Role of Fire in the Ecology and Management of Shortleaf Pine

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"To successfully reproduce and grow pines we must adapt silvicultural measures to the inherent habits of each species of pine...consisting of the use of prescribed controlled fire at intervals dependent on the species. This is relatively well understood for longleaf, loblolly, and slash pines."

"The relation of shortleaf pine to fire is not so well-known. The regime of prescribed burning needs to be a short enough intervals to keep hardwood sprouts killed back and not have destructive fires that kill saplings. It requires a high degree of technical skill to time the fires as to frequency, in such a manner that pine seedlings can be grown to the stage of effective resistance to winter burns, and the hardwoods kept down."

H.H. Chapman Yale University (1952)

Fire Shaped the Forest of the South

- Fire provides SL a competitive advantage over
 - Hardwoods
 - Other Pines notably Loblolly and Virginia
 - Xeric Oaks with similar fire adaptations (Post, Blackjack, Southern Red, etc)
- Shortleaf Bluestem forests maintained with frequent fire



Fire resitant, fire resilient, fire dependent, or fire adaptedshortleaf relies on frequent fire



Fire Adaptations – Mature Stands

- Thick Platy Bark
- Low amounts of flammable resin
- Needles do not burn as readily
- Resistant to mortality from crown scorch



Shortleaf Pine can withstand hot, dormant-season fires that kill even large hardwoods



Shortleaf is not fire proof, but does become resistant as it grows

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- 4 inch DBH (Walker & Wiant)
- 3-4 inch GLD (USFS Southern Regional Guide)
- 4 inch GLD > 90% chance of surviving (Stambaugh 2006)

- 1.5 inch GLD 50% chance of survival (Dey and Hartman 2005)
- 10' 15' tall (USFS Southern Regional Guide)
- 8-15 years depending on growth rates

Fire Adaptations – seedling and saplings

- Quick young growth
- Persistent cones
- Resistance to fire scar rot
- Sprouting





The Basal Crook





Sprouts vigorously



Shortleaf can sprout multiple times





Shortleaf sprouts better.....

- if burned in the Dormant Season
 - 90 % survival (Cain and Shelton)
 - Only 43% survived a mid- April burn (Lilly 2012)
 - 61% survival for spring burn in Ozarks (Dey & Hartman 2005)
- If burned with low intensity fire

Lilly et.al. 2012

- Mid-April burn
- All seedlings were less than 4 inch GLD.
- Overall 44 % survived
- 181 of 195 seedlings were top killed
- 109 of the top-killed sprouted (60%)
- 40 of the sprouts died during the growing season (37%)
- Summary: 14 survived + 69 sprouted = 44% survived the fire



GLD Affects (Lilly et.al. 2012)



- Mid-April burn
- All seedlings were less than 4 inch GLD.
- < 0.25 inches -75% died
- > 1.5 inches 87% died
- Between 0.25 .75 inches seems to be the sweet spot.

Crook Temperature is important

• Shortleaf sprouts better.....

If burned with low intensity fire (keeping basal crook below lethal threshold)





Shortleaf plantation 15 years after wildfire





Shortleaf or Oak sprouts which one survives fire better?





Percent Mortality after :

	One Burn	Three + Burns
Shortleaf	38	39
White Oak	5	22
Post Oak	9	24
Blackjack Oak	4	41
Scarlet Oak	10	44
Black Oak	10	28
Blackgum	3	50

*Bigger stems survived better **Survival continued to decrease with each burn

Dey and Hartman 2005 Forest Ecology and Management

Fire Frequency – varies North to South - East to West

- In general the frequency was reported as 1-25 years
 - 1-12 years (mean of 3.4 years) in the Ouachita Masters(1995)
 - 2-18 years in Ozarks Stambaugh (2005), Batek (1999)
 - 15-40 years in Jersey Pine Barrens Little (1945)
 - 16-26 years in Jersey Pine barrens Lutz (1944)
 - 2-15 years in the South Wade (2000) , Stanturf (2002)
 - 6 15 year drier sites
 - 2 6 year fertile sites
 - < 10 years for Shortleaf –Oak</p>
 - Few studies East of the Mississippi

Fire Return Interval



Fire Frequency affects natural regeneration

- 2-4 year Intervals
 - Promotes seedling regeneration
- 8 -15 year intervals
 - Favor seedling establishment



Shortleaf, Fire, and Loblolly Pine



Effects of Fire on SL & Lob Reproduction

- Three 65 year old Lob/SL-hardwood stands
- 2- plots/stand (1/4 acre)
- following a prescribe burn
- Counted SL and Lob seedlings and sprouts 2 year after the burn
- Thinned previously to about 70 80 BA
- Roger A Williams Louisiana Tech University

Effects of Fire on SL & Lob Reproduction

	Basal Area		Sprouts		Seedlings		
	SL	Lob	Shortleaf	Lobiolly	Shortleaf	Lobiolly	% Shortleaf
1	12	47	59	0	0	14	81%
2	26	55	51	4	12	99	38%
3	47	14	166	21	37	46	75%

- Shortleaf had the most sprouts
- Loblolly had the most seedlings

Affects of Fire on SL & Lob Reproduction

- Height
 - Sprout size = 11.2 inches
 - Seedling size = 4.8 inches

"SL able to recover from the effects of many fires which eliminate other pines from the forest"



Shortleaf Pine – Pinus echinata

QUESTIONS???

Shortleaf pine – Bluestem Ecosystem Ouchita Mountains - Arkansas

- Reduce SL BA to 60
- Remove hardwood midstory
- Burn -3-4 years
- Retain over-story Oaks







BEFORE





AFTER





Shortleaf – Mixed Stand





Shortleaf is Fire Dependent

- Young shortleaf pine grows slower and takes longer to dominate a site.
- Fire is required to maintain shortleaf on a site in the presence of other pine and hardwood competitors
- It is the sprouting feature that gives SL a competitive edge

Timber Belts of NC in 1894



- Hardwoods, no SL, some cedar and Va Pine
- SL overstory, small Post Oak and Black Jack Oak
- Shortleaf overstory with a broomsedgeMixed hardwoods with SL and Lob



"We travell'd, this day, about 25 Miles, over pleasant Savanna Ground, high, and dry, having very few trees upon it, and those standing at a great distance." Lawson 1701

Fire Shaped the Forests of the South

- Fire selects against SL x Lob hybrids
 - But only when they are young.

Shortleaf Natural Regeneration

• Apply Fire :

- Prior to seed dissemination (Late summer early fall)
- To control woody vegetation and prepare seedbed
- Several burns may be required
- Reduce BA to 30 -50



Mattoon 1915

Adapts to a wide variety of soils, but..... > is more abundant than loblolly on drier, better drained, less fertile sites in the Piedmont >low tolerance to poor soil aeration >low demand for nutrients >more drought resistant than black, scarlet, southern red oak, same as white oak

Disturbance Patterns Influenced the Shortleaf Forest

Naturally occurred

- Dry Oak—Hickory Forest
- Dry-Mesic Oak—Hickory Forest
- Dry Basic Oak—Hickory Forest
- Dry-Mesic Basic Oak—Hickory Forest
- Piedmont Monadnock Forest
- Xeric Hardpan Forest (all subtypes)
- Dry Piedmont Longleaf Pine Forest

