Flats and slopes of low, rolling topography over felsic rock on very deep, often very stony, well-drained soils with moderate permeability. Occasionally on steeper, south-facing slopes. Some of the drier sites on the Uwharrie NF and similar to sites supporting Dry Oak-Hickory ecological systems.
Disturbance regime: Exposed low ridges and flats somewhat susceptible to disturbance by high winds and limited lightening. Disturbance by fire highly variable from pre-European settlement till present day. Extensive burning by Native Americans before European settlement likely continued by early settlers and augmented by a moderately dense herbaceous herb layer and continuity of landscapes or “fire compartments.” Lack of fire, conversion of land to agriculture, and old-field abandonment, has occurred since this period. Fire regime condition class I (0-35 year return interval; surface fires of mixed severity).
Abundance and distribution on the Uwharrie NF: Outside Streamside forests approximately 8,200 acres potential, 2,300 acres currently dominated by longleaf pine.

Primarily in the southeastern and south-central portion of the Forest. Common near Troy, NC.

Abundance relative to the potential in the surrounding 4 counties: 10.4% of 73,300 potential acres.

Composition and structure (reference condition): Multi-aged woodland (25%-60% tree cover) with treeless canopy gaps occasionally as large as 1/4 acre in size; ½ to 2 acres in size on sites suitable for Schweinitz's sunflower. Canopy dominated by longleaf pine with occasional shortleaf pine and oaks or codominated by longleaf and shortleaf pine with occasional oaks. Characteristic hardwood associates may include: post oak, southern red oak and blackjack oak. Open (< 10% cover) midcanopy and shrub layer; characteristic species would include hillside blueberry, New Jersey tea, and common chinquapin. The herb layer is nearly continuous, diverse and includes characteristic species such as little bluestem, splitbeard bluestem, Virginia goat's-rue, yellow Indiangrass, poverty oat-grass, silky oat-grass, southern bracken, licorice goldenrod, Maryland goldenaster, leafy elephant's-foot, hyssopleaf eupatorium, late eupatorium, threadleaf coreopsis, common stargrass, helmet flower, starved witch grass, and forked witch grass.

Ecological condition benchmarks within the optimal extent of the Longleaf Pine Woodland system:

Key Factors Subject to Management Control	Indicator	Ecological Condition Benchmark (Percent of Optimal)				Current Condition	Current Rating
		Very good	Good	Fair	Poor		
Species Composition	Percent of acreage dominated by longleaf pine	> 75%	55%-75%	30%-55%	< 30%	23%	Poor
Canopy Structure	Percent of acreage at desired canopy closure [1/]	> 75%	55%-75%	30%-55%	< 30%	7% [2/]	Poor
Canopy Structure	Percent of acreage with canopy gaps ½ to 2 acres in size	> 75%	55-75%	30-55%	< 30%	unknown	unknown
Fire Regime	Percent of acreage burned at least twice in the last decade	> 75%	55%-75%	30%-55%	< 30%	17%	Poor
Abundance of reference condition	Percent of acreage at desired condition for all three indicators above	> 50%	30%-50%	10%-30%	< 15%	3% [3/]	Poor

[1/] desired canopy closure is 25%-60% [2/] in Botanical SIA or > 80 years in age , [3/] occurs only in Botanical SIA

Restoration of the longleaf pine woodland ecosystem is one of the primary themes for the proposed forest plan. Through increased thinning and prescribed fire treatments, canopy structure and species composition in the longleaf pine ecosystem will improve over time. Likewise, the fire regime will improve to a fair to good condition as prescribed fire continues to be used within these systems.

Xeric Oak Forest

Derivation: Piedmont Monadnock Forest (Schafale and Weakley 1990). Southern Piedmont Dry Oak-(Pine) Forest Ecological System (NatureServe 2004).

Environment: Exposed high ridges and knolls (commonly called Monadnocks), mostly over felsic or other highly resistant rock, on well-drained, moderately permeable,

extremely stony and extremely boulder soils. Some of the hottest and driest sites on the Uwharrie NF.

Disturbance regime: Susceptible to disturbance by high winds and lightning but fire does not carry well in the typically sparse herb layer and rocky soil surface. Canopy gaps likely more frequent than other ecological systems. Fire regime condition class I (0-35 year return interval; surface fires of mixed severity).

Abundance and distribution on the Uwharrie NF: Approximately 2,990 acres potential, 1,660 acres existing. Most common in the Badin Lake area, Birkhead Wilderness, and Woods Run area.

Abundance relative to the potential in the surrounding 4 counties: 30% of 9,650 acres potential.

Composition and structure (Reference condition): Patchy canopy dominated by chestnut oak with canopy gaps less than ¼ acre in size. Common associates may include: white oak, post oak, southern red oak, pignut hickory, and shortleaf pine. Patchy and open midcanopy dominated by sourwood, and blackgum. Scattered shrub layer includes characteristic species such as: hillside blueberry, deerberry, and black huckleberry. Sparse (< 30% cover) herb layer includes characteristic species such as pipsissewa, woodland Tick-trefoil, little bluestem, and Virginia goat's rue.

Ecological condition benchmarks within the optimal extent of the Xeric Oak system:

Key Factors Subject to Management Control	Indicator	Ecological Condition Benchmark (Percent of Optimal)				Current Condition	Current Rating
		Very good	Good	Fair	Poor		
Species Composition	Percent of acreage dominated by chestnut oak	> 85%	70%-85%	50%-70%	< 50%	40%	Poor
Canopy Structure	Percent of acreage at desired canopy closure [1/]	> 85%	70%-85%	50%-70%	< 50%	55% [2/]	Fair
Fire Regime	Percent of acreage burned at least twice in the last 15 years	> 85%	70%-85%	50%-70%	< 50%	15%	Poor
All above on Same site	Percent of acreage at or near reference condition especially understory species	> 75%	50%-75%	25%-50%	< 25%	3% [3/]	Poor

[1/] desired canopy closure is 60%-80%, [2/] Oak-dominated FSVEG types > 60 years in age , [3/] occurs only in Botanical SIA

Xeric Oak Forest would not be targeted for specific vegetation management projects to open the existing canopy structure. However, with greater emphasis on landscape level burning within oak dominated forests, there should be a small increase in canopy gaps and greater representation of fire-adapted herbs in the understory layer of the xeric oak system. There will be little change in ecological benchmarks ratings both for the short-term and long-term although the increased burning should move the fire regime from a poor to a fair rating.

Dry Oak-Hickory Forest (felsic)

Derivation: Dry Oak-Hickory Forest (Schafale and Weakley 1990), *Quercus falcata-Quercus alba - Cary alba / Oxydendrum arboreum / Vaccinium stamineum* Forest (NatureServe 2004).

Environment: Dry topographic positions, (convex upper slopes, mid-slopes, and low ridges) over felsic rock on moderately deep to very deep, well drained, soil with moderate permeability; often very stony, extremely stony, or extremely boulder soils. Some of the drier sites on the Uwharrie NF.

Disturbance regime: Wind disturbance, although not commonly severe, in combination with old tree mortality promotes canopy gaps. Burning by American Indians likely impacted these sites although fire would have been of low impact in the typically sparse herb layer. Fire regime condition class I (0-35 year return interval; surface fires of mixed severity).

Abundance and distribution on the Uwharrie NF: Outside Streamside Forests approximately 19,200 acres potential, 10,370 acres existing. This is the most abundant, non-successional ecological system on the Forest and is limited only on the eastern edge of Badin Lake and in the southeastern portion of the Forest where it is replaced by Longleaf Pine Woodlands.

Abundance relative to the potential in the surrounding 4 counties: 19% of 102,700 acres potential.

Composition and structure (desired condition): Relatively open canopy (60%-80% cover) with small (1/2 acre) to large (2 acre) canopy gaps. Forest dominated by dry site oaks or a mixture of oaks and up to 30% cover of shortleaf pine. Southern red oak, white oak, or post oak are the dominant species. Other characteristic trees include: chestnut oak, blackjack oak, black oak, scarlet oak, pignut hickory, mockernut hickory, and red hickory. Typical midcanopy trees include sourwood dogwood, and blackgum. Shrubs range from sparse to moderately dense, and may include hillside blueberry, deerberry, hairy highbush blueberry, and southern blueberry. The herb layer, although generally sparse, can be well developed in canopy gaps. Herbs include: rattlesnake plantain, hyssopleaf eupatorium, inland roundleaf eupatorium, Maryland goldenaster, licorice goldenrod, common stargrass, tick-trefoils, broomsedge, little bluestem, and yellow Indiangrass.

Ecological condition benchmarks within the optimal extent of the Dry Oak-Hickory Forest (felsic) system:

Key Factors Subject to Management Control	Indicator	Ecological Condition Benchmark (Percent of Optimal)				Current Condition	Current Rating
		Very good	Good	Fair	Poor		
Species Composition	Percent of acreage dominated by oaks and hickories or these species codominating with shortleaf pine	> 75%	55%-75%	30%-55%	< 30%	55%	Fair to Good
Canopy Structure	Percent of acreage at desired canopy closure [1/]	> 75%	55%-75%	30%-55%	< 30%	42% [2/]	Fair
Canopy Structure	Percent of acreage with canopy gaps ½ to 2 acres in size	> 75%	55%-75%	30%-55%	< 30%	unknown	unknown
Fire Regime	Percent of acreage burned at least twice in the last 15 years	> 75%	55%-75%	30%-55%	< 30%	4%	Poor
All above on Same site	Percent of acreage at or near reference condition especially understory species	> 50%	30%-50%	10%-30%	< 15%	10% [3/]	Poor

[1/] desired canopy closure is 60%-80% [2/] Oak dominated stands > 40 years in age , [3/] occurs only in Botanical SIA

Dry Oak-Hickory Forest (mafic)

Derivation: Basic Oak-Hickory Forest (Schafale and Weakley 1990), *Quercus alba - Cary glare - Fraxinus Americana / Acer leucoderme / Vitis rotundifolia* Forest; *Quercus alba - Quercus stellata - Cary carolinae-septentrionalis / Acer leucoderme - Cercis canadensis* Forest (NatureServe 2004).
Environment: Dry topographic positions, (convex upper slopes, mid-slopes, and ridges) over mafic rock on moderately deep to very deep, very stony to more often extremely boulder, well-drained soils. Some of the drier sites on the Uwharrie NF and similar to Dry Oak-Hickory felsic, and Longleaf Pine Woodland.
Disturbance regime: Wind disturbance, although not commonly severe, in combination with old tree mortality promotes canopy gaps. Burning by American Indians in low land areas likely impacted these sites although fire would have been of low impact in the typically sparse herb layer and rocky soil surface. Fire regime condition class I (0-35 year return interval; surface fires of mixed severity).
Abundance and distribution on the Uwharrie NF: Outside Streamside Forest, approximately 2,200 acres potential, 1,300 acres existing. Limited primarily to the eastern edge of FS lands at Badin Lake, near Big Creek east of highway 1301 and in the southeastern portion of the Birkheads. Most common in the Badin area.
Abundance relative to the potential in the surrounding 4 counties: 18% of 12,200 acres potential.
Composition and structure (desired condition): Relatively open to closed canopy with small (1/2 acre) to large (2 acre) canopy gaps. White oak is generally the most abundant tree. Other characteristic overstory trees include: chestnut oak, post oak, southern red oak, white ash, and pignut hickory. Other species in the canopy and subcanopy include: Carolina shagbark hickory, shortleaf pine, blackjack oak, chalk maple, redbud, and southern red cedar. The shrub and herb layers are generally sparse and may include the following species: farkleberry, whorled milkweed, northern oak grass, and pipssisiwa. The vine layer may be well-developed, and muscadine is common.

