

**NATURAL PLANT COMMUNITIES OF CAMP AGAPE
HARNETT COUNTY, NORTH CAROLINA**



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ABSTRACT

A survey classifying natural plant communities was conducted intermittently from 2019 to 2022 at Camp Agape, a private nonprofit environmental education facility located in Harnett County, North Carolina. The communities were matched with those described in Schafale's (2012) and Schafale and Weakley's (1990) 4th and 3rd approximations of natural plant communities of North Carolina, respectively. Nine distinct natural plant communities were classified and mapped in Camp Agape that best resembles the Piedmont Levee Forest, Piedmont Alluvial Forest, Piedmont Bottomland Forest, Piedmont/Mountain Semipermanent Impoundment, Low Elevation Seep, Floodplain Pool, Mesic Mixed Hardwood Forest, Dry – Mesic Oak – Hickory Forest, and Dry Oak – Hickory Forest communities as described by Schafale (2012) and Schafale and Weakley (1990).

INTRODUCTION

This report fulfills the requirements of the Independent Study Project (ISP) for completion of the North Carolina Botanical Garden (NCBG) Native Plant Studies Certificate Program. It was conducted under the advisement of plant ecologist and biogeographer, Julie Tuttle, Ph. D. The title and topic of the report was selected due to the author's past experiences and passion for mapping and classifying plant communities for the last 20 plus years. The author has also volunteered with ACE Ed on a few occasions in the past and has therefore, developed fond memories of working with this facility and its staff.

Camp Agape is listed as a significant natural heritage area in the Harnett County Natural Area Inventory Report produced by the NC Natural Heritage Program (NCNHP) (Sorrie, 2007). The natural communities documented in the 2007 inventory report include Piedmont Levee Forest, Piedmont Alluvial Forest, Piedmont/Mountain Semipermanent Impoundment, and Mesic Mixed Hardwood Forest. The Vernal Pool community was also mentioned in the 2007 inventory report which refers to the Low Elevation Seep community documented in this report. It is hoped that this report will help update the 2007 inventory report as well as documenting other natural communities located in Camp Agape.

Findings of this report will be submitted to the Agape Center for Environmental Education (ACE Ed) and the North Carolina Natural Heritage Program for educational purposes and documentation, respectively.

Project Study Area Description

Camp Agape lies in the Piedmont physiographic region of North Carolina (Figure 1) in Harnett County, North Carolina. More specifically, Camp Agape lies within the Northern Outer Piedmont Level IV Ecoregion (Griffith et. al, 2002). Camp Agape occurs on the north side of the Cape Fear River approximately three miles upstream of Raven Rock State Park. Elevations in the study area range from approximately 140 to 385 feet above mean sea level. The entire property of Camp Agape comprises 624 acres, located mostly in Harnett County with only the northwestern tip located in Chatham County. Since the

northern half of the property, north of Parkers Creek, was recently logged, the project study area for the survey includes only the area south of Parker's Creek (Figure 1) completely in Harnett County. This area incorporates the entire area used for ACE Ed. The project study area is approximately 394 acres in size.

Geology and Soils of the Project Study Area

Geologically, the project study area lies within the Raleigh Belt. This belt contains mostly gneiss, schist, and granite. Soils derived from gneiss, granite, and in part, schist, tend to be acidic and poor in nutrients.

The upland soils within the study area fall within the Cecil-Pacolet-Nason general soil map unit. This soil unit is on narrow ridges and long, steep slopes along the Cape Fear River. It is about 55% Cecil soils, 16% Pacolet soils, 7% Nason soils, and 22% of minor soils including Enon, Helena, Lillington, Louisa, and Orangeburg soils.

The floodplain soils along the Cape Fear River and Parkers Creek are within the Bibb-Wehadkee general soil map unit. This unit is about 47% Bibb soils, 21% Wehadkee soils, and 32% of minor soils including Augusta, Congaree, Chewacla, Portsmouth, and Roanoke soils.

The Harnett County Soil Survey identifies six soil types within the study area (Table 1 and Figure 3).

Table 1. Soils within Camp Agape Project Study Area

Soil Series	Mapping Unit	Acres in Study Area	Percent of Study Area
Cecil fine sandy loam, 2-8% slope	CeB	21.5	5.5%
Cecil fine sandy loam, 8-15% slope	CeD	123.5	31.4%
Chewacla and Congaree loams, frequently flooded	Ch	57.6	14.6%
Lillington very gravelly sandy loam, 2-8% slope	LnB	0.5	0.1%
Louisa fine sandy loam, 25-45% slope	LoF	130.6	33.1%
Pacolet fine sandy loam, 15-25% slope	PaE	57.3	14.5%
Water	W	3.0	0.8%
Total		394.0	100.0%

Water Resources within the Project Study Area

Water resources in the study area lie within the Cape Fear River basin. The Cape Fear River and Parkers Creek and their unnamed tributaries are located within the project study area. The location of each water resource is shown in Figure 4.

History of Camp Agape

The North Carolina Synod of the Lutheran Church formed a new camp committee in 1963 whose task it was to develop a master plan for church camping in the synod. This committee identified four geographic areas of the state where outdoor ministry should occur for Lutherans – the mountains, already served by Lutheridge; lower piedmont in the Lake Norman area; central piedmont in the triangle area; and the coastal area (Camp Agape, personal information).

The camp committee worked on the premise that needs of the congregations and synod dictate programs to meet those needs and that programs determine location and facilities. After purchasing a facility at Kure Beach, the committee turned its attention to the needs in the central part of the state. Realizing the potential for growth in the triangle area and needs for the 21st century, the synod purchased 432 acres of land along the Cape Fear River in 1967 in Harnett County near Raleigh. Through additional land acquisitions, Camp Agape grew to include 624 acres. One of the earliest program needs identified by the synod committee was family camping and congregational retreats. To meet this need, a family campground with modern facilities was completed in 1974. In that same year, Camp Agape was dedicated and officially opened on July 14, 1974 (Camp Agape, personal information).

The next major program need that was identified was the need for overnight facilities. In 1978, construction of the North Carolina Lutheran Men's Retreat Lodge was begun. It was officially dedicated on May 12, 1979 and was completely funded by the North Carolina Lutheran Men. Additional programs that were added to the ministry at Camp Agape over the next few years were Travel Ministry, canoe trips, day camp, and resident camping (Camp Agape, personal information).

In the spring of 1996, the corporate office was moved to the Agape site. In September of the same year, Hurricane Fran visited the site, wiping out several thousand trees at the camp. In 1997 Agape Kure Beach Ministries launched the annual giving club. River of Hope donors share the vision and values of this ministry through their gifts or time and treasure (Camp Agape, personal information).

With the addition of an expanded full-time summer staff, renewed emphasis was placed on summer camp, day camp, and inner-city ministries throughout the Evangelical Lutheran Church in America (ELCA) organization. Recognizing the need to provide environmental education to their congregations and area public schools, the Agape Center for Environmental (ACE) Education program was established in 1998 along with a facility for exhibits and workshops (Camp Agape, personal information).

METHODOLOGY

Twenty-two site visits to Camp Agape were conducted during March (1 visit), May (1 visit), June (1 visit), October (4 visits), November (5 visits), and December (1 visit) of 2019; January (1 visit) of 2020; March (1 visit) of 2021; and March (2 visits), April (2 visits), May (1 visit), and June (2 visits) of 2022. Dominant taxa were hand recorded in field book for each community encountered while walking each designated trail. A personal Garmin GPSMap 64st hand-held Global Positioning System (GPS) unit was used to GPS all the trails and plant communities that were too small to draw on field maps. Flowering specimens and examples of each represented community were photographed using personal Apple I-Phone 6 and I-Phone 12 smart phones. The field data was compiled and sorted into different natural plant communities as described by Schafale and Weakley (1990) and Schafale (2012). The natural community locations were estimated using United States Geological Survey (USGS) topographic maps and other field maps and field notes. The communities were then mapped using ArcGIS Geographic Information System (GIS) version 10.5.1 software application. Once map figures were created, they were then exported as a pdf file and incorporated into the report.

