

MANAGEMENT BY DISTURBANCE: THE LONGLEAF PINE-WIREGRASS
ECOSYSTEM AT THE AIKEN GOPHER TORTOISE HERITAGE PRESERVE

by

GENE BARRETT BUSSELL

(Under the Direction of Alfie Vick)

ABSTRACT

The Longleaf pine-wiregrass ecosystem covered much of the present day Southeastern United States prior to European settlement. It's estimated that over 92 million acres of forest existed. Around 2 million acres remain, with less than 10 thousand acres in old growth forests. The management and restoration of these ecosystems are often challenged by lack of baseline information of their old growth forests. In South Carolina, there are no old growth forests remaining. This thesis will explore historical descriptions, perceptions, and present-day interpretations of this ecosystem. These descriptions offer glimpses into its composition, disturbances, and processes. The most dynamic of these processes is fire, as the longleaf pine-wiregrass ecosystem is a fire dependent forest. The management and restoration of these ecosystems should reflect an understanding of past disturbances to these processes. This thesis asks the question can the restoration of processes serve as the minimal force for the natural regeneration of longleaf pine-wiregrass ecosystem? It envisions an experimental state preserve where the restoration of natural processes perpetuates the longleaf pine-wiregrass ecosystem and it's biodiversity.

INDEX WORDS: Longleaf pine-wiregrass; management; disturbance; processes; Sandhills; gopher tortoise; beargrass; wildflowers; fire; SC Heritage Trust Program; Aiken Gopher Tortoise Heritage Preserve; Aiken, South Carolina

MANAGEMENT BY DISTURBANCE: THE LONGLEAF PINE-WIREGRASS
ECOSYSTEM AT THE AIKEN GOPHER TORTOISE HERITAGE PRESERVE

by

GENE BARRETT BUSSELL

Bachelor of Landscape Architecture, University of Georgia 1987

A Thesis Submitted to the Graduate Faculty of The University of Georgia in Partial Fulfillment
of the Requirements for the Degree

MASTER OF LANDSCAPE ARCHITECTURE

ATHENS, GEORGIA

2005

© 2005

GENE BARRETT BUSSELL

All Rights Reserved

MANAGEMENT BY DISTURBANCE: THE LONGLEAF PINE-WIREGRASS
ECOSYSTEM AT THE AIKEN GOPHER TORTOISE HERITAGE PRESERVE

by

GENE BARRETT BUSSELL

Major Professor: Alfie Vick

Committee: Ian Firth
Kathleen Parker
Bob McCartney

Electronic Version Approved:

Maureen Grasso
Dean of the Graduate School
The University of Georgia
December 2005

DEDICATION

To Gene Stoney Bussell

“Tyger, Tyger burning bright,

In the Forests of the Night:

What Immortal hand or eye,

Could frame thy fearful symmetry?”

William Blake – *Songs of Experience*

To Rebecca Elizabeth Bussell

“Little Lamb who made thee,

Dost thou know who made thee”

William Blake – *Songs of Innocence*

ACKNOWLEDGEMENTS

I would like to thank my committee for their contributions to this thesis: Major Professor, Alfie Vick; Reading Chair, Professor Emeritus Ian Firth; committee members Professor Kathleen Parker, Geography and Bob McCartney. Professor Emeritus, Darrel Morrison's insight and guidance of this thesis is greatly appreciated. The staff of the South Carolina Department of Natural Resources in Columbia provided site and base information, as well as an early morning invitation to a prescribed burn. The University of South Carolina librarians were very helpful, especially Ross Taylor, map library specialist, while researching the history of aerial photography for the preserve. Thanks again to all.

TABLE OF CONTENTS

	Page
ACKNOWLEDGEMENTS	v
LIST OF FIGURES	vi
CHAPTER	
1 INTRODUCTION AND PROJECT SCOPE	1
2 THE GEOGRAPHY OF THE LONGLEAF PINE-WIREGRASS ECOSYSTEM	3
3 HISTORIC DESCRIPTIONS, PERCEPTIONS AND INTERPRETATIONS OF LONGLEAF PINE-WIREGRASS ECOSYSTEM	12
4 AIKEN GOPHER TORTOISE HERITAGE PRESERVE	27
5 MANAGEMENT AND RESTORATION OF PROCESSES	54
BIBLIOGRAPHY	69
APPENDICES	78
A LONGLEAF PINE-WIREGRASS PRESERVES VISITED FOR REFERENCE.....	78
B AERIAL PHOTOGRAPHY REFERENCES	79
C ORAL PRESENTATION: MAP OF SITE.....	81
D ORAL PRESENTATION: MAP OF INVENTORY.....	82
E ORAL PRESENTATION: MAP OF DISTURBANCES	83
F ORAL PRESENTATION: MAP OF PRESCRIBED BURNING.....	84
G ORAL PRESENTATION: MAP OF MANAGEMENT PRACTICES	85
H ORAL PRESENTATION: MAP OF WILDFLOWERS	86
I ORAL PRESENTATION: MAP OF WILDFLOWERS	87

LIST OF FIGURES

	Page
Figure 1: MAP – PRE-SETTLEMENT DISTRIBUTION OF LONGLEAF PINE.....	4
Figure 2: MAP – FALL-LINE SANDHILLS	5
Figure 3: TABLE – LONGLEAF PINE SERIES AND TYPES	7
Figure 4: PHOTO – FIRE	8
Figure 5: PHOTO – LIGHTENING STRIKE ON LONGLEAF PINE	9
Figure 6: PHOTO – LONGLEAF PINE –WIREGRASS.....	11
Figure 7: PHOTO – OLD GROWTH LONGLEAF PINE IN SC PHOTO	23
Figure 8: PHOTO – GOPHER TORTOISE BURROW.....	28
Figure 9: PHOTO – GOPHER TORTOISE BURROWS	29
Figure 10: PHOTO – BEARGRASS	30
Figure 11: MAP – AGTHP LOCATION MAP	31
Figure 12: PHOTO – AFTHP BOUNDARY MAP	33
Figure 13: PHOTO – LOG HITCH ROAD.....	34
Figure 14: PHOTO – SPRING BRANCH BAPTIST CHURCH	35
Figure 15: PHOTO – MULTI-AGE STANDS OF LONGLEAF PINE.....	36
Figure 16: PHOTO – MULTI-AGE STANDS OF LONGLEAF PINE.....	37
Figure 17: PHOTO – MULTI-AGE STANDS OF LONGLEAF PINE.....	38
Figure 18: PHOTO – PLANTED LONGLEAF PINE	39
Figure 19: PHOTO – 1989 LANDSAT IMAGE.....	41
Figure 20: PHOTO – 1994 LANDSAT IMAGE	42
Figure 21: PHOTO – 1999 LANDSAT IMAGE	43

Figure 22: PHOTO – PLANTED LONGLEAF PINE	45
Figure 23: PHOTO – DAM BREACH AT SPRING BRANCH.....	46
Figure 24: PHOTO – WATER STILL IMPOUNDED AFTER DAM BREACH	47
Figure 25: PHOTO – EXPOSED SLOPE	48
Figure 26: PHOTO – ATLANTIC WHITE CEDAR	49
Figure 27: PHOTO – HERBICIDE/GROUNDLAYER/WINTER.....	51
Figure 28: PHOTO – HERBICIDE/GROUNDLAYER/SUMMER	52
Figure 29: PHOTO – HERBICIDE/GROUNDLAYER/FALL.....	53
Figure 30: MAP – HISTORIC VEGETATION PATTERNS	55
Figure 31: PHOTO – PRESCRIBED BURNING AT THE AGTHP	56
Figure 32: PHOTO – GROUNDLAYER REGENERATING AT THE AGTHP	57
Figure 33: PHOTO – GROUNDLAYER IN SPRING AT THE AGTHP	58
Figure 34: PHOTO – GROUNDLAYER IN SUMMER AT THE AGTHP	59
Figure 35: PHOTO – GROUNDLAYER IN FALL AT THE AGTHP	60
Figure 36: PHOTO – GROUNDLAYER IN WINTER AT THE AGTHP	61
Figure 37: PHOTO – PINEYWOODS DROPSEED	64
Figure 38: PHOTO – GREENEYES	65
Figure 39: PHOTO – LADY LUPINE	66
Figure 40: PHOTO – GROUNDLAYER DIVERSITY	67

CHAPTER 1 INTRODUCTION AND PROJECT SCOPE

*“To see the world in a grain of sand, and heaven in a wildflower. To hold infinity in the palm of your hand and eternity in an hour.” - William Blake, *Auguries of Innocence**

This thesis envisions concepts for the management and restoration of natural processes at a remnant longleaf pine-wiregrass ecosystem in Aiken, South Carolina. The site is the Aiken Gopher Tortoise Heritage Preserve (AGTHP), owned by the State of South Carolina. It is one of sixty-nine heritage preserves that encompass 81,133 acres of land managed by the South Carolina Department of Natural Resources (SCDNR). It includes approximately 1,395 acres where plant communities are part a of longleaf pine-wiregrass ecosystem along the Sandhills of Aiken County, South Carolina.

The Sandhills occur between the Coastal Plain and Piedmont from the eastern portion of Alabama through Georgia, South Carolina and into central North Carolina. The topography is characterized by rolling hills and sandy soils. The longleaf pine-wiregrass ecosystem on the property consists of multi-aged stands of longleaf pines. These stands consist of naturally regenerated and/or planted pines. Diversity of ground layer varies. One of the primary reasons the site was purchased was to protect a small colony of gopher tortoises (*Gopherus polphemus*). This is the northernmost population of tortoises and a species of state concern, as well as a keystone species within the longleaf pine-wiregrass ecosystem (Eisenberg, 1983, p. 1-4). The site also has a several populations of Georgia beargrass (*Nolina georgiana*), another species of state concern.

An understanding of the history of the land disturbances will provide insight into the management and restoration of processes at the preserve. There is no documented old growth, longleaf pine-wiregrass ecosystems remaining in South Carolina to serve as a baseline (Wilson 2001, p. 58). What were old growth forests of longleaf pine-wiregrass ecosystems like in the South Carolina? A history of descriptions, perceptions and disturbances over the last 500 years will be created to help document this forest. Written descriptions of this once extensive landscape left by explorers, naturalists and passersby, provide a glimpse of its beauty and vastness. Sometimes their words are brief and cryptic, leaving the reader still to wonder. At other times, it is possible to truly sense the place and time as it once existed

This thesis is divided into five parts. Chapter 1 outlines the scope of the project. Chapter 2 is an overview of the geography and pre-settlement range of longleaf pine in the Southeastern United States, and a discussion of why the longleaf pine forest resources were exploited. Also included are descriptions of the different subtypes of longleaf pine-wiregrass ecosystems that exist, and the importance of fire in maintaining the diversity of these forests. Chapter 3 is an overview of historic descriptions, perceptions and interpretations of the longleaf pine ecosystem in South Carolina and the surrounding region. Chapter 4 inventories the AGTHP site. Photographs of the preserve document vegetation, natural processes, site disturbances, ponds, roads, trails, and structures. Chapter 5 provides a minimalist approach to the management and restoration of processes for the preserve. It is hoped that this thesis will be useful to SCDNR in both the management and restoration of the processes of the preserve, as well as potential data for future land managers and researchers of the Aiken Gopher Tortoise Heritage Preserve.

CHAPTER 2 THE GEOGRAPHY OF THE LONGLEAF PINE -WIREGRASS ECOSYSTEM

*“I name this land pine barren land, and the name is characteristic of the land.” Mark Catesby,
The Natural History of Carolina, Florida and Bahama Islands*

The Longleaf pine-wiregrass ecosystem covered much of the present day Southeastern United States prior to European settlement. It was estimated that over 92 million acres of contiguous forest existed, stretching from southeastern Virginia down through Florida and over into eastern Texas (Frost 1993, pg. 20). See Figure # 1. Around 2 million acres remain, with less than 10 thousand acres in old growth forests (Wilson 2001, pg. 58). It has been classified as an endangered ecosystem (Noss 1995, pg. 10). The longleaf pine-wiregrass ecosystem exhibits high biodiversity (Crofton, Elizabeth, W. 2001. pgs. 69-77). It's the diversity of species that contributes to the stability of the overall ecosystem (Odum, 1963. pg. 34).

The Sandhills occur between the Coastal Plain and Piedmont from the eastern portion of Alabama through Georgia, South Carolina and into central North Carolina, loosely in parallel with the coastline. The topography is characterized by rolling hills and sandy soils. This area is also known as the Fall-line and links the Coastal Plain with the Piedmont (Barry, 1980, p. 97). See Figure # 2.