Ecological condition benchmarks within the optimal extent of the Dry Oak-Hickory Forest (mafic) system:

Key Factors Subject to Management Control	Indicator	Ecological Condition Benchmark (Percent of Optimal)				Current Condition	Current Rating
		Very good	Good	Fair	Poor		
Species Composition	Percent of acreage dominated by oak-hickory	> 85%	70%-85%	50%-70%	< 50%	52%	Fair
Canopy Structure	Percent of acreage at desired canopy closure [1/]	> 85%	70%-85%	50%-70%	< 50%	44% [2/]	Poor
Fire Regime	Percent of acreage burned at least twice in the last 15 years	> 85%	70%-85%	50%-70%	< 50%	8%	Poor
All above on Same site	Percent of acreage at or near reference condition especially understory species	> 75%	50%-75%	25%-50%	< 25%	13% [3/]	Poor

[1/] desired canopy closure is 60%-80%, [2/] Oak-dominated FSVEG types > 70 years in age , [3/] occurs only in Botanical SIA

Restoration of dry oak-hickory forests (both mafic and felsic types) would be implemented on off-site forest types (loblolly and shortleaf pine). In addition, more gaps would be created within existing oak-dominated forests during the planning cycle. Emphasis would also be placed on increasing thinning harvests as well as prescribed burns. These actions would increase canopy gaps within this ecological system therefore increasing the current rating from poor to fair in the short-term. It is uncertain if the increase in prescribed burns within this habitat would increase the rating to good in the long-term (30 years), however burning should have a greater affect on improving canopy structure compared to other more mesic ecological systems. The amount of frequently burned acreage would improve four-fold during the life of the plan and would result in a change in the fire regime rating from poor to good. A greater emphasis of prescribed burning within the mafic types of this ecological system would increase the fire regime rating. With the increase in burning, canopy gap creation, and thinning harvest, the diversity of the canopy, midstory, and understory should improve, however it is uncertain if this would result in a change in the rating from fair to good in the short-term.

Dry-Mesic Oak-Hickory (felsic)

Derivation: Dry-Mesic Oak-Hickory Forest (Schafale and Weakley 1990). Southern Piedmont Dry Oak-(Pine) Forest Ecological System (NatureServe 2004).
Environment: Moderately sheltered topographic positions, (concave mid- and lower slopes, narrow draws) on moderately deep to very deep, often very stony to extremely boulder, well-drained soils with moderate permeability, over felsic rock.
Disturbance regime: Wind disturbance ameliorated over more exposed sites but aids in creation of canopy gaps. Burning by American Indians probably had little impact because fire would have carried quickly through the moderately dense herb layer. Fire regime condition class I (0-35 year return interval; surface fires of mixed severity).
Abundance and distribution on the Uwharrie NF: Outside Streamside Forests, approximately 9,150 acres potential, 6,670 acres existing. This is the second most abundant non-successional ecological system on the Forest and is limited only on the eastern edge of Badin Lake.
Abundance relative to the potential in the surrounding 4 counties: 21% of 46,280 acres potential.
Composition and structure (desired condition): Relatively open canopy with small (1/2 acre) to large (2 acre) canopy gaps. Forest dominated by mixtures of oaks and hickories, with white oak the most common species along with northern red oak, black oak, mockernut hickory, red hickory, and pignut hickory. Shortleaf pine may be common but not a dominant component. Red maple, Sweetgum, and tulip poplar present in some stands but not in abundance. Typical midcanopy trees include American holly, sourwood, dogwood, and blackgum. Shrubs range from sparse to moderately dense, and may include downy arrowwood, deerberry, hillside blueberry, blue huckleberry, and American strawberry-bush. The herb layer, although generally sparse, can be well developed in canopy gaps. Herbs include: rattlesnake plantain, woodland tick-trefoil, rattlesnake hawkweed, broomsedge, and little bluestem.

Ecological condition benchmarks within the optimal extent of the Dry-Mesic Oak-Hickory (felsic) system:

Key Factors Subject to Management Control	Indicator	Ecological Condition Benchmark (Percent of Optimal)				Current Condition	Current Rating
		Very good	Good	Fair	Poor		
Species Composition	Percent of acreage dominated by oak-hickory forests	> 75%	55%-75%	30%-55%	< 30%	65%	Good
Canopy Structure	Percent of acreage at desired canopy closure [1/]	> 75%	55%-75%	30%-55%	< 30%	51% [2/]	Fair
Fire Regime	Percent of acreage burned at least twice in the last 20 years	> 75%	55%-75%	30%-55%	< 30%	9%	Poor
All above on Same site	Percent of acreage at or near reference condition especially understory species	> 50%	30%-50%	10%-30%	< 15%	11% [3/]	Poor

[1/] desired canopy closure is 60%-90% [2/] Oak dominated stands > 40 years in age , [3/] occurs only in Botanical SIA

Dry-mesic Oak-Hickory (mafic)

Derivation: Basic Oak-Hickory Forest (Schafale and Weakley 1990), *Quercus alba - Cary ovata / Cercis Canadensis* Forest; *Quercus alba - Quercus rubra - Carya glabra / Viburnum rafinesquianum / Viola tripartita* Forest (NatureServe 2004).
Environment: Moderately sheltered topographic positions, (concave mid- and lower slopes, narrow draws) on moderately deep to very deep, very stony to more often extremely boulder, well-drained soils over mafic rock.
Disturbance regime: Wind disturbance ameliorated over more exposed sites but aids in creation of canopy gaps. Burning by American Indians likely impacted these sites but would have little impact because fire would have carried quickly through the moderate herb layer or poorly through the rocky soil surface. Fire regime condition class I (0-35 year return interval; surface fires of mixed severity).
Abundance and distribution on the Uwharrie NF: Outside Streamside Forests, approximately 820 acres potential, 625 acres existing. Limited primarily to the eastern edge of FS lands at Badin Lake, near Big Creek east of highway 1301 and in the southeastern portion of the Birkheads. Most common in the Badin area.
Abundance relative to the potential in the surrounding 4 counties: 17% of 4,985 acres potential
Composition and structure (desired condition): Closed canopy with small (1/2 acre) to large (2 acre) canopy gaps and moderately well-developed subcanopy, shrub, and herbaceous layers with about 25% total cover per stratum. Dominated by white oak or white oak and shagbark hickory in combination with other characteristic species of oak and hickory such as: post oak, chestnut oak, black oak, mockernut hickory, and pignut hickory. Red maple, Sweetgum, and tulip poplar may be present but not in abundance. Other species in the canopy and subcanopy include: redbud, winged elm, and shortleaf pine. Herbs include: ebony spleenwort, Carolina supplejack, black-edge sedge, Christmas fern, rattlesnake fern, and common foamflower.

Ecological condition benchmarks within the optimal extent of the Dry-mesic Oak-Hickory (mafic) system:

Key Factors Subject to Management Control	Indicator	Ecological Condition Benchmark (Percent of Optimal)				Current Condition	Current Rating
		Very good	Good	Fair	Poor		
Species Composition	Percent of acreage dominated by oak-hickory forests	> 85%	70%-85%	50%-70%	< 50%	74%	Good
Canopy Structure	Percent of acreage at desired canopy closure [1/]	> 85%	70%-85%	50%-70%	< 50%	54% [2/]	Fair
Fire Regime	Percent of acreage burned at least twice in the last 20 years	> 85%	70%-85%	50%-70%	< 50%	10%	Poor
All above on Same site	Percent of acreage at or near reference condition especially understory species	> 75%	50%-75%	25%-50%	< 25%	14% [3/]	Poor

[1/] desired canopy closure is 60%-90%, [2/] Oak-dominated FSVEG types > 70 years in age , [3/] occurs only in Botanical SIA

Restoration of Dry-Mesic Oak-Hickory Forest (both mafic and felsic types) would be implemented on off-site forests (loblolly and shortleaf pine). In addition, small to large canopy gaps would be created within existing oak-dominated forests during the planning cycle. Emphasis would also be placed on increasing thinning harvests as well as prescribed burns. As with Dry Oak-Hickory Forest these actions should increase canopy gaps within this ecological system but in contrast should increase the current rating from fair to good in the short and long-term. The amount of burning within this type would more than double over the life of the plan, however, this may not result in a change in the fire regime rating since this ecological system is the second most dominant type within the Uwharrie NF. With the increase in burning, canopy gap creation, and thinning harvest the diversity of the canopy, midstory, and understory should improve, and should result in a change in the rating from good to very good in the long-term.

Southern Piedmont Mesic Forest

Derivation: Mesic Mixed Hardwood Forest (Schafale and Weakley 1990), Southern Piedmont Mesic Forests (NatureServe 2004).
Environment: Sheltered topographic positions (concave lower slopes, steep north-facing slopes, narrow draws) on moderately deep to very deep, moderately well to well-drained soils, often with higher pH.
Disturbance regime: Severe wind storms, although rare, aid in creation of canopy gaps. Burning of bottomlands by American Indians to maintain open conditions for tending agricultural crops likely impacted sites in lower slope positions. However, because this ecological system occurs in moist and topographically sheltered sites, fire occurred only rarely and with low intensity beginning with European settlement and continuing to the present period. Fire regime condition classes I (0-35 year return interval; surface fires of mixed severity) and V (200 year return interval, stand replacement and mixed severity).
Abundance and distribution on the Uwharrie NF: Outside Streamside Forests, approximately 1,220 acres potential, 1,076 acres existing. This ecological system is scattered across the Forest but more common in the Badin area, and near Woods Run, Island Creek, and the Pekin area.

Abundance relative to the potential in the surrounding 4 counties: 6.5% of 14,500 acres potential

Composition and structure (desired condition): Closed, mature (> 70 years in age) canopy dominated by mesophytic trees. American beech is nearly always present. Other characteristic species include northern red oak, tulip poplar and red maple. White ash and shagbark hickory occur on higher pH soils. Typical understory trees include dogwood, and sourwood on more acidic soils and chalk maple, painted buckeye, and hop-hornbeam on more basic soils. The herb layer is dense with indicators of higher pH soils including: black cohosh, wild ginger, maidenhair fern, bloodroot and those indicators of lower pH soils including: Christmas fern, woodland tick-trefoil, common foamflower, common alumroot, fairywand, beechdrops, and rattlesnake fern.

Ecological condition benchmarks within the optimal extent of the Southern Piedmont Mesic system:

Key Factors Subject to Management Control	Indicator	Ecological Condition Benchmark (Percent of Optimal)				Current Condition	Current Rating
		Very good	Good	Fair	Poor		
Species Composition	Percent of acreage dominated by American beech and other trees characteristic of mesic sites	> 85%	70%-85%	50%-70%	< 50%	60%	Fair
Species Composition	Percent of acreage with less than 10% NNIS cover	> 85%	70%-85%	50%-70%	< 50%	35%	Poor
Canopy Structure	Percent of acreage at desired canopy closure [1/]	> 85%	70%-85%	50%-70%	< 50%	60% [2/]	Fair
All above on Same site	Percent of acreage at or near reference condition especially understory species	> 75%	50%-75%	25%-50%	< 25%	25% [3/]	Fair

[1/] desired canopy closure is 80%-100%, [2/] Stands > 70 years in age, [3/] one-half of stands in Botanical SIA

Control of NNIS would be the primary vegetation management projects within this ecological type during the life of the plan. The rating for species composition has the greatest potential for change with a short-term rating of poor and a long-term improvement to good as the abundance of NNIS decreases. The aging of the canopy with natural small-scale disturbance should improve the canopy structure and species composition to a rating of good.