RESULTS - NATURAL PLANT COMMUNITIES

Nine natural plant communities as described by Schafale and Weakley's (1990) 3rd and Schafale's (2012) 4th approximations of natural communities of North Carolina were identified in the project study area: Piedmont Levee Forest, Piedmont Alluvial Forest, Piedmont Bottomland Forest, Piedmont/Mountain Semipermanent Impoundment, Low Elevation Seep, Floodplain Pool, Mesic Mixed Hardwood Forest, Dry-Mesic Oak-Hickory Forest, and Dry Oak-Hickory Forest. A brief description of each community type follows. Figures 4, 5, and 6 show the approximate location and extent of these communities in the project study area. However, transition areas between community types exist throughout the project study area and are not depicted in the previously listed figures. The species observed are listed in the descriptions below and are included in Appendix B.

Piedmont Levee Forest

The Piedmont Levee Forest community occurs on natural levees and point bar deposits of Piedmont rivers and large stream floodplains. Soils of this community is medium to coarse-textured alluvial soils and are generally mapped as Congaree or Chewacla series (see Table 1 and Figure 3 for comparison). This community type's hydrology is seasonally to intermittently flooded (Schafale and Weakley, 1990).

The Piedmont Levee Forest occurs along the natural levee of the Cape Fear River immediately adjacent to the river channel. It borders the Cape Fear River channel throughout the extent of the project study area (Figure 4). This community grades landward into the Piedmont Alluvial Forest community along the northern half of the Cape Fear River floodplain and into the Piedmont Bottomland Forest community along the southern half of the Cape Fear River floodplain within the project study area (Figure 4). Canopy species observed include hackberry (*Celtis laevigata*), sycamore (*Platanus*

occidentalis), river birch (*Betula nigra*), green ash (*Fraxinus pennsylvanica*), sweet gum (*Liquidambar styraciflua*), bitternut hickory (*Carya cordiformis*) and American elm (*Ulmus americanus*). Understory and shrub species observed include ironwood (*Carpinus caroliniana*), southern sugar maple (*Acer floridanum*), American holly (*Ilex opaca*), pawpaw (*Asimina triloba*), northern spicebush (*Lindera benzoin*), Chinese privet (*Ligustrum sinense*), and giant cane (*Arundinaria gigantea*). Dominant vine and herbaceous species observed in this community include common greenbrier (*Smilax rotundifolia*), poison ivy (*Toxicodendron radicans*), Virginia creeper (*Parthenocissus quinquefolia*), wild grape (*Muscadinia rotundifolia*), Japanese stiltgrass (*Microstegium vimineum*), river oat (*Chasmanthium latifolium*), and Virginia wild rye (*Elymus virginica*).

Piedmont Alluvial Forest

The Piedmont Alluvial Forest community occurs on river and stream floodplains of the Piedmont in which separate fluvial landforms and associated vegetation zones are too small to distinguish. Soils of this community are various alluvial soils and are generally mapped as Congaree or Chewacla series (see Table 1 and Figure 3 for comparison). This community type's hydrology is seasonally to intermittently flooded (Schafale and Weakley, 1990).

The Piedmont Alluvial Forest community is located within the northern portion of Cape Fear River floodplain surrounding the Piedmont Semipermanent Impoundment Community between the Piedmont Levee Forest and Mesic Mixed Hardwood Forest communities in the project study area (Figure 4). This community within the floodplain of Cape Fear River is heavily affected hydrologically by the beaver impoundment, making it wetter than the Piedmont Alluvial Forest community within the Parkers Creek floodplain. The community within the Parkers Creek floodplain is immediately adjacent to the creek channel and is bordered landward by the Mesic Mixed Hardwood Forest community (Figure 4).

Species composition in this community is similar to that described in the Piedmont Levee Forest community with canopy species including sycamore (*Platanus occidentalis*), river birch (*Betula nigra*), red maple (*Acer rubrum*), tulip poplar (*Liriodendron tulipifera*), sweet gum (*Liquidambar styraciflua*), swamp chestnut oak (*Quercus michauxii*), and bitternut hickory (*Carya cordiformis*). Understory and shrub species include American holly (*Ilex opaca*), ironwood (*Carpinus caroliniana*), eastern hop-hornbeam (*Ostrya virginiana*), northern spicebush (*Lindera benzoin*), boxelder (*Acer negundo*), southern sugar maple (*Acer floridanum*), umbrella tree (*Magnolia tripetala*), painted buckeye (*Aesculus sylvatica*), Chinese privet (*Ligustrum sinense*), silky dogwood (*Cornus amomum*), pawpaw (*Asimina triloba*), yellowroot (*Xanthorhiza simplicissima*), American hazelnut (*Corylus americana*), and strawberry bush (*Euonymus americanus*). Herbaceous and vine species include Japanese stiltgrass (*Microstegium vimineum*), mayapple (*Podophyllum peltatum*), bedstraw (*Galium aparine*), sedges (*Carex* spp.), spring beauty (*Claytonia virginiana*), southern lady fern (*Athyrium asplenoides*), Christmas fern (*Polystichum acrostichoides*), bittercress (*Cardamine* spp.), rue anemone (*Thalictrum thalictroides*), woodreed grass (*Cinna arundinacea*), foamflower (*Tiarella cordifolia*), violets (*Viola* spp.), round-lobed liverleaf (*Hepatica americana*), little brown

jug (*Hexastylis arifolia*), star chickweed (*Stellaria pubera*), river oat (*Chasmanthium latifolium*), Japanese honeysuckle (*Lonicera japonica*), wild grape (*Muscadinia rotundifolia*), Virginia creeper (*Parthenocissus quiquefolia*), crossvine (*Bignonia capreolata*), trumpet creeper (*Campsis radicans*), and common greenbrier (*Smilax rotundifolia*).

Piedmont Bottomland Forest

The Piedmont Bottomland Forest community occurs on floodplain ridges and terraces other than the active levees adjacent to the river channel in the Piedmont. Soils of this community are various alluvial soils and are generally mapped as Congaree or Chewacla series (see Table 1 and Figure 3 for comparison). This community type's hydrology is intermittently flooded (Schafale and Weakley, 1990).

The Piedmont Bottomland Forest community is located on a terrace outside the active levee in the southern portion of the Cape Fear River floodplain within the project study area between the Piedmont Levee Forest and Mesic Mixed Hardwood Forest communities (Figure 4). The canopy, understory, and shrub layers observed include cherrybark oak (*Quercus pagoda*), swamp chestnut oak (*Quercus michauxii*), American elm (*Ulmus americana*), red maple (*Acer rubrum*), sweetgum (*Liquidambar styraciflua*), river birch (*Betula nigra*), tulip poplar (*Liriodendron tulipifera*), bitternut hickory (*Carya cordiformis*), pawpaw (*Asimina triloba*), possumhaw (*Ilex decidua*), winged elm (*Ulmus alata*), southern sugar maple (*Acer floridanum*), and Chinese privet (*Ligustrum sinense*). Herbaceous and vine species include mayapple (*Podophyllum peltatum*), bedstraw (*Galium aparine*), sedges (*Carex* spp.), lion's foot (*Prenanthes serpentaria*), Christmas fern (*Polystichum acrostichoides*), and wild grape (*Muscadinia rotundifolia*).

