

**Historical Composition of the *Pinus palustris* Community in Oak Mountain State Park: A Preliminary Survey**

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## **ABSTRACT**

The longleaf pine (*Pinus palustris* Mill.) was once the most abundant pine in the southeastern United States. Timber production, urban development, and fire suppression have impacted the longleaf pine community to such a great extent that it is now listed as the second most endangered ecosystem in the U.S. Many different efforts are being made to conserve this precious ecosystem that is home to such a diverse array of plants and animals. The objective of this preliminary study was to get an idea of what the historical longleaf composition and structure once was on Double Oak Mountain in Oak Mountain State Park, Alabama. A survey was conducted on the longleaf pine stumps in the selected plot near the wildlife refuge center in Oak Mountain State Park, measuring the height and diameter. The diameter at average stump height and the DBH was then measured on the living longleaf pines that were > 137.2 cm in height. This data was then used to create an approximation of what the stump DBH might have been. It was found that the DBH for the longleaf stump community was not significantly different compared to other old-growth longleaf pine stands. The longleaf pine stands on the ridgetops in Oak Mountain State Park were found to have a significantly smaller DBH. The density of the longleaf stump community was significantly less dense than any other longleaf pine stand studied. Thus, suggesting that the historical longleaf pine community in Oak Mountain State Park was relatively the same structure as the longleaf stands today. However, the data suggests that the longleaf pine composition was historically thinner and more spread out throughout the park. Further research on the longleaf pine stumps is needed to have a better idea of what the historical composition of Oak Mountain State Park was like. This pilot study and future studies can then be used as reference models for management and restoration of the longleaf pine community on Double Oak Mountain.

## **INTRODUCTION**

Longleaf pine (*Pinus palustris* Mill.) forest once covered 37.2 million ha in the southeastern United States (Maceina 2000). The longleaf community was dramatically altered after European settlement in the region. Tar, turpentine, and rosin production were just a few of the products heavily manufactured from the longleaf pine forest. Eventually, the mature longleaf pines that survived were cut for timber (Peet 1993). Due to the impacts of the naval stores industry, lumber extraction, grazing, and agriculture the longleaf pine range was decreased to a mere 3% of its former range, covering fewer than 1.2 million ha (Peet 1993; Varner 1998; Outcalt 2000).

The longleaf pine ecosystem is home to a vast array of distinctive plants and animals, many of which are endemic (Outcalt 2000). Longleaf pine forest is now listed as the second

most endangered ecosystem in the United States (Varner 2003). Urban development and fire suppression have left less than 0.01% old-growth longleaf pines (Varner 2003). Longleaf pine is absolutely dependant on fire for stand maintenance and reproduction. As a result of fire suppression a thick undergrowth of broadleaved species that prevent longleaf seedlings from taking root develop (Peet 1993). The absence of fire also causes a build up of fuel levels and the understory species diversity declines (Peet 1993).

In Alabama, the longleaf range has drastically reduced from 15 million acres to approximately 535,000 acres (Alliance 2002). Places like Fort McClellan Military Reservation (1917) and Oak Mountain State Park (1927) were established to protect the montane longleaf pines. Logging removed much of the established old-growth longleaf pines in the Choccolocco Mountain and Double Oak Mountain areas (Johnson; Maceina 2000; Johnson 2002). The majority of the remnant longleaf pine community is second-growth (Bridges 1989; Outcalt 2000). The logging allowed lighter seeded, more aggressive species to invade into the longleaf pine forest (Johnson). This results in poor wildlife habitat for all the species of the longleaf community, which leads to a decline and loss of biodiversity in the wildlife and plant communities in Alabama.

Many efforts are being made to address the conservation and reestablishment of the longleaf. The purpose of this pilot study is to survey the longleaf pine stump community in Oak Mountain State Park in order to have a better idea of what the historical longleaf pine composition once was. This information can then be applied to long-term goals for the restoration and management of second-growth stands in the park (Jill M. Noel 1998; Johnson 2002). There has been no other research published looking at longleaf pine stumps. This pilot study was designed in hopes of pioneering new ways to visualize the original longleaf

community as it once was prior to European settlement. The longleaf stumps in the selected plot were measured average stump height. The diameter at stump height was then compared to the diameter at breast height in all the living longleaf pines to give an equation that would approximate the DBH of the longleaf stumps. The data of the longleaf stump community was hypothesized to be structurally different from the second-growth longleaf pines.