Streamside Forest

Derivation: One-hundred foot zone adjacent to perennial streams plus adjacent floodplain / alluvial soils; this is the estimate of the zone of stream influence (humidity, habitat adjacency) on adjacent forests and the influence of adjacent forests on streams i.e. the capability of adjacent forests to provide trees capable of adding large woody debris for hydrologic stability and in stream fish habitat; Piedmont/Mountain Bottomland Forest, Piedmont/Low Mountain Alluvial Forest, Piedmont/Mountain Levee Forest (Schafale and Weakley 1990); Piedmont Small Stream Forest (Schafale and Weakley 2005); Southern Piedmont Large Floodplain Forest Ecological System, Southern

Piedmont Small Floodplain and Riparian Forest Ecological Systems. (NatureServe 2004). Also includes concepts from: Dry-mesic Oak-Hickory Forest (mafic and felsic), Mesic Forests, Dry Oak-Hickory Forest, and Longleaf Pine Woodland.
Environment: Topographically sheltered**,** Moist lowlands, adjacent to perennial streams/rivers on moderately deep to very deep, somewhat poorly to well-drained soils; some are very stony to extremely boulder.
Disturbance regime: Many sites frequently to occasionally flooded; most sites are seldom to never flooded but are adjacent to flood zones. Burning of bottomlands by American Indians to maintain open conditions for tending agricultural crops was very likely to have impacted these sites to a great extent, by excluding most tree, shrub, and herb species for many centuries. However, because this ecological system occurs in moist and topographically sheltered sites, fire occurred only rarely and with low intensity beginning with European settlement and continuing to the present period. Fire regime condition classes I (0-35 year return interval; surface fires of mixed severity) and V (200 year return interval, stand replacement and mixed severity).
Abundance and distribution on the Uwharrie NF: Approximately 6,800 acres delineated. This ecological system occurs across the Forest but is most prominent adjacent to the Uwharrie River, Moccasin Creek, upper Little Creek, Cheek Creek, and the upper reaches of the Little River south of Nancy's Mountain.
Abundance relative to the potential in the surrounding 4 counties: 10% of 70,000 acres potential.
Composition and structure (desired condition): Streamside Forests are a complex of 4 ecological systems that are centered on Large Floodplain and Small Floodplain - Riparian Forest ecological systems. These alluvial influenced systems comprise 22% (1,400 acres) of the complex. Dry-Mesic Oak Hickory Forests, which are adjacent to these systems, comprise 73% (4,800 acres) of the Streamside Forest zone but are seldom influenced directly by alluvial processes. Less than 5% (300 acres) of the zone includes Dry Oak Hickory Forests and Longleaf Pine Woodlands. These systems are described in detail at the beginning of this subsection.

In the floodplains of small to medium-sized streams, where flooding and alluvial processes have some, but limited, influence on vegetation, the canopy, subcanopy, shrub, and herbaceous layers are often well-developed. Widespread species such as sweetgum and tulip poplar may be common along with upland species as well as characteristic alluvial species such as sycamore and river birch. Other characteristic species may include: Common spicebush and common jack-in-the-pulpit. These forests may also be dominated by American beech, white oak, red oak, and green ash with a fairly dense, streamside shrub layer that includes ti-ti and mountain laurel, and an herb layer dominated by galax with wood anemone, northern green-and-gold, yellow yam, Christmas fern, and sedges.

In floodplain terraces and levees along larger streams and rivers the forest canopy is nearly complete to somewhat open and dominated by tulip poplar, sweetgum with water oak, sycamore, river birch, loblolly pine, and cherrybark oak. The understory is dominated by ironwood, silverbell, and common pawpaw. Giant cane often forms dense thickets. Species characteristics in the herb layer include: false nettle, Chrismas fern,

Jack-in-the-pulpit, Virginia wild-rye, bluestem goldenrod, and slender spikegrass. Vines are frequently prominent, including poison ivy, Virginia creeper, crossvine, and wild grape. Aquatic and emergent communities of active and abandoned beaver ponds or similar small, man-made impoundments or floodplain pools are imbedded within this ecological system. These areas may contain the following shrubs: button bush, and Swamp rose, or floating or submergent aquatics herbs such as: green arrow-arum, water lily, cowlily, hornwort, watermilfoil, pondweed, and arrowhead. These communities may be subject to severe disturbance from flooding at irregular intervals.

Ecological condition benchmarks within the optimal extent of forests directly influenced by alluvial processes in this system:

Key Factors Subject to Management Control	Indicator	Ecological Condition Benchmark (Percent of Optimal)				Current Condition	Current Rating
		Very good	Good	Fair	Poor		
Species Composition	Percent of acreage dominated by Sycamore, River birch, Sweetgum, Tulip poplar, Cherrybark oak, or Loblolly Pine	> 85%	70%-85%	50%-70%	< 50%	32%	Poor
Species Composition	Percent of acreage with less than 10% exotic species cover	> 85%	70%-85%	50%-70%	< 50%	35%	Poor
Canopy Structure	Percent of acreage at desired canopy closure [1/]	> 85%	70%-85%	50%-70%	< 50%	56% [2/]	Fair
Hydrologic Regime	Percent of acreage with unaltered hydrology	> 85%	70%-85%	50%-70%	< 50%	≈ 75%	Good
All above on Same site	Percent of acreage at or near reference condition especially understory species	> 75%	50%-75%	25%-50%	< 25%	7% [3/]	Poor

[1/] desired canopy closure is 80%-100%, [2/] Stands > 70 years in age, [3/] occurs only in Botanical SIA

Ecological condition benchmarks within the optimal extent of forests not directly influenced by alluvial processes in this system:

Key Factors Subject to Management Control	Indicator	Ecological Condition Benchmark (Percent of Optimal)				Current Condition	Current Rating
		Very good	Good	Fair	Poor		
Species Composition	Percent of acreage dominated by oaks and hickories	> 75%	55%-75%	30%-55%	< 30%	45%	Fair
Canopy Structure	Percent of acreage at desired canopy closure [1/]	> 75%	55%-75%	30%-55%	< 30%	42% [2/]	Fair
Fire Regime	Percent of acreage burned at least twice in the last 20 years	> 75%	55%-75%	30%-55%	< 30%	18%	Poor
All above on Same site	Percent of acreage at or near reference condition especially understory species	> 50%	30%-50%	10%-30%	< 15%	10% [3/]	Poor

[1/] desired canopy closure is 60%-80% [2/] Oak-hickory FSVEG types > 70 years in age , [3/] occurs only in Botanical SIA

Within the mesic zone, vegetation management would occur primarily to restore longleaf pine woodlands and dry-mesic oak-hickory forests where loblolly or shortleaf pine currently exists. Within headwater areas, prescribed burning would be increased to

maintain or restore the fire-adapted ecological systems. NNIS control work would be emphasized within these types since the targeted restoration areas are some of the more disturbed habitats across the Uwharrie NF. In those areas influenced by alluvial processes, the greatest change in species composition would be as a result of NNIS projects which would improve species diversity and improve the rating from poor to good over the long-term. As these alluvial forests age, the overall canopy structure should improve. For those non-alluvial influenced forests, the restoration of loblolly or shortleaf-dominated forests should result in an improved ranking from fair to good for species composition and canopy structure and possibly an improvement in the fire regime from poor to fair with an increased emphasis within sites that are undergoing restoration.

Shortleaf Pine-Oak Woodland

Derivation: *Pinus echinata-Quercus stellata-Quercus marilandica / Andropogon gyrans –Chrysopsis mariana* Woodland: Southern Piedmont Glades and Barrens Ecological System (NatureServe 2004) and, in part, *Pinus echinata-Quercus marilandica / Kalmia latifolia – Symplocos tinctoria* Woodland: Southern Piedmont Dry Oak-(Pine) Forest Ecological System (NatureServe 2004).
Environment: Exposed, often west to south-facing upper slopes, mostly over felsic rock on deep, well-drained, moderately permeable, and extremely stony and extremely boulder soils or over mafic rock on deep, well drained extremely boulder soils. These are some of the hottest and driest sites on the Uwharrie NF.
Disturbance regime: Susceptible to disturbance by high winds and lightning. Fire regime condition class IV (35-100 year return interval; mostly stand replacement severity).
Abundance and distribution on the Uwharrie NF: Uncommon, < 100 acres potential, <20 acres existing. Most all of the sites are in the Badin Lake area.
Abundance relative to the potential in the surrounding 4 counties: 50% of 170 acres potential.
Composition and structure (Reference condition): Open woodland dominated by shortleaf pine, Virginia pine, and chestnut oak or by shortleaf pine, blackjack oak and chestnut oak. Other characteristic trees include: blackgum, white oak, scarlet oak, black oak on soils derived from felsic rock or Carolina shagbark hickory, persimmon, and white ash on soils derived from mafic rock. On felsic soils mountain laurel, horsesugar, and dwarf huckleberry may form a dense shrub layer with a sparse herb layer that may include: bushy broomsedge, northern oat grass, silky oat grass, and Virginia goat's rue. On mafic soils, characteristic shrub species include: farkleberry, southern blackhaw, redbud, and New Jersey tea with a diverse herb layer that may include: Elliott's broomsedge, butterfly pea, starved witch-grass, sand hills bean and many others.

Ecological condition benchmarks within the optimal extent of the Shortleaf Pine-Oak Woodland system:

Key Factors Subject to Management Control	Indicator	Ecological Condition Benchmark (Percent of Optimal)				Current Condition	Current Rating
		Very good	Good	Fair	Poor		
Species Composition	Percent of acreage dominated by shortleaf pine	> 95%	85%-95%	70%-85%	< 70%	28%	Poor

Key Factors Subject to Management Control	Indicator	Ecological Condition Benchmark (Percent of Optimal)				Current Condition	Current Rating
		Very good	Good	Fair	Poor		
Canopy Structure	Percent of acreage at desired canopy closure [1/]	> 95%	85%-95%	70%-85%	< 70%	68% [2/]	Poor
Fire Regime	Percent of acreage burned at least twice in the last decade	> 95%	85%-95%	70%-85%	< 70%	0%	Poor
All above on Same site	Percent of acreage at or near reference condition especially understory species	> 75%	50%-75%	35%-50%	< 35%	28% [3/]	Poor

[1/] desired canopy closure is 25-60% [2/] occurs only in Botanical SIA

This rare habitat type is primarily only present within the steepest slopes of the Badin Lake area. In 2010, the first prescribed burn was completed across the highest quality example of this ecological system. During the life of the proposed plan there would be an emphasis on more frequent burning within this ecological system. As a result the canopy structure rating should improve from poor to fair and the fire regime should increase to fair in the short-term and good in the long-term.

Southern Piedmont Glades and Barrens

Derivation: Low Elevation Rocky Summit, Piedmont Mafic Cliff, Piedmont Acidic Cliff (Schafale and Weakley 1990). Southern Piedmont Glades and Barrens (NatureServe 2004).
Environment: Rock outcrops on low elevation ridges and peaks, and very steep to vertical cliffs on stream bluffs, lower, or mid slopes. Soil is very shallow over mafic or felsic rock or accumulated in rock crevices.
Disturbance regime: Susceptible to disturbance by high winds in more exposed sites. Soil erosion by wind and water is probably common. Extensive burning by American Indians before European settlement did not likely impact these sites greatly because fire does not carry well in the very sparse herb layer and barren rock. Fire regime condition class I (0-35 year return interval; surface fires of mixed severity).
Abundance and distribution on the Uwharrie NF: This Ecological System is known from only 11 locations and is very limited in extent, occurring on less than 100 acres Forest-wide. Many sites are in the Badin Lake area near Falls Mountain, Shingle Trap Mountain, and above the Uwharrie river. Other prominent occurrences are at Dark Mountain, above Barnes Creek and Poison Fork between Dark Mountain and Long Mountain, at Walker Mountain, upper Wood Run, and Cedar Rock Mountain.
Abundance relative to the potential in the surrounding 4 counties: Unknown
Composition and structure (reference condition): Open woodlands to nearly treeless communities with highly variable composition. Open woodland canopy may be dominated by Virginia red cedar and winged elm with eastern red and Virginia pine. Other woody species include fringetree, pignut hickory, sand hickory, white ash, farkleberry, hillside blueberry, persimmon, and winged sumac. The sparse herb layer may be dominated by little bluestem. Other characteristic herb species include: whorled milkweed, long-stalked aster, ebony spleenwort, crossvine, hairy lipfern, silky oat-grass, starved witch grass, open-flower witch grass, pineweed, rock spikemoss, yellow Indian

grass, and shielded-sorus polypody. On more acidic substrates post oak, chestnut oak, and pignut hickory may form an open canopy over little bluestem, oat grass, and needle grass. Many additional woodland plant community types are possible in this system.