Piedmont/Mountain Semipermanent Impoundment

The Piedmont/Mountain Semipermanent Impoundment community occur in beaver ponds and similar small, old, undisturbed, and man-made impoundments. They generally are in floodplains or low gradient valleys. Hydrology of this community type is permanently flooded in the center, grading outward to the prevailing hydrology of the surrounding area (Schafale and Weakley, 1990).

The Piedmont/Mountain Semipermanent Impoundment community is located in the Cape Fear Floodplain and is embedded within the Piedmont Alluvial Forest, near Ironwood and Swamp Trails (Figure 4). It is a large beaver pond created in an old meander channel of the Cape Fear River. This community appears to be expanding downstream along the relic channel based on recent beaver activity. Common species observed within the beaver pond impoundment include crimson-eyed hibiscus (*Hibiscus moscheutos*), cattail (*Typha latifolia*), lizard's tail (*Saururus cernuus*), rice cutgrass (*Leersia oryzoides*), sedges (*Carex* spp.), arrow arum (*Peltandra virginica*), marsh dayflower (*Murdannia keisak*), buttonbush (*Cephalanthus occidentalis*), black willow (*Salix nigra*), tag alder (*Alnus serrulata*), and river birch (*Betula nigra*). This site is recorded in the NCNHP report by Sorrie (2007) as County significant.

Two small Piedmont/Mountain Semipermanent Impoundment communities also occur at the fringes of the pond near Holly Trail. These two communities were dominated by tag alder (*Alnus serrulata*), lizard's tail (*Saururus cernuus*), and sedges (*Carex* spp.).

Low Elevation Seep

The Low Elevation Seep community is composed of springs and seeps occurring at the base of slopes or the edges of floodplains. This community is often quite small with permanently saturated, usually mucky soils and provide important breeding and foraging sites for amphibians such as the southeastern dwarf salamander (*Eurycea quadridigitata*), red salamander (*Pseudotriton ruber*), mud salamander (*Pseudotriton montanus*), four-toed salamander (*Hemidactylium scutatum*), and spring peeper (*Pseudacris crucifer*) (Schafale and Weakley, 1990).

Three low elevation seeps occur within the floodplain of Parkers Creek along the Parkers Creek Trail (Figure 3). Common vegetation observed at these sites include wild raisin (*Viburnum nudum*), northern spicebush (*Lindera benzoin*), red chokeberry (*Aronia arbutifolia*), lizard's tail (*Saururus cernuus*), jack-in-the-pulpit (*Arisaema triphyllum*), arrow arum (*Peltandra virginica*), netted chainfern (*Woodwardia areolata*), cinnamon fern (*Osmundastrum cinnamomeum*), fowl manna grass (*Glyceria striata*), marsh dayflower (*Murdannia keisak*), duck potato (*Sagittaria latifolia*), water hemlock (*Cicuta maculata*), and sedges (*Carex* spp.). These low elevation seeps best resemble the Floodplain Subtype as described by Schafale, 2012.

Other small low elevation seeps occur at the base of slopes before entering headwater streams throughout the project study area (Figure 4). These seeps are floristically like the Parkers Creek seeps with wild raisin (*Viburnum nudum*), beautyberry (*Callicarpa americana*), lizard's tail (*Saururus cernuus*), jack-in-the-pulpit (*Arisaema triphyllum*), fowl mannagrass (*Glyceria striata*), giant cane (*Arundinaria gigantea*), sedges (*Carex* spp.), false nettle (*Boehmeria cylindrica*), netted chainfern (*Woodwardia areolata*), royal fern (*Osmunda regalis*), and cinnamon fern (*Osmundastrum cinnamomeum*), being most prevalent. These low elevation seeps best resemble the Typic Subtype as described by Schafale, 2012.

Floodplain Pool

The Floodplain Pool community occurs in natural sloughs, such as abandoned river channels, or rounded depressions in the floodplain of the Piedmont and Mountains, holding water much or all the year. Vegetation is sparse, usually found only along the edges and lacking plants in the deepest part (Schafale, 2012).

One floodplain pool was observed in the Cape Fear River floodplain immediately adjacent to the Mesic Mixed Hardwood Forest community along the Ironwood Trail (Figure 4). Vegetation along the periphery include hop sedge (*Carex lupulina*), lizard's tail (*Saururus cernuus*), red maple (*Acer rubrum*), and river birch (*Betula nigra*).

Mesic Mixed Hardwood Forest

The Mesic Mixed Hardwood Forest (Piedmont Subtype) occurs on lower slopes, steep north-facing slopes, ravines, and occasionally well-drained small stream bottoms, on deep well-drained, somewhat acidic soils. Typical soil series include Cecil, Georgeville, Pacolet, Tatum, Wedowee, Tallapoosa, and Louisburg (Schafale and Weakley, 1990) (see Table 1 and Figure 3 for comparison).

The Mesic Mixed Hardwood Forest community grades downward to the Piedmont Alluvial Forest community on both the Cape Fear River and Parkers Creek floodplains and to the Piedmont Bottomland Forest community on the Cape Fear River floodplain. This community grades upslope to the Dry-Mesic Oak-Hickory Forest community within the project study area (Figure 4). Canopy and understory trees observed in this community include American beech (*Fagus grandifolia*), northern red oak (*Quercus rubra*), tulip poplar (*Liriodendron tulipifera*), red maple (*Acer rubrum*), white oak (*Quercus alba*), flowering dogwood (*Cornus florida*), eastern hop-hornbeam (*Ostrya virginiana*), ironwood (*Carpinus caroliniana*), white ash (*Fraxinus americana*), and American holly (*Ilex opaca*). Shrub species observed include deerberry (*Vaccinium stamineum*) downy arrowwood (*Viburnum rafinesquianum*), blackhaw (*Viburnum prunifolium*), mapleleaf viburnum (*Viburnum acerifolium*), witch hazel (*Hamamelis virginiana*), beautyberry (*Callicarpa americana*), serviceberry (*Amelanchier arborea*), and strawberry bush (*Euonymus americanus*). A nice patch of mountain laurel (*Kalmia latifolia*) and pinkster flower (*Rhododendron periclymenoides*) was present in this community along the Laurel Trail on north facing slopes. Species observed in the herb and vine layers include Christmas fern (*Polystichum acrostichoides*), violets (*Viola* spp.), witch grasses (*Dichanthelium* spp.), little brown jug (*Hexastylis arifolia*), crane fly orchid (*Tipularia discolor*), nakedflower ticktrefoil (*Desmodium nudiflorum*), dimpled trout lily (*Erythronium umbilicatum*), round-lobed liverleaf (*Hepatica americana*), beech drops (*Epifagus virginiana*), foamflower (*Tiarella cordifolia*), American alumroot (*Heuchera americana*), rue anemone (*Thalictrum thalictroides*), star chickweed (*Stellaria pubera*), mayapple (*Podophyllum peltatum*), spring beauty (*Claytonia virginica*), green and gold (*Chrysogonum virginianum*), trailing arbutus (*Epigaea repens*), bloodroot (*Sanguinaria canadensis*), bittercress (*Cardamine* spp.), Indian cucumberroot (*Medeola virginiana*), rattlesnake fern (*Botrychium virginianum*), ebony spleenwort (*Asplenium platyneuron*), downy rattlesnake plantain (*Goodyera pubescens*), pipsissewa (*Chimaphila maculata*), lion's foot (*Prenanthes serpentaria*), Japanese honeysuckle (*Lonicera japonica*), Virginia creeper (*Parthenocissus quinquefolia*), poison ivy (*Toxicodendron radicans*), and wild grape (*Muscadinia rotundifolia*). A small patch of richweed (*Collinsonia canadensis*), a plant indicative of basic soils, was observed in this community along Parkers Creek Trail just upslope of the Parkers Creek floodplain.

