ARE WE OVER-MANAGING LONGLEAF PINE?

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ABSTRACT

Longleaf pine (*Pinus palustris* Mill.) is not loblolly (*Pinus taeda* L.) or slash pine (*Pinus elliottii* L.). There is the need for a paradigmatic shift in our thinking about longleaf pine. All too often we think of longleaf as an intolerant species, slow-grower, difficult to regenerate, and yet it dominated the pre-settlement Southeastern forest; how can that be? Wahlenberg, in his 1946 book about longleaf pine, wrote that mismanagement of longleaf pine has been the rule rather than the exception, due to the ignorance of the unique life history and incomplete knowledge of factors determining the life and death of seedlings and hence the succession of forest types. Using data from the Regional Longleaf Growth Study and from what had been a virgin stand of longleaf pine, the Flomaton Natural Area, this presentation will focus on examining data from areas that have been/were allowed to grow "unmanaged", i.e. no timber cutting. How did longleaf pine stay on the landscape before we almost managed it out of existence?

INTRODUCTION

Longleaf pine (*Pinus palustris* Mill.) ecosystems are considered to be in a perilous condition. A report by the U.S. Department of Interior lists the longleaf pine ecosystem as the second-most threatened ecosystem in the U.S. (Noss 1989). The original longleaf pine forest was self-perpetuating where seedlings always had to be present. It reproduced itself in openings in the overstory where young stands developed. These openings would have ranged from a few tenths of an acre due to the loss of a single tree to a lightning strike or wind fall, a few acres due to insects or a larger scale wind event, to large openings of several thousands of acres due to tornados or hurricanes. Regardless of the event size, longleaf pine was able to regenerate these openings. The result was a park-like, uneven-aged forest, composed of many even-aged stands of varying sizes.

The character of the ecosystem is best maintained with natural regeneration, with optimum use of silvicultural treatments simulating the processes that have long maintained longleaf ecosystems over the millennia. However, no phase of longleaf pine management presents more complex and critical problems than does its reproduction. Solutions depend on understanding the prerequisites of the process, the characteristics of seed-bearing trees and longleaf pine seed crops, and the possible causes of failure after seed fall. Predicting seedling performance under varying levels of overstory competition is important for understanding the consequences of silvicultural systems.

Many of the factors governing the ability of longleaf pine to reproduce are obscure, and the innumerable ecological influences are so interrelated as to make their interpretation difficult. A major regeneration problem is irregular seed production. Seed crops considered adequate for regeneration occur at 5- to 7-year intervals, on average, with exceptions. Longleaf pine is generally considered the most intolerant of the southern pines (Baker 1949). It is intolerant of competition from any source especially overstory competition. Survival and growth are closely related to longleaf pine's two unique silvical characteristics: its grass-stage and its high tolerance of fire. The grass-stage usually lasts 4-5 years but may range from 2 to 20 years. If competing species are allowed to grow freely, they will completely dominate the site while longleaf seedlings are still in the grass-stage. Once this has occurred, the longleaf pine stand can never regain dominance without some type of intervention. Unsatisfactory regeneration in longleaf pine forests may be attributed largely to the lack of management or unwise management.

It was recognized at the turn of the 20th century that natural regeneration of longleaf pine would be difficult because of human activities and its own life history. Problems with the regeneration of longleaf pine were noted by Schwarz (1907) when he wrote "Longleaf pine has an astonishing power of resistance to fires, except during its very early life, points to the possibility of possible renewal, in spite of the many destructive human agencies that are constantly threatening it." Wells and Shunk (1931) wrote this about the demise of longleaf pine: "In its pristine condition with millions of trees measuring a yard or more in basal diameter, the Pinus palustris ecosystem unquestionably presented one of the most wonderful forests in the world. And today hardly an

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acre is left in North Carolina to give its citizens a conception of what nature had wrought in an earlier day. The complete destruction of this forest constitutes one of the major social crimes of American history."

Wahlenberg (1946) in his landmark text "Longleaf pine: Its use, ecology, regeneration, protection, growth, and management" devoted three chapters to the topic of longleaf pine regeneration, nearly one-quarter of the book. In his introduction he stated "Where formerly it had complete possession of the land, it has often failed to reproduce; this failure has resulted in deterioration of land values in many localities." The two major problems he identified for the frequent failure were: 1: fire, whether too frequent, killing recent regeneration, or too infrequent resulting in competition from other species; and 2: logging practices that left little or nothing on the ground or no seed trees. He summed this up by saying "Mismanagement of longleaf pine has been the rule rather than the exception, due to ignorance of the unique life history and incomplete knowledge of factors determining the life and death of seedlings and hence the succession of forest types."

There has been renewed interest in longleaf pine over the past 10-15 years for a variety of reasons. It is valued as a straight-growing tree of higher value than other southern pines. It is relatively resistant to insects and wind, as well as being very tolerant of fire. Several threatened and endangered species are often associated with frequently burned longleaf pine ecosystems, such as the red-cockaded woodpecker and gopher tortoise. For wildlife, in general, the understory groundcover and "open pine" habitat of these frequently burned ecosystems are highly valued. Most recently, there is "America's Longleaf Initiative" and its impossible goal of increasing longleaf pine 3.4 million acres today to 15 million over the next 15 years (America's Longleaf Initiative 2009).

