Restoration of Shortleaf Pine in the Southern United States-Strategies and Tactics

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The dominant frequent-fire adapted forest ecosystems in North America are iconic places…

Shortleaf pine-bluestem, Management Area 22 Poteau RD, Ouachita NF, Scott Co., Arkansas

…that have declined,

and are continuing to be at risk of continued decline,

on the southern forested landscape.

Unburned shortleaf pine-oak stand
Jessieville RD
Ouachita NF
Saline County, AR

Photo by JM Guldin, Nov 2014

Forest Futures[1/] forecast of forest area by forest type, 1950 to 2050

Cornerstone E
- High urbanization
- High timber prices
- More planting

Area by forest type	Natural pine	Oak-pine	Planted pine
1950	72.5 million ac	28 million ac	1 million ac
1980	50.0 million ac	30 million ac	15 million ac
2010	31.5 million ac	22 million ac	40 million ac
2050	13.5 million ac	13.5 million ac	67 million ac
Net, 1950-2050	(-59 million ac)	(-14.5 million ac)	+66 million ac

Cornerstone F
- Low urbanization
- Low timber prices
- Less planting

Area by forest type	Natural pine	Oak-pine	Planted pine
1950	72.5 million ac	28 million ac	1 million ac
1980	50.0 million ac	30 million ac	15 million ac
2010	31.5 million ac	22 million ac	40 million ac
2050	24.0 million ac	19 million ac	48 million ac
Net, 1950-2050	(-48.5 million ac)	(-9 million ac)	+47 million ac

[1/] Wear and Greis, 2013. Southern Forest Futures Project Technical Report. USFS GTR SRS-178. https://www.treesearch.fs.fed.us/pubs/44183

The productivity of planted loblolly pine stands is driving that change on industrial lands

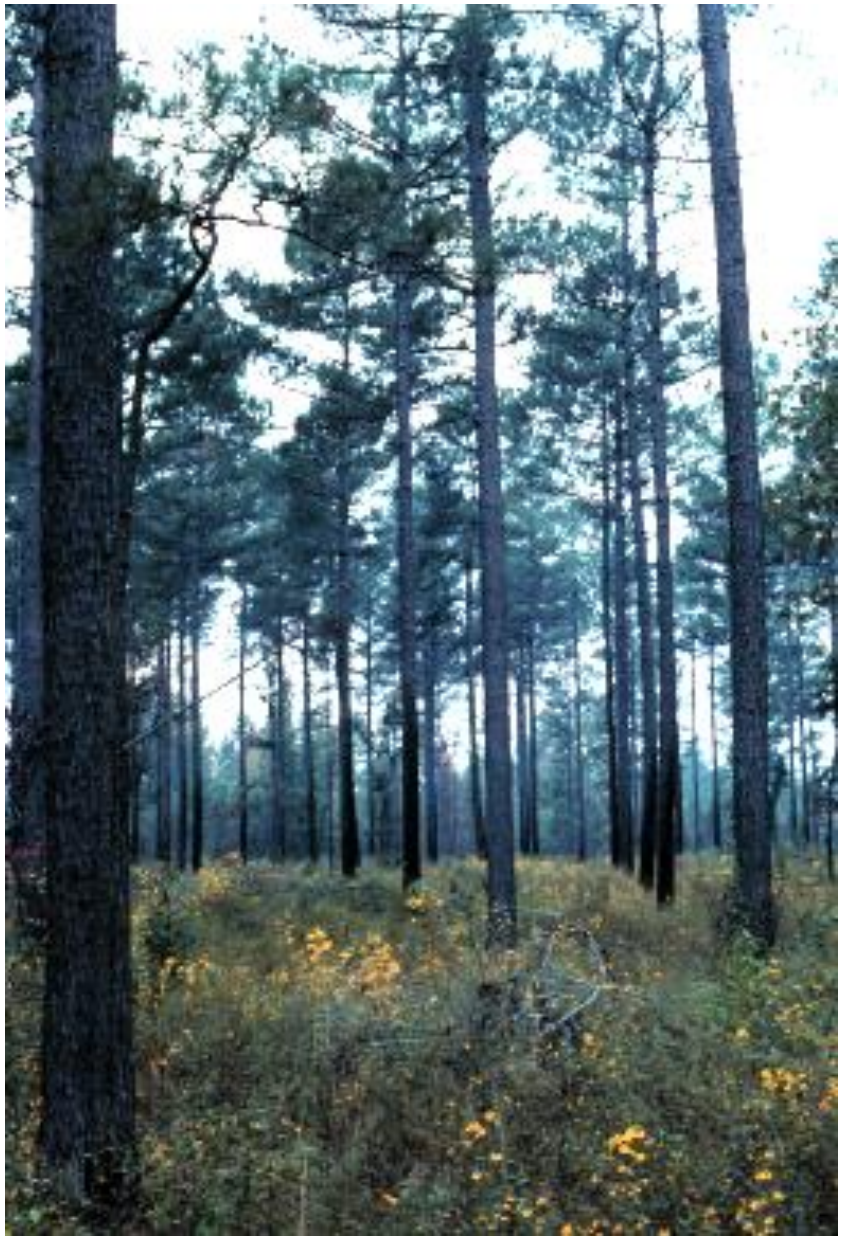


Photo by JM Guldin

Georgia-Pacific
~1982, Drew Co AR

Natural mixed loblolly-shortleaf pine
Rotation age 45 yrs
MAI ~ 480 bf/ac/yr
(~4 T/ac/yr)

Plum Creek
2012, Drew Co AR

Planted loblolly pine
Rotation age 25 yrs
MAI ~ 10 T/ac/yr

Photo by JM Guldin

In addition, for the past 80 years, controlling woodland fires has been a high priority, lest they become wildfires

CCC firefighters in Arkansas, 1930s

Wildfire near Ola, Arkansas, 2012

Photo by JM Guldin

Prevailing Condition

Photo by JM Guldin

Ouachita shortleaf pine

The bottom line:

1) Natural pine and pine-hardwood stands are much reduced in area;
2) Their condition has degraded as well.

Mixed pines, east Texas

Photo by JM Guldin

Why is the loss of native naturally-regenerated, fire-adapted southern pine forest types an issue?