Dry-Mesic Oak-Hickory Forest

The Dry-Mesic Oak-Hickory Forest community occurs on mid slopes, low ridges, upland flats, and other dry-mesic upland areas on acidic soils. Typical soil series include Cecil, Georgeville, Pacolet, Tatum, Kalmia, Wedowee, Tallapoosa, Wagram, and Stallings (Schafale and Weakley, 1990) (see Table 1 and Figure 3 for comparison).

The Dry-Mesic Oak-Hickory Forest community grades downslope to the Mesic Mixed Hardwood Forest community and upslope to the Dry Oak-Hickory Forest community (Figure 4). Gradual transitions between this community and the other two adjacent communities exist making boundary delineations between these communities difficult. This community is somewhat more disturbed than the other previously described communities due to more recent clearing and logging. The boundary of this community between its two adjacent communities was set by the prevalence of American beech and other mesophytic species downslope (Mesic Mixed Hardwood Forest community) and prevalence of dryer oak species such as southern red oak (*Quercus falcata*), post oak (*Quercus stellata*), and rock chestnut oak (*Quercus montana*) upslope (Dry Oak-Hickory Forest community).

This forest community is dominated by mixtures of oaks and hickories, including white oak (*Quercus alba*), northern red oak (*Quercus rubra*), black oak (*Quercus velutina*), scarlet oak (*Quercus coccinea*), mockernut hickory (*Carya tomentosa*), and pignut hickory (*Carya glabra*). Loblolly pine (*Pinus taeda*), shortleaf pine (*Pinus echinata*), tulip poplar (*Liriodendron tulipifera*), and sweetgum (*Liquidambar styraciflua*) were abundant in the more disturbed areas. Understory species include red maple (*Acer rubrum*), American beech (*Fagus grandiflora*), flowering dogwood (*Cornus florida*), sourwood (*Oxydendrum arboreum*), water oak (*Quercus nigra*), red cedar (*Juniperus virginiana*), American holly (*Ilex opaca*), black cherry (*Prunus serotina*), eastern redbud (*Cercis canadensis*), and black gum (*Nyssa sylvatica*). Shrubs include downy arrowwood (*Viburnum rafinesquianum*), deerberry (*Vaccinium stamineum*), farkleberry (*Vaccinium arboreum*), beautyberry (*Callicarpa americana*), and strawberry bush (*Euonymus americanus*). Vines including wild grape (*Muscadinia rotundifolia*), poison ivy (*Toxicodendron radicans*), crossvine (*Bignonia capreolata*), trumpet creeper (*Campsis radicans*), common greenbrier (*Smilax rotundifolia*), and Carolina jessamine (*Gelsemium sempervirens*) are also present. Common herbs observed include little brown jug (*Hexastylis arifolia*), cranefly orchid (*Tipularia discolor*), downy rattlesnake plantain (*Goodyera pubescens*), bluets (*Houstonia caerulea*), pipsissewa (*Chimaphila maculata*), partridgeberry (*Mitchella repens*), nakedflower trectickfoil (*Desmodium nudiflorum*), and rattlesnakeweed (*Hieracium venosum*).

Dry Oak-Hickory Forest

The Dry Oak-Hickory Forest community occurs on ridgetops, upper slopes, steep south-facing slopes, upland flats with limited root depth, and other relatively dry upland areas on acidic soils. Typical soil series include Cecil, Georgeville, Pacolet, Kalmia, Goldston, Wagram, and Misenheimer (Schafale and Weakley, 1990) (see Table 1 and Figure 3 for comparison).

This community occurs on the highest elevations throughout the project study area and grades downslope into the Dry-Mesic Oak-Hickory Forest community (Figure 4). Like the Dry-Mesic Oak-Hickory Forest community, it is somewhat disturbed in areas due to logging and clearing in the past 30 – 50 years. The boundary between this community and the adjacent Dry-Mesic Oak-Hickory Forest community was set when the dryer oak species became less prevalent and more dry-mesic species such as northern red oak (*Quercus rubra*) became more prevalent.

This forest community's canopy is dominated by dryer site oaks including white oak (*Quercus alba*), southern red oak (*Quercus falcata*), post oak (*Quercus stellata*), and rock chestnut oak (*Quercus montana*) along with various other oak and hickory species such as blackjack oak (*Quercus marilandica*), scarlet oak (*Quercus coccinea*), black oak (*Quercus velutina*), mockernut hickory (*Carya tomentosa*), and pignut hickory (*Carya glabra*). Loblolly pine (*Pinus taeda*) and shortleaf pine (*Pinus echinata*) are present in the more disturbed areas. Understory and shrub species observed include sourwood (*Oxydendrum arboreum*), red maple (*Acer rubrum*), black gum (*Nyssa sylvatica*), flowering dogwood (*Cornus florida*), farkleberry (*Vaccinium arboreum*), deerberry (*Vaccinium stamineum*) persimmon (*Diospyros virginiana*), and sassafras (*Sassafras albidum*). Vine and herb species observed include wild grape (*Muscadinia rotundifolia*), poison ivy (*Toxicodendron radicans*) spotted wintergreen (*Chimaphila maculata*), and little brown jug (*Hexastylis arifolia*).

DISCUSSION AND CONCLUSION

Overall, this project proved to be a great example of rigorously testing Schafale and Weakley's (1990) and Schafale's (2012) 3rd and 4th Approximation of Classification of Natural Communities of North Carolina documents, respectively. Identifying nine distinct plant community types within a 394-acre plot speaks well for the diversity of habitat that Camp Agape provides.

It is believed that the findings of nine distinct plant communities in Camp Agape is accurate and well represents what is described in the references. Even the more disturbed communities such as the Dry-Mesic Oak-Hickory Forest and Dry Oak-Hickory Forest communities, have relatively undisturbed areas that closely resembles those described in the references. What could be subject for debate may be the community boundary lines as depicted in Figures 4, 5, and 6. Transitional areas between the communities exist, especially between the Mesic Mixed Hardwood Forest and Dry-Mesic Oak-Hickory Forest communities, and between Dry-Mesic Oak-Hickory Forest and Dry Oak-Hickory Forest communities, making it more difficult for community boundary delineation due to overlap of similar species between adjacent communities. Therefore, the potential changes that could result, would be a shift in the community boundaries up or downslope between the adjacent communities. However, the communities would still exist in their designated landscape position relative to one another.

Hopefully this project will help serve Camp Agape's environmental outreach and help update the NCNHP's report of 2007. Certainly, this project should also open numerous opportunities for more plant studies at Camp Agape, such as performing a complete plant inventory for each community described; performing a bryophyte community analysis due to the abundance of various mosses and liverworts observed in Camp Agape; performing a graminoid inventory of grasses, sedges, and rushes; and conducting a further investigation into areas with assemblages indicating basic soil inclusions. Faunal studies including bird, herpetofauna, and insect inventories would be beneficial to the environmental outreach as well. Overall, Camp Agape should be considered as an excellent site for hosting a BioBlitz event that can help launch these studies.

