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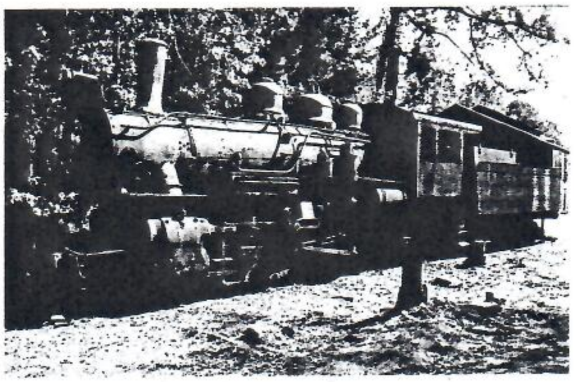

FOREST FOR OUR FUTURE

Restoration and Management of Longleaf Pine Ecosystems: Silvicultural, Ecological, Social, Political and Economic Challenges

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LONGLEAF PINE ACTIVITIES IN VIRGINIA: 1998 - 2000

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ABSTRACT: Longleaf pine is a very rare tree in Virginia with only 4432 trees remaining in four wild stands in the state. Most of the trees are found on only two sites, Blackwater Ecological Preserve (n=2139) and South Quay (n = 2251). The Blackwater Preserve is a protected area while the South Quay tract is owned by International Paper. In order to protect and manage these remaining resources several avenues of research have been pursued. These efforts include: a reproductive model for the Blackwater Ecological Preserve calculating time to stand regeneration based on stem diameter, growth rate, and seed yield; Virginia Department of Forestry initiation of a native Virginia longleaf orchard; a plan for a functional native Virginia longleaf pine seed production area utilizing the South Quay tract with projected seed yields; our efforts involving elementary school students raising, planting, and doing research on longleaf pine; successful efforts to root longleaf pine from needle fascicles; pilot projects with landowners.

INTRODUCTION

Longleaf pine (*Pinus palustris* Mill.) reaches its northern limit in Virginia and is considered extremely rare in the state (Killeffer 1999). Frost (2000) estimated longleaf pine forests in Virginia occupied as much as 1.5 million acres at the time of European settlement. Today only 4432 trees remain on less than 800 acres (Sheridan et al. 1999b). To reverse these drastic declines in population size a recovery effort has been initiated. This paper highlights longleaf pine restoration and conservation efforts in Virginia from 1998 - 2000.

Reproductive Model

The only protected longleaf pine ecosystem in Virginia is the Blackwater Ecological Preserve in Isle of Wight County. Reproduction of longleaf pine at the preserve is currently inadequate to produce grass stage seedlings (Sheridan et al. 1999b). When will the longleaf stand at the Blackwater Ecological Preserve be capable of natural regeneration? If longleaf pine fecundity and growth rate can be calculated then a prediction of when regeneration will occur can be made.

Platt et al. (1988) found a rather close correlation between the stem diameter of longleaf pine and the number of cones produced. Boyer (1998) determined that 360 cones per acre are needed just to get the first successful seedling and Croker (1973) calculated that the average number of seeds per longleaf cone is 50. This translates into a requisite 18,000 seeds/acre for regeneration. Sheridan et al. (1999b) performed a calculation synthesizing these authors results and longleaf pine seed-fall data collected at the preserve and found that only a third the amount of seed necessary for successful regeneration was produced in 1987. This inadequate seed production is caused by the lack of cones produced by small diameter trees. Deficiencies in seed production were still evident in 1998 since only 9 grass stage seedlings were counted in the census (Sheridan et al. 1999b), many possibly planted in a previous study (Plocher 1993). Seed production in 1998 was estimated at only 3000 seeds/acre if one assumes 15 trees/acre from census data and 4 cones per tree based on a 20 cm. diameter tree (Platt et al. 1988). Hence current lack of regeneration at the preserve can be explained through calculations with fecundity data.

Increment core data of longleaf pine at the preserve may be used to calculate average growth rate. Average growth rate can then be used to estimate when trees will have stem diameters large enough for successful regeneration. The average diameter of the stand in the 1998 census was 20 cm. (Sheridan et al. 1998b). Plocher (1993) stated that the entire stand was cut and burned from 1955-1957 and either planted in Louisiana longleaf or naturally regenerated. Assuming 40 years of growth by 1998 and an average stem diameter of 20 cm. the average rate of growth was calculated as 0.5 cm./year. Validation of this assumption was provided by increment core data collected in 2000 that disclosed an average age of 43 years (range 38-46 growth rings, n=12) and growth rate of 0.54 cm/year.