…those habitats are underrepresented on the landscape,

with loss of flora and fauna that depend upon those habitats

MA22, shortleaf pine-bluestem management area, Ouachita NF

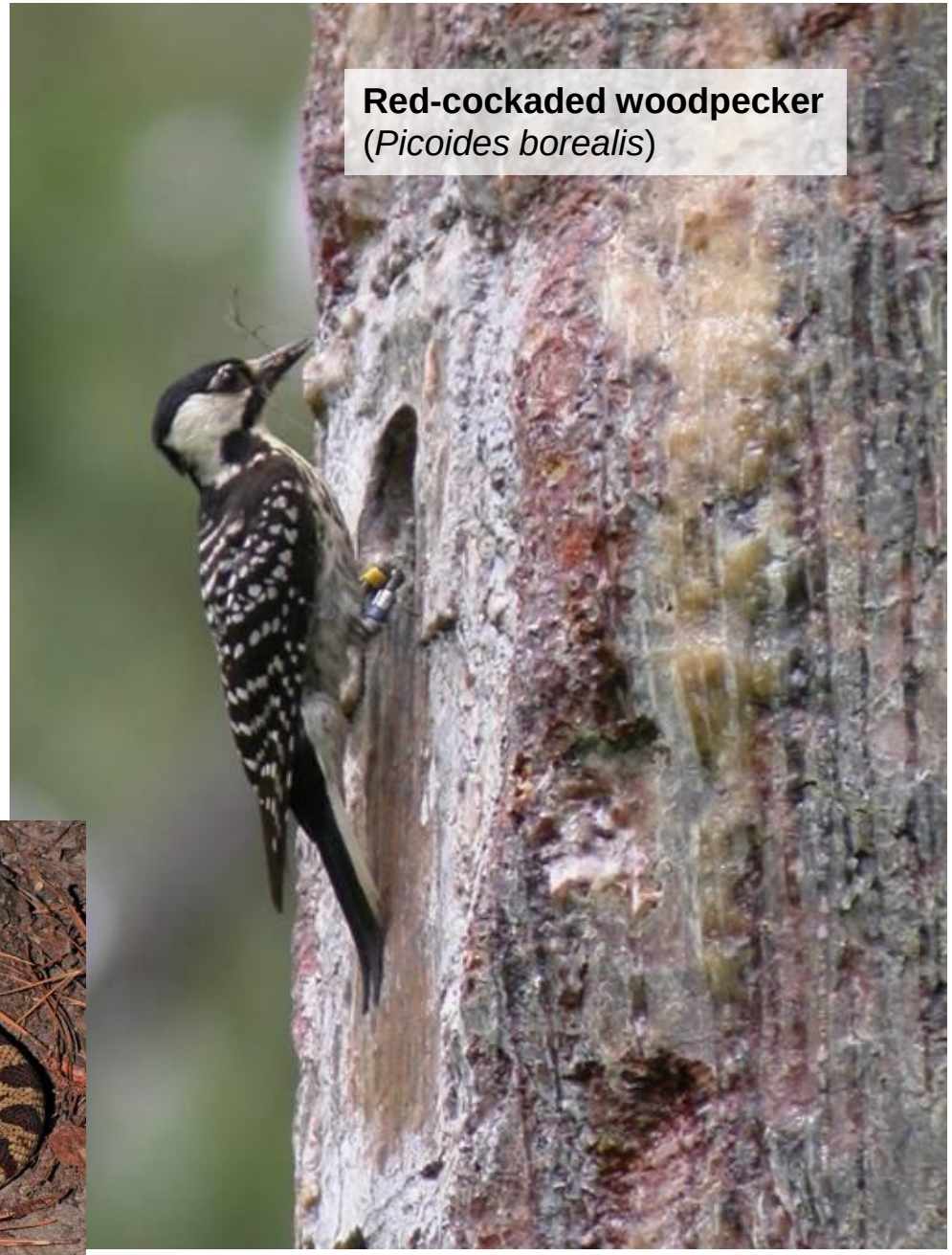
This has led to:
a) Extirpation of native species

b) Population reductions of other species

c) Endangered and threatened status, officially or in review, for still other species--

Harperella
(*Ptilimnium nodosum*)

Louisiana pine snake
(*Pituophis ruthveni*)



Red-cockaded woodpecker
(*Picoides borealis*)

Archetypal example of the decline: longleaf pine ecosystems

Historically	91 million acres
Today	4.3-4.7 million acres
Since 1970	*no net loss*

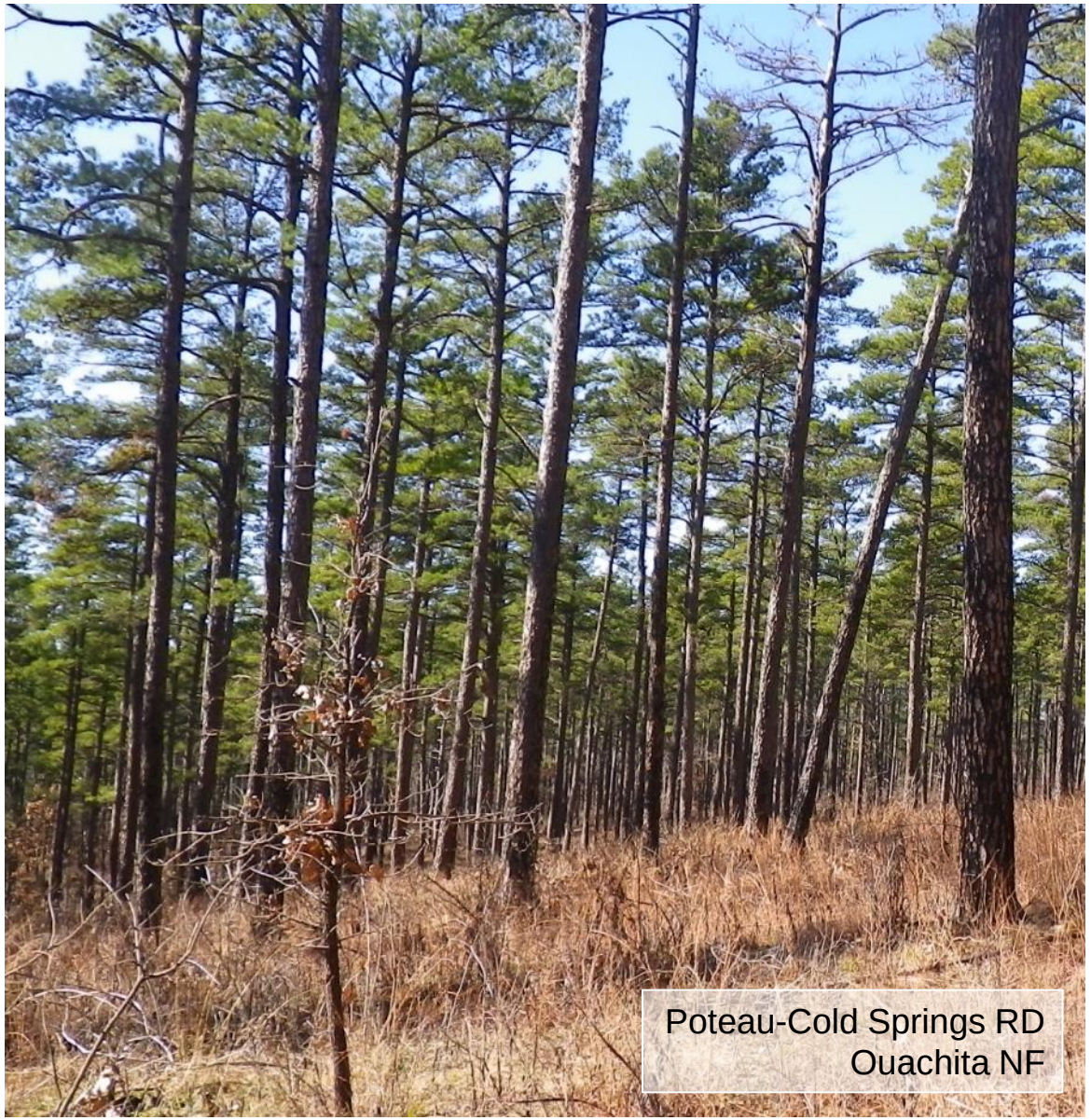
Active restoration program from 2010-2025 under America's Longleaf Restoration Initiative
Goal: 8 million ac

However, there is an equally pressing threat:

- The loss of shortleaf pine across the South

- And, the degradation and loss of shortleaf pine ecosystems

Historically	70-80 million acres
Today	6 million acres
Since 1980	***down > 50 percent!***



Five states have seen decline of > 500K ac in shortleaf pine since 1980:

- Alabama
- Mississippi
- Texas
- Arkansas
- Georgia

(and Louisiana, Tennessee, and Oklahoma are all down > 400K ac)