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Appendix A Figures

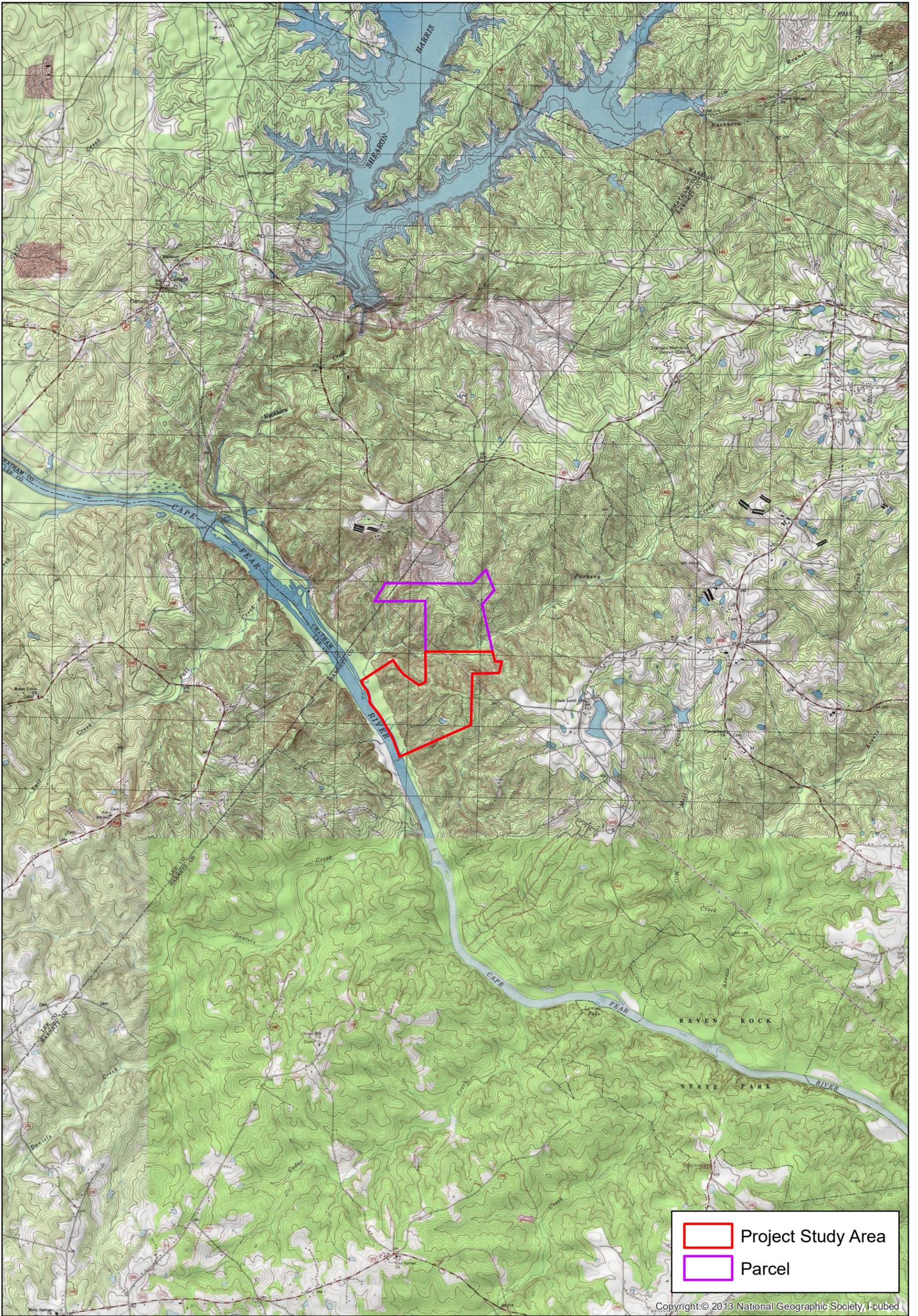


Figure 1: Vicinity Map
Camp Agape
Harnett & Chatham Counties



Soil Map—Harnett County, North Carolina
(Camp Agape Soils Map)



Figure 3. Soil Map for Camp Agape Project Study Area

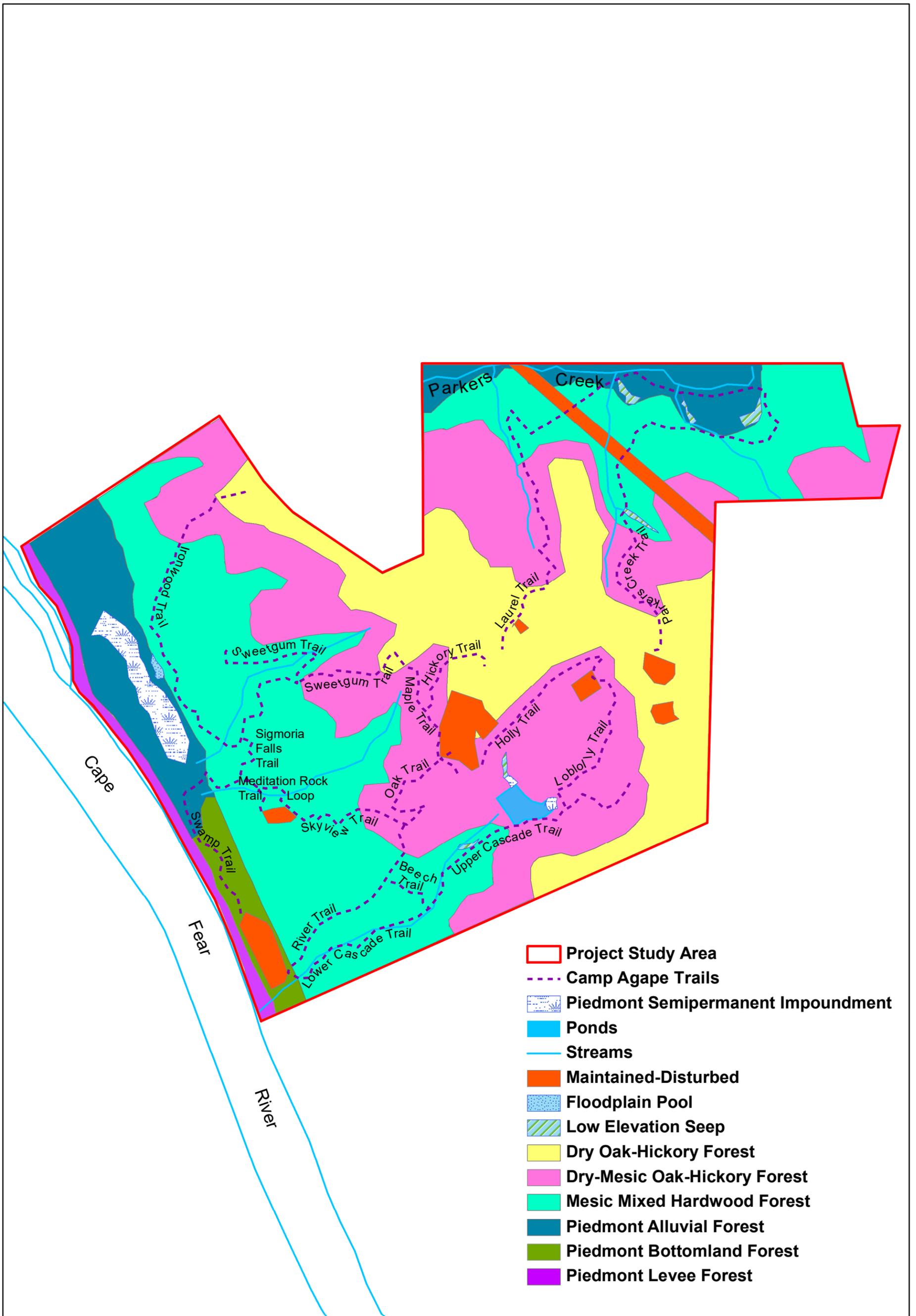
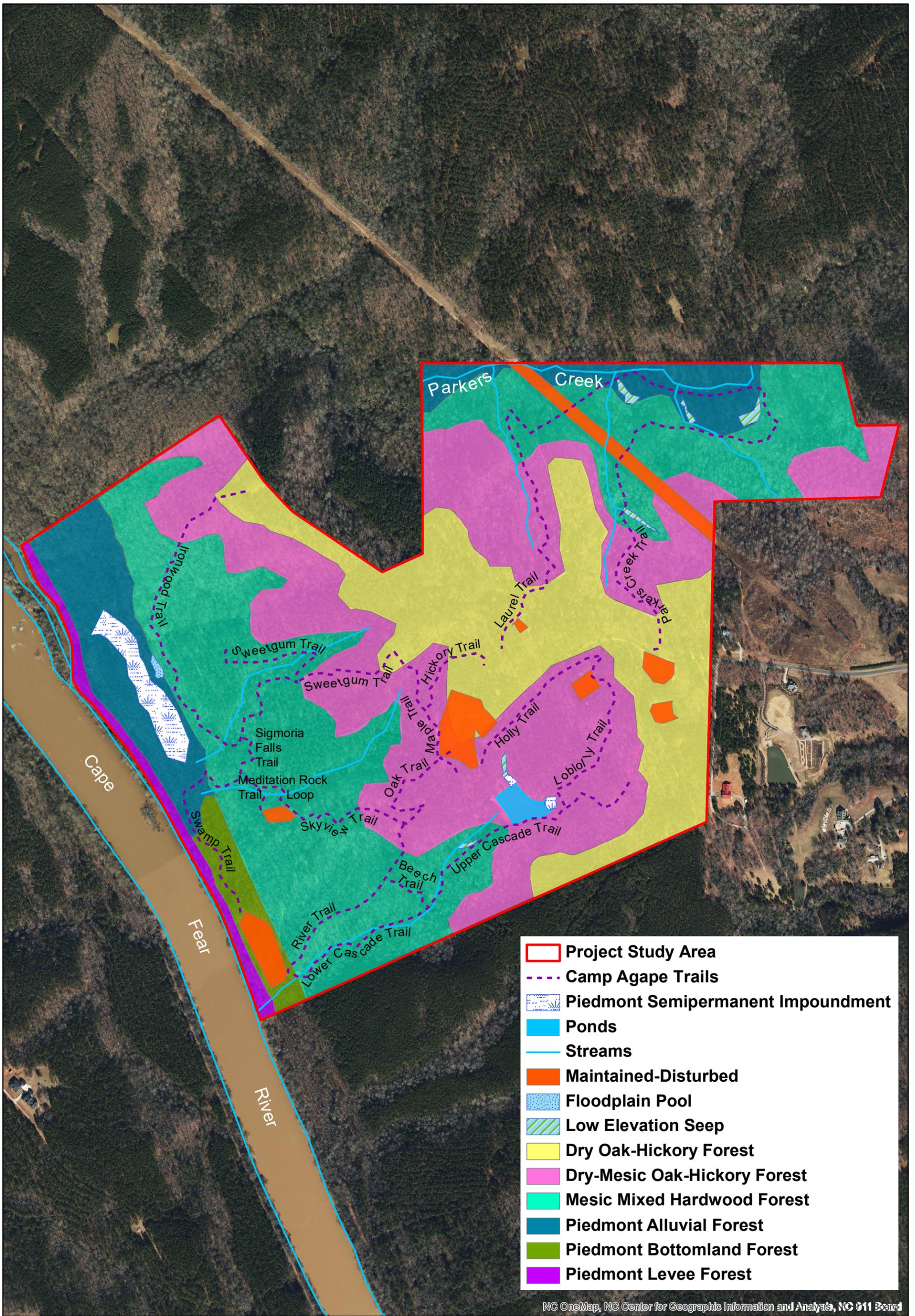