## **METHODS**

This study of longleaf pine took place in Oak Mountain State Park of Pelham in Shelby County. The 9,000 acre park sits on the southernmost points in the Appalachian chain, Double Oak Mountain (Johnson). The forest composition in Oak Mountain State park is mixed pine-hardwood forest, but once the area was composed of mostly longleaf pine (Johnson 2002). The logging of most of the longleaf forest on the southern, western, and southwestern slopes left behind only remnant clumps of old-growth longleaf, as well as stumps (Johnson). A stand located near the wildlife rehabilitation center was chosen to conduct this pilot study due to its easy accessibility. A previously study plot was then extended to go from the northern base to the southern base of the hill, resulting in a 20m by 175m plot.

Within the plot, a survey measuring the height and diameter was conducted on all longleaf stumps. The height of all the stumps was then averaged to give a stump height of 23.2 cm. A second survey was then taken on all living longleaf pine > than 137.2 cm (1.37m). Using a DBH tape, the diameter of the longleaf pines was measured at stump height (23.2 cm) and again at breast height (137.2 cm). For the purposes of this study the stump community represents the historical composition of the longleaf pine. The living longleaf pines > 137.2 cm will be referred to as second growth.

A scatter plot was then created with the data gathered on diameter at breast and stump height of the living longleaf pine community. The trend line equation,  $y=0.8303x+0.2543$  (Figure 1), was then used to find the approximate diameter of the historical long leaf community. This data was then compared to the second growth community and six other plots. The six other plots were selected because their composition closely followed that of old growth. Three of the six were found in the foothills (Plots 11, 12, and 13) of Oak Mountain State Park. The other three plots (Plots R11, R12, and R13) were set in the ridge tops of Double Oak Mountain.

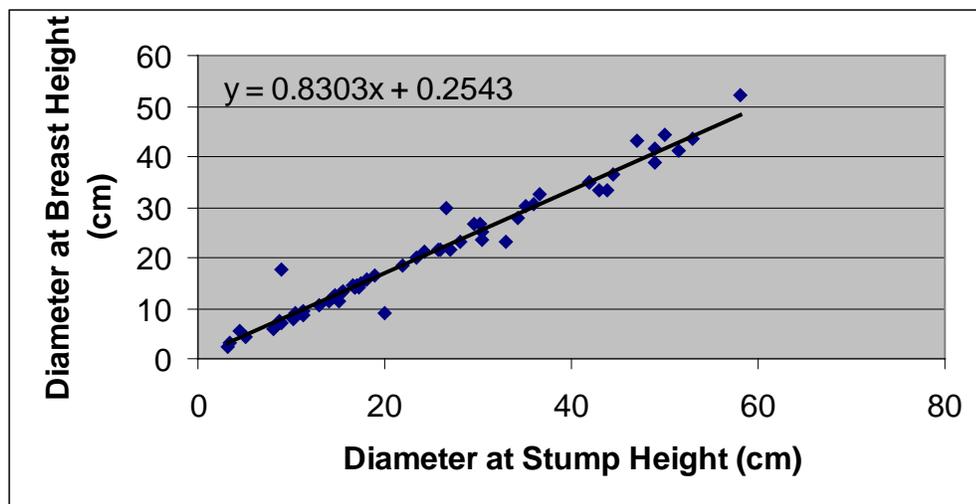


Figure 1. Diameter at stump height (23.2 cm) compared to diameter at breast height (137.2 cm) in the second-growth longleaf pines in Oak Mountain State Park in Pelham, Alabama.