Ecological condition benchmarks within the optimal extent of the Southern Piedmont Glades and Barrens system:

Key Factors Subject to Management Control	Indicator	Ecological Condition Benchmark (Percent of Optimal)				Current Condition	Current Rating
		Very good	Good	Fair	Poor		
Species Composition	Percent of acreage dominated by characteristic tree species	> 95%	85%-95%	70%-85%	< 70%	unknown	unknown
Canopy Structure	Percent of acreage at desired canopy closure [1/]	> 95%	85%-95%	70%-85%	< 70%	unknown	unknown
Fire Regime	Percent of acreage burned at least twice in the last 20 years	> 95%	85%-95%	70%-85%	< 70%	0%	Poor
All above on Same site	Percent of acreage at or near reference condition especially understory species	> 75%	50%-75%	35%-50%	< 35%	unknown	unknown

[1/] desired canopy closure is 0%-25%

Glades and Barrens are small habitats that typically occur within a matrix of dry upland ecological systems. They would be protected during the planning cycle and primarily influenced by an increased prescribe burn program. Given the dispersed nature of these habitats, the likelihood of improving the fire regime rating from poor to fair is unlikely although the current condition is expected to improve from 0% to around 50%.

Southern Piedmont Mafic Hardpan Woodland

Derivation: Xeric Hardpan Forest (Schafale and Weakley 1990). Southern Piedmont Mafic Hardpan Woodland Ecological System (NatureServe 2004).
Environment: Upland flats and gentle slopes mostly over mafic rock on moderately deep to very deep, often very stony or boulder, well-drained soils with slow permeability likely due to an impermeable clay subsoil.
Disturbance regime: Extensive burning by American Indians before European settlement likely impacted these sites. Fire regime condition class I (0-35 year return interval; surface fires of mixed severity).
Abundance and distribution on the Uwharrie NF: This Ecological System is known from only 6 locations and is very limited in extent, occurring on less than 20 acres forest-wide. The largest site is about 5 acres in size. Most (6) sites are in the Badin Lake area near the Arrowhead campground, West Branch, and above the Badin lake dam. The highest quality site is in the southern end of the Forest near the confluence of Cheek Creek and Sand Branch. Two sites occur at the headwaters of South prong of the Little River and Reedy Creek in the northern end of Forest. These are the only sites that do not occur in the Montgomery County Soil Survey on soils derived from mafic rock.
Abundance relative to the potential in the surrounding 4 counties: Unknown
Composition and structure (reference condition): Open woodland canopy dominated by, somewhat stunted, post oak and blackjack oak. A variety of other characteristics overstory tree species may be present including: Carolina shagbark hickory, white ash,

pignut hickory, white oak, and black oak. Typical midstory and understory trees include: Virginia red cedar, persimmon, redbud, and winged elm. The understory shrub layer is sparse and may include: deerberry, farkleberry, and hillside blueberry. Characteristic species in the continuous herb layer include: needlegrass, northern oat grass, licorice bedstraw, Carolina jessamine, whip nutrush, saw greenbrier, glaucous greenbriar, and muscadine.

Ecological condition benchmarks within the optimal extent of the Southern Piedmont Mafic Hardpan Woodland system:

Key Factors Subject to Management Control	Indicator	Ecological Condition Benchmark (Percent of Optimal)				Current Condition	Current Rating
		Very good	Good	Fair	Poor		
Species Composition	Percent of acreage dominated by Post oak and Blackjack oak	> 95%	85%-95%	70%-85%	< 70%	13%	Poor
Canopy Structure	Percent of acreage at desired canopy closure [1/]	> 95%	85%-95%	70%-85%	< 70%	13%	Poor
Fire Regime	Percent of acreage burned at least twice in the last decade	> 95%	85%-95%	70%-85%	< 70%	10%	Poor
All above on Same site	Percent of acreage at or near reference condition especially understory species	> 75%	50%-75%	35%-50%	< 35%	10%	Poor

[1/] desired canopy closure is 25%-60%

During the life of the plan there would be an emphasis on protecting these habitats and increasing the frequency of prescribe burning. With the more frequent burning regime the species composition and canopy structure would improve. There would be an emphasis to prioritize burns within these rare communities to move the poor to a good rank for canopy structure, species composition, and frequency of burns.

Southern Piedmont/Ridge and Valley Upland Depression Swamp

Derivation: Upland Depression Swamp Forest (Schafale and Weakley 1990). Southern Piedmont / Ridge and Valley Upland Depression Swamp Ecological System (NatureServe 2004).
Environment: Upland flats, mostly over mafic rock on moderately deep to very deep, often very stony or boulder, well-drained soils with slow permeability.
Disturbance regime: Seasonal to intermittent flooding. Exposed upland susceptible to disturbance by high winds and limited lightening. Extensive burning by American Indians before European settlement likely impacted these sites, and during drought periods may have resulted in stand replacement. However, because this ecological system occurs in sites than may be moist to inundated for much of the year and understory fuels are sparse, fire probably occurred only rarely and with low intensity. Fire regime condition classes I (0-35 year return interval; surface fires of mixed severity) and V (200+ year interval; stand replacement and mixed severity).
Abundance and distribution on the Uwharrie NF: This Ecological System is known on only 9 locations and is very limited in extent, approximately 60 acres Forest-wide. The largest sites are only about 2 acres in size. Most (7) sites are in the Badin Lake area near the Arrowhead campground, Badin Lake group campground, and above the Badin dam.

Four sites are also known in upper Reedy Creek in the northern part of the Forest and 1 site is known near Walker Mountain.

Abundance relative to the potential in the surrounding 4 counties: Unknown

Composition and structure (reference condition): Closed forest canopy dominated by willow oak or codominant with or replaced by overcup oak, swamp white oak, swamp chestnut oak, or Sweetgum. Shrubs are sparse but may include: black highbush blueberry, highbush blueberry, buttonbush, inkberry, and arrowwood. Herbs are also sparse but may include: bladder sedge, longleaf spikegrass, and Eastern mannagrass. Mosses are abundant and include: *Climacium americanum* and *Sphagnum lescurii*. Upland pools are also included in this Ecological System; they are known from only two locations on the Forest - at Pleasant Grove Church and northwest of Roberdo. Upland pools lack significant tree cover except on their edge and are thought to be geologically successional to Upland Swamps. Characteristics tree species include: black gum, willow oak, and sweetgum. Characteristic shrub, herb, and moss species include: buttonbush, swamp doghobble, royal fern, lamp rush, sedges, and sphagnum moss.

Ecological condition benchmarks within the optimal extent of the Southern Piedmont/Ridge and Valley Upland Depression Swamp system:

Key Factors Subject to Management Control	Indicator	Ecological Condition Benchmark (Percent of Optimal)				Current Condition	Current Rating
		Very good	Good	Fair	Poor		
Species Composition	Percent of acreage dominated by Willow oak, Overcup oak, Swamp white oak or other characteristic tree species	> 95%	85%-95%	70%-85%	< 70%	86%	Good
Canopy Structure	Percent of acreage at desired canopy closure [1/]	> 95%	85%-95%	70%-85%	< 70%	86%	Good
Hydrologic Regime	Percent of acreage with unaltered natural hydrology	> 95%	85%-95%	70%-85%	< 70%	73%	Fair
All above on Same site	Percent of acreage at or near reference condition especially understory species	> 75%	50%-75%	35%-50%	< 35%	73%	Good

[1/] desired canopy closure is 60%-100%

Piedmont Seepage Wetlands

Derivation: Hillside Seepage Bog, Piedmont Boggy Streamheads, Low Elevation Seep, (Schafale and Weakley 1990). Piedmont Seepage Wetlands (NatureServe 2004).

Environment: Gently sloping wetlands in uplands or edges of bottomlands and wetlands along small intermittent or permanent stream beds. Soils are deep to very deep, often very stony, poorly to somewhat poorly-drained soils with slow permeability. Sites are seasonally to constantly saturated by seepage.

Disturbance regime: Burning by American Indians, especially along bottomlands, to maintain open conditions for tending agricultural crops likely impacted these sites. However, because this ecological system occurs in moist sites, fire occurred only rarely and with low intensity especially after European settlement and continuing to the present

period. Fire regime condition classes I (0-35 year return interval; surface fires of mixed severity) and V (200 year return interval, stand replacement and mixed severity).

Abundance and distribution on the Uwharrie NF: This Ecological System is known to occur in less than 20 locations, approximately 200 acres Forest-wide. This ecological system includes sites on the edges of bottomlands and wetlands along small intermittent and perennial stream beds (Piedmont Boggy Streamheads) which account for 2/3s of the locations and over 95% of the total extent of the system. Piedmont Boggy Streamheads are almost entirely imbedded within the Streamside Forests Ecological System but are described here in more detail. Hillside Seepage Bogs and Low Elevation Seeps are the least common components of this system accounting for fewer than 23 sites and are less than three acres in extent. Most prominent along Densons Creek, Haystack Branch, Poison Fork, Sand Branch, and West Branch.

Abundance relative to the potential in the surrounding 4 counties: Unknown

Composition and structure (reference condition): Streamside seepage areas are imbedded within forests and have a scattered tree canopy that may include: sweetgum, black gum, Sweetbay, and persimmon. The understory may contain: American holly, common winterberry, American strawberry bush, Virginia sweetspire, Southern wild raisin, tag alder, and ti-ti. The diverse herb layer is dominated by cinnamon fern, royal fern, skullcap, Southern lady fern, blaspheme-vine, and muscadine. Common spicebush and Yellowroot may occur along more well-developed stream channels. Hillside Seepage Bogs are imbedded in forests and woodlands and have a patchy to open canopy that may include: swamp red maple, tulip poplar, sweetgum, or longleaf pine. Characteristic shrubs include: evergreen bayberry, blue huckleberry, Southern blackhaw, tag alder, and red chokeberry. The herb layer is diverse and may contain: yellow pitcher plant, purple pitcher plant, bushy broomsedge, Pinebarrens sandreed, Northern oatgrass, savanna eupatorium, whip nuthatch, yellow-eyed grass, and *Sphagnum* ssp.

Ecological condition benchmarks within the optimal extent of the Piedmont Seepage Wetlands system:

Key Factors Subject to Management Control	Indicator	Ecological Condition Benchmark (Percent of Optimal)				Current Condition	Current Rating
		Very good	Good	Fair	Poor		
Species Composition	Percent of acreage dominated by characteristic wetland species	> 95%	85%-95%	70%-85%	< 70%	70%	Fair
Canopy Structure	Percent of acreage at desired canopy closure [1/]	> 95%	85%-95%	70%-85%	< 70%	75%	Fair
Hydrology	Percent of acreage with unaltered natural hydrology	> 95%	85%-95%	70%-85%	< 70%	80%	Fair
Fire Regime	Percent of acreage within fire compartments burned at least twice in the last 15 years	> 95%	85%-95%	70%-85%	< 70%	75%	Fair
All above on Same site	Percent of acreage at or near reference condition especially understory species	> 75%	50%-75%	35%-50%	< 35%	65%	Good

[1/] desired canopy closure is 25%-100% [2/] only occurs in Botanical SIA

Successional and planted forest

Derivation: Semi-natural Forest, Cultivated Forest (NatureServe 2004).
Environment: Xeric to mesic topographic positions (ridges, upper slopes, mid slopes, lower slopes), over felsic rock, or less commonly over mafic rock on mostly moderately deep to very deep, well drained, soil with moderate permeability; often very stony, extremely stony, or extremely boulder soils.
Disturbance regime: Variable.
Abundance and distribution on the Uwharrie NF: Approximately 20,500 acres outside the streamside forest zone. This is the most abundant ecological system on the Forest and occurs in nearly every parcel of land. Successional loblolly pine forests are more common in the southern part and the Forest; successional shortleaf pine forests are more common in the central and northern part of the Forest. Successional forests are less extensive in the Wilderness and Badin Lake area but are still quite common in these areas.
Composition and structure (current condition): Successional Forests represent early- to mid successional pine plantations, and mid- to late-successional forests resulting from other past disturbance such as agricultural or other land clearing. The latter category may include old fields, old pastures, clearcuts, stands resulting from stand replacement fire, and to a lesser extent, eroded areas. Successional Forests are divided into two groups:

1) Loblolly pine, which includes 10,700 acres of stands identified as Loblolly pine (FSVEG forest type 31), and 615 acres identified as Loblolly pine-Hardwood (FSVEG forest type 13), and
2) Shortleaf pine, which includes about 7,000 identified as Shortleaf pine (FSVEG forest type 32), 1,925 acres identified as Shortleaf pine-Oak (FSVEG forest type 12), 270 acres of Virginia pine (FSVEG forest type 33), and 30 acres of Virginia pine-oak (FSVEG forest type 16).