The longleaf pine ecosystem is described as having four major types (xeric, subxeric, mesic, and seasonally wet). Within these types there are twenty-three subtypes. Five belong to the xeric series and occur on well-drained sands. Six occur within the subxeric, four occur

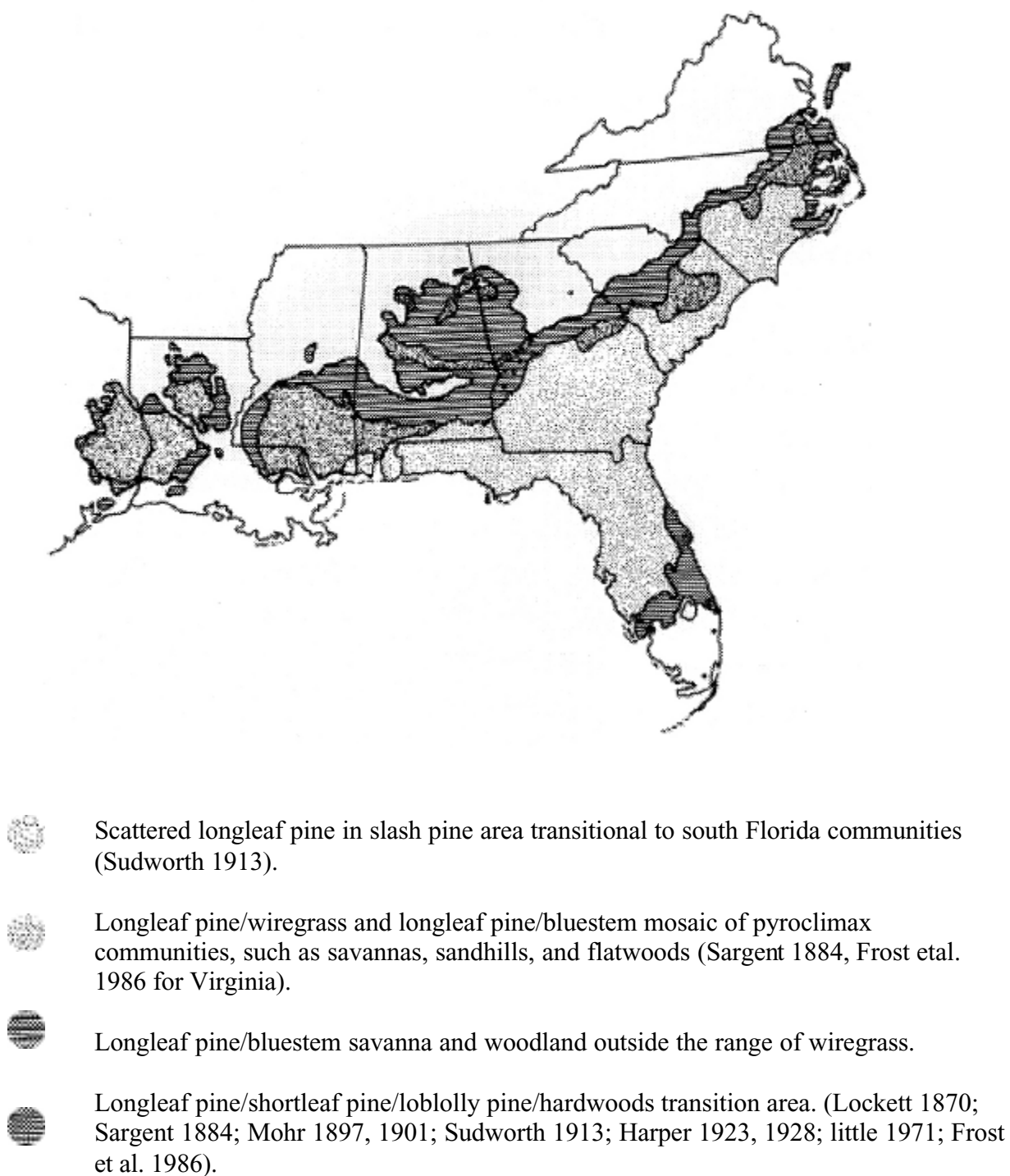


Figure 1: Pre-settlement Distribution of Longleaf Pine (Frost, 1993)

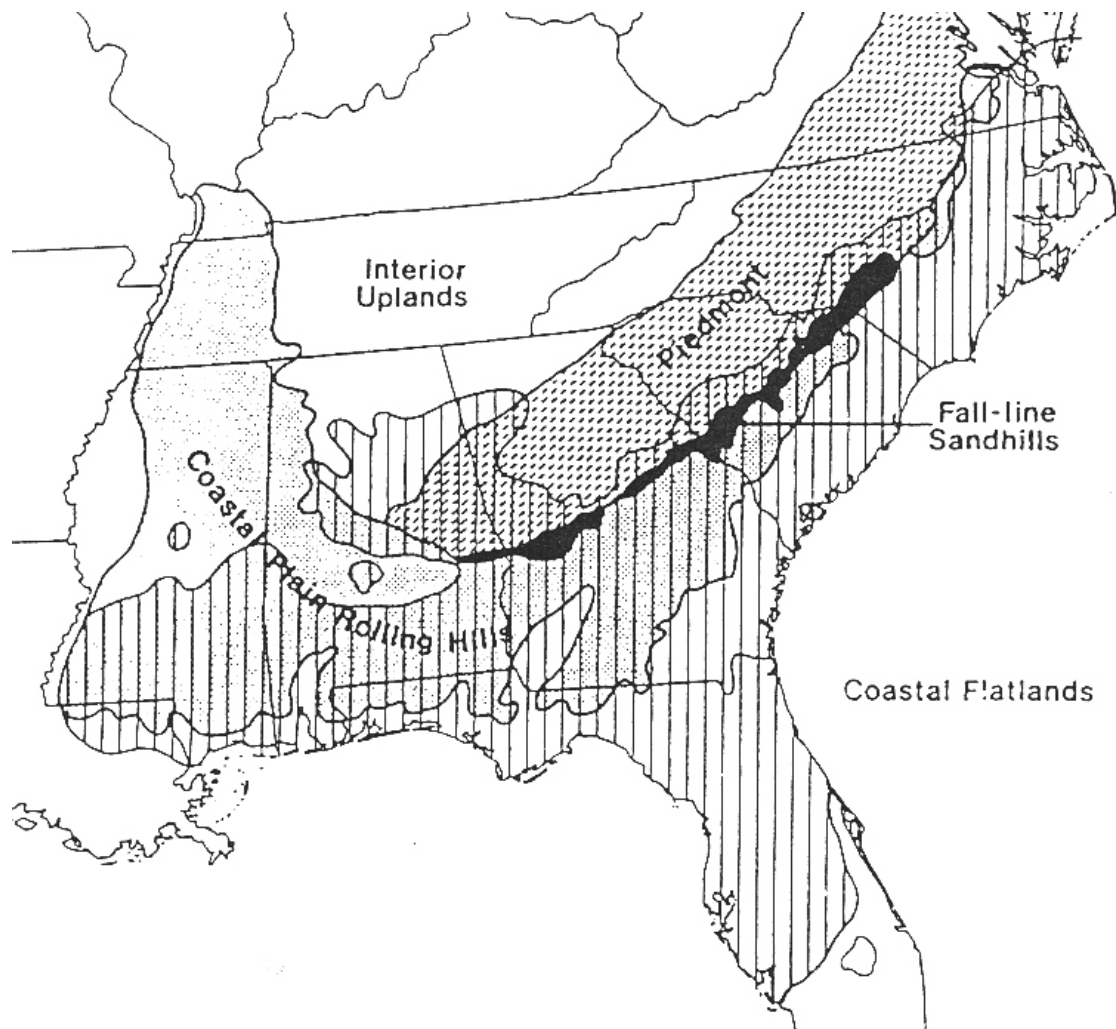


Figure 2: Fall-line of Sandhills (Peet and Allard, 1993) Vertical lines represent range of longleaf pine.

within the mesic, and eight occur within seasonally wet areas. (Peet and Allard, 1993, p. 45).

See Figure #3.

Aiken County has more longleaf pine-wiregrass ecosystems than any other county in the state with around 78,000 acres (Outcalt and Sheffield 1996). These ecosystems are dependent of several factors that affect composition. John Barry concludes in the *Natural Vegetation of South Carolina* that several conditions are evident and states the following:

1. Water seems to be the most noticeable variant;
 2. Sterility of the soil varies considerably;
 3. High insolation (exposure to sunlight) is limiting in certain areas;
 4. Fire is an important natural factor; and
 5. The presence of a clay subsoil is more conducive to floristic variation
- (Barry, 1980. p. 100)

At the Aiken Gopher Tortoise Heritage Preserve the longleaf pine ecosystem type is xeric upland. Typical vegetation in xeric uplands include scattered longleaf pine (*Pinus palustris*) forming the overstory, with an open understory of scrub oaks such as turkey oak (*Quercus laevis*) and bluejack oak (*Quercus incana*). The groundlayer consists of grasses, such as wiregrass (*Aristida beyrichiana*) and a diversity of herbs (Peet and Allard 1993, p54; Nelson pg. 31).

The longleaf pine-wiregrass ecosystem is dependent of fire to maintain its biodiversity (Noss 1989, pgs. 211-213). See Figure #4. Lightning plays an important role in igniting fires in these ecosystems (Vogl, 1972, p 183). See Figure # 5. Fire frequency in the Sandhills occurs every 1-3 years (Frost, 1993, pg. 77). Longleaf pine ecosystems that are burned on a regular

- | |
|--|
| <p>Xeric Longleaf Pine Woodland Series</p> <ul style="list-style-type: none"> • Fall-line Xeric Longleaf Woodland • Atlantic Xeric Longleaf Woodland • Southern Xeric Longleaf Woodland • Atlantic Maritime Longleaf Woodland • Gulf Maritime Longleaf Woodland <p>Subxeric Longleaf Pine Woodland Series</p> <ul style="list-style-type: none"> • Fall-line Subxeric Longleaf Woodland • Atlantic Subxeric Longleaf Woodland • Southern Subxeric Longleaf Woodland <ul style="list-style-type: none"> (Southern Clayhill Subxeric Longleaf Woodland) (Longleaf-Sand Pine Woodland) (Florida Subxeric Longleaf Woodland) • Subxeric Longleaf Saw Palmetto Woodland • Piedmont/Upland Subxeric Longleaf Pine Woodland <ul style="list-style-type: none"> (Upland Subxeric Longleaf Woodland) (Piedmont Subxeric Longleaf Woodland) (Fall-line Clayhill Subxeric Longleaf Pine Woodland) • Serpentine Subxeric Longleaf Woodland <p>Mesic Longleaf Pine Woodland Series</p> <ul style="list-style-type: none"> • Fall-line Mesic Longleaf Woodland • Fall-line Slope Mesic Longleaf Woodland • Southern Mesic Longleaf Woodland <ul style="list-style-type: none"> (Coosa Mesic Longleaf Woodland) <p>Seasonally-Wet Longleaf Pine Woodland Series</p> <ul style="list-style-type: none"> • Fall-line Longleaf Seepage Savanna • Fall-line Longleaf Seepage Bog • Atlantic Longleaf Savanna • Southern Longleaf Savanna • Southern Longleaf Seepage Savanna • Atlantic Longleaf Flatwood • Southern Longleaf Flatwood • Piedmont Longleaf Flatwood |
|--|

Figure 3: Longleaf Pine Series and Types. 23 different longleaf pine ecosystems are described. (Peet and Allard, 1993)



Figure 4. Photo: Fire at AGTHP.



Figure 5. Photo: Longleaf Pine struck by lightening at AGTHP.

basis exhibit higher biodiversity. The ecosystem can often take on a meadow like appearance with an overstory of longleaf pine, an open understory, and groundlayer of wiregrass. See Figure #6.

Since European settlement of the Southeast longleaf pine ecosystems have declined as much as 98% (Noss and Cooperrider 1989, p 211). There are many factors that have led to the degradation of the longleaf pine-wiregrass ecosystem. Among them: logging, grazing, farming, naval store production (turpentine), suppressed fire regimes, feral hogs, and the conversion of land to pine plantations. The end result of these disturbances is a loss of biodiversity of both the plants and animals that exist within these ecosystems.