Another statistical analysis was conducted on the longleaf pine densities to give an idea what the forest composition was historically like and how is compared to the present composition as well as the other locations throughout Oak Mountain State Park. The density of the historical longleaf pine community was also compared to the longleaf pine density in Fort McClellan. Fort McClellan is part of the Choccolocco Mountain range in northeastern Alabama and contains a large community of mountain longleaf pines (Varner 2003). Two sites, hereafter referred to as Caffey Hill and Red-tail Ridge, were used in a study conducted by J. M. Varner, John S. Kush, and Ralph S. Meldahal on the Sturctural Characteristics of Frequently-Burned

Old-Growth Longleaf Pine Stands in the Mountains of Alabama. A t-test was then run on the data gathered on the tree density in Caffey Hill and Red-tail Ridge and the data gathered on the historical longleaf pine community in Oak Mountain State Park. This was determined using an alpha value of 0.05.

## **RESULTS**

There were some minor difference in the DBH between the stands (Table 1), the only the DBH of the ridgetop plot in Oak Mountain State Park were statistically significant compared to the historical longleaf pines (p-value=0.00242). The DBH of the typical old-growth long leaf pine stands, Caffey Hill and Red-tail Ridge, were not significantly different from the DBH of the historic longleaf pines (historic compared to Caffey Hill p-value=0.4118 and historic compared to Red-tail Ridge p-value=0.8991).

<b>Plot</b>	<b>Sample Size</b>	<b>Mean DBH</b>	<b>Standard Deviation</b>	<b>Range</b>
11	30	21.58 cm	16.34 cm	47.10 cm
12	82	14.83 cm	9.74 cm	29.50 cm
13	52	15.48 cm	13.23 cm	49.00 cm
R11	172	10.28 cm	6.49 cm	35.50 cm
R12	69	17.64 cm	10.94 cm	47.10 cm
R13	54	13.91 cm	8.61 cm	35.50 cm
Caffey Hill (Varner 2003)	N/A	14.7 cm	N/A	N/A
Red-tail Ridge (Varner 2003)	N/A	20.3 cm	N/A	N/A
Second Growth Stand	59	20.63 cm	12.36 cm	36.25 cm
Historical Longleaf Stand	26	19.50 cm	10.13 cm	6.86 cm

Table 1. Structural characteristics of the old growth longleaf pine stand in the pilot survey plot compared with other longleaf pine stands in Oak Mountain State Parks and Fort McClellan, Alabama.

Historical longleaf Stand density was found to be significant smaller compared to any other longleaf stands (p-value > 0.05). The longleaf density per meter<sup>2</sup> for R11 was a great deal higher than any other plots. Caffey Hill, Red-tail Ridge, and foothills plot 11 all had around the same longleaf pine density.

