

## LONGLEAF PINE DYNAMICS ON A FLATWOODS SITE: A STUDY ON THE CROATAN NATIONAL FOREST

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**ABSTRACT:** Natural regeneration of longleaf pine is one of the most important management tools natural resource managers have at their disposal to perpetuate existing longleaf pine stands in the southern United States. Some studies indicate a tendency for longleaf to regenerate in gaps within the already open park-like stand structure. However, high variation and unpredictability in year-to-year cone production make natural regeneration problematic. Most longleaf pine gap studies have been conducted on sandhills or excessively drained sites; however, the more poorly drained flatwood and savanna sites are generally more productive and contain higher numbers of rare and endangered species. Research sites on the eastern Coastal Plain of North Carolina, in the Croatan National Forest, have been established to examine natural regeneration issues. These sites, on moderate to poorly drained soils, contain second-growth longleaf with intact understories, and have been winter burned every two to four years for the last 20 years. We propose to relate stand management, cone production and regeneration rates with measures of site productivity.

### INTRODUCTION

The Croatan National Forest (CNF) is located on the Coastal Plain of North Carolina between Morehead City and New Bern. Its 65,000 hectares contain longleaf pine communities, bottomland hardwoods, saltwater estuaries, and raised swamps, called pocosins--which account for almost half of the Forest's acreage. Bounded on three sides by tidal rivers and the Bogue Sound, the forest is defined by water boundaries. Blackwater creeks originate deep in the forest.

Only an estimated 5,000 hectares of longleaf pine (Outcalt and Sheffield, 1996) remain on the CNF, making restoration and management of these communities a priority. The major tools in this effort are the proper use of fire, and utilization of natural regeneration.

Fire plays a crucial role in the management of longleaf communities on the CNF. Fire suppression promotes development of a dense canopy of species other than longleaf pine, growth of a thick shrub midstory, and loss of the fire adapted, shade intolerant understory species. Controlled burns maintain the endangered red-cockaded woodpecker's habitat, while removing competing vegetation for the Croatan's most unusual plants--the carnivorous Venus fly traps, sundews, and pitcher-plants.

Longleaf pine forests are considered endangered communities of the southeastern USA. Aside from being the dominant tree species, longleaf pine is also considered a keystone species of these community types. Re-establishment and regenerating longleaf pine seedlings is a major focus for conserving and restoring longleaf pine forests throughout the region. Proper management of longleaf pine forests is needed by the National Forest Systems to meet the multiple-use demands placed on that ecosystem, while preserving a rare community type. Another land management consideration is the move toward longer rotations and uneven-aged stands.

### STUDY SITES

Study sites are located on the Croatan National Forest, Carteret County, NC. All sites are predominantly on Onslow soils--a moderately to somewhat poorly drained, loamy sand (fine-loamy, siliceous, thermic Spodic Paleudults). This soil is highly acidic and generally nutrient poor (Goodwin 1977). Annual precipitation in the region averages 1210 mm but extended droughts occur during the growing season. Mean annual temperature is 17° C with the coldest temperatures in January (0.5° C) and the warmest in July (32.9° C).

The study sites have a typical longleaf flatwoods/savanna vegetative structure--a mature, uneven-aged overstory dominated by longleaf pine (with scattered loblolly and pond pines), no midstory, and relatively low understory dominated by a mix of woody and herbaceous vegetation. Stand ages range from 70 to 100 years. For the past 20 years, study sites have been prescribed burned every 2-4 years in the winter, and all sites have been burned within the last year. In general, the study sites contain similar dominant understory

plants, including *Gaylussacia* spp.; *Vaccinium* spp.; *Ilex* spp.; *Persea borbonia*; *Magnolia virginiana*; *Aristida stricta*; *Andropogon* spp.; *Pteridium aquilinum*; and *Eupatorium* spp.

## RESEARCH OBJECTIVES AND METHODS

To better understand the environmental and vegetative conditions, and management activities that impact cone production, seedling survival, and growth of longleaf pine on poorly drained sites, the following guidelines were established:

- Four study sites, each containing three measurement plots, have been established.
- Longleaf pine overstory and grass stage seedlings will be stem mapped. Diameter at breast height (1.37 m; DBH), crown diameter and total height will be measured on the overstory.
- Vegetation surveys will be conducted to quantify percent cover and biomass by species.
- Longleaf pine flower and cone counts will be done yearly, beginning in 2000.
- Estimates of monthly needle production and fuel loads will be determined using litter traps.
- Soil temperature, soil moisture, and light (PAR) will be measured monthly.
- Soil cores will be taken to determine belowground biomass, and sub samples of soil will be collected for nutrient analyses.

## LONGLEAF PINE CONE CROPS

One of the major components in longleaf pine management is the production of cones and viable seed. Compared to other southern pines, longleaf is a sporadic seed producer. Wahlenberg (1946) noted that good seed crops might occur every 5 to 7 years, while Maki (1952) reported heavy seed crops occur over much of the longleaf range once in 8 to 10 years.

For successful regeneration, the minimum size of a cone crop is considered to be 1850 cones/hectare or roughly 30 cones per tree (Boyer and White 1989). In the past 30 years, six of the nine cone crops considered adequate for natural regeneration have occurred since 1990 (Boyer 1998). The 1996-longleaf seed crop was one of those "much-anticipated" region-wide seed crops. Whether the interest is natural or artificial regeneration, it is important to know when to expect a bountiful seed crop.

## DEVELOPMENT OF LONGLEAF PINE SEEDS

The visual development of longleaf pine seed extends into three calendar years. Seed ripen and fall between late September and early November. The following is an abbreviated guideline for the longleaf pine seed development process.

Approximate months prior to seedfall and what happens:

27 months - differentiation between male and female flowers occur; usually July

22 months - male flowers appear, usually December

19 months - female flowers appear and pollination occurs, usually February to April

5 months - fertilization occurs, usually May to June of seedfall year

## MANAGEMENT IMPLICATIONS

- Monitor cone crops and utilize them when an opportunity occurs.
- Larger cone crops are characterized by higher seed viability (Boyer 1973) and increased seedling establishment (Gemmer *et al.* 1940).
- When large crops occur, capture as much reproduction as possible.
- Longleaf pine forests can survive reproduction droughts.

## CONCLUSION

This study will address conditions of regeneration in natural longleaf pine stands. It intends to fill a void of regeneration information on moderately to poorly drained soils of the North Carolina Coastal Plain. This study will provide critical information for the Croatan National Forest in its management and restoration of longleaf pine communities, as well as adding to the body of knowledge about longleaf pine. Ideally, this work will be the first phase of a larger study. Based on the data gathered, we will install treatments to test practices that will provide more predictable and successful natural regeneration within an economically viable framework.

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