Therefore, a reproductive model of time to natural regeneration at the Blackwater Ecological Preserve can be constructed based on the following parameters.

Assumptions

- 360 cones/acre required to obtain first seedling (Boyer 1998)
- cones produce an average of 50 seeds (Croker 1973)
- longleaf pine with stem diameter of 45 cm will produce 24 cones/tree (Platt et al. 1988)
- even distribution of trees
- no mortality
- regular prescribed fire

Data

- 2139 longleaf pine cover 143 acres at preserve
- = average density of 15 trees/acre
- growth rate has averaged 0.54 cm/year
- average stem diameter of 20 cm in 1998

Calculation to Time of Regeneration

15 trees/acre x 24 cones/tree = 360 cones/acre
45 cm - 20 cm = 25 cm to grow
25 cm/1 x 1 year/0.54 cm = 46 years

Adjustments to Model

This reproductive model assumes an even distribution of longleaf pine on the Blackwater Ecological Preserve. However, longleaf pine tends to be patchy in distribution at the preserve. Higher densities of longleaf pine caused by this patchy distribution may accelerate regeneration estimates. On the other hand aspects of stand structure may also affect local regeneration. Cone production will be higher on dominant and co-dominant trees, which are larger than the 20 cm average. Competition from surrounding longleaf, loblolly, and pond pine may limit cone production on dominant trees. Management efforts may be required to provide a stand structure more conducive to natural regeneration (John Scrivani, pers. comm.).

An additional factor to also consider is the possibility of an exceptional mast crop producing enough seeds for regeneration prior to the calculated regeneration time. However, bumper crops of such magnitude are very infrequent and have only been recorded twice in the past 50 years (Boyer 1998).

Mortality effects, however, may significantly retard estimates of time to regeneration. For example, annual mortality rates of longleaf pine range from 0.08 for trees of 2.54 cm to less than 0.01 for trees greater than 15 cm (Quicke et al. 1997). Quicke et al. (1997) however excluded catastrophic events, such as fire, from their model. Fire is an essential component of restoration and maintenance of the longleaf pine ecosystem and should be considered in such a model. Catastrophes have been included in models of other rare species (Root 1998).

Platt et al. (1988) reported mortality of 1.75-2.65% for longleaf pine in a fire maintained preserve in south Georgia. This can be contrasted with the rather high 10.3% mortality rate of adult longleaf pine at the Blackwater Ecological Preserve after burning (Plocher 1993). These high mortality rates of longleaf pine at Blackwater Ecological Preserve may reflect catastrophic effects on a fire-suppressed system. The preserve is now being burned on a regular basis and a better assessment of mortality can now be made. This assessment may be made by comparison of plot survival to census data. Once mortality data is obtained the model may be adjusted to recalculate time to stand regeneration

Virginia Department of Forestry Initiates Longleaf Orchard

The Virginia Department of Forestry is carefully evaluating remaining, native longleaf pine trees in Virginia for selection as part of a seed orchard. Scions from native trees have been taken and grafts have been successfully made. These ramets have been planted in the field at the Department's New Kent Forestry Center. The goal is to have a final orchard of 50 or more trees supplying high quality, Virginia source, seedlings for local forestry demands (Anonymous 2000a).

Functional Native Virginia Longleaf Pine Seed Production Area

While the Virginia Department of Forestry is preparing a native longleaf pine seed orchard it may be decades before the facility is in seedling production. In the interim the native longleaf pine site in Suffolk City at South Quay (Sheridan et al., 1999b) could serve as a functional orchard, or seed production area, for longleaf pine seed (Sheridan 1999). Two thousand two hundred and fifty one longleaf pine occur on 459 acres at the South Quay tract. Ninety percent of these trees (n = 2030) occur on only two tracts totaling 275 acres. Calculations of seed production based on stem diameter at these two tracts result in an estimated possible annual yield of 211,950 seeds (Table 1).

Initial cone collections at the South Quay tract in 1997 were inefficient and resulted in a low yield per cone due to an early maturing cone crop in Virginia. Since 1997, cone collections have been performed earlier in the season to determine optimal cone collection time. In late September 2000 mature, green, unopened cones were harvested and an average yield of 60 seeds per cone was obtained (Table 2), closely matching the average value of 50 seeds per cone reported by Croker (1973).