Figure 6. Photo: Longleaf pine-wiregrass at the Joseph W. Jones Ecological Research Station in Newton, Georgia

CHAPTER 3 HISTORIC DESCRIPTIONS, PERCEPTIONS, AND INTERPRETATIONS OF LONGLeAF-PINE WIREGRASS ECOSYSTEM

“The glare of woods-fire began to light the sky on the horizons, and the smell of pine smoke filled the damp evening air. Fires were burning in all directions; some of them had been burning a week or longer, while others had been burning only since that afternoon.” Erskine Caldwell, *Tobacco Road*

Native Americans played an important role in burning the longleaf pine forests prior to written history (Denevan, 1992 p. 369-385). Interestingly, the timeframe of interaction of the first inhabitants of these forests are being reconsidered, primarily through the discovery of the Topper archaeological site in Orangeburg County, South Carolina. Funded by the *National Geographic*, a study of the site has given evidence of the existence of man in this area far earlier than previously believed, and it could go back as far as 50,000 years. This is 25,000 years earlier than previously thought, making it one of the first areas to be settled in the Americas. This archaeological discovery expands the length of time between the interaction man and the longleaf pine-wiregrass ecosystems.

European exploration into the Americas brought new interactions into the processes of these ecosystems, including harvesting timber, and pitch and tar production (Silver 1990, p. 123). There are many accounts of explorer’s descriptions, perceptions and interaction with the longleaf pine-wiregrass ecosystems that have been recorded in various journals and books.

One of the first written descriptions of the Southeastern United States was of Hernando DeSoto’s journey through the Carolinas in 1541. It is believed he passed within a few miles of the Aiken Gopher Tortoise Heritage Preserve near the Aiken State Natural Area (formerly Aiken

State Park). A journal account worth noting is their party's crossing the Savannah River from the position of Augusta, Georgia into present day Aiken, South Carolina.

"This day we lost many pigs that we had brought tame from Cuba, which the current carried off." (*The Desoto Chronicles*)

This is an interesting passage, because it does not state that the pigs perished, only that they were carried off by the current. If they survived, this could have been one of the early inadvertent introductions of pigs into the forest. This would later impact the natural regeneration of the forests as the swine would uproot and feed upon longleaf pine seedlings.

English naturalist, John Lawson's journey through the Carolinas in 1700 really focused on the Indians, but provided many descriptions of the of the forests. Lawson used Indian guides and traveled along the Santee and Wateree Rivers. Lawson thoroughly describes the people and also landscape in *A New Voyage to Carolina*. The following is a description of a recently burned forest, an indication to Lawson that Indians must be near.

"We travell'd about twenty Miles, lying near a Savanna that was over-flown with Water; where we were very short of Victuals, but finding the Woods newly burnt, and on fire in many Places, which gave us great Hopes that Indians were not far of."

(*A New Voyage to Carolina*)

Traveling further, Lawson notes in his journal a large expanse of shrubs that is most likely blueberries:

“The next Morning, Santee Jack told us, we should reach the Indian Settlement betimes that Day; about Noon, we pass'd by several fair Savanna's, very rich and dry; seeing great Copses of many Acres that bore nothing but Bushes, about the Bigness of Box-trees; which (in the Season) afford great Quantities of small Black-berries, very pleasant Fruit, and much like to our Blues, or Huckle-berries, that grow on Heaths in England.”

(A New Voyage to Carolina)

One of the most simplistic descriptions of the longleaf pine-wiregrass ecosystem is found in, *The Natural History of Carolina, Florida and the Bahama Islands* by Mark Catesby chronicling his 1715 exploration of the Carolinas and Virginia. Text below is how it appeared in the description.

“The third and worft Kind of Land is the Pine barren Land, the Name implying its Character. The Soil is light fterril Sand, productive of little elfe but Pine-Trees, from which notwithstanding are drawn beneficial Commodities, of abfolute Ufe in Shiping, and other Ufes, fuch as Mafts, Timber, & Pitch, Tar, Rofin and Turpentine. One third Part of tehe Country is, I believe, of this Soil.”

(The Natural History of Carolina, Florida and the Bahama Islands)

He further describes another plant community separately.

“Another kind of Land may be obferved more fterril than that of Pine barren Land; this Land is rejected, and not capable of Cultivation, and produces nothing but fhrubby Oaks,

bearing Acorns at the Height of two Feet; I think it is called Shrubby Oak-Land.”

(The Natural History of Carolina, Florida and the Bahama Islands)

The importance of longleaf pine to the economy of South Carolina as a colony was profound. Water Edgar’s *South Carolina A History* he states the following:

“...naval stores (tar, pitch, and turpentine, and masts) joined the list of South Carolina Exports.”

Also,

“By 1720 South Carolina produced more naval stores for the empire than any other colony, and the value of its exports to the mother country had risen from \$887,000 in 1710 to \$6.4 million.”

(South Carolina A History)

DeBrahm’s *Report of the General Survey in the Southern District of North America* in 1757 further describes these forests as part of his efforts to create the a map of South Carolina. His descriptions are really an analysis of the natural resources. He clearly states that the descriptions of the lands being barren are a reference to lack of potential cultivation for farming.

“The soil along the Coast has as yet not been able to invite the industrious to reap Benefit of its Capacity, for the common Opinion of Man (who claim Experience in the Nature of Vegetation) is diametrically opposite in its Prejudice, so that as yet no Experiment has been made on it, but stands condemned as a barren Land unfit for any Cultivation;

(Report of the General Survey in the Southern District of North America)

The “The Swamp Land Produces” and “The rich Land bears” are direct descriptions of the resources to be ‘had’ in this new land. In his description of “The sandy Soil produces”, he states:

“Altho’ This Soil is equally rejected with that of the Sea Coast as unfit for Cultivation, yet on account of its Grass, the Land is chosen for Pasturage, both for the Horses and Cattle; the Yellow Pine is esteemed the best for Boards, both used in the building of Houses and Vessels; and the Pitch-Pine (Longleaf) furnishes Turpentine, Tar and Pitch, as also good Posts for Garden Fence and Cottages.”

(Report of the General Survey in the Southern District of North America)

DeBrahm’s also discusses the use of fire by Native Americans in his report:

The burning of the Grass and Underwoods in the Forrests is an ancient Custom of the Indians; they practiced it, in order to allure the Deers upon the new Grass as also to discover the Impression of their Enemies Tracts in the new burnt Ground...”

(Report of the General Survey in the Southern District of North America)

It is worth noting, that Kitchen’s Mill, which is just a few miles from the preserve and near the Aiken State Natural Area is reference as far back as 1789.

“Kitchen’s Mill was located on Burcalo (or Burkelo) Creek, said to be an Indian name, a branch on the east side of the South Fork of the Edisto near the Old Tory Road from Fort Moore to the Congarees where Pine Log Bridge crosses...”

Also,

“...the area was settled by two brothers who probably came from Charleston. Their mill was first built to saw timber, which they rafted down the Edisto to Charleston.”

Also,

“Joseph Kitchings, a son of John and father of Jacob C.Kitching, held land at the mill site in 1789. Jacob purchase 4,086 acres...”

(Aiken County: The Only South Carolina County Founded During Reconstruction)

The early presence of this mill gives an indication of how long the surrounding area may have been timbered.

Bartram's Travels in 1791 is considered one of the definitive journals of botanical exploration in early America. He provides many descriptions of ecosystems. There are many references to Longleaf Pine. In the following he had a different opinion than earlier explorers and notes the diversity of plants. He writes:

“This plain is mostly a forest of the great long-leafed pine, the earth covered with grass, interspersed with an infinite variety of herbaceous plants, and embellished with extensive savannas.” (*Bartram's Travels*)

He further writes:

“A magnificent grove of stately pines, succeeding to the expansive wild plains we had a long time traversed, had a pleasant effect, rousing the faculties of the mind, awakening the imagination by its sublimity, and arresting every active, inquisitive idea, by the variety of the scenery.” (*Bartram’s Travels*)

Though most of his travels were in Georgia, Bartram crossed the Savannah River, over into present day Aiken County, South Carolina, at Silverbluff. Although he spent very little time in the sandhills, his descriptions of the longleaf pine ecosystems in Georgia are some of the most uplifting, early passages written on these forests. He writes:

“vast forests of the most stately pine trees that can be imagined” (*Bartram’s Travels*)

Botanist F. Andre Michaux provided detailed descriptions of Longleaf Pine in its natural settings as well as its potential economic benefits in his book *The North American Sylva*. He states:

“Toward the north, the Long-leaved Pine first makes its appearance near Norfolk, in Virginia, where the pine-barrens begin. It seems to be especially assigned to dry, sandy soils, and it is found almost without interruption in the lower parts of the Carolinas, Georgia, and the Floridas ...With this exception, the Long-leaved Pine forms the unbroken mass of woods which covers this extensive country.”

(*The North American Sylva*)

He also writes:

“This wood subserves a great variety of uses; in the Carolinas, Georgia, and the Floridas, four-fifths of the houses are built of it, except the roof, which is covered with shingles of Cypress; but in the country the roof is also of Pine, and is renewed after fifteen or eighteen years, a considerable interval in a climate so warm and humid. A vast consumption takes place for the enclosure of cultivated fields. In Naval architecture this is the most esteemed of the Pines; in the Southern States, the keel, the beams, the side-planks and the pins by which they are attached to the ribs, are of this tree.”

(The North American Sylva)

Another description is one by North Carolina conservationist B.W. Wells. His account is of old growth longleaf pine ecosystem in the Sandhills of North Carolina. He writes:

“For any true nature lover of that day (1810 report), it must have been a thrilling experience to have traversed the seemingly endless mazes of the virgin longleaf pine forest amid the sixty to one hundred feet high boles, under the shady tasseled tops whispering while roaring eternally in the winds. Underfoot was the deep brown carpet of needles, broken here and there by wiregrass tussocks. So compact was the needle-leaved canopy that trail travelers of that early day could go for miles in comfortable shade. On the level sandhill tops the trees were of slender stature. On the lower slopes, or where roots could make contact with the favorable water retaining clay or sand, the giant trunks were found ranging around three feet in diameter. At no other point in its native Southland did this, the most beautiful pine in the world, attain a finer development that it did in our own Sandhills.” *(The Natural Communities of North Carolina)*

This description of the forests in the Sandhills of North Carolina, is mentioned here because it closely follows a later description (1888) of old growth longleaf pine ecosystem in the Sandhills of South Carolina.

In 1852, Frederick Law Olmsted, the founding father of landscape architecture in America, began a journey traveling throughout the Southern United States, documenting the social conditions of the time and questioning the practice of slavery. In *The Slave States* he describes ‘nature’ while traveling in the eastern portion of South Carolina.

“The character of the scenery was novel to me, the surface very flat, the soil a fine-grained, silvery white sand, shaded by a continuous forest of large pines, which had shed their lower branches, so that we could see from the coach-top, to the distance of a quarter of a mile, everything upon the ground. In the swamps, which were frequent and extensive, and on their borders, the pines gave place to cypresses, with great pedestal trunks, and protuberant roots, throwing up an awkward dwarf progeny of shrub cypress, and curious bulbous-like stumps, called ‘cypress-knees.’ Mingled with these were a few of our common deciduous trees, the white-shafted sycamore, the gray beech, and the shrubby black-jack oak, with broad leaves, brown and dead, yet glossy and reflecting sun-beams. Somewhat rarely, the red cedar, and more frequently than any other tree except the cypress, the beautiful holly. Added to these, there was often a thick undergrowth of evergreen shrubs. Vines and creepers of various kinds grew to the tops of the tallest trees, and dangled beneath and between their branches, in intricate network. The tylandria hung in festoons, sometimes several feet in length, and often completely clothed the trunks and every branch of the trees in the low ground. It is like a fringe of

tangle hair, of a light gray pearly color, and sometimes produces exquisite effects when slightly veiling the dark green, purple and scarlet of the cedar, and the holly with their berries. The mistletoe also grew in large, vivid, green tufts, on the ends of the branches of the oldest and largest trees. A small, fine and wiry dead grass, hardly perceptible, even in the most open ground, from the coach tops, was the only sign of herbage. Large black buzzards were constantly in sight, sailing slowly, high above the tree-tops. Flocks of larks, quails, and robins were common, as were also doves, swiftly flying in small companies. The red-headed woodpecker could at any time be heard hammering the old tree-trunks, and would sometimes show himself, after his rat-tat, cocking his head archly, and listening to hear if the worm moved under the bark. The drivers told me that they had, on previous days, as they went over the road, seen deer, turkeys and wild hogs.”

(The Slave States)

Olmsted’s writings give a good description of the different plant communities within the landscape, and also provide one of the few descriptions of wiregrass.

One of the best descriptions of the old growth longleaf pine-wiregrass ecosystem within the Sandhills, is provided in the 1888 *South Carolina Resources and Population Institutions and Industries*.