Young (1-20 years in age) pine plantations may be dominated by an open to near complete canopy of loblolly pine or shortleaf pine with little understory, a subcanopy of red maple, dogwood, and Sweetgum with few oaks. The herbaceous layer is sparse or nearly absent. Pine plantations greater than 20 years in age often have a closed canopy (depending upon past damage by Southern Pine Beetle) of loblolly or shortleaf pine, and a well-developed subcanopy of hardwoods including red maple and sweetgum, scarlet, black and white oak, blackgum, and hickories. The shrub layer may include: hillside blueberry, winged sumac, black huckleberry, and beautyberry. The herb layer is sparse but may the following invasive-exotic species: Japanese honeysuckle and Japanese stilt grass.

Older (>50 years in age) stands resulting from past disturbance are often dominated by loblolly pine and sweetgum (dry-mesic to mesic sites) or shortleaf pine and mixed oaks (xeric to dry-mesic sites). Tree, shrub, and herb species are variable on these sites and may include: willow oak, winged elm, black cherry, muscadine, poison ivy, Southern blackberry, common dog-fennel, hyssopleaf eupatorium, common rough fleabane, smooth goldenrod, common ragweed, and common greenbrier. In the southern part of

the Forest, species more common in the coastal plain and sandhills may occur, such as: creeping blueberry, dwarf serviceberry, and sandhill St.-John's-wort.

Current and Potential Ecological condition:

The Successional Forest Ecological System is found on a wide variety of sites that could support forest communities and species found in at least five other Ecological Systems on the Uwharrie National Forest (**Table 1**). Successional Loblolly pine stands occupy approximately 3,905 acres where Longleaf pine forest communities would be better adapted, and nearly 7,000 acres where Oak-Hickory forests could occur (4,355 Dry Oak-Hickory and 2,430 acres of Dry-mesic Oak-Hickory). Successional Shortleaf pine stands occupy approximately 830 acres where Longleaf pine forest communities would be better adapted, and over 7,000 acres where Oak-Hickory forest could occur (5,285 Dry Oak-Hickory and 2,055 acres of Dry-mesic Oak-Hickory). These areas represent restoration opportunities for Longleaf and Oak-Hickory forests on 19,000 acres.

Table 1. Ageclass distribution of Successional Loblolly and Shortleaf Pine Ecological Systems occurring within other major Ecological Systems on the Uwharrie National Forest

Ageclass (years)	0-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90	91-100	100+	All ages
Potential Ecol. System	Existing Ecological System: LOBLOLLY PINE											
Xeric Oak	-	20	40	60	170	10	-	-	-	-	-	300
Longleaf pine	-	860	440	1,140	715	170	70	50	220	235	5	3,905
Dry Oak-Hickory	100	840	730	1,160	885	200	85	75	170	85	25	4,355
Dry-mesic Oak-Hickory	45	425	375	680	515	105	50	50	115	70	-	2,430
Mesic Forests	25	90	25	70	20	5	-	-	45	10	-	290
Total acres (nearest 5 ac.)	175	2,245	1,615	3,110	2,305	490	210	180	555	410	40	11,335
Total proportion (nearest.5)	1.5%	20.0%	14.0%	27.0%	20.0%	4.0%	2.0%	1.5%	5.0%	4.0%	-	
Potential Ecol. System	Existing Ecological System: SHORTLEAF PINE											
Xeric Oak	60	285	180	105	5	-	-	10	30	10	145	830
Longleaf pine	115	120	65	45	5	15	60	140	140	85	40	830
Dry Oak-Hickory	580	980	570	515	10	60	60	720	540	430	720	5,185
Dry-mesic Oak-Hickory	255	310	220	210	-	20	45	260	230	240	265	2,055
Mesic Forests	15	20	20	5	-	5	5	70	50	10	35	235
Total acres (nearest 5 ac.)	1,030	1,725	1,060	890	30	105	170	1,200	990	780	1,215	9,195
Total proportion (nearest.5)	11.0%	19.0%	12.0%	10.0%	-	1.0%	2.0%	13.0%	11.0%	9.0%	13.0%	1

Appendix C. Supporting tables

Table C-1. Limiting factors [1/] to threatened, endangered, sensitive and locally rare species on the Uwharrie NF and rangewide. Source of information for rangewide limiting factors = Southern Appalachian Species Viability Project 2002; source of information for limiting factors on the UNF = local knowledge.

On UNF?	SCIENTIFIC NAME (Common Name)	Rangewide limiting factors	Limiting factors on the Uwharrie NF
Threatened or Endangered Birds			
yes historic	*Picoides borealis* (Red-cockaded woodpecker)	habitat loss & fragmentation, lack of open habitat, lack of fire, lack of mature (southern yellow pine) forest structure	lack of open habitat, lack of mature (southern yellow pine) forest structure, lack of fire
Threatened or Endangered Mammals			
no extirpated	*Canis rufus* (Red wolf)	human persecution, habitat loss and fragmentation, interspecific factors (hybridization with coyote)	extirpation
no extirpated	*Puma concolor cougar* (Eastern cougar)	human persecution, habitat loss and fragmentation, lack of prey in the 1800's	extirpation
Threatened or Endangered Vascular Plants			
no	*Echinacea laevigata* (Smooth coneflower)	habitat loss & fragmentation, lack of open habitat, habitat vulnerability	lack of open habitat, lack of fire
yes	*Helianthus schweinitzii* (Schweinitz's sunflower)	habitat loss and fragmentation, lack of open habitat, habitat vulnerability, lack of fire	lack of open habitat, habitat vulnerability, lack of fire
no	*Rhus michauxii* (Michaux's sumac)	habitat loss and fragmentation, lack of fire, population distribution, habitat vulnerability.	lack of open habitat, lack of fire
Sensitive Bird Species			
no	*Aimophila aestivalis* (Bachman's sparrow)	lack of mature (pine) forest structure, lack of fire	lack of mature (pine) forest structure, lack of fire, lack of open habitat
yes	*Haliaeetus leucocephalus* (Bald eagle)	habitat loss and fragmentation, human disturbance, pesticides	lack of mature forest structure, human disturbance
yes	*Lanius ludovicianus migrans* (Migrant loggerhead shrike)	habitat loss and fragmentation, pesticides, lack of fire	distribution of populations, lack of open habitat, lack of fire
Sensitive Vascular Plant Species			
no	*Acmispon helleri* (Carolina birdfoot-trefoil)	habitat loss and fragmentation, unknown	lack of open habitat, unknown
yes	*Amorpha schwerinii* (Piedmont Indigo-bush)	forest management, hydrologic modification, human disturbance (military operations), lack of fire	lack of fire, human disturbance (illegal OHV and horse use)
no	*Berberis canadensis* (American barberry)	lack of open habitat, eradication programs, lack of fire, fire suppression, non-native invasive species, naturally limited habitat	lack of open habitat, lack of fire, naturally limited habitat
yes	*Carex impressinervia* (Ravine sedge)	habitat loss and fragmentation, lack of mature forest structure, hydrologic modification, non-native invasive species	lack of mature forest structure, non-native invasive species
no	*Danthonia epilis* (Bog oatgrass)	habitat loss and fragmentation, naturally limited habitat, hydrologic modification	distribution of populations, naturally limited populations
yes	*Eurybia mirabilis* (Piedmont aster)	habitat loss and fragmentation, population distribution, unknown	distribution of populations, unknown
yes	*Fothergilla major* (Large witch-alder)	habitat loss and fragmentation, population distribution	habitat vulnerability, unknown
no	*Heuchera caroliniana* (Carolina alumroot)	habitat loss and fragmentation, forest management	unknown, (NC watch list species not tracked by State)
no	*Lindera subcoriacea* (Bog spicebush)	naturally limited habitat, hydrologic modification, prescribed fire (plow lines)	naturally limited habitat
no	*Solidago plumosa* (Yadkin river goldenrod)	naturally limited habitat, human disturbance, non-native invasive species, population distribution	naturally limited habitat
yes	*Symphyotrichum georgianum* (Georgia aster)	lack of open habitat, habitat vulnerability, lack of fire	lack of open habitat, habitat vulnerability lack of fire
Sensitive Nonvascular Plant Species			
no	*Scopelophila cataractae* (Agoyan cataract moss)	habitat loss and fragmentation, naturally limited habitat, unknown	naturally limited habitat
yes	*Xanthoparmelia monticola*	habitat loss and fragmentation, naturally	naturally limited habitat

On UNF?	SCIENTIFIC NAME (Common Name)	Rangewide limiting factors	Limiting factors on the Uwharrie NF
	(a rock-shield lichen)	limited habitat	
Locally Rare Bird Species			
no	*Accipiter striatus* (Sharp-shinned hawk)	naturally limited habitat (in the southern periphery of breeding range), pesticides	unknown
Locally Rare Mammal Species			
no	*Myotis austroriparius* (Southeastern myotis)	human disturbance (destruction of cave hibernacula and introduction of white-nose syndrome), habitat vulnerability	habitat vulnerability, unknown
yes	*Condylura cristata pop. 1* (Star-nosed mole)	hydrologic function, unknown	unknown
Locally Rare Amphibian Species			
yes	*Ambystoma talpoideum* (Mole salamander)	naturally limited habitat, hydrologic modification, forest management	distribution of populations, naturally limited habitat
no	*Ambystoma tigrinum tigrinum* (Eastern tiger salamander)	naturally limited habitat, habitat loss and fragmentation, hydrologic modification	naturally limited habitat
yes	*Ophisaurus attenuatus* (Slender glass lizard)	habitat loss and fragmentation	lack of open habitat
no	*Heterodon simus* (Southern hognose snake)	habitat loss and fragmentation, non-native invasive species (red imported fire ants), human persecution, pesticides, unknown	lack of open habitat, non-native invasive species
no	*Micrurus fulvius* (Eastern coral snake)	habitat loss and fragmentation, , non-native invasive species (red imported fire ants)	unknown
Locally Rare Insect Species			
no	*Acronicta albarufa* (Barrens daggermoth)	habitat loss and fragmentation, distribution of populations, pesticide	lack of mature (oak) forest structure, lack of fire, unknown
no	*Heterocampa varia* (A notodontid moth)	habitat loss and fragmentation, forest management, naturally limited habitat, pesticide	lack of mature (oak) forest structure, lack of fire, naturally limited habitat
no	*Hyperstrotia aetheria* (A noctuid moth)	unknown	unknown
no	*Amblyscirtes alternata* (Dusky roadside-skipper)	habitat loss and fragmentation, forest management, prescribed fire, lack of fire, unknown	lack of fire, unknown
no	*Euphyes bimacula* (Two-spotted skipper)	habitat loss and fragmentation, hydrologic function	hydrologic function
no	*Satyrium edwardsii* (Edwards' hairstreak)	habitat loss and fragmentation, unknown	unknown
no	*Cicindela patruela* (Northern barrens tiger beetle)	habitat loss and fragmentation, lack of fire, naturally limited habitat, human disturbance	lack of mature (oak) forest structure, lack of fire, naturally limited habitat
Locally Rare Vascular Plant			
yes	*Anemone berlandieri* (Southern Anemone)	habitat loss and fragmentation, human disturbance (OHV, quarrying for limestone), naturally limited habitat	distribution of populations, naturally limited habitat, human disturbance
no	*Arabis missouriensis* (Missouri rockcress)	habitat loss and fragmentation, naturally limited habitat	naturally limited habitat
no	*Baptisia alba var alba* (Thick-pod white wild indigo)	lack of open habitat, habitat vulnerability, lack of fire	lack of open habitat, lack of fire
no	*Baptisia australis var. aberrans* (Prairie blue wild indigo)	habitat loss and fragmentation, naturally limited habitat	naturally limited habitat, lack of open habitat, lack of fire
no	*Callitriche terrestris* (Terrestrial water-starwort)	habitat loss and fragmentation, hydrologic modification, forest management practices, naturally limited habitat	hydrologic modification, forest management practices
yes	*Cardamine dissecta* (Dissected toothwort)	forest management, lack of mature forest structure	distribution of populations, forest management
no	*Carex bushii* (Bush's sedge)	naturally limited habitat, hydrologic modification	naturally limited habitat, hydrologic modification
no	*Celastrus scandens* (American bittersweet)	habitat loss and fragmentation, forest management, hybridization with non-	non-native invasive species, lack of mature forest structure