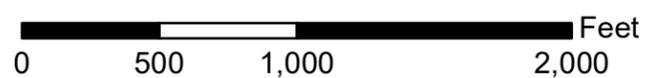
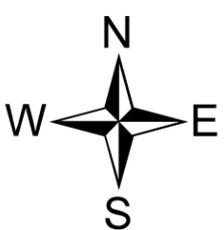
Figure 4. Natural Communities of Camp Agape General Map
Harnett County, North Carolina





NC OneMap, NC Center for Geographic Information and Analysis, NC 911 Board

Figure 5. Natural Communities of Camp Agape Aerial Map
Harnett County, North Carolina



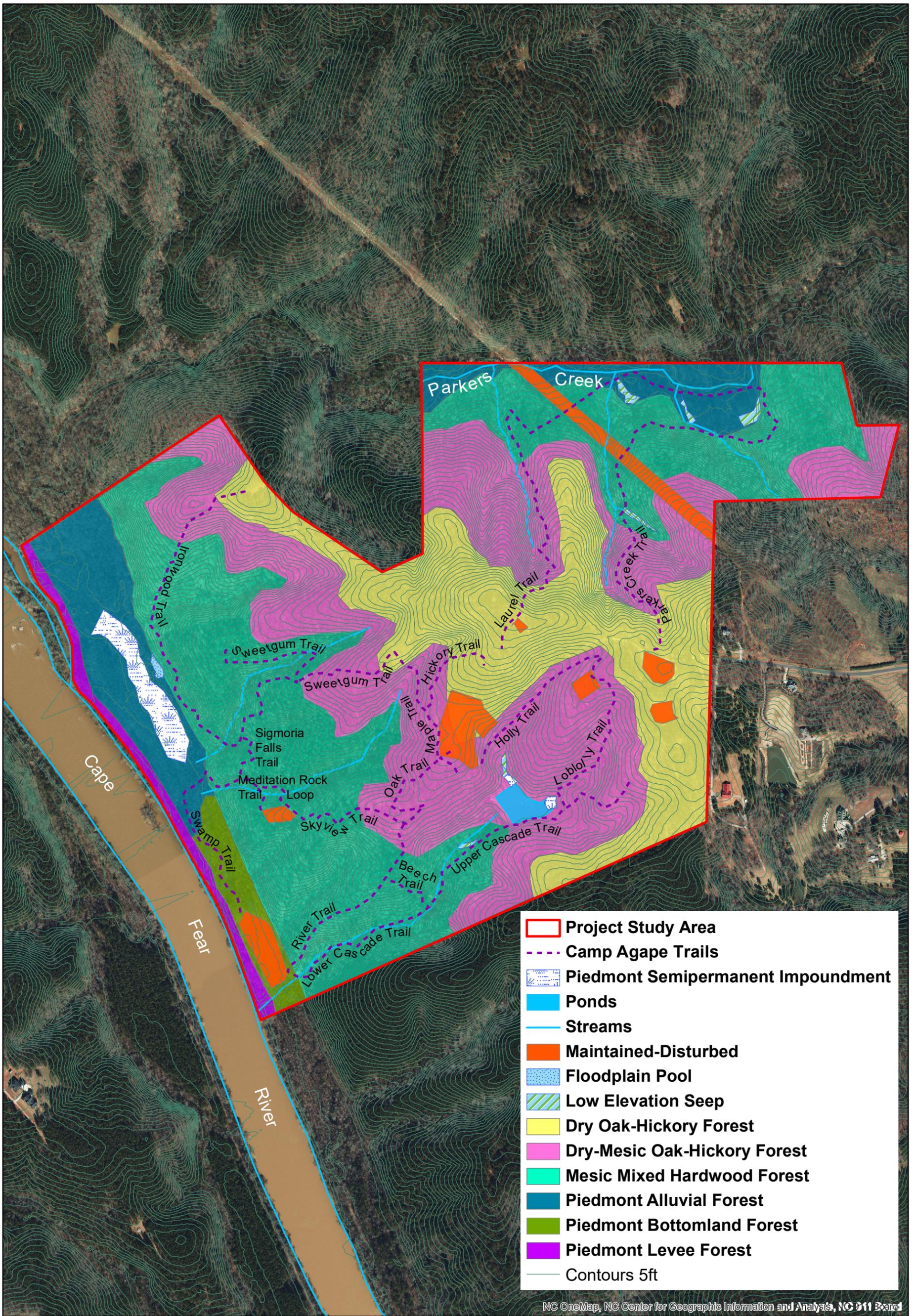
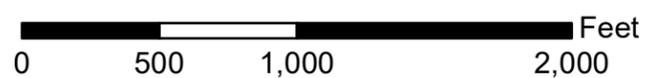
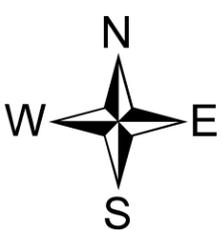