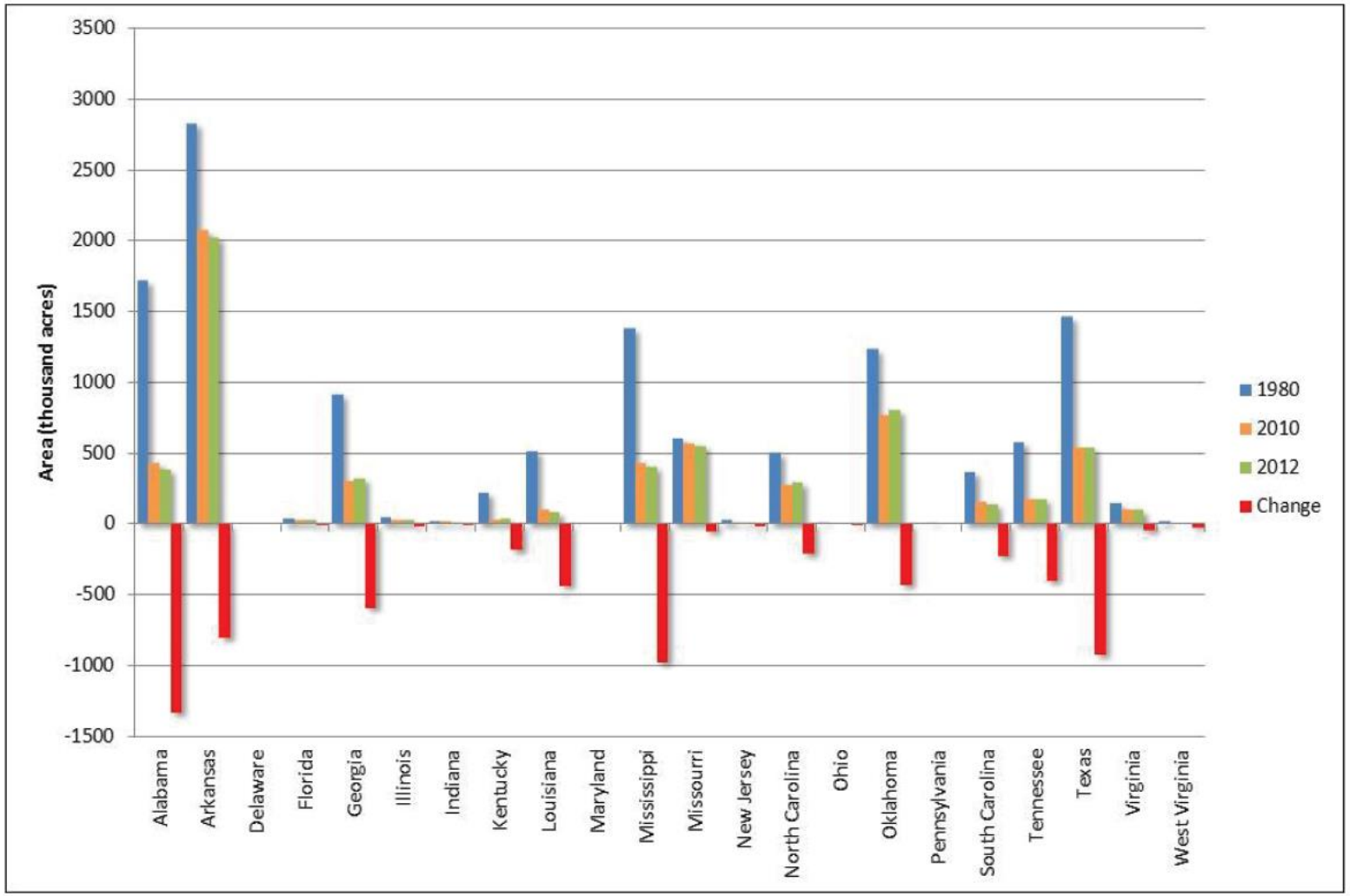


Figure 2. *Decline in shortleaf pine acres on FIA forest plots within historic shortleaf pine range by state, 1980-2012 (unpub. data from Chris Oswalt, cited in Shortleaf Pine Restoration Plan (2016)*

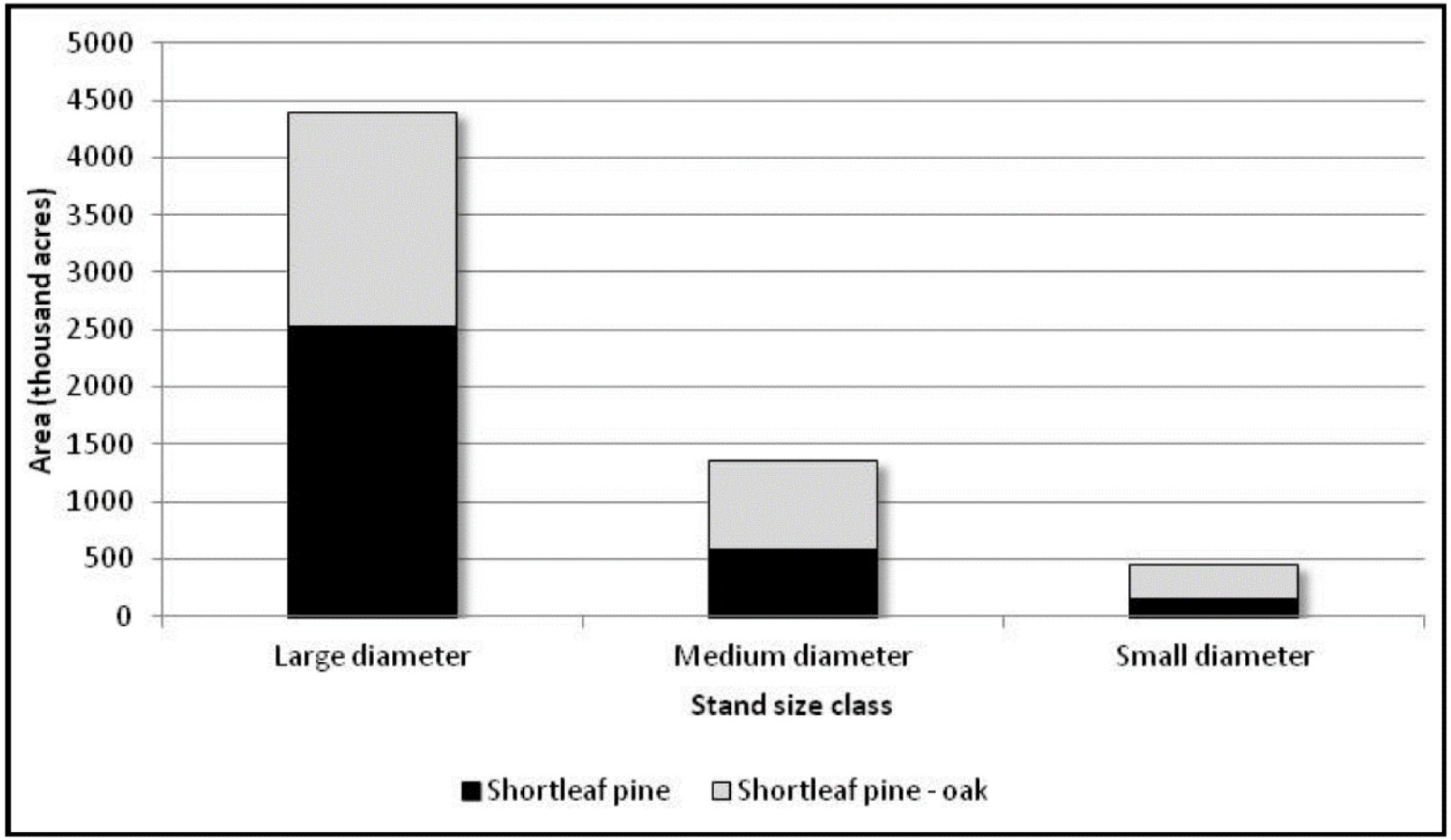
In all these states, in and around 1980:

- large family-owned forest industries that manage mixed pine forests of natural origin have changed ownership to vertically-integrated forest products companies
- in some cases, those changed ownership again (and again) to REIT/TIMO lands
- coincides with an increase in planted pine acreage by 25 million ac

→ *We suspect that a majority of this decline is on the highly productive Coastal Plan sites, where*
- the natural range of shortleaf pine is sympatric with loblolly pine, and
- where sites have been converted from native stands to more productive plantations

The distribution of tree size in existing shortleaf pine stands is skewed towards large diameter trees