On UNF?	SCIENTIFIC NAME (Common Name)	Rangewide limiting factors	Limiting factors on the Uwharrie NF
		native invasive species, lack of mature forest structure	
yes	*Cirsium carolinianum* (Carolina thistle)	habitat loss and fragmentation, lack of open to partially open habitat, lack of fire	lack of open to partially open habitat, lack of fire
yes	*Collinsonia tuberosa* (Piedmont horsebalm)	habitat loss and fragmentation, forest management, unknown	distribution of populations, forest management
yes	*Desmodium fernaldii* (Fernald's Tick-trefoil)	habitat loss and fragmentation, lack of open to partially open habitat, lack of fire	lack of open to partially open habitat, lack of fire
no	*Dichanthelium annulum* (Ringed witchgrass)	habitat loss and fragmentation, lack of fire, lack of open habitat	lack of fire, canopy structure (open)
yes	*Dichanthelium boreale* (Northern witch grass)	lack of open habitat, lack of fire	lack of open habitat, lack of fire
no	*Dodecatheon meadia var. meadia* (Eastern shooting star)	habitat loss and fragmentation, naturally limited habitat	naturally limited habitat
no	*Echinacea purpurea (*Purple coneflower)	habitat loss and fragmentation, naturally limited habitat, lack of open habitat, lack of fire	naturally limited habitat, lack of open habitat, lack of fire
no	*Gillenia stipulata* (American ipecac)	habitat loss and fragmentation, naturally limited habitat	naturally limited habitat
no	*Helenium brevifolium* (Littleleaf sneezeweed)	habitat loss and fragmentation, hydrologic modification, forest management practices, naturally limited habitat	naturally limited habitat, hydrologic modification
yes	*Helianthus laevigatus* (Smooth sunflower)	lack of open habitat, lack of fire, non-native invasive species	lack of open habitat, lack of fire, non-native invasive species
no	*Hexalectris spicata* (Crested coralroot)	habitat loss and fragmentation, forest management, naturally limited habitat	naturally limited habitat
no	*Liatris aspera* (Rough Blazing Star)	habitat loss and fragmentation, naturally limited habitat, lack of open habitat, lack of fire	naturally limited habitat, lack of open habitat, lack of fire
no	*Lilium canadense ssp. editorum* (Red Canada lily)	habitat loss and fragmentation, hydrologic modification, forest management practices, naturally limited habitat	naturally limited habitat
no	*Matelea decipiens* (Glade milkvine)	habitat loss and fragmentation, naturally limited habitat	distribution of populations, naturally limited habitat
yes	*Parthenium auriculatum* (Glade wild quinine)	naturally limited habitat, habitat loss and fragmentation, lack of open habitat	distribution of populations, naturally limited habitat
no	*Pellaea wrightiana* (Wright's cliffbrake)	habitat loss and fragmentation, naturally limited habitat	naturally limited habitat
no	*Plantago cordata* (Heartleaf plantain)	habitat loss and fragmentation, hydrologic modification (altered streamflow, enrichment of streams from agricultural fertilizers)	hydrologic modification
no	*Polygala senega* (Seneca Snakeroot)	habitat loss and fragmentation, naturally limited habitat, lack of open habitat, lack of fire	naturally limited habitat, lack of open habitat, lack of fire
yes	*Pseudognaphalium helleri* (Heller's rabbit tobacco)	habitat loss and fragmentation, lack of open habitat, habitat vulnerability, lack of fire	lack of open habitat, habitat vulnerability, distribution of populations, lack of fire
yes	*Quercus austrina* (Bluff oak)	habitat loss and fragmentation, naturally limited habitat	naturally limited habitat
yes	*Ruellia purshiana* (Pursh's wild-petunia)	lack of open habitat, habitat vulnerability, lack of fire	distribution of populations, lack of open habitat, habitat vulnerability, lack of fire
no	*Salvia azurea* (Azure Sage)	lack of open habitat, habitat vulnerability, lack of fire	distribution of populations, lack of open habitat, habitat vulnerability, lack of fire
yes	*Sedum glaucophyllum* (Cliff Stonecrop)	habitat loss and fragmentation, naturally limited habitat	naturally limited habitat
no	*Silphium terebinthinaceum* (Prairie rosinweed)	habitat loss and fragmentation, naturally limited habitat	naturally limited habitat
yes	*Smilax hugeri (*Huger's Carrion-flower)	habitat loss and fragmentation, forest management	distribution of populations, forest management
no	*Solidago radula* (Western rough goldenrod)	habitat loss and fragmentation, naturally limited habitat	naturally limited habitat

On UNF?	SCIENTIFIC NAME (Common Name)	Rangewide limiting factors	Limiting factors on the Uwharrie NF
no	*Solidago rigida var. glabrata* (Southeastern bold goldenrod)	habitat loss and fragmentation, naturally limited habitat	naturally limited habitat
no	*Stachys sp. 1* (a Hedge nettle)	naturally limited habitat, unknown	naturally limited habitat, unknown
yes	*Stewartia ovata* (Mountain camellia)	habitat loss and fragmentation, interspecific factors.	distribution of populations
no	*Symphyotrichum laeve var. concinnum* (Smooth blue aster)	habitat loss (conversion of sites to limestone quarries) and fragmentation, human disturbance (illegal OHV, horse use), lack of fire.	lack of open habitat, lack of fire, naturally limited habitat
yes	*Tradescantia virginiana* (Virginia spiderwort)	lack of mature forest structure	distribution of populations
no	*Tridens chapmanii* (Chapman's redtop)	habitat loss and fragmentation, lack of open habitat, lack of fire	lack of open habitat, lack of fire
yes	*Trifolium reflexum* (Buffalo Clover)	habitat loss and fragmentation, lack of open habitat, lack of fire	lack of open habitat, lack of fire
yes	*Viola walteri* (Prostrate Blue Violet)	habitat loss and fragmentation, non-native invasive species	distribution of populations
Locally Rare Nonvascular Plant Species			
no	*Weissia sharpii* (A moss)	habitat loss and fragmentation, naturally limited habitat	naturally limited habitat

[1/] **Limiting Factor Category**	**Limiting Factor Description**
Habitat loss & fragmentation	Limited by habitat loss or fragmentation caused by land use conversion. In the case of Uwh NF Limiting Factors, this may include conversions on inholdings or surrounding private land.
Lack of open habitat	Limited by habitat degradation resulting from canopy closure and / or midcanopy tree and shrub development
Lack of mature forest structure	Limited by lack of mature deciduous forest structure that may include abundant snags, down wood and den trees or mature pine forest structure that includes open park-like conditions.
Lack of fire	Limited by habitat modification resulting from lack of regular fire
Lack of prey	Limited by low populations of prey species
Extirpation	Limited by having been extirpated in a portion of its range and being disjunct from remaining populations
Naturally limited habitat	Limited by naturally restricted abundance or distribution of potential habitat, such environmental conditions associated with mafic or calcareous substrates, rock outcrops, or wetlands.
Distribution of populations	Limited by poorly distributed populations including single isolated occurrences
Habitat vulnerability	Limited by susceptibility of roadsides or rights-of-ways to periodic direct and indirect impacts from herbicide use, improper mowing, or vehicle accidents – or vulnerability of habitat components, e.g., snags
Interspecific factors	Limited by interactions with other native species through competition, predation, hybridization, or nest parasitism
Non-native invasive species	Limited by interaction / competition with non-native species
Disease or pests	Limited by diseases or pests
Hydrologic modification	Limited by modification of hydrology associated with wetlands and other aquatic systems.
Forest management	Limited by habitat modification or direct effects to individuals resulting from a variety of common forest management practices
Prescribed fire	Limited by habitat modification or direct effects to individuals resulting from the use of prescribed burning especially fire plowline creation
Human disturbance	Limited by human presence that results in disruption of animal behavior or trampling of plants, including impacts from recreation uses
Human persecution	Limited and/or extirpated by human persecution through hunting, trapping and poisoning
Pesticides/Toxins/Eradication programs	Limited by environmental toxins resulting from pollution or pesticides or eradication programs such as gypsy moth control or control of alternate hosts (barberry) for black stem rust of wheat
Unknown	Limiting factors are obviously at work due to evidence or rarity or declines, but they are largely unknown.

Table C-2. Relative importance of the Uwharrie NF in sustaining threatened, endangered, sensitive, and locally rare species in North Carolina, in the Piedmont, and range wide based on species habitat relationships, species and habitat rarity, and threats.

Scientific Name (Common Name)	Species G-rank, S-rank	Habitat G-rank	Potential suitable[1/] habitat abundance on Uwh NF	EOs* on Uwh NF	EOs in Piedmont	Relative importance [2/] of Uwharrie NF in sustaining species		
						Piedmont	State	Range wide
Threatened or Endangered Birds								
Picoides borealis (Red-cockaded woodpecker)	G3, S2	G2	common	2 (H)	17	very low	very low	very low
Threatened or Endangered Mammals								
Canis rufus (Red wolf)	G1Q, S1		common	0	0	very low	very low	very low
Puma concolor cougar (Eastern cougar)	G5THQ, SH		abundant	0	0	very low	very low	very low
Threatened or Endangered Vascular Plants								
Echinacea laevigata (Smooth coneflower)	G2G3, S1	G2?	rare	0	26	low	low	very low
***Helianthus schweinitzii* (Schweinitz's sunflower)**	**G3, S3**	**G2, G2? G2G4**	**common**	**26**	**192**	**high**	**high**	**high**
Rhus michauxii (Michaux's sumac)	G2G3, S2	G2	rare	0	13	low	very low	very low
Sensitive Bird Species								
Aimophila aestivalis (Bachman's sparrow)	G3, S3B, S2N	G2	common	0	0	very low	very low	very low
Haliaeetus leucocephalus (Bald eagle)	G5, S3B, S3N	G5	uncommon	4	50	low	very low	very low
Lanius ludovicianus migrans (Migrant loggerhead shrike)	G4T3Q		rare	0	0	very low	very low	very low
Sensitive Mammal Species								
Myotis leibii (Eastern small-footed bat)	G3, S2		common	1	3	moderate	very low	very low
Sensitive Vascular Plant Species								
Acmispon helleri (Carolina birdfoot-trefoil)	G3, S3	G2G4	common	0	74	moderate	low	low
***Amorpha schwerinii* (Piedmont Indigo-bush)**	**G3G4, S3**	**G2G4 G4G5**	**abundant**	**36**	**80**	**high**	**high**	**moderate**
Berberis canadensis (American barberry)	G3, S2	G2, G2?	uncommon	0	23	low	very low	very low
***Carex impressinervia* (Ravine sedge)**	**G2, S1**	**G2G4 G3G4**	**uncommon**	**5**	**16**	**high**	**high**	**high**
Danthonia epilis (Bog oatgrass)	G3G4, S3	G2G3	rare	0	2	low	very low	very low
Eurybia mirabilis (Piedmont aster)	G2G3, S2	G3G4	uncommon	1	31	low	low	low
Fothergilla major (Large witch-alder)	G3, S3	G4G5 G2G4	abundant	6	31	moderate	low	very low
Heuchera caroliniana (Carolina alumroot)	G3, S3	G3G4 G4G5	common	0	30+	low	low	very low
Lindera subcoriacea (Bog spicebush)	G2G3, S2S3	G2G3	rare	0	3	low	very low	very low
Solidago plumosa (Yadkin river goldenrod)	G1, S1	G?	very rare	0	2	low	low	low
Symphyotrichum georgianum (Georgia aster)	G2G3, S2	G2?,G2 G2G4	uncommon	8	36	moderate	moderate	low
Sensitive Nonvascular Plant Species								
Scopelophila cataractae (Agoyan cataract moss)	G3, S1	?	rare	0	6	low	low	very low
Xanthoparmelia monticola (a rock-shield lichen)	G2?, S2?	G2?	very rare	1	1	very low	very low	very low
Locally Rare Mammal Species								
Myotis austroriparius (Southeastern myotis)	G3G4, S2	G2G4 G?	common	0	1	very low	very low	very low