Longleaf pine is classified as a very shade intolerant species, but it has none of the characteristics associated with early successional species. It is not a prolific seed producer, the seed is not disseminated great distances, and its early growth is not rapid. Regeneration of longleaf pine occurs erratically. Excellent mast years occur once every 4–7 years, with variations locally. Is longleaf pine as intolerant as we are led to believe which would lead to our mismanagement of the species? We will examine data from parts of three studies to look at this question. Data from unthinned plots (unmanaged stands) from a long-term growth and yield study and from a virgin stand of longleaf pine as well as two comparative studies will be presented.

RESEARCH STUDIES

REGIONAL LONGLEAF GROWTH STUDY

In 1964 the U.S. Forest Service established the Regional Longleaf Growth Study (RLGS) in the east Gulf Region (Farrar 1978). The original objective of the study was to obtain a database for the development of growth and yield predictions for naturally regenerated, even-aged longleaf pine stands. Plots were installed to cover a range of ages, densities, and site qualities. At the time of establishment, plots were assigned a target basal area class of 30, 60, 90, 120, or 150 square feet/acre. The RLGS is inventoried every 5 years. It is now in its 45th year re-measurement. Several plots have been left unthinned to follow stand development over time. The data from these unthinned plots will be used to discuss longleaf pine stand dynamics.

FLOMATON NATURAL AREA

Private, state, and federal land managers have recently undertaken ecological restoration of the longleaf pine forests in the southeastern United States. Restoration to this point has lacked information on reducing litter accumulations, herbaceous species establishment, changes in overstory structure, and the fate of longleaf pine regeneration during the restoration process. One area where the impacts of ecological restoration on longleaf pine forests were being studied was the Flomaton Natural Area (FNA). The FNA was a 60-acre, virgin stand of longleaf pine that underwent more than 45 years of fire suppression. In 1995, a major restoration project was undertaken with the re-introduction of fire (Kush and Meldahl 1996). For the next decade the FNA was monitored and managed as an old-growth longleaf pine habitat. The stand was burned again in 1996, 1997, 1999, 2001, 2002, and 2003. A fuelwood operation was also conducted in 1996, in which all hardwood trees were mechanically removed.

ESCAMBIA EXPERIMENTAL FOREST

Dr. William Boyer has said for years that "longleaf pine will catch up" (Personal Communication. William Boyer. Several times over the past two decades. Principal Silviculturist, U.S. Forest Service, Devall Street, Auburn, AL 36830). One of the many reasons for his statement came from two of the many studies of unpublished material in his file cabinets from work he conducted on the Escambia Experimental Forest (EFF) located south of Brewton, AL. In one study, Dr. Boyer examined the role overstory competition played in the release of seedlings in the understory. The second study compared a longleaf pine plantation to a nearby naturally regenerated stand. The planting of longleaf pine coincided with a longleaf pine seed crop on the EEF.

RESULTS

REGIONAL GROWTH STUDY

A series of RLGS plots were established on the EEF in 1985 from the 1969 seed crop. Several of these plots were left unthinned. At the time of establishment, these unthinned plots had just over 3,500 trees/acre that were at least 0.6-inches diameter at breast height (DBH) at age 16 years. The basal area of these plots averaged 81 square feet/acre. At age 31, density had dropped to 1850 trees/

acre while basal area had increased to 171 square feet/acre. Hurricane Ivan struck these plots in 2004 and resulted in a nearly 2 percent loss in density and subsequent drop in basal area between ages 31 and 36 years old. At the last re-measurement, now 41 years old, these plots still had just over 1,000 trees/acre and a basal area of 162 square feet/acre.

At age 16 over 80 percent of the trees were in the 1- and 2-inch DBH classes. When DBH was plotted versus trees/acre at age 16, the result was the typical “reverse-J” shape that is often associated of uneven-aged stands. As time progressed, this curve has flattened out to have more of a traditional even-aged distribution approaching a “bell shaped curve”. At age 41, there are still 1- and 2-inch DBH trees but there are also several trees that are 10- and 11-inches in DBH.

FLOMATON NATURAL AREA

Kush and others (2004) presented the results from six years of monitoring longleaf pine regeneration and development of seedlings in several gaps. Unfortunately, observations from the FNA came to an end a few years ago (Kush 2009). One final observation came from a tree that had a DBH of 36.2 inches and was 340 years old when it was killed by a “trash fire”. A disk was cut from near the base of the tree and growth rings were measured. The tree had a DBH of 4.2-inches when it was 115 years old in the year 1767. Something happened around that time which released the tree. It was putting on its most growth between the years 1925 and 1950 when it was 273 years old.