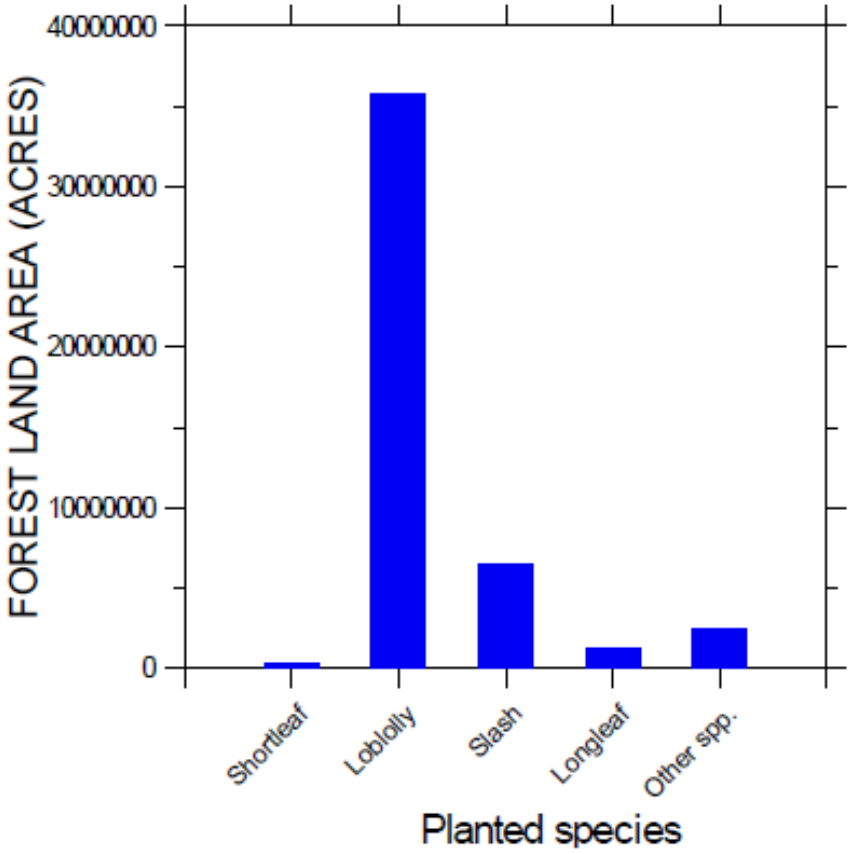
…raises concerns about long-term sustainability



Size distribution of shortleaf pine and pine-oak stands using FIA data, 2010 *(Oswalt, 2012)*

And not much shortleaf pine is planted!

FIA data on tree-sized planted stands
(trees > 1.0 inches dbh in the stand)



Total planted tree-sized area:
46,172,109 ac

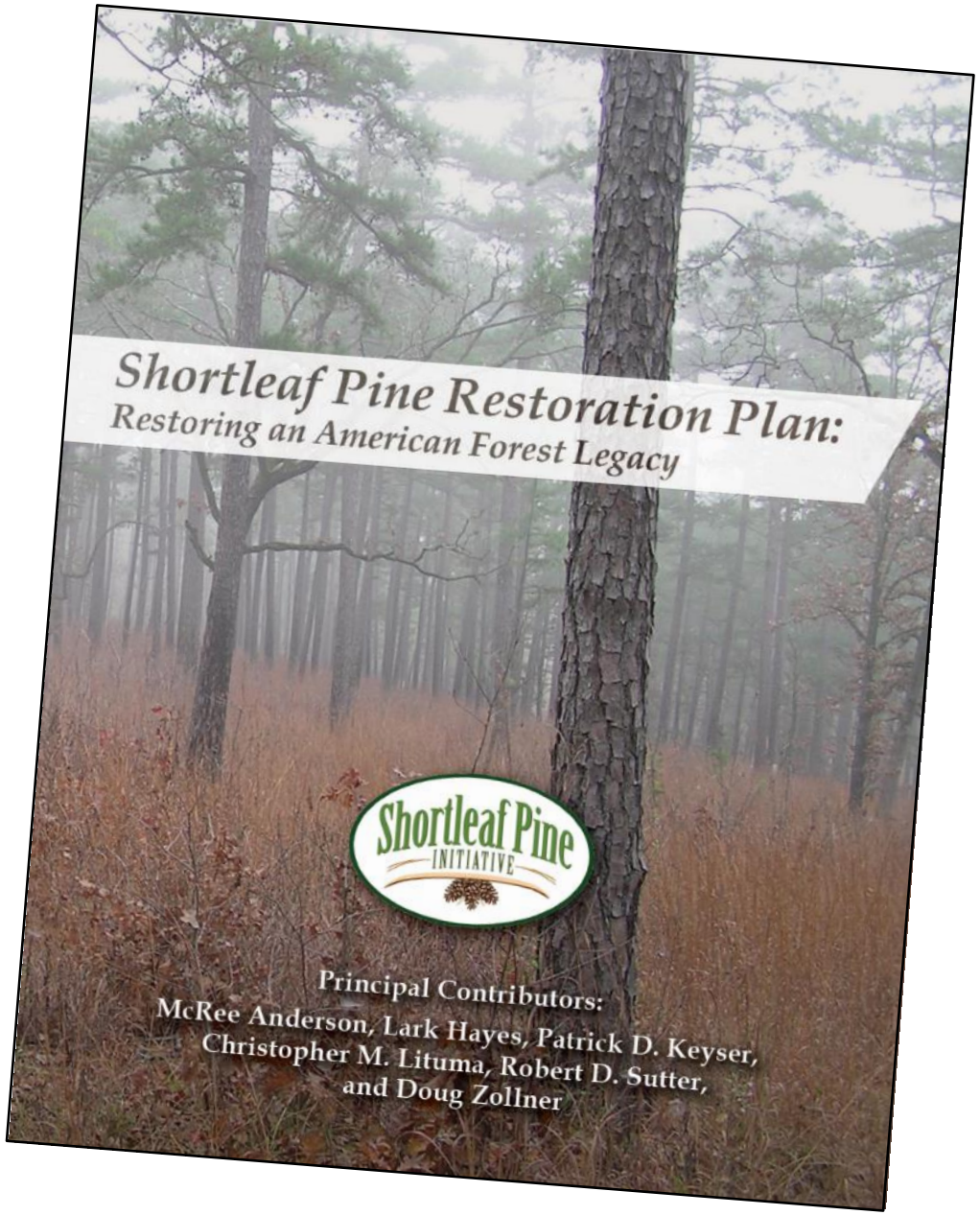
Total planted tree-sized shortleaf area:
287,184 ac
(0.6 percent of total)

80% of these in the Ouachitas and Ozarks

(graph by JF Rosson 0915)

The release of the Range-wide Conservation Plan for Shortleaf Pine in the summer of 2016

- outlines a series of optimum restoration strategies
- increased needs for coordination among proponents interested in shortleaf pine
- ways for partners to work together



Finally, what does this existing shortleaf pine resource look like?