“The growth is almost exclusively long leaf pine, and on the more barren ridges, even this tree becomes stunted, and sometimes, on the higher and finer sand crests, yields its place to the New Jersey tea plant, which alone covers the dazzling whiteness of the sands. Usually, however, there is a heavy growth of long leaf pine, and this tree here --- almost

on its northern limit in the State attains its highest perfection, not only as regards size, trees of three feet and four feet in diameter being not uncommon, but also as to the quality of its wood, which has more heart and is more resinous than elsewhere, a fact duly recorded in the names of localities, as Lightwood creek and Lightwood Knot springs, the inhabitants of even this mild climate being not unmindful of the light and warmth furnished by this excellent fuel. There is often an undergrowth of the forked leaf blackjack, and where there is a suspicion of moisture in the soil, this is replaced by the round leaf blackjack, a sure indication here of better soil. On the hillsides, there are not unfrequently outcroppings of kaolin, and here a growth of kalmia adds a pleasing variety to the monotony of the pine forest.”

(South Carolina Resources and Population Institutions and Industries)

This is a telling description of an old-growth longleaf forest, as well as insight into the subtle differences within the longleaf pine-wiregrass ecosystem. This book was updated 25 years later in 1908. The title was changed to *Handbook of South Carolina Resources, Institutions and Industries of The State*; however, the format is identical to that of the original 1888 edition. The change in the description of the old growth forests in the Sandhills is startling: In a mere 25 years, the old-growth, longleaf forests had been timbered and replaced with other trees. See Figure #7.

“The forest originally consisted of long-leaf pine, but being nearly all cut for timber, it has been succeeded by the short-leaf pine, and scrub oak.”

(Handbook of South Carolina Resources, Institutions and Industries of The State)



Figure 7: Photo: Old Growth Long-leaf pine-wiregrass ecosystem in SC. (State of South Carolina – Handbook of South Carolina Resources, 1908)

In 1916, Roland Harper, describes in the *Journal of Geography*, the development of agriculture in the Pine-Barrens of the Southeastern United States. He writes:

“As the long-leaf pine is one of the most useful of trees, and is by far the most abundant tree in the pine-barrens, the increasing demand for its lumber and resinous products from the manufacturing communities of the North and treeless areas of the West has given employment to thousands of people, laid the foundations for many new towns, and brought wealth to numerous “captains of industry.” This undoubtedly has been an important factor in the development of the region under consideration; but where the production of lumber and naval stores has declined with the exhaustion of the forests the population has usually continued to increase at about the same rate, and it is now much greater than could be supported by forest industries alone.”

(Journal of Geography)

But even with the increase of agriculture, the advent of the Great Depression, would change farming in South Carolina. The federal government, who bought out failed farms as a relief measure in the 1930's, created the Sandhills State Forest. Over 25,000 acres of the state forest is now planted in longleaf (Lucas 1996, pg. 28).

Erskine Caldwell chronicled the cultural landscape of the Sandhills in Georgia the 1930s in his book *Tobacco Road*. Tobacco Road was a real place that existed along the Sandhills in Richmond County, Georgia. Caldwell's description of poor white farmers, and their struggle to keep their farms is a poignant time capsule of the economic struggles of the region during the Great Depression. Many tenant farmers left agriculture for a better life that came with better

paying jobs in cotton mills located in the cities of Augusta, Georgia and across the Savannah River into Graniteville, South Carolina (in Aiken County).

More recently, in the 1950's, the life of the forest can be found in a tune sung by Hank Williams. '*Setting the Wood Afire*' is a metaphor for life and the forest on fire.

“You clap hands and I'll start bowing
We'll do all the laws allowin'
Tomorrow I'll be right back plowing
Setting the woods on fire”
(*'Setting the Wood Afire'*)

Present day South Carolina botanist Richard Porcher describes the long-leaf pine-wiregrass ecosystem, as “The Pineland Gardens” is his 1995 book *Wildflowers of the Carolina Lowcountry*.

“Imagine, if you will, the hundreds of thousands of acres of almost pure stands of longleaf pine that greeted the early settlers as they moved inland from the coast of the Atlantic and Gulf coast states. Here were unbroken longleaf pine forests with trees over 120 feet tall and 40 or more inches in diameter.”
(*Wildflowers of the Carolina Lowcountry*)

In her book *Ecology of a Cracker Childhood*, environmentalist Janisse Ray provides an apt description of the disturbances to the longleaf pine in South Georgia.

“Passing through my homeland it was easy to see that Crackers, although fiercely rooted in the land and willing to defend it to death, hadn't had the means, the education or the ease to care particularly about its natural communities. Our

relationship with the land wasn't one of give and return. The land itself has been the victim of social dilemmas – racial injustice, lack of education, and dire poverty. It was overtilled; eroded; cut; littered; polluted; treated as a commodity, sometime the only one, and not a living thing. Most people worried about getting by, and when getting by meant using the land, we used it. When getting by meant ignoring the land, we ignored it.” (*Ecology of a Cracker Childhood*)

These descriptions of the longleaf pine-wiregrass ecosystem provide clues to its vastness and diversity. Its history is briefly summarized in Lawrence S. Earley's book, *Looking for Longleaf*. He states:

“Longleaf's decline has been attributed to a great many things but is most easily explained in three words – need, greed, and mismanagement. People cut the forest, burned it to farm and make spaces to live, exploited its resources, and changed the natural processes that had evolved with it and maintained it”. (*Looking for Longleaf*)

It's important to note that there are many other historical accounts of the longleaf pine-wiregrass ecosystem in South Carolina. In 1791 President George Washington traveled through the Sandhills. He thought it was “a pine barren of the worst sort, being hilly as well as poor” (Burke, Carolyn S. 1998, pg. 38). Undoubtedly, other descriptions exist in letters, journals, and manuscripts yet to be archived and researched. The University of South Carolina libraries is providing access to a host of online digital imagery (i.e., Sanborn Fire Insurance Maps, photographs, etc.) that will also give future researchers clues and descriptions to this forest.

CHAPTER 4 AIKEN GOPHER TORTOISE HERITAGE PRESERVE

“Nothing is more beautiful, nothing more mysterious, nothing more breathtaking, nothing more surreal,” Janisse Ray, *Ecology of a Cracker Childhood*

The Aiken Gopher Tortoise Heritage Preserve (AGTHP) is owned by the State of South Carolina. It is one of sixty-nine heritage preserves that encompass 81,133 acres of land managed by the South Carolina Department of Natural Resources (SCDNR).

One of the primary reasons the site was purchased was to protect a small colony of gopher tortoises (*Gopherus polphemus*). This is the northernmost population of tortoises and a species of state concern. See Figure #8 and # 9. It is also a “keystone species” within the longleaf pine-wiregrass ecosystem (Eisenberg, 1983, p. 1-4). There are accounts that one of the reasons the tortoises exist at this site is because the property was owned and protected by bootleggers (Gibbons, 1995 p. 6, Bennett, 2001 pers. comm.). The site also has several populations of Georgia beargrass (*Nolina georgiana*), another species of state concern. See Figure #10.

The AGTHP is located approximately 5 miles east of the town of Windsor, in Aiken County, South Carolina. The county is located in the western part of the state. See Figure #11. The preserve is approximately 1,395 acres whose plant communities is part of a longleaf pine-wiregrass ecosystem along the Sandhills of Aiken County, South Carolina. The preserve is part of the Edisto River Basin (Marshall, 1993, pg. 6, SCDNR, 1996 p27). Pond Branch and Spring Branch are small streams that flow through the property. Spring Branch flows into Pond Branch



Figure 8. Photo: Gopher Tortoise Burrow at AGTHP



Figure 9. Photo: Gopher Tortoise Burrows at AGTHP (Photosource: Gopher Tortoise and Land Use Survey of the South Edisto Shrublands)



Figure 10. Photo: Beargrass (*Nolina georgiana*) at AGTHP

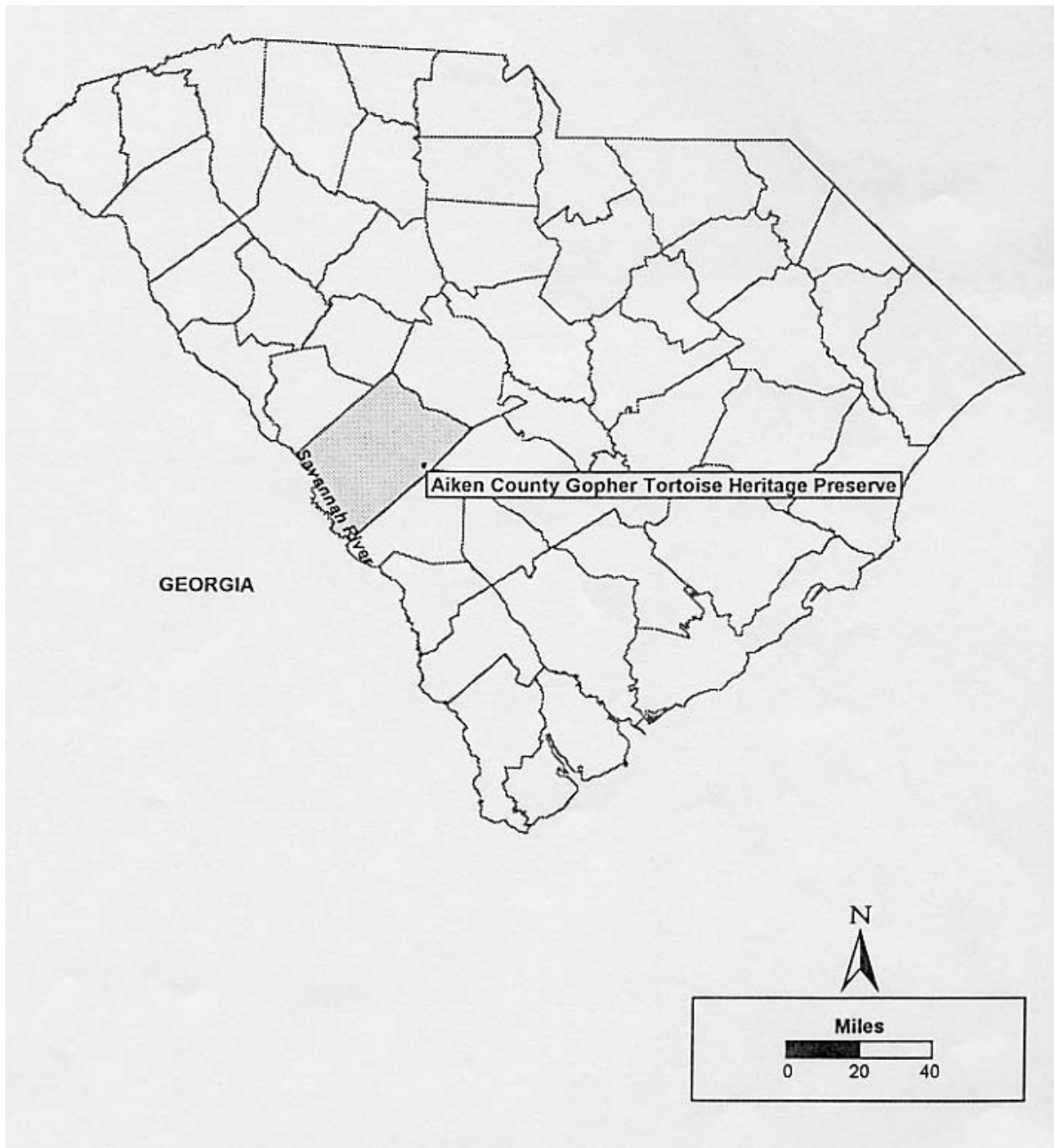


Figure 11. Aiken Gopher Tortoise Heritage Preserve (AGTHP) Location Map. (source SCDNR)

and then Pond Branch flows offsite into the South Fork of the Edisto River. Several dams were built to create ponds along Spring Branch over the past several decades. See figure #12.

Dirt roads form some of the boundaries of the site, and provide opportunities for passerby to view the longleaf pine-wiregrass ecosystem. See Figure #13. The preserve lies around 250 feet above mean sea level. Soils are primarily Troup–Lakeland–Fuquay series. These soils are well-drained, sandy soils that consist of loamy subsoil, and excessively drained soils that are sandy throughout (USDA Soil Survey 1981). The preserve surrounds the Spring Branch Baptist Church in its southwest corner. See Figure #14.