ESCAMBIA EXPERIMENTAL FOREST

In the first study, longleaf pine total seedling height was examined by years since released from a shelterwood overstory. Portions of the overstory were removed every year for eight years and seedlings from each of the eight areas were tracked. At the end of the first eight years, seedlings which had their overstory removed at 1- and 2-years were above DBH. Those released between 3- and 7-years were out of the grass-stage. The seedlings that had just had the overstory removed at age eight were still in the grass stage. These trees were re-measured 21 years later and there were no differences in total height. Trees released at age one were 62 feet tall and those released at age eight were 58 feet tall. The trees in between those years fell between the two heights.

In the second study, volume growth was tracked over time comparing the site prepped longleaf pine plantation to a nearby naturally regenerated stand. At age 14, the plantation had nearly three times the volume of the natural stand, nearly 900 cubic feet/acre compared to 280 cubic feet/acre. The two stands were followed over time. By age 36 the trees in the natural stand were taller than the trees in the plantation. At age 39, the plantation and natural stand had nearly 4,200 cubic feet/acre in volume.

DISCUSSION

There may be little interest by any landowner or land manager to allow longleaf pine stands to develop at the high densities of over 3,500 trees/acre at age 16. The point is that you can do it. In many cases with longleaf pine that is just how nature managed it. When a gap was created in a forest, there were seedlings there to fill in the gap. The first 41 years of those unthinned plots from the RLGS demonstrate that longleaf pine does not stagnate in such dense stand conditions. Insects and/or diseases are not a problem in longleaf pine as they would most likely be with the either loblolly (Pinus taeda L.) or slash pine (Pinus elliottii L.).

The FNA demonstrated that we could get longleaf pine regeneration where none had existed. At the time restoration efforts were initiated in the FNA, there were no longleaf pines smaller than 3-inches DBH. Seven years into the effort there were no longleaf pine trees smaller than 4-inches DBH. However, there were longleaf pine seedlings in the understory and that several of them already out of the grass-stage (Kush and others 2004). In addition, the disk from a 340 year old tree showed that longleaf pine is not a slow grower at old ages and it does respond to release. These are characteristics most often associated with what are called tolerant species.

The studies from the EEF reinforce the above results. Whether seedlings were released at age 1 or age 8 from their overstory competition, by age 29 there was no difference in total height. Is this a characteristic of an intolerant species? A naturally regenerated stand of longleaf pine caught in total volume and surpassed in total height a longleaf pine plantation by age 36. If you have an existing stand of longleaf pine, does the added expense of site preparation and buying tree seedlings pay off? Longleaf pine is not an intolerant species that grows quickly from the start and you can plan on being able to thin at an early age. This work from the EEF shows that longleaf pine just starts to really grow when it is 20-40 years old. It is at age 35-40 when longleaf pine will be large enough in DBH to make utility poles. These 10-12-inch DBH poles are currently worth nearly twice the dollars sawtimber is given the same weight.

CONCLUSION

We are losing the best quality longleaf pine stands in structure and ground cover through the loss of natural stands of longleaf pine on privately-held lands. We need to maintain what existing stands are left, and yes, we need to give landowners and land managers reasons to plant longleaf pine. However, more importantly, we need to get information to the people who have longleaf pine to help them understand how to maintain it and their options for the future.

There is a paradigmatic shift going on in forestry in the southern United States. Landowners and land managers are looking for different management options. A majority of landowners no longer have income as the major reason for managing their forests. Alternative revenue streams from non-traditional forest values such as wildlife and hunting leases, pine straw harvesting, agroforestry, and "maybe" a potential for carbon credits are now of interest. Longleaf pine may let landowners and land managers explore more land management options than the other southern pines, especially where prescribed fire is a management tool.

Longleaf pine is not for everyone, but just as important, it must be remembered that longleaf pine is not loblolly nor is it slash pine and should not be grown like it is. If you want a tree that has early, rapid growth and grows fast at wide spacing's, then plant loblolly or slash pine. Some questions which are important to consider when making decisions: is longleaf pine intolerant? Ask Chapman (1932). Why is there a need to get the tree out of the grass-stage quickly if it "catches up"? Why does longleaf pine need to be planted at low densities? If you get a fast-growing, limby tree, why the additional expense of planting longleaf? And at low densities, will longleaf keep its form, and will it be wind firm?

The above questions to think about are tree specific, but what about at the forest/ecosystem level? Can we have red-cockaded woodpeckers or gopher tortoises without longleaf pine? Yes. Can we have groundcover species, such as wiregrass, without longleaf pine? Yes. Can we have "open pine" habitat sought by many without longleaf pine? Yes. Can we have a longleaf pine forest/ecosystem without longleaf pine? No!

Are we over-managing (mismanaging) longleaf pine? What Wahlneberg wrote in 1946 still holds true today. We continue to ignore the characteristics which make longleaf pine unique among the southern pines. It is not loblolly or slash pine and should not be grown as such. We need to do a better job of educating landowners and land managers about its unique life history. Finally, we should grow longleaf pine like nature did if we truly value the longleaf characteristics we say we do.

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