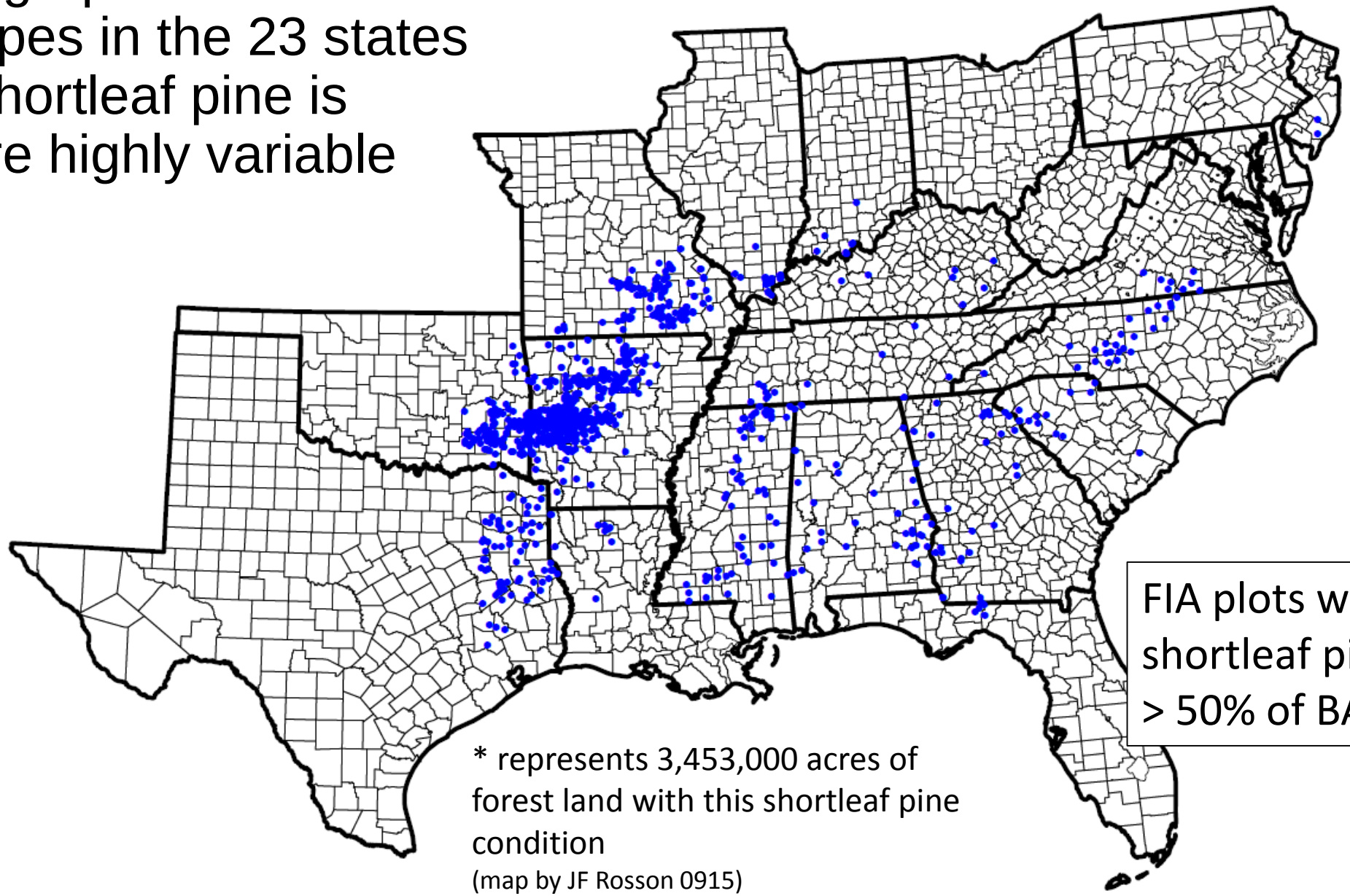
Of the 6 million acres of Southern forests currently in shortleaf pine:

Shortleaf pine type	3.235 million ac	54 %
Shortleaf pine-oak type	2,796 million ac	46 %

By way of comparison, longleaf pine at 4.3 million ac in 2012:

Longleaf pine	3.301 million ac	77 %
Longleaf pine-oak	0.985 million ac	23 %

The geographic conditions and forest types in the 23 states where shortleaf pine is found are highly variable



* represents 3,453,000 acres of forest land with this shortleaf pine condition

(map by JF Rosson 0915)

That map suggests that silvicultural prescriptions to manage shortleaf pine in fully-stocked shortleaf pine-dominated stands in the Ouachita Mountains of Arkansas and Oklahoma…

Shortleaf pine in MA22
Poteau RD, Ouachita NF, Scott County AR

…will be different from the silvicultural prescriptions to manage shortleaf pine in fully-stocked shortleaf pine-dominated stands in the Ozark Plateau in Arkansas and Missouri…

Shortleaf pine-scarlet oak stand
Pioneer Forest, Salem MO

…and different from efforts required to regenerate shortleaf pine in pure or mixed stands in the Cumberland Plateau of eastern Tennessee..

Catoosa State WMA
Crossville TN

..or, the southern Appalachians of western North Carolina….

Shortleaf pine stand, Uwharrie RD, NFs of North Carolina (Mike Black)

…or, the northern edge of Appalachian-Blue Ridge complex as far north as Pennsylvania….

Shortleaf pine in Pennsylvania Blue Ridge
Juniata County, PA
(hunting camp founded by my grandfather; cousins are still active members)

Photo by JM Guldin, Apr 2013

…or, the pine barrens of New Jersey.

Shortleaf pine thinned and burned in New Jersey (Bob Williams)

What factors must a landowner, or the forester advising a landowner, consider when planning a project for restoration of shortleaf pine?

Active RCW cluster, MA22, Ouachita NF

1. Is the site of suitable size to allow for cost effective forest management activities – site prep., planting, Rx fire, thinning, and final harvest?

Although actual acreage varies for a variety of reasons, small parcels of less than 25 acres should be approached with caution unless part of a larger landscape of similar management.

Poletimber planted stand of shortleaf pine
Thinned and cyclic Rx fire
MA22, Ouachita NF

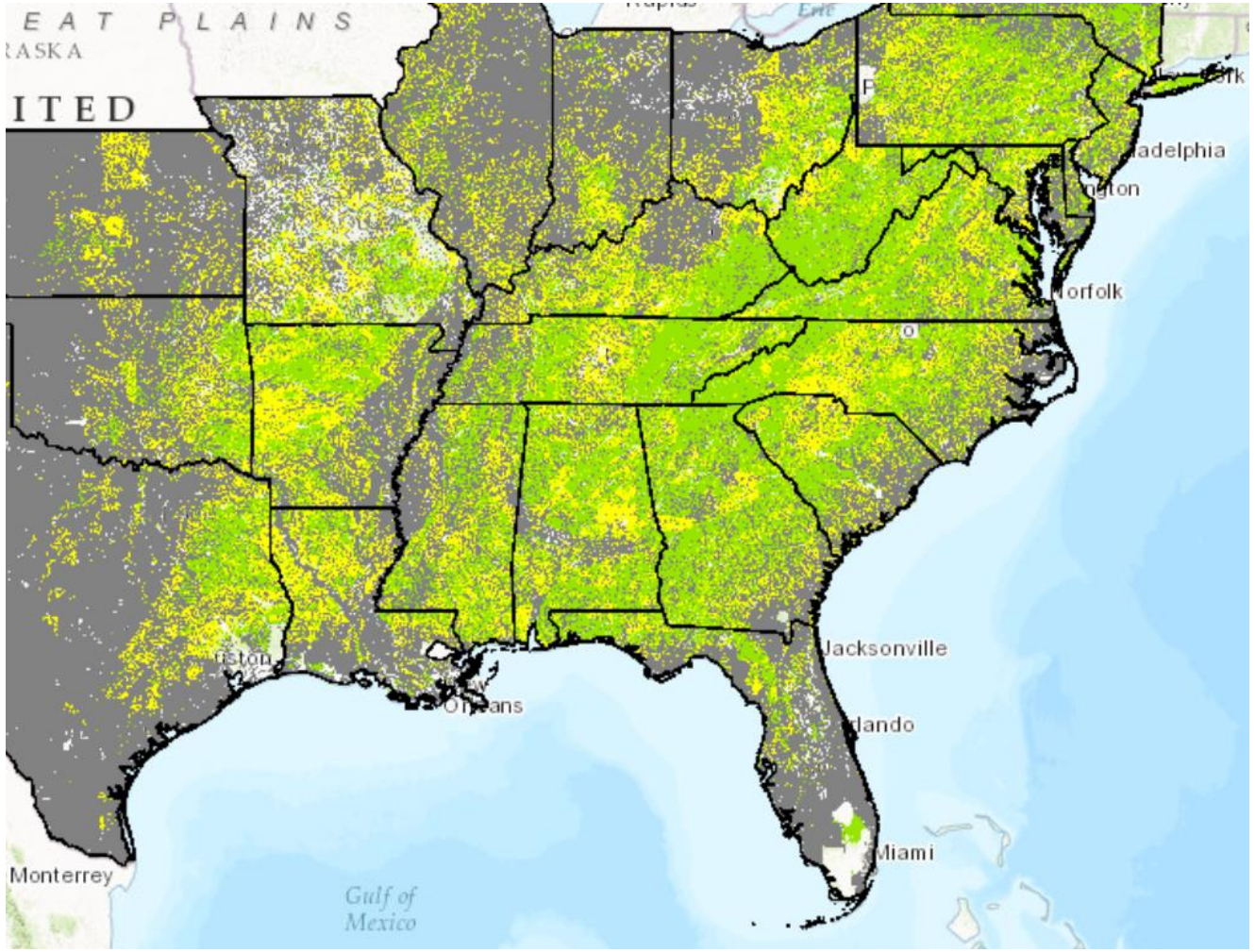
2. Do the sites currently support stands that have a manageable existing shortleaf pine component, or is shortleaf pine rare or absent from the stands?