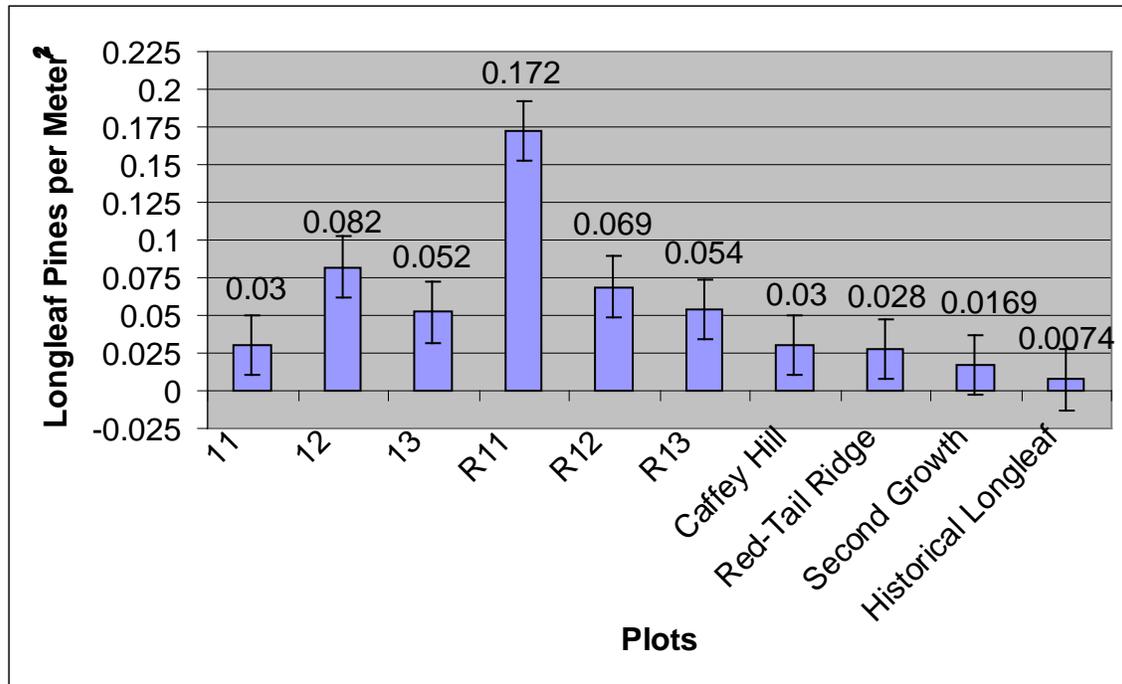


Figure 2. Longleaf pine density per meter<sup>2</sup> for the old-growth, second-growth, Fort McClellan stands, and the Oak Mountain State Park plots in Alabama.

## DISCUSSION

Past research reports the average DBH for old-growth pines to be around 60-63 cm (Varner 2003). This is a great deal more than our reported DBH for the historical old-growth pines, as well as any other DBH. The DBH was significantly different for the historical longleaf compared to the ridgetop longleaf pines in Oak Mountain State Park. It was concluded that the ridgetop longleaf pines were smaller due to the harsher environment and terrain. The pilot study plot was located near the foothills, due to richer soil and environment the growing environment for the historical longleaf was better. Surprisingly the DBH was not significantly different for the historical longleaf compared to the second-growth longleaf. The historical longleaf was found to have a very similar DBH as other old-growth longleaf pines. There was not a significant difference in the DBHs of the historical and Fort McClellan stands. This leads to the belief that

our approximation of the DBH for the historical longleaf community was very similar and close to the actual DBH for old-growth longleaf pines.

While there not that many structural differences in the historical longleaf stand compared to longleaf stands found today, there were compositional differences. It was found, as expected that the historical longleaf pine community was less dense than the second-growth longleaf stand. The historical longleaf stand was found to be significantly less dense than all of the present longleaf stands. This large difference in tree density could be due to many things. One of the major possible flaws is the density only accounting for longleaf pine that have been clear cut.

The pilot survey did not take into account the longleaf pines not cut, thus counting old-growth longleaf pines in the second-growth longleaf pines data. The stand density was around the same low proportion for the Caffey Hill, Red-tail Ridge, and foothill 11 plots. While the density for these plots was greater than the historical longleaf pine, it is shown that these areas represent old-growth communities. Historically it is shown that old-growth pines communities have a low stand density (Jill M. Noel 1998; Varner 1998; Outcalt 2000). This creates an open canopy, allowing sunlight to reach the understory of the longleaf ecosystem. From the information gathered just in the pilot study plot, we can see that the longleaf pines are becoming to thick. This data suggests the need for a prescribed burn to that the longleaf pine ecosystem can get back into check. The fire would kill the less tolerant hardwood species, and decrease the amount of ground litter. This in return would open up the tree canopy and allow plant species to take root in the understory, creating a more diverse composition in the longleaf pine community.

Little is known about the montane longleaf pine community. This pilot study achieved its purpose by providing a glimpse of what the longleaf pine composition and structure might have been. The knowledge gained from this pilot study and future studies will aid in setting objectives

for future longleaf pine conservation. Stump surveys for all the plots examined in this pilot study would create a better idea of what the historical longleaf community once was compared to the community today. Due to time restriction and lack of man power these surveys were not possible. Other possible research includes mapping out the historical longleaf community by completing a stump survey over a larger area in the park. From this the historical longleaf range could be measured and compared to the present longleaf range. There is not documented account for the historical longleaf pine community in Oak Mountain State Park. This documentation would aid the restoration and management of the second-growth longleaf stands, creating healthier longleaf pine ecosystem.

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