Figure 6. Natural Communities of Camp Agape Contour Map
Harnett County, North Carolina



Appendix B Plant Species Observed

Piedmont Levee Forest

Common Name

Scientific Name

Canopy

American elm	<i>Ulmus americana</i>
Bitternut hickory	<i>Carya cordiformis</i>
Box elder	<i>Acer negundo</i>
Green ash	<i>Fraxinus pennsylvanica</i>
Hackberry	<i>Celtis laevigata</i>
River birch	<i>Betula nigra</i>
Sweetgum	<i>Liquidambar styraciflua</i>
Sycamore	<i>Platanus occidentalis</i>

Understory

American holly	<i>Ilex opaca</i>
Black walnut	<i>Juglans nigra</i>
Ironwood	<i>Carpinus caroliniana</i>
Pawpaw	<i>Asimina triloba</i>
Serviceberry	<i>Amelanchier arborea</i>
Southern sugar maple	<i>Acer floridanum</i>

Shrub Layer

Chinese privet	<i>Ligustrum sinense</i>
Giant cane	<i>Arundinaria gigantea</i>
Northern spicebush	<i>Lindera benzoin</i>

Woody Vines

Common greenbrier	<i>Smilax rotundifolia</i>
Poison ivy	<i>Toxicodendron radicans</i>
Virginia creeper	<i>Parthenocissus quinquefolia</i>
Wild grape	<i>Muscadinia rotundifolia</i>

Ground Layer

Japanese stiltgrass	<i>Microstegium vimineum</i>
River oat	<i>Chasmanthium latifolium</i>
Virginia wild rye	<i>Elymus virginica</i>

Piedmont Alluvial Forest

Common Name

Scientific Name

Canopy

American elm	<i>Ulmus americana</i>
Bitternut hickory	<i>Carya cordiformis</i>
Red maple	<i>Acer rubrum</i>
River birch	<i>Betula nigra</i>
Swamp chestnut oak	<i>Quercus michauxii</i>
Sweetgum	<i>Liquidambar styraciflua</i>
Sycamore	<i>Platanus occidentalis</i>
Tulip poplar	<i>Liriodendron tulipifera</i>

Understory

American hazelnut	<i>Corylus americana</i>
American holly	<i>Ilex opaca</i>
Black walnut	<i>Juglans nigra</i>
Box elder	<i>Acer negundo</i>
Eastern hop-hornbeam	<i>Ostrya virginiana</i>
Ironwood	<i>Carpinus caroliniana</i>
Painted buckeye	<i>Aesculus sylvatica</i>
Pawpaw	<i>Asimina triloba</i>
Southern sugar maple	<i>Acer floridanum</i>
Umbrella tree	<i>Magnolia tripetala</i>

Shrub Layer

Chinese privet	<i>Ligustrum sinense</i>
Giant cane	<i>Arundinaria gigantea</i>
Northern spicebush	<i>Lindera benzoin</i>
Silky dogwood	<i>Cornus amomum</i>
Strawberry bush	<i>Euonymus americanus</i>
Yellowroot	<i>Xanthorhiza simplicissima</i>

Woody Vines

Common greenbrier	<i>Smilax rotundifolia</i>
Crossvine	<i>Bignonia capreolata</i>
Japanese honeysuckle	<i>Lonicera japonica</i>
Poison ivy	<i>Toxicodendron radicans</i>
Trumpet creeper	<i>Campsis radicans</i>
Virginia creeper	<i>Parthenocissus quinquefolia</i>
Wild grape	<i>Muscadinia rotundifolia</i>

Ground Layer

Bedstraw	<i>Galium aparine</i>
Bittercress	<i>Cardamine</i> spp.

Piedmont Alluvial Forest continued

Ground Layer

Christmas fern	<i>Polystichum acrostichoides</i>
Foamflower	<i>Tiarella cordifolia</i>
Japanese stiltgrass	<i>Microstegium vimineum</i>
Little brown jug	<i>Hexastylis arifolia</i>
Mayapple	<i>Podophyllum peltatum</i>
River oat	<i>Chasmanthium latifolium</i>
Round-lobed liverleaf	<i>Hepatica americana</i>
Rue anemone	<i>Thalictrum thalictroides</i>
Sedges	<i>Carex</i> spp.
Southern lady fern	<i>Athyrium asplenoides</i>
Spring beauty	<i>Claytonia virginiana</i>
Star chickweed	<i>Stellaria pubera</i>
Violets	<i>Viola</i> spp.
Woodreed grass	<i>Cinna arundinacea</i>

Piedmont Bottomland Forest

Common Name

Scientific Name

Canopy

American elm	<i>Ulmus americana</i>
Bitternut hickory	<i>Carya cordiformis</i>
Cherrybark oak	<i>Quercus pagoda</i>
Red maple	<i>Acer rubrum</i>
River birch	<i>Betula nigra</i>
Swamp chestnut oak	<i>Quercus michauxii</i>
Sweetgum	<i>Liquidambar styraciflua</i>
Tulip poplar	<i>Liriodendron tulipifera</i>

Understory

Pawpaw	<i>Asimina triloba</i>
Possumhaw	<i>Ilex decidua</i>
Southern sugar maple	<i>Acer floridanum</i>
Winged elm	<i>Ulmus alata</i>

Shrub Layer

Chinese privet	<i>Ligustrum sinense</i>
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Woody Vines

Wild grape	<i>Muscadinia rotundifolia</i>
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Ground Layer

Bedstraw	<i>Galium aparine</i>
Christmas fern	<i>Polystichum acrostichoides</i>
Lion's foot	<i>Prenanthes serpentaria</i>
Mayapple	<i>Podophyllum peltatum</i>
Sedges	<i>Carex</i> spp.

Piedmont/Mountain Semipermanent Impoundment

Common Name

Scientific Name

Canopy

Black willow

Salix nigra

River birch

Betula nigra

Understory

Buttonbush

Cephalanthus occidentalis

Tag alder

Alnus serrulata

Ground Layer

Arrow arum

Peltandra virginica

Cattail

Typha latifolia

Crimson-eyed hibiscus

Hibiscus moscheutos

Lizard's tail

Saururus cernuus

Marsh dayflower

Murdannia keisak

Rice cutgrass

Leersia oryzoides

Sedges

Carex spp.

Low Elevation Seep (Floodplain Subtype)

Common Name Scientific Name

Shrub Layer

Northern spicebush	<i>Lindera benzoin</i>
Red chokeberry	<i>Aronia arbutifolia</i>
Wild raisin	<i>Viburnum nudum</i>

Ground Layer

Arrow arum	<i>Peltandra virginica</i>
Cinnamon fern	<i>Osmundastrum cinnamomeum</i>
Duck potato	<i>Sagittaria latifolia</i>
Fowl manna grass	<i>Glyceria striata</i>
Jack-in-the-pulpit	<i>Arisaema triphyllum</i>
Lizard's tail	<i>Saururus cernuus</i>
Marsh dayflower	<i>Murdannia keisak</i>
Netted chainfern	<i>Woodwardia areolata</i>
Sedges	<i>Carex</i> spp.
Water hemlock	<i>Cicuta maculata</i>

Low Elevation Seep (Typic Subtype)

Common Name Scientific Name

Shrub Layer

Beautyberry	<i>Callicarpa americana</i>
Wild raisin	<i>Viburnum nudum</i>

Ground Layer

Cinnamon fern	<i>Osmundastrum cinnamomeum</i>
False nettle	<i>Boehmeria cylindrica</i>
Fowl manna grass	<i>Glyceria striata</i>
Giant cane	<i>Arundinaria gigantea</i>
Jack-in-the-pulpit	<i>Arisaema triphyllum</i>
Lizard's tail	<i>Saururus cernuus</i>
Netted chainfern	<i>Woodwardia areolata</i>
Royal fern	<i>Osmunda regalis</i>
Sedges	<i>Carex</i> spp.