Working with a minor manageable shortleaf pine component may be one of the better and least expensive ways to restore shortleaf pine.

Seed trees of both loblolly and shortleaf pine
Group shelterwood demonstration
Crossett EF, Ashley Co., AR

3. Are the sites where restoration is planned dry and xeric, or wet and mesic?

Shortleaf can grow across a wide range of soil types, but it may have competitive advantage versus other conifers and hardwoods on dry, xeric conditions, especially in the western part of its range.

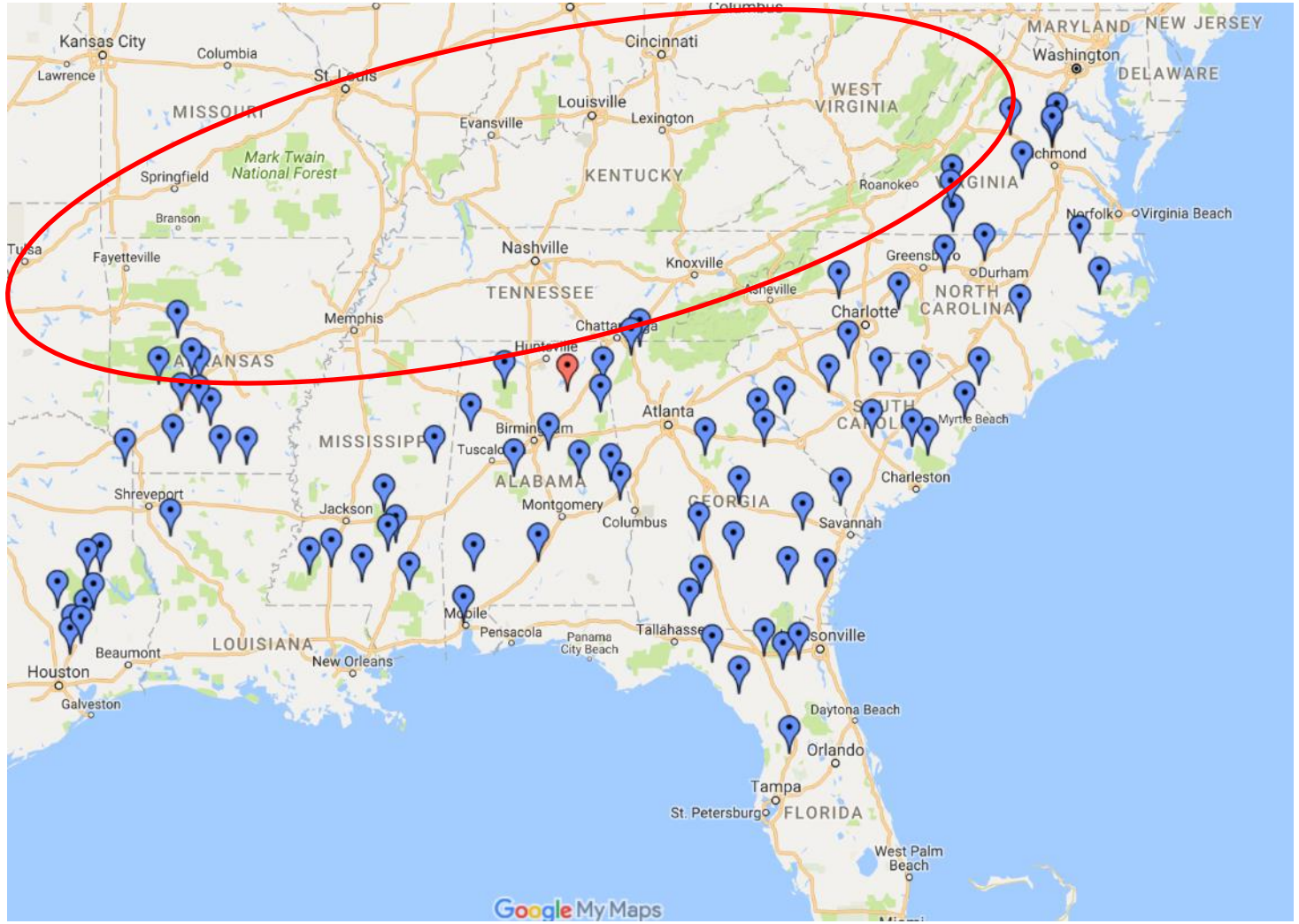


Shortleaf pine soil limitation map
Site suitability and decision support tool
Shortleaf Pine Initiative web site
http://shortleafpine.net/tools-and-resources/site-suitability-and-decision-support-tool

4. Are the sites where restoration is planned within the woodshed of local mills, and are there local markets for pine timber?

Knowing there is a market for trees harvested during thinning and ultimately for mature shortleaf will be critical to enable a cost-effective restoration program.

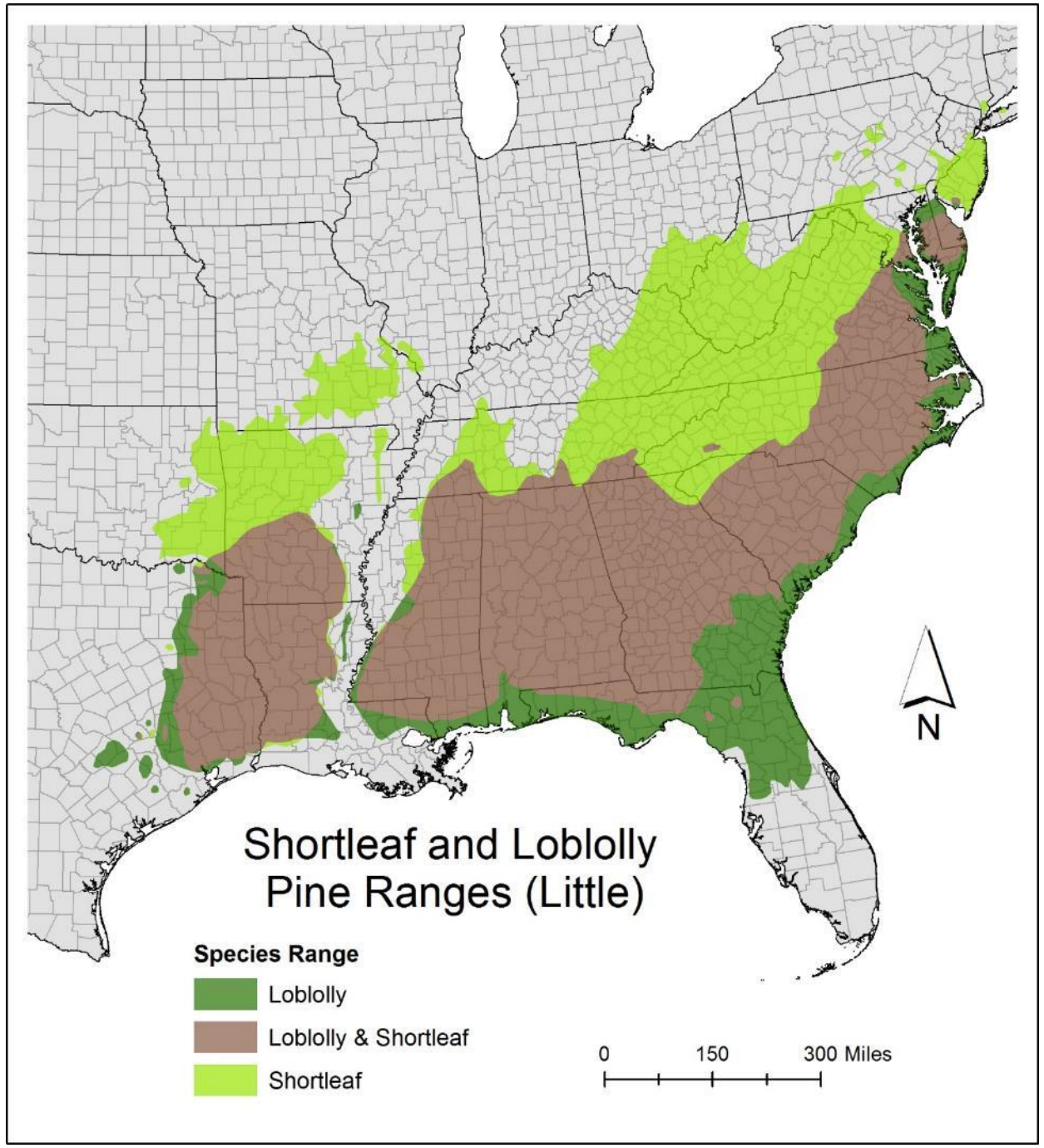
Not many mills is the allopatric range of shortleaf!