The South Carolina Department of Natural Resources has determined that the Aiken Gopher Tortoise Heritage Preserve consists of primarily three plant communities (Aulbach-Smith, 1994, p. 5, SCDNR 1999, 3-4). A xeric longleaf pine upland, a (streamside) pocosin, and a bay community. In his introduction to *The Natural Communities of South Carolina*, John Nelson stresses the importance of defining plant communities. He states:

“The maintenance of an accurate inventory of a region’s natural resources must involve a system for classifying its natural communities. These communities themselves represent identifiable units which, like individual plant and animal species of concern, contribute to the overall natural diversity characterizing a given region” (Nelson, 1986 p. I).

Although the focus of this thesis is on the longleaf pine-wiregrass ecosystem, all of these plant communities define the site. All have had disturbances such as timbering, road building and dam building. Multi-age stands of longleaf pines both naturally regenerated and planted exist throughout the preserve. See Figures #15, #16, #17 and #18.

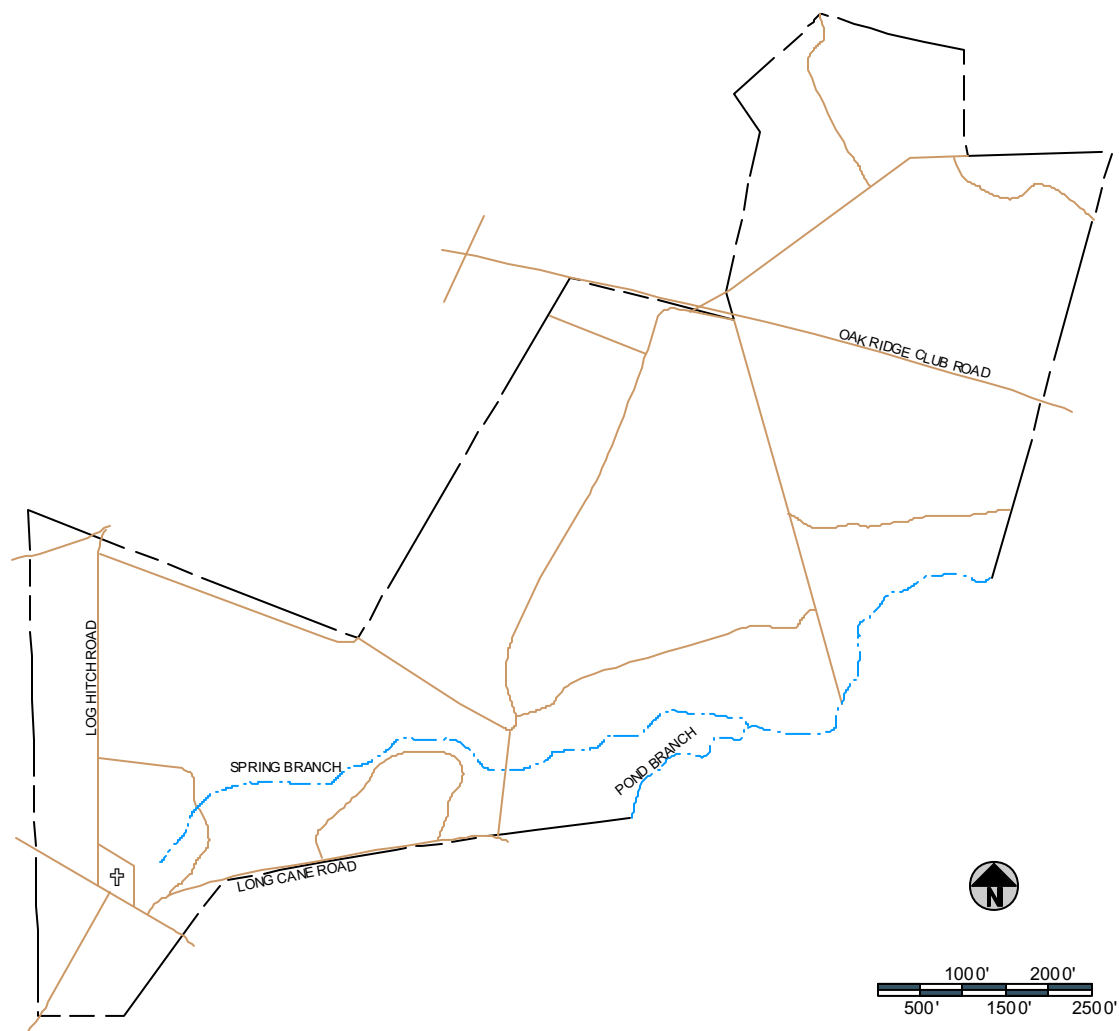


Figure 12. Boundary map of Aiken Gopher Tortoise Heritage Preserve.



Figure 13. Photo: Log Hitch Road at AGTHP.



Figure 14. Photo: Spring Branch Baptist Church



Figure 15. Photo: Multi-age stands of longleaf pine both naturally regenerated and planted along Spring Branch at AGTHP.



Figure 16. Photo: Multi-age stands of Longleaf Pine both naturally regenerated and planted at AGTHP.



Figure 17. Photo: Multi-age stands of Longleaf Pine both naturally regenerated and planted at AGTHP.



Figure 18. Photo: Planted longleaf pine at AGTHP.

One of the methods used in this thesis to determine past land uses and disturbances was a review of the aerial photography over the past sixty years 1938-1999 (Egan, 2000. p138). (See Appendix B. Aerial Photography for an abbreviated version of land uses/disturbances. Also included in this appendix are map reference numbers). The source of the aerial photography used while researching the land use history of the AGTHP was from the University of South Carolina's Map Library. Maps were interpreted using a loop and by groundtruthing at the preserve. The 1938 aerial has the fewest land uses and the least disturbance. Forest appears to have naturally regenerated from previous timbering. The Spring Branch is free-flowing and historic plant community patterns are apparent. A lot of the roads and trails lead to the Spring Branch Baptist Church. The first pond shows up behind the church in the 1943 aerial. Small portions of forest are timbered beginning in 1943 aerial up to the 1955 aerial. A larger second pond shows up in the 1951 aerial. The 1959 aerial have larger portions of the forest being timbered, but also tree planting. The 1966 aerial have the largest forest disturbances from timbering. The land is also being terraced as a part of the timbering and tree planting. The 1970 aerial show areas of open fields in portions that were cut in 1966. There are also new areas being timbered. The 1979 aerial show open fields, new areas being timbered and tree planting. These patterns continue through the 1989 Landsat with the addition of a new pond. A large soil disturbance appears in this aerial most likely from the dam building needed for the last pond nearby. This pond is also on the Spring Branch. At the present time this area is eroding and re-vegetation has been slow to occur. The color-enhanced aspect of the 1989, 1994, and 1999 Landsat aerials make it easier to interpret where the more mature stands of longleaf pine trees occur on the preserve. See Figures #19, 20, 21. This may be beneficial to SCDNR should they decide to start a colony of red-cockaded woodpeckers (*Picoides borealis*) on the site, as several of these stands are over 50 years of age.

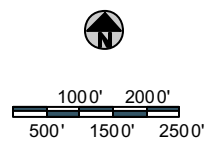


Figure 19. LandSat photo 1989 with AGTHP boundary

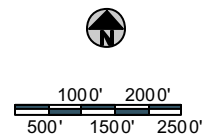
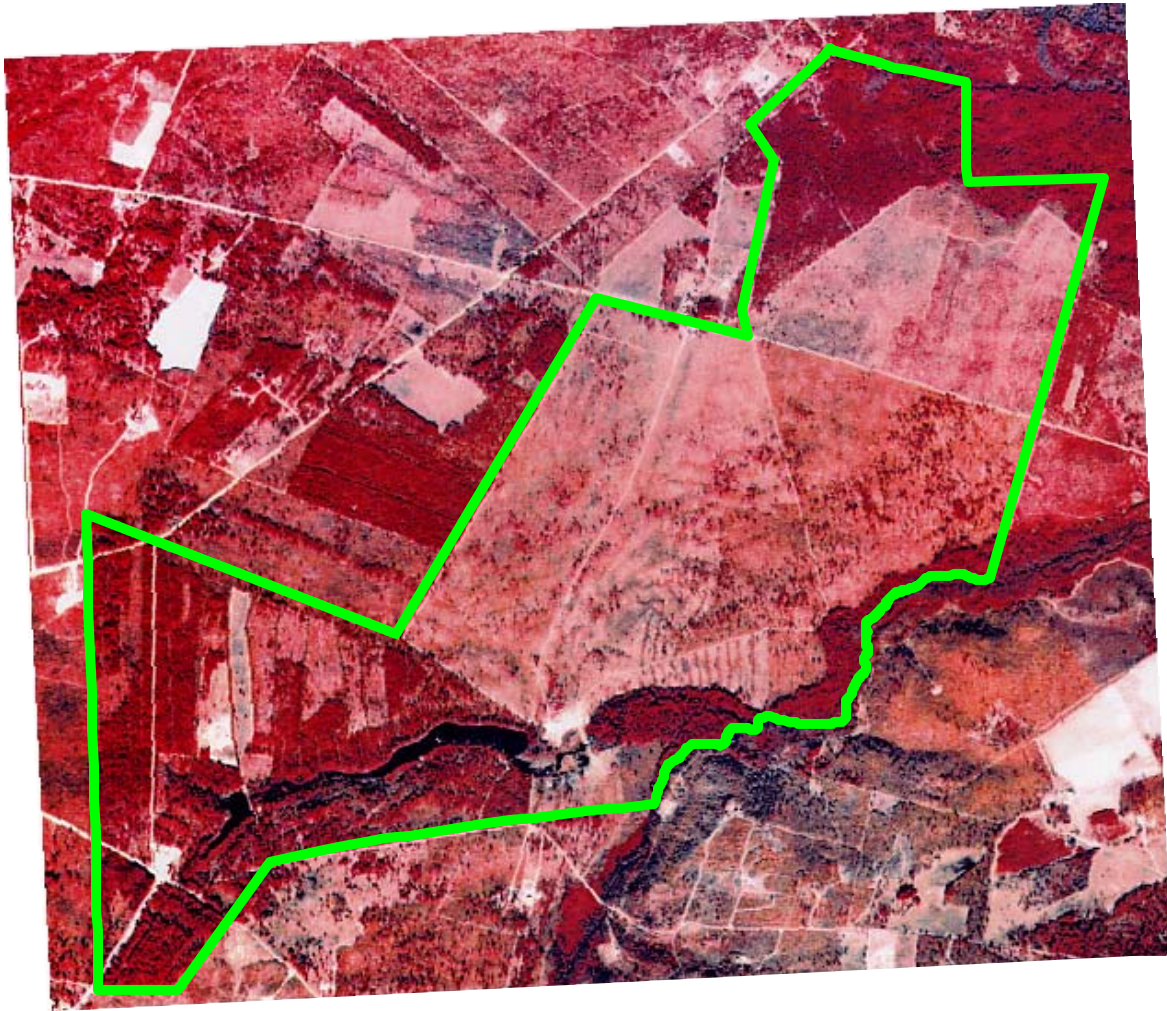