Scientific Name (Common Name)	Species G-rank, S-rank	Habitat G-rank	Potential suitable[1/] habitat abundance on Uwh NF	EOs* on Uwh NF	EOs in Piedmont	Relative importance [2/] of Uwharrie NF in sustaining species		
						Piedmont	State	Range wide
Condylura cristata pop. 1 (Star-nosed mole)	G5T2Q, S2	G2G3 G2G4 G1	rare	1	3	very low	very low	very low
Locally Rare Reptile and Amphibian Species								
Ambystoma talpoideum **(Mole salamander)**	**G5, S2**	**G2G3 G2G4 G1**	**common**	**2**	**15**	**high**	**high**	**very low**
Ambystoma tigrinum tigrinum (Eastern tiger salamander)	G5T5	G2G3 G2G4 G1	common	0	3	very low	very low	very low
Ophisaurus attenuatus (Slender glass lizard)	G5, S2S3		rare	0	0	very low	very low	very low
Heterodon simus (Southern hognose snake)	G2, S2		rare	0	0	very low	very low	very low
Micrurus fulvius (Eastern coral snake)	G5, S1		rare	0	0	very low	very low	very low
Locally Rare Bird Species								
Accipiter striatus (Sharp-shinned hawk)	G5, S2B, S4N		abundant	0	2	very low	very low	very low
Locally Rare Insect Species								
Acronicta albarufa (Barrens daggermoth)	G3G4, S1S2	G2? G4?	rare	0	0	very low	very low	very low
Heterocampa varia (A notodontid moth)	G3G4, S1S2		very rare	0	0	very low	very low	very low
Hyperstrotia aetheria (A noctuid moth)	GNR, S1S2		very rare	0	0	very low	very low	very low
*Amblyscirtes alternata (*Dusky roadside-skipper)	G2G4, S2		very rare	0	0	very low	very low	very low
Euphyes bimacula (Two-spotted skipper)	G4, S2	G2G4 G2G3	rare	0	1	very low	very low	very low
Satyrium edwardsii (Edwards' hairstreak)	G4, S2		uncommon	0	0	very low	very low	very low
Cicindela patruela (Northern barrens tiger beetle)	G3, S2?		very rare	0	0	very low	very low	very low
Locally Rare Vascular Plant Species								
Anemone berlandieri (Southern Anemone)	G4?, S2	G2?	very rare	1	13	low	low	very low
Arabis missouriensis (Missouri rockcress)	G5?Q, S1	G2?	very rare	0	12	low	low	very low
Baptisia alba var alba (Thick-pod white wild indigo)	G5T3T5, S2	G2, G2?, G2G4	uncommon	0	24	moderate	low	very low
Baptisia australis var. aberrans (Prairie blue wild indigo)	G5T2, S2	G2, G2?	rare	0	24	low	low	low
Callitriche terrestris (Terrestrial water-starwort)	G5, S2	G2G3	rare-uncommon	0	4	moderate	low	very low
Cardamine dissecta (Dissected toothwort)	G4?, S2	G3G4	uncommon	2	11	low	low	very low
Carex bushii (Bush's sedge)	G4, S1	G2G3	rare	0	6	low	very low	very low
Celastrus scandens (American bittersweet)	G5, S2?	G3G4	uncommon	0	6	low	very low	very low
Cirsium carolinianum **(Carolina thistle)**	**G5, S2**	**G2, G2? G2G4 G3G4**	**common**	**9**	**20**	**high**	**moderate**	**very low**
Collinsonia tuberosa (Piedmont horsebalm)	G3G4, S1	G3G4	common-uncommon	1	9	moderate	low	low
Desmodium fernaldii (Fernald's Tick-trefoil)	G4	S1	G2, G4?	1	1	moderate	low	very low
Dichanthelium annulum (Ringed witchgrass)	GNR, S1	G2? G2G3	rare	0	15	moderate	low	unknown

Scientific Name (Common Name)	Species G-rank, S-rank	Habitat G-rank	Potential suitable[1/] habitat abundance on Uwh NF	EOs* on Uwh NF	EOs in Piedmont	Relative importance [2/] of Uwharrie NF in sustaining species		
						Piedmont	State	Range wide
Dichanthelium boreale (Northern witch grass)	G5, S1	G2G4	uncommon	2	5	moderate	low	very low
Dodecatheon meadia var. meadia (Eastern shooting star)	G5T5, S2	G2, G2G4 G2G3	uncommon	0	11	low	very low	very low
*Echinacea purpurea (*Purple coneflower)	G4, S1	G2, G2?	rare	0	5	low	very low	very low
Gillenia stipulata (American ipecac)	G5, S2	G2?, G2G3	rare-uncommon	0	30	low	very low	very low
Helenium brevifolium (Littleleaf sneezeweed)	G4, S2	G2G3	rare	0	8	low	very low	very low
***Helianthus laevigatus* (Smooth sunflower)**	**G4, S2**	**G2 G4G5**	**abundant**	**23**	**74**	**moderate**	**moderate**	**low**
Hexalectris spicata (Crested coralroot)	G5, S2	G2? G2G3	rare-uncommon	0	27	low	very low	very low
Liatris aspera (Rough Blazing Star)	G4G5, S1	G2? G2G3	rare-uncommon	0	6	low	very low	very low
Lilium canadense ssp. editorum (Red Canada lily)	G5T4, S1	G2G3	rare	0	2	low	very low	very low
Matelea decipiens (Glade milkvine)	G5, S2	G2?, G2	very rare	1	24	low	very low	very low
Parthenium auriculatum (Glade wild quinine)	G3G4, S2	G2	very rare	3	41	low	very low	very low
Pellaea wrightiana (Wright's cliffbrake)	G5, S1	G2	very rare	0	2	low	low	very low
Plantago cordata (Heartleaf plantain)	G4, S1	G?	rare	0	2	low	very low	very low
Polygala senega (Seneca Snakeroot)	G4G5, S2	G2, G2G3	rare-uncommon	0	2	low	very low	very low
Pseudognaphalium helleri (Heller's rabbit tobacco)	G3G4, S3	G2, G2?	very rare	2	27	low	very low	very low
Quercus austrina (Bluff oak)	G4?, S1	G?	rare	1	3	moderate	low	very low
***Ruellia purshiana* (Pursh's wild-petunia)**	**G3, S2**	**G2G3**	**rare**	**1**	**21**	**moderate**	**moderate**	**low**
Salvia azurea (Azure Sage)	G4G5, S2	G2	rare-uncommon	0	1	moderate	very low	very low
Sedum glaucophyllum (Cliff Stonecrop)	G4, S2	G2	rare-vary rare	1	8	low	very low	very low
Silphium terebinthinaceum (Prairie rosinweed)	G4G5, S2	G2, G2?	very rare	0	36	low	very low	very low
*Smilax hugeri (*Huger's Carrion-flower)	G3G4, S2	G3G4	uncommon	1	3	low	very low	very low
Solidago radula (Western rough goldenrod)	G5?, S1	G2G2?	rare	0	8	low	very low	very low
Solidago rigida var. glabrata (Southeastern bold goldenrod)	G5T4, S2	G2?, G2	rare	0	17	low	very low	very low
Stachys sp. 1 (a Hedge nettle)	GNR, S1	G2G4?	very rare	0	1	low	low	low
Stewartia ovata (Mountain camellia)	G4, S2	G?, G3G4	rare - uncommon	1	11	very low	very low	very low
Symphyotrichum laeve var. concinnum (Smooth blue aster)	G4T4, S2	G2, G2? G2G3	rare-uncommon	0	20	low	very low	very low
Tradescantia virginiana (Virginia spiderwort)	G5, S1	G3G4?	rare	1	7	low	low	very low
Tridens chapmanii (Chapman's redtop)	G3, S1S2	G2, G2G4	rare-uncommon	0	3	low	very low	very low
Trifolium reflexum (Buffalo Clover)	G3G4, S1S2	G2, G2G4	rare-uncommon	2	20	low	very low	very low
Viola walteri (Prostrate Blue Violet)	G4G5, S1	G3G4	uncommon	2	2	moderate	low	very low
Locally Rare Nonvascular Plant Species								

Scientific Name (Common Name)	Species G-rank, S-rank	Habitat G-rank	Potential suitable[1/] habitat abundance on Uwh NF	EOs* on Uwh NF	EOs in Piedmont	Relative importance [2/] of Uwharrie NF in sustaining species		
						Piedmont	State	Range wide
Weissia sharpii (A moss)	G3, S1?	G2?	very rare	0	3	low	very low	very low

*Element Occurrence, as documented by NC Natural Heritage Program

[1] The potential extent of ecological systems, i.e., environments, that could provide habitat conditions to support the species; multiple entries indicate multiple ecological systems that could provide suitable habitat conditions.

Suitable Habitat Abundance Definition

- Abundant: Potential for > 10,000 acres on the Uwharrie NF.
- Common: Potential for 3,000 – 10,000 acres on the Uwharrie NF.
- Uncommon: Potential for 1,000 – 3,000 acres on the Uwharrie NF.
- Rare: Potential for 150-1,000 acres on the Uwharrie NF.
- Very rare: Potential for < 150 acres on the Uwharrie NF.

[2/] Relative Importance Category Definition

- High: Generally more than 50% of *secure* populations and/or habitat is on the Uwharrie NF; species significantly depends on the Uwharrie NF populations and/or habitat
- Moderate: Generally 20-50% of *secure* populations and/or habitat is on the Uwharrie NF; species moderately depends on the Uwharrie NF populations and/or habitat
- Low: Generally 5-20% of *secure* populations and/or habitat is on the Uwharrie NF; species has low dependence on the Uwharrie NF populations and/or habitat
- Very low: Generally < 5% of *secure* populations and/or habitat is on the Uwharrie NF; species has very low dependence on the Uwharrie NF populations and/or habitat
- Unknown: Information is insufficient to assess the importance of populations and habitat on the Uwharrie NF for this species

Table C-3: Common and scientific names for species in ecological system descriptions

American barberry (*Berberis canadensis*)
American beech (*Fagus grandiflora*)
American bittersweet (*Celastrus scandens*)
American holly (*Ilex opaca* var. *opaca*)
American strawberry bush (*Euonymus Americana*)
American-ipecac (*Gillenia stipulata)*
Arrowhead (*Sagittaria spp.)*
Arrowwood (*Viburnum dentatum*)
Beechdrops (*Epifagus virginiana*)
Black cherry (*Prunus serotina*)
Black cohosh (*Cimicifuga racemosa*)
Black gum (*Nyssa sylvatica*)
Black highbush blueberry (*Vaccinium fuscatum*)
Black huckleberry (*Galussacia baccata*)
Black oak (*Quercus velutina*)
Black-edge sedge (*Carex nigromarginata*)
Blackgum (*Nyssa sylvatica*)
Blackjack oak (*Quercus marilandica)*
Bladder sedge (*Carex intumescens*)
Blaspheme-vine (*Smilax laurifolia*)
Bloodroot (*Sanguinaria canadensis*)
Blue huckleberry (*Gaylussacia frondosa*)
Bluestem goldenrod (*Solidao caesia*)
Bluff oak (*Quercus austrina*)
Bog oat-grass (*Danthonia epilis*)
Bog spicebush (*Lindera subcoriacea*