Google search, “Sawmill map of SE”
https://www.google.com/maps/d/viewer?mid=1ytU6tRwfrZI5Z6Hu0Y5fypBavqk&hl=en&ll=36.91176091967472%2C-98.87790138242434&z=6

5. Is the site for shortleaf pine within the natural range of loblolly pine, or to the north of it?

It will be easier for landowners to justify planting shortleaf pine if it's to the north of loblolly pine's natural range.



Map created by: Steven Weaver, SREF

http://shortleafpine.net/growing-shortleaf-pine/site-selection-and-preparation/maps/shortleaf-pine-other-relevant-maps

Simple plantation G&Y model using FVS, 40-year rotation length

Arkansas Coastal Plain example

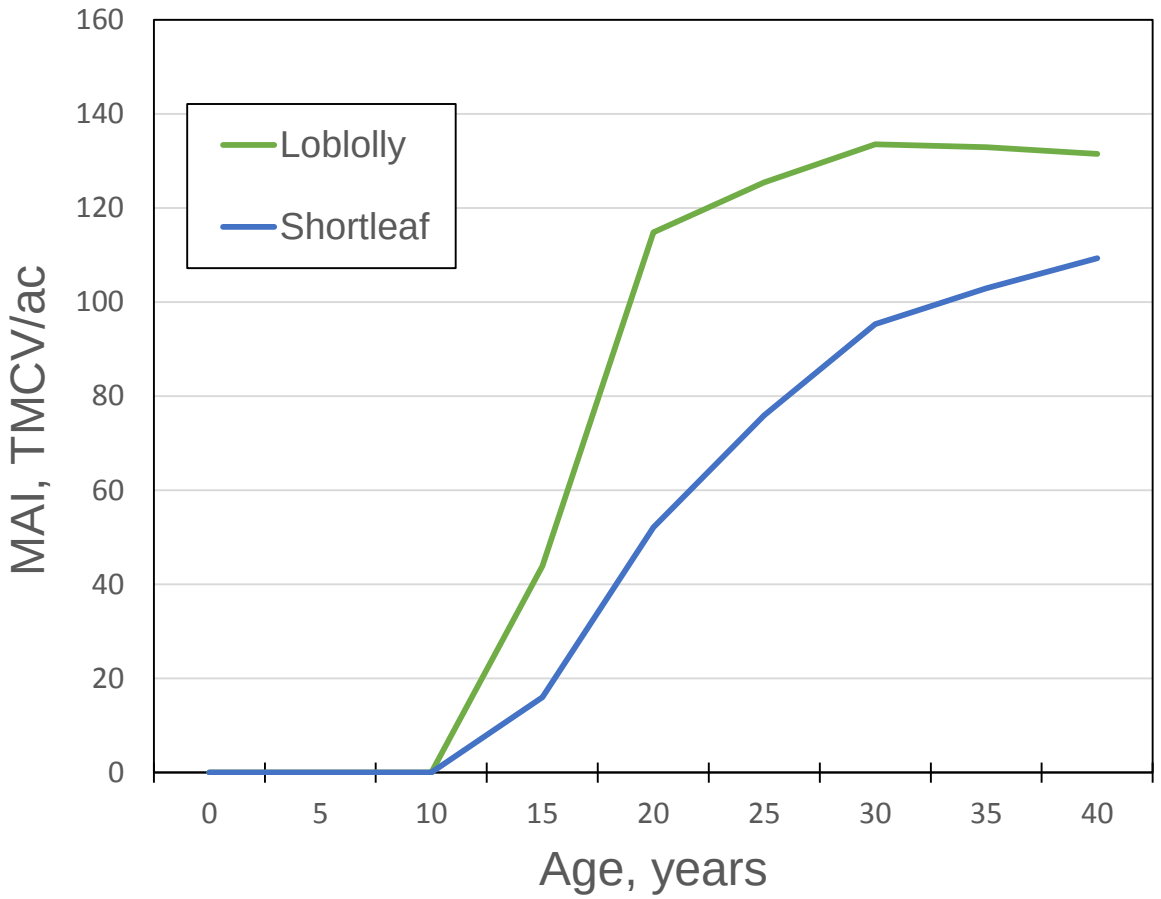
Age 0 Plant 605 TPA, 8'x9'
Assume 90% survival

Age 20 Thin from below to 70 ft^2/ac

Age 30 Thin from below to 70 ft^2/ac

Age 40 Calculate MAI, total merch. cubic volume, ft^3/ac

Faster early volume growth rates for loblolly pine vs shortleaf pine on typical west Gulf Coastal Plain sites