Figure 20. LandSat photo 1994 with AGTHP boundary

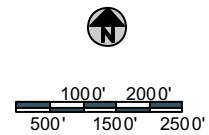
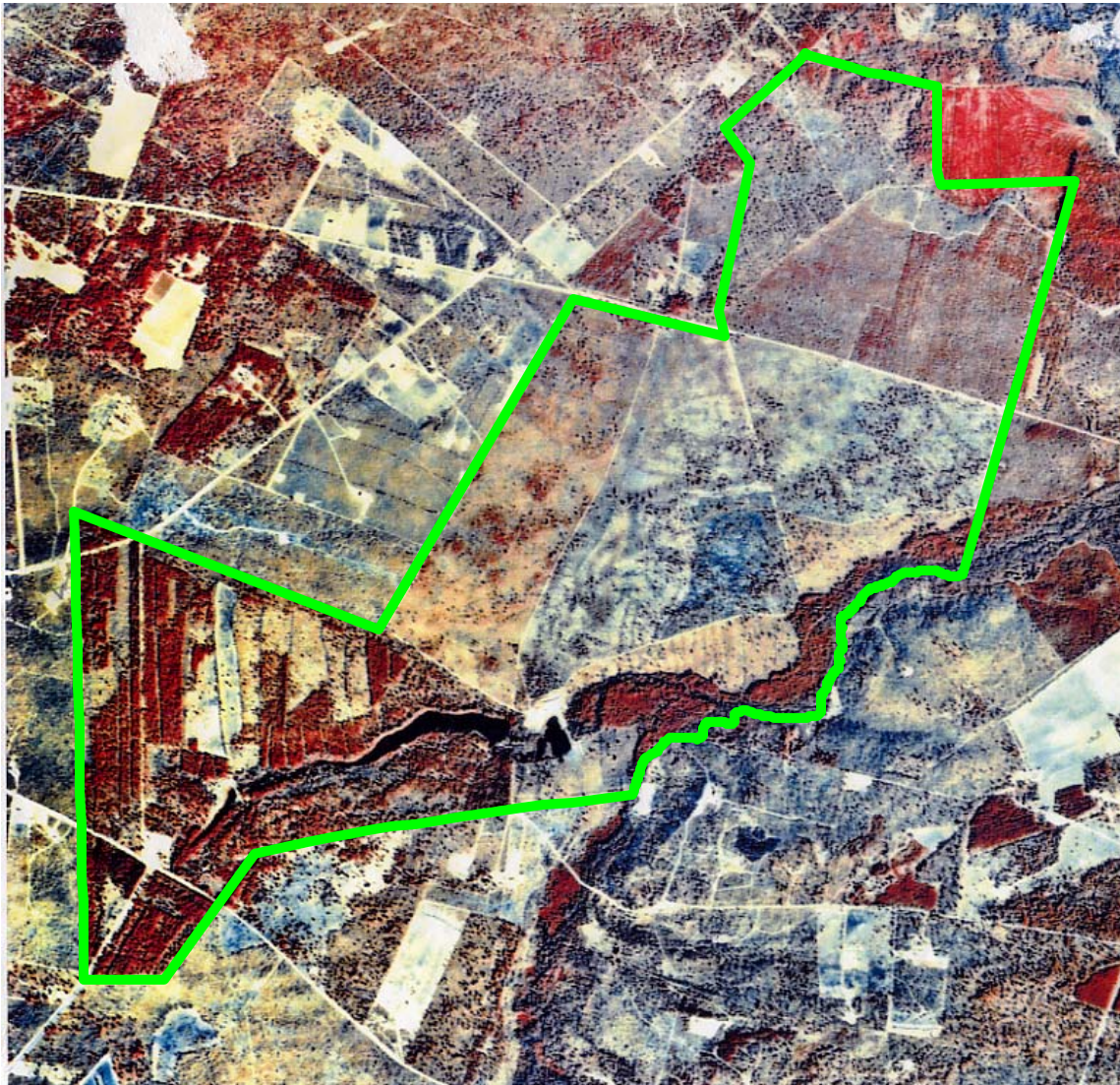


Figure 21. LandSat photo 1999 with AGTHP boundary

Using a loop and groundtruthing help determine different site disturbances over the years. The preserve has been used for farming, houses, for harvesting timber, for hunting, planted for pine plantations, bootlegging, road building, dam building, and ponds. SCDNR has planted some longleaf pines in disturbed areas. See Figure #22. The areas along Spring Branch showed the most disturbances to its plant communities with disruptions of the stream for ponds. SCDNR has breached all dams; however, they are still holding back water, and not back to their historic flow. See Figure #23 and #24. The aerial photography shows a large exposed slope created when the final pond along Spring Branch was built in the late 80's. See Figure #25.

SCNDR has also planted a stand of Atlantic White Cedar (*Chamaecyparis thyoides*) along the Spring Branch. See Figure #26. A planting such as this may be more appropriate closer to the South Fork of the Edisto River as natural stands of the cedars already exist in this area (Aulbach-Smith, 1994, p. 2).

A review of the aerial photography over the years shows that many of the roads and trails have been on the site for decades. A lot of the early trails lead to the church. This could be simply related to property ownership. Also, perhaps due to the dryness of the ecosystem, it may take longer for vegetation to regenerate on exposed areas.

A very important consideration with the AGTHP preserve is the gopher tortoise population. It is a keystone species within the longleaf pine-wiregrass ecosystem. Its burrows have been documented to provide feeding ground and shelter for over 300 animal species (Wilson 2001, p73). The fact they still exist attests to the diversity of the site. It is important that their numbers grow to increase the diversity of the entire site. The SCDNR has initiated



Figure 22. Photo: Planted longleaf pine at AGTHP by SCDNR



Figure 23. Photo: Dam breach at Spring Branch at AGTHP.



Figure 24. Photo: Water that is still impounded at Spring Branch. Note the stumps.



Figure 25. Photo: Slope disturbed by grading for pond dam at AGTHP.



Figure 26. Photo: Planted Atlantic White Cedar (*Chamaecyparis thyoides*) by SCDNR
at AGTHP.

efforts to improve the groundlayer by prescribed burning and using herbicides to reduce the scrub oaks. The intent is to open up the understory to improve the light so the numbers of grasses and plants that provide sustenance for the turtles can increase. See Figures #27, #28 and #29. However, not much is known about gopher tortoises in this part of its range (Tuberville and Dorcas, 2001. p181).

Large forest fires occurred near the AGTHP in 1966 and 1967. The Windor Fire burned over 6000 acres in early April 1966. The Oakwood-State Park fire burned over 4000 acres in early April 1967. This fire burned several structures and caused one fatality (SC State Commission of Forestry, 1966-1967 reports). The danger of fire, either by natural occurrence or through prescribed burning is a reality to the management of this preserve.

There have been large-scale disturbances at the AGTHP. These include the suppression of fire, disruption to the hydrologic processes (dam/pond building along Spring Branch), the disturbance to vegetation, both through timbering and planting pines over the decades at the site. However, time is on the side of South Carolina Department of Natural Resources. Just as it took decades to disturb processes of the ecosystem, it will take decades to restore the processes that perpetuate the longleaf pine-wiregrass ecosystem and its biodiversity.



Figure 27. Photo: Herbicide treated turkey oaks at AGTHP in winter. Note the groundlayer.



Figure 28. Photo: Herbicide treated turkey oaks at AGTHP in summer. Note the groundlayer.



Figure 29. Photo: Herbicide treated turkey oaks at AGTHP in fall. Note the groundlayer.

CHAPTER 5 MANAGEMENT AND RESTORATION OF PROCESSES

“Ecosystem management stresses the integrity of system processes, the importance of local context, and the unpredictable and contingent nature of living systems”.

Robert E. Cook, *The George Wright FORUM*

This thesis explored the historical descriptions, perceptions and present day interpretations of the longleaf pine-wiregrass ecosystem. Documentation of the disturbances and management practices were an important aspect of this thesis. Analysis of aerial photography and groundtruthing were used to determine past land uses and disturbances to the preserve. It also used aerial photography to determine the historic vegetation patterns of the site. See Figure #30.

The goal for the project is to manage and restore the natural processes to perpetuate the of the remnant longleaf pine-wiregrass ecosystem at the AGTHP. The premise is in order to best manage the preserve; you must first understand the historical disturbances to the natural processes that would help perpetuate the longleaf pine-wiregrass ecosystem. Biodiversity is an important goal, and ultimately man is also a ‘keystone’ species in this longleaf pine-wiregrass ecosystem, an active participant in the processes of fire. It also recognizes the ‘New Paradigm’ and that the natural world is subject to drastic changes. (Picket et al, 1992, pgs. 66-88).

One of the objectives for the site would be the restoration of the natural process of fire through prescribed burning and then natural regeneration of the groundlayer. See Figures #31, #32, #33, #34, #35 and #36. Presently, the SCDNR has initiated burning every year to help

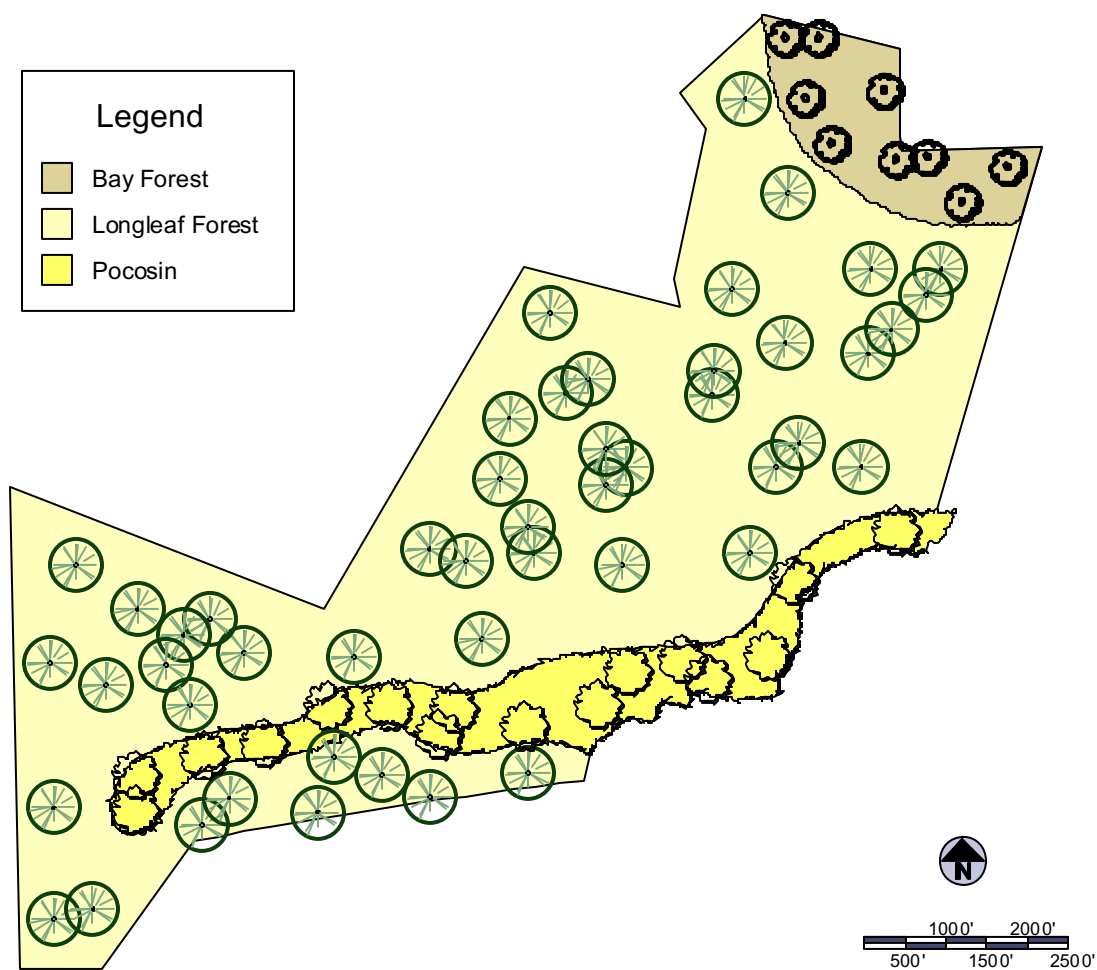


Figure 30. HISTORIC VEGETATION PATTERNS



Figure 31. Photo: Prescribed Burning by SCDNR at the AGTHP.



Figure 32. Photo: Longleaf Pine with new growth of groundlayer emerging one week after burn at the AGTHP.



Figure 33. Photo: Groundlayer in the spring after prescribed burning at AGTHP.



Figure 34. Photo: Groundlayer in the summer after prescribed burning at AGTHP.



Figure 35. Photo: Groundlayer in the fall after prescribed burning at AGTHP.



Figure 36. Photo: Groundlayer in the winter after prescribed burning at AGTHP.

jump start the ground layer and improve habitat for the tortoises. Once these areas are more stable, perhaps SCDNR could return to a more natural fire regime of 1 to 3 years (Frost, C.C. 1993, pg. 77).

Remove the remaining dams entirely so the water is no longer impounded, returning the historic water flow back to Spring Branch. This would require removal of some trees and vegetation, and then re-grading. This would reduce the amount of water being impounded. Once the natural flow of Spring Branch is restored, the area could return to its historic vegetation pattern. One of the largest and most apparent disturbances on the site is the exposed slopes near the lower pond along Spring Branch. Perhaps the soil that is removed from the dams could be placed back on the eroded areas to stabilize the slopes, allowing the slopes to revegetate.

The restoration of processes should serve as the force for the natural regeneration of longleaf pine-wiregrass ecosystem. A minimalist approach is proposed for the regeneration of the longleaf pines and groundlayer. In many areas of the preserve the groundlayer is diverse, with an array of grasses and forbs. In some places, especially where there has been a disturbance to the soil, (such as roads, farming, or the mechanical planting of pines, there is very little groundlayer). Areas that are diverse could serve as a “seedbank” for places with a weak groundlayer. The natural process of regeneration may be disrupted in areas that are in planted pine. It may be necessary to randomly “thin” trees to restart this process and allow more light to the groundlayer. This could facilitate natural regeneration of longleaf pine as well as increasing the diversity of the groundlayer, a great benefit to the preserve’s “keystone species” the gopher tortoise.