Broomsedge (*Andropogon virginicus* var. *virginicus*)
Bushy broomsedge (*Andropogon glomeratus*)
Butterfly pea (*Clitoria mariana*)
Buttonbush (*Cephalanthus occidentalis* var. *occidentalis*)
Canby's bulrush (*Schoenoplectus etuberculatus*)
Carolina alumroot (*Heuchera caroliniana*)
Carolina jessamine (*Gelsemium sempervirens*)
Carolina shagbark hickory (*Cary carolinae-septentrionalis*)
Carolina supplejack (*Berchemia scandens*)
Carolina thistle (*Cirsium carolinianum*)
Chalk maple (*Acer leucoderme*)
Chapman's redtop (*Tridens chapmanii*)
Cherrybark oak (*Quercus pagoda*)
Chestnut oak (*Quercus montana*)
Christmas fern (*Polystichum acrostichoides* var. *acrostichoides)*
Cinnamon fern (*Osmunda cinnamomea*)
Common alumroot (*Heuchera americana*)
Common chinquapin (*Castanea pumila* var. *pumila*)
Common dog-fennel (*Eupatorium capillifolium*)
Common foamflower (*Tiarella cordifolia var. collina*)
Common greenbrier (*Smilax spp)*
Common jack-in-the-pulpit (*Arisaema tripyllum ssp. triphyllum*)
Common pawpaw (*Asimina triloba*)
Common ragweed (*Ambrosia artemisiifolia*)
Common rough fleabane (*Erigeron strigosus*)
Common spicebush (*Lindera benzoin*)
Common stargrass (*Hypoxis hirsuta*)
Common winterberry (*Ilex verticillata*)
Cowlily (*Nuphar lutea*)
Creeping blueberry (*Vaccinium crassifolium*)
Crested coralroot (*Hexalectis spicata*)
Crossvine (*Bignonia capreolata*)
Deerberry (*Vaccinium stamineum*)
Dissected toothwort (*Cardamine dissecta*)
Dogwood (*Cornus florida*)
Downy arrowwood (*Viburnum rafinesquianum*)
Dwarf huckleberry (*Gaylussacia dumosa*)
Dwarf serviceberry (*Amelanchier stolonifera*)
Eastern mannagrass (*Glyceria septentrionalis*)
Eastern prairie blue wild indigo (*Babtisia australis* var. *aberrans*)
Eastern red maple (*Acer rubrum var. rubrum*)
Eastern shooting star (*Dodecatheon media ssp. media*)
Eastern Small-footed myotis (*Myotis leibii*)
Ebony spleenwort (*Asplenium platyneuron* var. *platyneuron*)
Echinacea laevigata (*Smooth coneflower*)
Elliott's Broomsedge (*Andropogon gyrans*)
Evergreen bayberry (*Morella caroliniensis*)
Fairywand (*Chamaelirium luteum*)
False nettle (*Boehmeria cylindrical*)
Farkleberry (*Vaccinium arboretum*)
Four-toed salamander (*Hemidactylium scutatum*)
Fringetree (*Chionanthus virginicus*)
Galax (*Galax urceolata*)
Georgia aster (*Symphyotrichum georgianum*)
Giant cane (*Arundinaria gigantea*)
Glade milkvine (*Matelea decipiens*)
Glade wild quinine (*Parthenium integrifolium* var. *auriculatum*)
Glaucous greenbrier (*Smilax glauca*)
Green Arrow-arum (*Peltandra virginica*)
Green ash (*Fraxinus pennsylvanica*)
Hairy highbush blueberry (*Vaccinium fuscatum*)
Hairy lipfern (*Cheilanthes lanosa*)

Heartleaf plantain (*Plantago cordata*)
Hedge nettle (*Stachy sp. 1*)
Heller's rabbit tobacco (*Pseudognaphalium helleri*)
Helmet flower (*Scutellaria integrifolia*)
Highbush blueberry (*Vaccinium corymbosum*)
Hillside blueberry (*Vaccinium pallidum*)
Hop-hornbeam (*Ostrya virginiana*)
Hornwort (*Ceratophyllum* spp)
Horsesugar (*Symplocos tinctoria*)
Hyssopleaf eupatorium (*Eupatorium hyssopifolium* var. *hyssopifolium*)
Indian physic (*Porteranthus stipulatus*)
Inkberry (*Ilex decidua*)
Inland roundleaf eupatorium (*Eupatorium rotundifolium* var. *ovatum*)
Ironwood (*Carpinus caroliniana ssp caroliniana*)
Jack-in-the-pulpit (*Arisaema triphyllum*)
Japanese honeysuckle (*Lonicera japonica*)
Japanese stilt grass (*Microstegium vimineum*).
Lamp rush (*Juncus effuses*)
Large witch alder (*Fothergilla major*)
Late eupatorium (*Eupatorium serotinum*)
Leafy elephant's-foot (*Elephantopus carolinianus*),
Licorice bedstraw (*Galium circaezans*)
Licorice goldenrod (*Solidago odora* var. *odora*)
Little bluestem (*Schizachyrium scoparium*)
Littleleaf sneezeweed (*Helinium brevifolium*)
Longleaf pine (*Pinus palustris*)
Longleaf spikegrass (*Chasmanthium sessiliflorum*)
Long-stalked aster (*Symphyotrichum dumosum* var. *dumosum*)
Maidenhair fern (*Adiantum pedatum*)
Maryland goldenaster (*Chrysopsis mariana*)
Missouri rockcress (*Arabis missouriensis*)
Mockernut hickory (*Carya alba*)
Mole salamander (*Ambystoma talpoideum*)
Mosses: (*Climacium americanum*)
Mountain camellia (*Stewartia ovata*)
Mountain laurel (*Kalmia latifolia*)
Muscadine (*Vitis rotundifolia*)
Narrow-leaved aster (*Symphyotrichum laeve var. concinnum*)
Needlegrass (*Piptochaetium avenaceum*)
New Jersey tea (*Ceanothus americana*)
Northern green-and-gold (*Chrysogonum virginianum*)
Northern oak grass (*Danthonia spicata*)
Northern red oak (*Quercus rubra*)
Oat grass (*Danthonia spicata*)
Open flower witch grass (*Dichanthelium laxiflorum*)
Overcup oak (*Quercus lyrata*)
Painted buckeye (*Aesculus sylvatica*)
Persimmon (*Diospyros virginina*)
Piedmont aster (*Eurybia mirabilis*)
Piedmont horsebalm (*Collinsonia tuberosa*)
Piedmont indigo bush (*Amorpha schwerinii*)
Pignut hickory (*Carya glabra*)
Pinebarrens sandreed (*Calamovilfa brevipilis*)
Pineweed (*Hypericum gentianoides)*
Pipsissewa (*Chimaphila maculata*)
Poison ivy (*Toxicodendron radicans*)
Pondweed (*Potamogeton* spp)
Post oak (*Quercus stellata*)
Poverty oat-grass (*Danthonia spicata*)
Purple pitcher plant (*Sarracenia purpurea*)
Pursh's wild petunia *(Ruella purshiana)*
Rafinesque's Big-eared bat (*Corynorhinus rafinesquii*)

Rattlesnake fern (*Botrychium virginianum*)
Rattlesnake hawkweed (*Hieracium venosum*)
Rattlesnake plantain (*Chimaphila maculata*)
Ravine sedge (*Carex impressinervia*)
Red chokeberry (*Photinia pyrifolia*)
Red hickory (*Carya ovalis*)
Red maple (*Acer rubrum*)
Redbud (*Cercis canadensis*)
Red-cockaded woodpecker (*Picoides borealis)*
Ringed witch grass (*Dichanthelium annulum*)
River birch (*Betula nigra*)
Rock spikemoss (*Selaginella rupestris*)
Royal fern (*Osmunda regalis* var. *spectabilis*)
Sand hickory (*Cary palida*)
Sand hills bean (*Phaseolus polystachios*)
Savanna eupatorium (*Eupatorium leucolepis*)
Saw greenbrier (*Smilax bona-nox*)
Scarlet oak (*Quercus coccinea* var. *coccinea*)
Schweinitz's sunflower (*Helianthus schweinitzii*)
Sedges (*Carex* spp)
Shagbark hickory (*Carya ovata*)
Sharp-shinned hawk (*Accipiter striatus*)
Shielded-sorus polypody (*Pleopeltis polypodioides* ssp. *michauxiana*)
Shortleaf pine (*Pinus echinata*)
Silky oat-grass (*Danthonia sericea* var. *sericea*),
Silverbell (*Halesia tetraptera var. tetraptera*)
Silver-haired bat (*Lasioncteris noctivagans*)
Skullcap (*Scutellaria integrifolia*)
Slender spikegrass (*Chasmanthium laxum*)
Smooth coneflower (*Echinacea laevigata*)
Smooth goldenrod (*Solidago gigantea*)
Smooth sunflower (*Helianthus laevigatus*)
Sourwood (*Oxydendrum arboretum*)
Southern anemone (*Anemone berlandieri*)
Southern blackberry (*Rubus argutus*)
Southern blackhaw (*Viburnum rufidulum*)
Southern blueberry (*Vaccinium tenellum*)
Southern bracken (*Pteridium aquilinum* var. *pseudocaudatum*)
Southern lady fern (*Athyrium filix-femina* ssp *asplenioides*)
Southern red cedar (*Juniperus virginiana* var. *virginiana*)
Southern red oak (*Quercus falcata*)
Southern wild raisin (*Viburnum nudum* var. *nudum*)
Sphagnum mosses: (*Sphagnum lescurii)*
Splitbeard bluestem (*Andropogon ternarius var. ternarius*)
St.-John's-wort (*Hypericum lloydii*)
Starved witch grass (*Dichanthelium depauperatum*)
Swamp chestnut oak (*Quercus michauxii*)
Swamp doghobble (*Leucothoe racemosa*)
Swamp red maple (*Acer rubrum* var. *trilobum)*
Swamp rose (*Rosa palustris)*
Swamp white oak (*Quercus bicolor*)
Sweetbay (*Magnolia virginiana)*
Sweetgum (*Liquidambar styraciflua*)
Sycamore (*Platanus occidentalis*)
Tag alder (*Alnus serrulata*)
Thick-pod white wild indigo (*Baptisia alba*)
Thin-pod white wild indigo (*Baptisia albescens*)
Threadleaf coreopsis (*Coreopsis verticillata*)
Tick-trefoils (*Desmodium* spp.)
Ti-ti (*Cyrilla racemiflora*)
Tulip poplar (*Liriodendron tulipifera*)
Virginia creeper (*Parthenocissus quinquefolia*)

Virginia goat's-rue (*Tephrosia virginiana*)
Virginia pine (*Pinus virginiana*)
Virginia red cedar (*Juniperus virginiana var. virginiana*)
Virginia spiderwort (*Tradescantia virginiana*)
Virginia sweetspire (*Itea virginica*)
Virginia wild-rye (*Elymus virginicus*)
Warbling vireo (*Vireo gilvus*)
Water lily (*Nmphaea odorata*)
Water oak (*Quercus nigra*)
Watermilfoil (*Myriophyllum* spp)
Western rough goldenrod (*Solidago radula* var. *radula*)
Whip nutrush (*Scleria triglomerata*)
White ash (*Fraxinus americana*)
White oak (*Quercus alba*)
Whorled milkweed (*Asclepias verticillata*)
Wild ginger (*Asarum canadense*)
Wild grape (*Vitis spp.).*
Willow oak (*Quercus phellos*)
Winged elm (*Ulmus alata*)
Winged witchgrass (*Dichanthelium annulum*)
Witch alder (*Fothergilla major*)
Wood anemone (*Anemone quinquefolia* var. *quenquefolia*)
Woodland tick-trefoil (*Desmodium nudiflorum*)
Wright's cliff-brake (*Pellaea wrightiana*)
Yadkin River goldenrod (*Solidago plumosa)*
Yellow Indian grass (*Sorghastrum nutans*)
Yellow pitcher plant (*Sarracenia flava*)
Yellow yam (*Dioscorea quaternata*)
Yellow-eyed grass (*Xyris ambigua)*
Yellowroot (*Xanthorhiza simplicissima*)