Floodplain Pool

Common Name

Scientific Name

Canopy

Red maple

Acer rubrum

River birch

Betula nigra

Ground Layer

Hop sedge

Carex lupulina

Lizard's tail

Saururus cernuus

Mesic Mixed Hardwood Forest

Common Name

Scientific Name

Canopy

American beech	<i>Fagus grandifolia</i>
Northern red oak	<i>Quercus rubra</i>
Red maple	<i>Acer rubrum</i>
Tulip poplar	<i>Liriodendron tulipifera</i>
White oak	<i>Quercus alba</i>

Understory

American holly	<i>Ilex opaca</i>
Eastern hop-hornbeam	<i>Ostrya virginiana</i>
Flowering dogwood	<i>Cornus florida</i>
Ironwood	<i>Carpinus caroliniana</i>
White ash	<i>Fraxinus americana</i>

Shrub Layer

Beautyberry	<i>Callicarpa americana</i>
Blackhaw	<i>Viburnum prunifolium</i>
Deerberry	<i>Vaccinium stamineum</i>
Downy arrowwood	<i>Viburnum rafinesquianum</i>
Mapleleaf viburnum	<i>Viburnum acerifolium</i>
Mountain laurel	<i>Kalmia latifolia</i>
Pinkster flower	<i>Rhododendron periclymenoides</i>
Serviceberry	<i>Amelanchier arborea</i>
Strawberry bush	<i>Euonymus americanus</i>
Witch hazel	<i>Hamamelis virginiana</i>

Woody Vines

Japanese honeysuckle	<i>Lonicera japonica</i>
Poison ivy	<i>Toxicodendron radicans</i>
Virginia creeper	<i>Parthenocissus quinquefolia</i>
Wild grape	<i>Muscadinia rotundifolia</i>

Ground Layer

American alumroot	<i>Heuchera americana</i>
Beech drops	<i>Epifagus virginiana</i>
Bittercress	<i>Cardamine</i> spp.
Bloodroot	<i>Sanguinaria canadensis</i>
Christmas fern	<i>Polystichum acrostichoides</i>
Crane-fly orchid	<i>Tipularia discolor</i>
Dimpled trout lily	<i>Erythronium umbilicatum</i>
Downy rattlesnake plantain	<i>Goodyera pubescens</i>
Ebony spleenwort	<i>Asplenium platyneuron</i>

Mesic Mixed Hardwood Forest continued

Ground Layer

Foamflower	<i>Tiarella cordifolia</i>
Green and gold	<i>Chrysogonum virginianum</i>
Indian cucumberroot	<i>Medeola virginiana</i>
Lion's foot	<i>Prenanthes serpentaria</i>
Little brown jug	<i>Hexastylis arifolia</i>
Mayapple	<i>Podophyllum peltatum</i>
Nakedflower ticktrefoil	<i>Desmodium nudiflorum</i>
Pipsissewa	<i>Chimaphila maculata</i>
Rattlesnake fern	<i>Botrychium virginianum</i>
Richweed	<i>Collinsonia canadensis</i>
Round-lobed liverleaf	<i>Hepatica americana</i>
Rue anemone	<i>Thalictrum thalictroides</i>
Spring beauty	<i>Claytonia virginiana</i>
Star chickweed	<i>Stellaria pubera</i>
Trailing arbutus	<i>Epigaea repens</i>
Violets	<i>Viola</i> spp.
Witch grasses	<i>Dichanthelium</i> spp.

Dry-Mesic Oak-Hickory Forest

Common Name

Scientific Name

Canopy

Black oak	<i>Quercus velutina</i>
Loblolly pine	<i>Pinus taeda</i>
Mockernut hickory	<i>Carya tomentosa</i>
Northern red oak	<i>Quercus rubra</i>
Pignut hickory	<i>Carya glabra</i>
Scarlet oak	<i>Quercus coccinea</i>
Shortleaf pine	<i>Pinus echinata</i>
Sweetgum	<i>Liquidambar styraciflua</i>
Tulip poplar	<i>Liriodendron tulipifera</i>
White oak	<i>Quercus alba</i>

Understory

American beech	<i>Fagus grandifolia</i>
American holly	<i>Ilex opaca</i>
Black cherry	<i>Prunus serotina</i>
Blackgum	<i>Nyssa sylvatica</i>
Eastern redbud	<i>Cercis canadensis</i>
Flowering dogwood	<i>Cornus florida</i>
Ironwood	<i>Carpinus caroliniana</i>
Red cedar	<i>Juniperus virginiana</i>
Red maple	<i>Acer rubrum</i>
Sourwood	<i>Oxydendrum arboreum</i>
Water oak	<i>Quercus nigra</i>

Shrub Layer

Beautyberry	<i>Callicarpa americana</i>
Deerberry	<i>Vaccinium stamineum</i>
Downy arrowwood	<i>Viburnum rafinesquianum</i>
Farkleberry	<i>Vaccinium arboreum</i>
Strawberry bush	<i>Euonymus americanus</i>

Woody Vines

Carolina jessamine	<i>Gelsemium sempervirens</i>
Common greenbrier	<i>Smilax rotundifolia</i>
Crossvine	<i>Bignonia capreolata</i>
Poison ivy	<i>Toxicodendron radicans</i>
Trumpet creeper	<i>Campsis radicans</i>
Wild grape	<i>Muscadinia rotundifolia</i>

Dry-Mesic Oak-Hickory Forest continued

Ground Layer

Bluets	<i>Houstonia caerulea</i>
Cranefly orchid	<i>Tipularia discolor</i>
Downy rattlesnake plantain	<i>Goodyera pubescens</i>
Little brown jug	<i>Hexastylis arifolia</i>
Nakedflower ticktrefoil	<i>Desmodium nudiflorum</i>
Partridgeberry	<i>Mitchella repens</i>
Pipsissewa	<i>Chimaphila maculata</i>
Rattlesnakeweed	<i>Hieracium venosum</i>

Dry Oak-Hickory Forest

Common Name Scientific Name

Canopy

Black oak	<i>Quercus velutina</i>
Blackjack oak	<i>Quercus marilandica</i>
Loblolly pine	<i>Pinus taeda</i>
Mockernut hickory	<i>Carya tomentosa</i>
Pignut hickory	<i>Carya glabra</i>
Post oak	<i>Quercus stellata</i>
Rock chestnut oak	<i>Quercus montana</i>
Scarlet oak	<i>Quercus coccinea</i>
Shortleaf pine	<i>Pinus echinata</i>
Southern red oak	<i>Quercus falcata</i>
White oak	<i>Quercus alba</i>

Understory

Blackgum	<i>Nyssa sylvatica</i>
Flowering dogwood	<i>Cornus florida</i>
Persimmon	<i>Diospyros virginiana</i>
Red cedar	<i>Juniperus virginiana</i>
Red maple	<i>Acer rubrum</i>
Sassafras	<i>Sassafras albidum</i>
Sourwood	<i>Oxydendrum arboreum</i>

Shrub Layer

Deerberry	<i>Vaccinium stamineum</i>
Farkleberry	<i>Vaccinium arboreum</i>

Woody Vines

Poison ivy	<i>Toxicodendron radicans</i>
Wild grape	<i>Muscadinia rotundifolia</i>

Ground Layer

Little brown jug	<i>Hexastylis arifolia</i>
Pipsissewa	<i>Chimaphila maculata</i>