Possible strategies for the AGTHP:

One strategy would be to shift the public focus/interpretation of the site as a place of refuge for the gopher tortoise, to a place to observe wildflowers and also a refuge for the gopher tortoise. There are many logical reasons to make this change. The numbers of gopher tortoises are few, and they are rarely sighted. They are also best left alone so their numbers can increase naturally or through relocation by the SCDNR.

The preserve has a diversity of wildflowers. Many of these flowers are dramatic and bloom over a long period of time. The long bloom periods provide lots of opportunities for observation. The Poaceae family, Compositae family, and the Fabaceae family all offer many species with long bloom periods at the preserve. See Figures #37, #38, #39 respectively. Collectively, the groundlayer presents a rich diversity of flora. See Figure #40. Shifting the focus toward wildflowers could educate the community and increase the appreciation and understanding of the diversity longleaf pine-wiregrass ecosystem. This would in turn increase the interest in the preserve as a source of pride for the local, regional and state communities. A simple trail along an existing firebreak could be used for viewing. A local volunteer group could help interpret the wildflowers at AGTHP site, which would benefit SCDNR in the future.

Further strategies would be to continue to expand the site through future land acquisitions. Explore creating linkages between plant communities not part of the present preserve through private conservation easements. Let this site, the Henderson Heritage Preserve, and the nearby Aiken State Natural Area (formerly the Aiken State Park), become resource areas for studying the longleaf pine-wiregrass ecosystem along the Sandhills of South Carolina. Good models would Tall Timbers Research Station in Florida or Joseph Jones Ecological Research



Figure 37. Photo: Pineywoods Dropseed (*Sporobolus junceus*) at AGTHP.



Figure 38. Photo: Greeneyes (*Berlandiera pumila*) at AGTHP.



Figure 39. Photo: Lady Lupine (*Lupinus villosus*) at AGTHP.



Figure 40. Photo: Groundlayer exhibits a rich diversity of flora at the AGTHP.

Center in Georgia as possible to emulate. The nearby Aiken State Natural Area could be the site for this center.

Documentation of the disturbances and management practices were an important aspect of this thesis. All photos are by author unless otherwise noted. It is hoped that SCDNR can reference the historic descriptions, the photos of the site, and the analysis of the land use data (from the interpretation of the aerial photography) for the future management of processes at the preserve. Leon Neel, land manager for the old growth longleaf pine-wiregrass ecosystem at the Greenwood Tract (See Appendix A) for the last fifty years, says “you cannot manage a forest by a formula” (Neel 2000, pers. comm). Since land managers at the preserve will change over the years, it is hope that SCDNR will document how the site was managed for future generations of land managers and researchers.

Perhaps, at some point in the future, the longleaf pine-wiregrass ecosystem at the Aiken Gopher Tortoise Heritage Preserve will appear as the descriptions of the old growth forests of the Sandhills as described in the 1888 *South Carolina Resources and Population Institutions and Industries*.

BIBLIOGRAPHY

Aulbach-Smith, Cynthia, 1994. *Gopher Tortoise and Land Use Survey of the South Edisto Shrublands*. Report Prepared for: Nongame & Heritage Trust, SC Wildlife & Marine Resources Department, Columbia

Barry, John M., 1980. *Natural Vegetation of South Carolina*, University of South Carolina Press, Columbia

Batson, Wade T. 1964. *Wild Flowers in South Carolina*, University of South Carolina Press, Columbia

Bell, C. Ritchie, and Bryan J. Taylor 1982 *Florida Wild Flowers* Laurel Hill Press, Chapel Hill

Bennett, Stephen, 1996. "Longleaf – The Adaptable Pine." *South Carolina Wildlife* 43:1:29

Boyce, Stephen G., et al. 1993. *Biodiversity of the Southeastern United States*, New York: John Wiley & Sons, Inc.

Burke, Carolyn S., 1998. *A Legacy of Disturbance: Observations on the Restoration and Management of a Longleaf Pine-Wiregrass Ecosystem in Aiken, South Carolina*. University of Georgia, MLA Thesis

Caldwell, Erskine, 1932. *Tobacco Road*, New York: Grosset & Dunlap, p. 160.

Catesby, Mark, 1715. *The Natural History of Carolina, Florida, and the Bahama Islands*

Clayton, Lawrence A., Vernon James Knight, Jr., and Edward C. Moore (Edtrs): 1993, *The De Soto Chronicles : The Expeditions of Hernanado De Soto to North America in 1539-1543*, University of Alabama Press, Tuscaloosa

Cook, Robert E. 1996. Is Landscape Preservation an Oxymoron? *The George Wright FORUM* 13(1): 42-53

Crofton, Elizabeth W. 2001. Flora and Fauna of the Longleaf Pine-Grassland Ecosystem. *The Fire Forest Longleaf Pine-Wiregrass Ecosystem*. Georgia Wildlife Federation, Covington: Natural Georgia Series, Vol. 8, Number 2

Denevan, William M., 1992. The Pristine Myth: The Landscape of the Americas in 1492. *Annals of the Association of American Geographers*. Vol. 82 (3) pp.369-385

De Vorse, Jr., Louis, Ed. *DeBrahm's Report of the General Survey in the Southern District of North America*, University of South Carolina Press, Columbia 1971

Duncan, Wilbur H., and Marion B. Duncan, 1999 *Wildflowers of the Eastern United States*, The University of Georgia Press, Athens

Duncan, Wilbur H., and Leonard E. Foote 1975 *Wildflowers of the Southeastern United States*, The University of Georgia Press, Athens

Earley, Lawrence, S. 2004. *Looking for Longleaf The Fall and Rise of an American Forest*. The University of North Carolina Press, Chapel Hill

Edgar, Walter. 1998 *South Carolina A History*. The University of South Carolina Press, Columbia

Egan, David and Evelyn Howell (eds) 2000. *The Historical Ecology Handbook: A Restorationist's Guide to Reference Ecosystems*, Island Press, Connecticut

Eisenberg, J.F., 1983. The gopher tortoise as a keystone species, pp. 1-4 Bryant, R.J. and Franza, R.. eds. *Proceedings of the Fourth Annual Meeting*, Gopher Tortoise Council, Florida State Museum

Frost, C.C. 1993. Four Centuries of Changing Landscape Patterns in the Longleaf Pine Ecosystem. Hermann, Sharon, ed. *The Longleaf Pine Ecosystem: Ecology Restoration, and Management, Proceeding, 18th Tall Timber Fire Ecology Conference*. Tall Timbers Research, Inc. Tallahassee, Florida. pgs. 17-43

Frost, C.C. 1993. Presettlement Fire Frequency Regimes of the United States: A First Approximation. Hermann, Sharon, ed. *The Longleaf Pine Ecosystem: Ecology Restoration, and Management, Proceeding, 18th Tall Timber Fire Ecology Conference*. Tall Timbers Research, Inc. Tallahassee, Florida. pg. 77.

Gibbons, Whit. 1995. Why do bootleggers make good conservationists? *Newsletter of the Minnesota Herpetological Society*. Vol.15, No. 8, p. 6.

Godfrey, Robert, K. 1988 *Trees, Shrubs, and Woody Vines of Northern Florida and Adjacent Georgia and Alabama* The University of Georgia Press, Athens

Gordon, Kay 2001, "Aiken Gopher Tortoise" *South Carolina Wildlife* January-February Vol. 48, No. 1

Harper, Francis, Ed., 1988. *The Travels of William Bartram*, The University of Georgia Press, Athens

Harper, Roland. 1916. "Development of Agriculture in the Pine-Barrens of the Southeastern United States." *Journal of Geography* 15:42-48

Hermann, Sharon, ed. 1993. *Proceeding 18th Tall Timbers Fire Ecology Conference, The Longleaf Pine Ecosystem: Ecology, Restoration and Management, Tallahassee*, Tall Timbers Research, Inc. Tallahassee, Florida

Hobbs, Richard J., and David A. Norton, 1996. "Toward a Conceptual Framework for Restoration Ecology" *Restoration Ecology* Vol. 4 No. 2 pp. 93-110

Kovacik, Charles F. and John Winberry, 1987. *South Carolina: A Geography*. Westview Press, Boulder

Lawson, John, 1709. *A New Voyage to Carolina*. London.

Lucas, Greg, 1996. Longleaf Legacy. *South Carolina Wildlife* Volume 43, Number 1, p. 28.

Marshall, William D., Ed. *Assessing Change in the Edisto River Basin: An Ecological Characterization*. South Carolina Water Resources Commission, Report No. 177

Michaux, Andre F., 1871. *The North American Sylva*. W.M. Rutter & Co. Philadelphia, pgs. 106-116.

Nelson, John B. 1986. *The Natural Communities of South Carolina*. South Carolina Wildlife and Marine Resource Department. Columbia

Noss , Reed F. and Allen W. Cooperrider. 1994, *Saving Nature's Legacy: Protecting and Restoring Biodiversity*. Island Press, Washington, D.C.

Noss, Reed F., 1989. Longleaf Pine and Wiregrass: Keystone Components of an Endangered Ecosystem. *Natural Areas Journal* Volume 9, Number 4, pgs. 211-213.

Noss, Reed F. and Edward T. LaRoe III, and J. Michael Scott. 1995 *Endangered Ecosystems of the United States: A Status Report on America's Vanishing Habitat and Wildlife*. U.S. Department of the Interior, National Biological Service, Washington, D.C. Biological Report #28.

Odum, Eugene. 1963. *Ecology*. Holt, Rinehart and Winston, New York

Olmsted, Frederick Law, 1856. *A Journey in the Seaboard Slave States, with remarks on their Economy*. Dix and Edwards, London

Outcalt, Kenneth W. and Raymond Sheffield, 1996. *The Longleaf Pine Forest: Trends and Current Conditions*. Asheville: U.S. Department of Agriculture Forest Service, Southern Research Station, Resource Bulletin SRS, 23p.

Peet, Robert K. and Dorothy J. Allard. 1993 "Longleaf Pine Vegetation of the Southern Atlantic and Eastern Gulf Coast Regions: A Preliminary Classification." In Hermann, ed. *Proceeding 18th Tall Timber Fire Ecology Conference: The Longleaf Pine Ecosystem: Ecology, Restoration and Management*: pgs. 45-81.

Pickett et al., The New Paradigm in Ecology: Implications for Conservation Biology above the Species Level. *Conservation Biology*. pgs. 66-88.

Porcher, Richard D. and Douglas Alan Rayner. 2001 *A Guide to the Wildflowers of South Carolina*, University of South Carolina Press, Columbia

Porcher, Richard D. 1995 *Wildflowers of the Carolina Lowcountry and Lower Pee Dee* University of South Carolina Press, Columbia

Radford, Albert E., Harry E. Ahles, and C. Ritchie Bell. 1968 *Manual of the Vascular Flora of the Carolinas*, The University of North Carolina Press, Chapel Hill

Ray, Janisse, 1999 *Ecology of a Cracker Childhood*, Milkweed Editions, Minneapolis: pgs.164-165

Schafale, Michael, and Alan S. Weakly. 1990. *Classification of the Natural Communities in North Carolina Third Approximation*. North Carolina Heritage Program, Raleigh

Silver, Timothy, 1990 *A New Face on the Countryside Indians, Colonist, and Slaves in South Atlantic Forests 1500-1800*. Cambridge University Press, Cambridge

South Carolina Department of Natural Resources, 1999. *Aiken Gopher Tortoise Heritage Preserve Management Plan*. Heritage Trust Program, Columbia

South Carolina Department of Natural Resources, 1996. *Managing Resources for a Sustainable Future The Edisto River Basin Project Report*. SCDNR, Columbia

SC State Commission of Forestry, 1966-1967 Fire Record Reports: Broad River Road, Columbia

State of South Carolina, 1883. *South Carolina Resources and Population. Institutions and Industries*. The State Board of Agriculture of South Carolina, Walker, Evans & Cogwell, Printers, Charleston

State of South Carolina, 1908. *Handbook of South Carolina Resources, Institutions and Industries of the State*. The State Department of Agriculture, Commerce and Immigration, Columbia

Taylor, Walter Kingsley. 1998. *Florida Wildflowers in Their Natural Communities*. University of Florida Press, Gainesville

Tuberville, Tracy D. and Michael E. Dorcas “Winter Survey of a Gopher Tortoise Population in South Carolina” *Chelonian Conservation and Biology*, 2001 4(1): pgs.182-186

United States Department of Agriculture. 1981, *Soil Survey of Aiken County Area South Carolina*. National Cooperative Soil Survey

Vandervelde, Isabel. 1999, *Aiken County: The Only South Carolina County Founded During Reconstruction*. The Reprint Company, Spartanburg

Vogl, Richard J. 1972, Fire in the Southeastern Grasslands. *Proceedings from the 12th Annual Tall Timbers Fire Ecology Conference*: Tall Timbers Research, Inc.