Cones are simply and efficiently collected at South Quay using a 30-foot telescoping forestry pole to knock cones off the tree. This low technology approach avoids damage to the sensitive area through heavy equipment and results in enough seedlings to meet current (non-forestry) demand for longleaf pine restoration in Virginia. A more aggressive harvest of cones could also meet forestry demands. An important point to consider is that the South Quay tract is one of the last native longleaf stands in Virginia currently capable of supplying seed for restoration. As environmental stewards we have a responsibility to ensure that native Virginia longleaf pine is propagated and planted in the state in preference to other genotypes.

Educational Efforts

Potomac Elementary School, in King George County, Virginia was awarded both the Toyota Tapestry and Dominion Virginia Power Partnership Grant to help restore Virginia's longleaf pine and pitcher plants. Students studied germination rates of longleaf pine and reintroduced their 95 seedlings to a county from which longleaf pine had been extirpated in Virginia. The reintroduction occurred at a Virginia Department of Transportation wetland mitigation site (Harris 1999, Anonymous 2000b, Sheridan et al. 2000a, Tenant 2000) and represented a significant recovery effort for longleaf pine in the state. Propagation and research efforts continue in school yard "mini-nurseries".

Regenerating Longleaf Pine from Needle Fascicles

Our goal is to capture the entire native Virginia longleaf pine genome on one preserve. Since non-native longleaf pine trees have been co-planted with indigenous material in some stands truly native provenance may be compromised through seed harvests. If needle fascicles from mature trees can be rooted and regenerated then an entirely native longleaf pine genome can be established on a preserve. Fascicles from grass stage longleaf pine up to three years old can be successfully rooted within one month. The technique involves placing the fascicles upright in a 1cm deep solution of 100 ppm IBA followed by maintenance in a nutrient solution of 60 ppm Boric Acid, 40 ppm Ammonium Nitrate, and 20 ppm Thiamine-HCl (Nelson et al. 1992, Sheridan et al. 2000b). Rooting rates with Virginia longleaf pine have been as high as 65% (Table 3). Only 5% of rooted fascicles have entered the shoot initiation phase while many show evidence of apical meristem development after 10 months. Survival and growth of rooted fascicles, called "needlings", is comparable with conventional seedlings (Lott and Nelson 1999). Although scientists have not been able to get fascicles from longleaf pine over 3 years old to root, researchers eventually hope to find a successful technique to make fascicles from older longleaf pine trees root and regenerate.

Pilot Projects with Landowners

Test sites are important in convincing landowners that longleaf pine is a potential tree for reforestation. Experimental plantings have been done to show landowners that longleaf pine can be successfully planted in Virginia and that growth is satisfactory.

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Table 3. Percentage of fascicles from two year old longleaf pine seedlings that developed roots.

Seedling #	# Fascicles	% rooted	Comments
1	34	0	------------
2	57	0	------------
3	31	65	callus on unrooted fascicles
4	16	0	callus on unrooted fascicles
5	29	24	callus on unrooted fascicles
6	41	10	mix of green and dead fascicles remaining
7	40	0	all dead
8	52	3	50% fascicles still green
9	40	20	50% fascicles still green
10	27	44	44% fascicles still green

Table 1. Calculated cone and seed yield at South Quay longleaf pine stand in Suffolk City, Virginia.

DBH (cm)	Tract 1 # Trees	# Cones/tree	Total	Tract 2 # Trees	# Cones/tree	Total
3	8	0	0	54	0	0
5	10	0	0	17	1	0
8	20	0	0	219	0	0
10	27	1	27	232	1	232
13	22	1	22	168	1	168
15	23	1	23	170	1	170
18	12	1	12	159	1	159
20	26	2	52	144	2	288
23	27	4	108	130	4	520
25	28	4	112	101	4	404
28	22	4	88	75	4	300
30	19	6	114	42	6	252
33	10	6	60	26	6	156
36	12	6	72	22	6	132
38	8	12	96	13	12	156
41	9	12	108	7	12	84
43	2	18	36	4	18	72
46	5	18	90			
48	3	18	54			
51	1	24	24			
53	2	24	48			
Total	296		1146	1737		3093

Calculation

Tract	Total cones	x	Avg. seed/cone	Total seeds
1	1146		50	57,300
2	3093		50	154,650
Total				211,950

Table 2. Longleaf pine seed yield per cone and date of harvest at South Quay, Suffolk City, Virginia.

Date	# Cones	# Seeds	Avg. seed/cone
11/3-11/14/97	121	2614	22
10/15/99	51	1293	25
9/29/2000	47	2855	61