Wells, B. W. 2002, *The Natural Gardens of North Carolina*, The University of North Carolina Press, Chapel Hill

Wharton, Charles, H. 1989. *The Natural Environments of Georgia*, Georgia Department of Natural Resources, Bulletin 114

Wilson, James R. 2001, *The Fire Forest*, The Georgia Wildlife Press, Covington, Natural Georgia Series, Volume 8, Number 2, p. 58.

APPENDIX A

Longleaf pine-wiregrass preserves visited as reference sites:

South Carolina Sandhills NWR	SC
Victoria Bluff Heritage Preserve	SC
Tillman Heritage Preserve	SC
Henderson Heritage Preserve	SC
Hitchcock Woods	SC
Barber Bog (aka Doe Run)	GA
Springfield Plantation (Private)	GA
Wade Tract (Private)	GA
Greenwood Tract	GA
Ichauaway	GA
Tall Timbers Research Station	FLA
Saint Marks National Wildlife Refuge	FLA

APPENDIX B

The source of the aerial photography used while researching the land use history of the AGTHP was from the University of South Carolina's Map Library. Maps were interpreted using a loop and by groundtruthing at the preserve.

Black and White Aerial Photography:

1938 Map Number #'s: 310, 312, 328, and 330

Land Uses/Disturbances: Roads, Trails, Residential, Church, and Farming.

1943 Map Number #'s: 6C108, 6C109

Land Uses/Disturbances: Roads, Trails, Residential, Church, Farming, Timbering, and a Pond (1).

1951 Map Number #'s: 3H156, 4H42

Land Uses/Disturbances: Roads, Trails, Residential, Church, Farming, Timbering, and Ponds (2).

1955 Map Number #'s: 1P118, 1P119, 1P131, 1P132

Land Uses/Disturbances: Roads, Trails, Residential, Church, Farming, Timbering, and Ponds (2).

1959 Map Number #'s: 1AA120, 1AA73, 1AA74

Land Uses/Disturbances: Roads, Trails, Residential, Church, Timbering, Tree Planting, Planting Pines, and Ponds (2)

1966 Map Number #'s: 2GG170, 2GG185

Land Uses/Disturbances: Roads, Trails, Church, Timbering, Tree Planting, Open Fields (for hunting) and Ponds (2).

1971 Map Number #'s: 1MM120, 2MM156

Land Uses/Disturbances: Roads, Trails, Church, Timbering, Tree Planting, Open Fields (for hunting) and Ponds (2).

1979 Map Number #'s: 178131, 17850

Land Uses/Disturbances: Roads, Trails, Church, Timbering, Tree Planting, Open Fields (for hunting) and Ponds (2).

Landsat Aerial Photography:

1989 Map Number #'s: N/A

Land Uses/Disturbances: Roads, Trails, Church, Timbering, Tree Planting, Open Fields (for hunting) Large Eroded Bank (from dam building) and Ponds (3).

1994 Map Number #'s: N/A

Land Uses/Disturbances: Roads, Trails, Church, Timbering, Tree Planting, Open Fields (for hunting), Large Eroded Bank (from dam building) and Ponds (3).

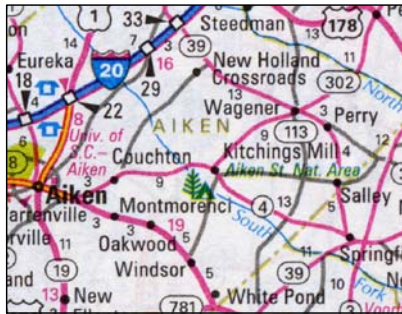
1999 Map Number #'s: N/A

Land Uses/Disturbances: Roads, Trails, Church, Timbering, Tree Planting, Open Fields (for hunting), Large Eroded Bank (from dam building) and Ponds (3).

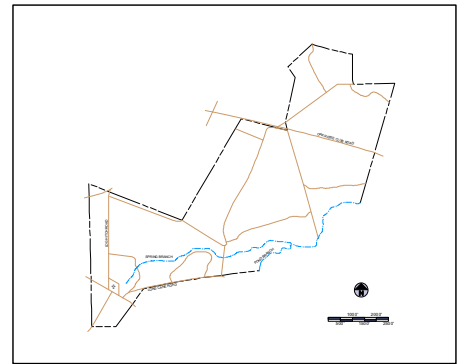
HERITAGE PRESERVE LOCATION



SOUTH CAROLINA STATE ROAD MAP



AIKEN GOPHER TORTOISE HERITAGE PRESERVE BOUNDARY MAP



GOPHER TORTOISE BURROW



GOPHER TORTOISE



photo source from Google image search

GEORGIA BEARGRASS



LOG HITCH ROAD



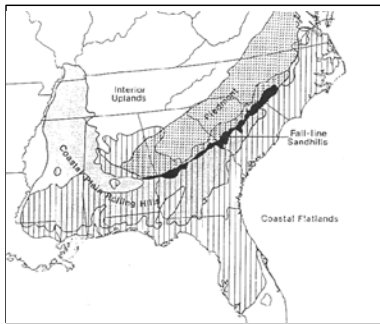
Site

AIKEN GOPHER TORTOISE HERITAGE PRESERVE

AIKEN, SOUTH CAROLINA
SCHOOL OF ENVIRONMENTAL DESIGN - UNIVERSITY OF GEORGIA



SANDHILLS AND LONGLEAF PINE



(Source Peet and Allard 1995) vertical lines represent longleaf pine range

PRESETTLEMENT RANGE OF LONGLEAF PINE

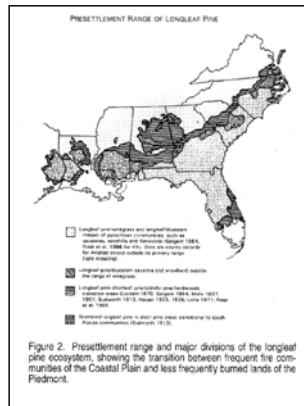
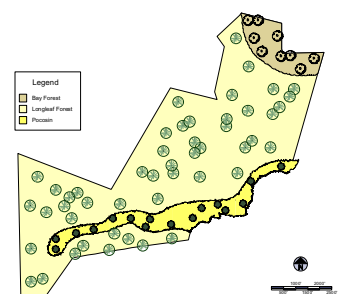


Figure 2. Presettlement range and major divisions of the longleaf pine ecosystem, showing the transition between frequent fire communities of the Coastal Plain and less frequently burned lands of the Piedmont.

HISTORIC VEGETATION PATTERNS



OLD GROWTH LONGLEAF PINE - GEORGIA



WIREGRASS ON FIRE



OLD GROWTH LONGLEAF PINE - SOUTH CAROLINA



Inventory

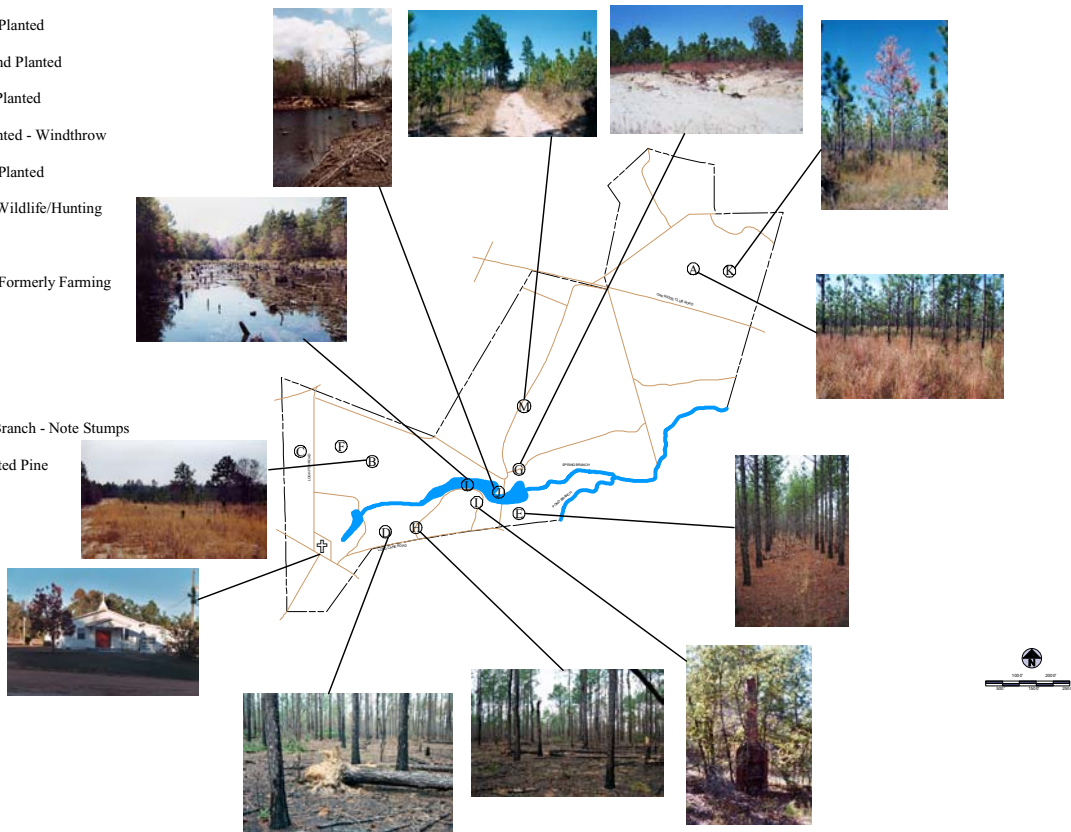
AIKEN GOPHER TORTOISE HERITAGE PRESERVE

AIKEN, SOUTH CAROLINA

SCHOOL OF ENVIRONMENTAL DESIGN - UNIVERSITY OF GEORGIA



- A - Planted Longleaf Pine - Mechanically Planted
- B - Planted Longleaf Pine/Hedgerow - Hand Planted
- C - Planted Loblolly Pine - Mechanically Planted
- D - Planted Slash Pine - Mechanically Planted - Windthrow
- E - Planted Shortleaf Pine - Mechanically Planted
- F - Invasive Exotic - Bicolor Lespedeza - Wildlife/Hunting
- G - Exposed Slopes
- H - Planted Slash Pine & Wind Damage - Formerly Farming
- I - Structure
- J - Dam Breached
- K - Lightening Strike
- L - Water Still Impounded Along Spring Branch - Note Stumps
- M - Both Naturally Regenerated And Planted Pine



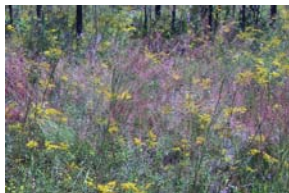
Disturbances

AIKEN GOPHER TORTOISE HERITAGE PRESERVE

AIKEN, SOUTH CAROLINA
SCHOOL OF ENVIRONMENTAL DESIGN - UNIVERSITY OF GEORGIA



In South Carolina, signage along the roads offers mixed messages about fire.



Prescribed Burning

AIKEN GOPHER TORTOISE HERITAGE PRESERVE

AIKEN, SOUTH CAROLINA

SCHOOL OF ENVIRONMENTAL DESIGN - UNIVERSITY OF GEORGIA





HERBICIDE TREATMENT



MECHANICAL PLANTING



HAND PLANTING
(Atlantic White Cedar)



Management Practices

AIKEN GOPHER TORTOISE HERITAGE PRESERVE

AIKEN, SOUTH CAROLINA

SCHOOL OF ENVIRONMENTAL DESIGN - UNIVERSITY OF GEORGIA





Wildflowers

AIKEN GOPHER TORTOISE HERITAGE PRESERVE

AIKEN, SOUTH CAROLINA

SCHOOL OF ENVIRONMENTAL DESIGN - UNIVERSITY OF GEORGIA





Wildflowers

AIKEN GOPHER TORTOISE HERITAGE PRESERVE

AIKEN, SOUTH CAROLINA

SCHOOL OF ENVIRONMENTAL DESIGN - UNIVERSITY OF GEORGIA