Simple plantation G&Y model using FVS, 40-year rotation length

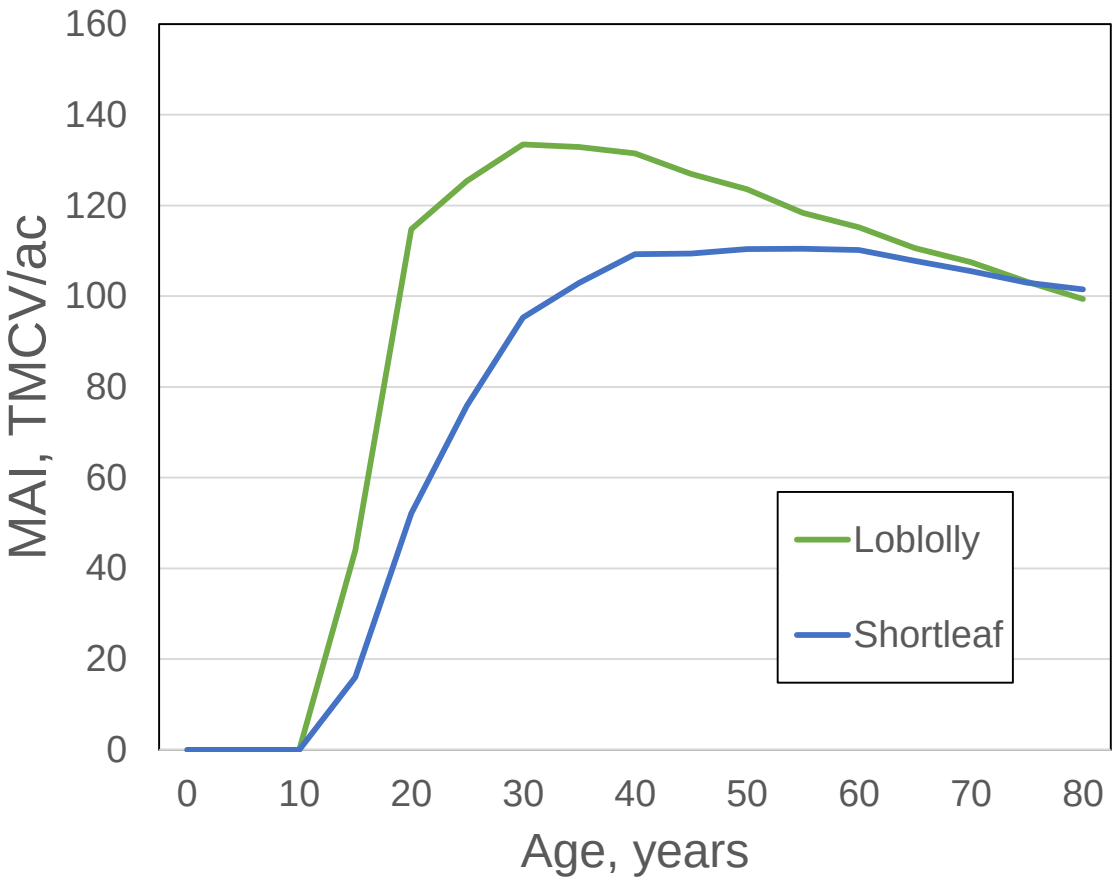
Arkansas Coastal Plain example

Age 0 Plant 605 TPA, 8'x9'
Assume 90% survival

Age 20-70 Thin from below to 70 ft^2/ac

Age 80 Calculate MAI, total merch. cubic volume, ft^3/ac

But…shortleaf pine catches up over time, and provides more options for mature stand management (i.e., RCWs)



6. Is the site characterized by homogeneous within-stand topography (where prescribed fire can be easily applied) or is it in rough topography?

Prescribed burning, especially in young stands, will be easier to apply on sites that are relatively homogeneous rather than in rugged terrain.

Prescribed fire effects, Feb 2017
Second age cohort, 4-10 yrs old
MA22, Ouachita NF

Prescribed fire in rugged and steep terrain is an entirely different matter

Conifer stands on part, but not all, of an Appalachian hillside
Southwestern Virginia

7. Does the site have a history of agricultural use, or has it always been in forest?

If the site has an agricultural past, work will be needed to restore understory flora as well as shortleaf pine.

40-yr-old loblolly pine planted on an old cotton field
(former) Sudden Sawlog Study, Ashley County AR

Stands with no agricultural history--understory flora may well come back on their own from suppressed rootstocks.

Big bluestem

Elliott's bluestem

Little bluestem

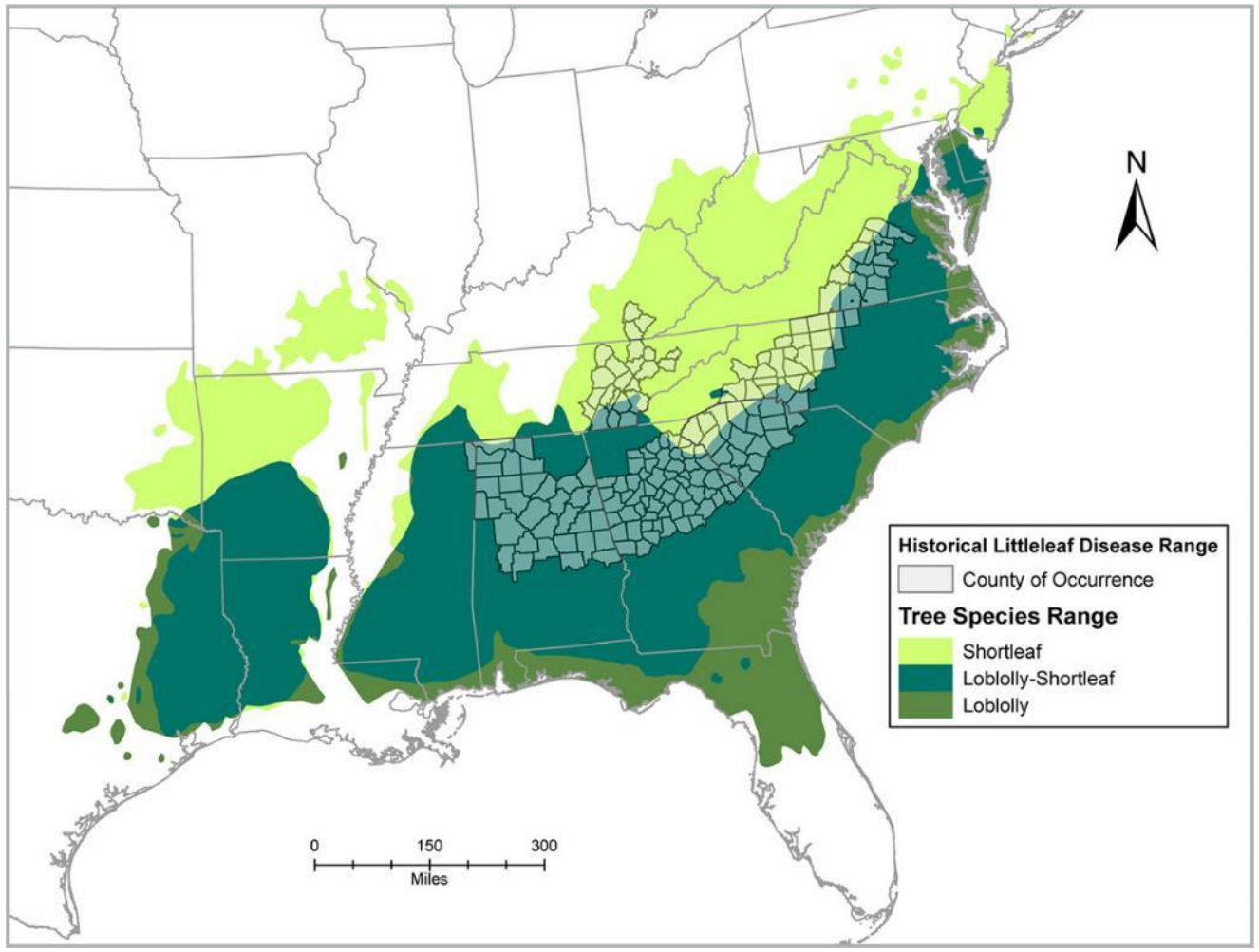
Broomsedge

Otherwise—artificial regeneration of native understory plant species may be needed

Harvesting grass seed is feasible, but not exactly easy, in open, well-burned shortleaf pine stands

8. Is the site within the range of littleleaf disease, and if so, is it on eroded terrain?

Factor type	Organism, Characteristic, or Quality
Biological	Primary fungal pathogen: *Phytophthora cinnamomi* Rands Susceptible host: several southeastern pines (especially shortleaf pine) Secondary fungal pathogen: *Pythium* species Secondary organism: several nematode species
Site	Primary site factors: history of littleleaf disease Secondary site factors: site index, slope, aspect
Soil	Primary soil factors: Soil erosion and internal drainage Secondary soil factors: soil nutrition and aeration



http://shortleafpine.net/growing-shortleaf-pine/forest-health/diseases-and-pests/littleleaf-disease

It will probably be easier to restore shortleaf pine on sites that have not had littleleaf disease in the past, or if within the range of littleleaf, on healthy uneroded sites

-good soil aeration

-thinning to maintain tree vigor

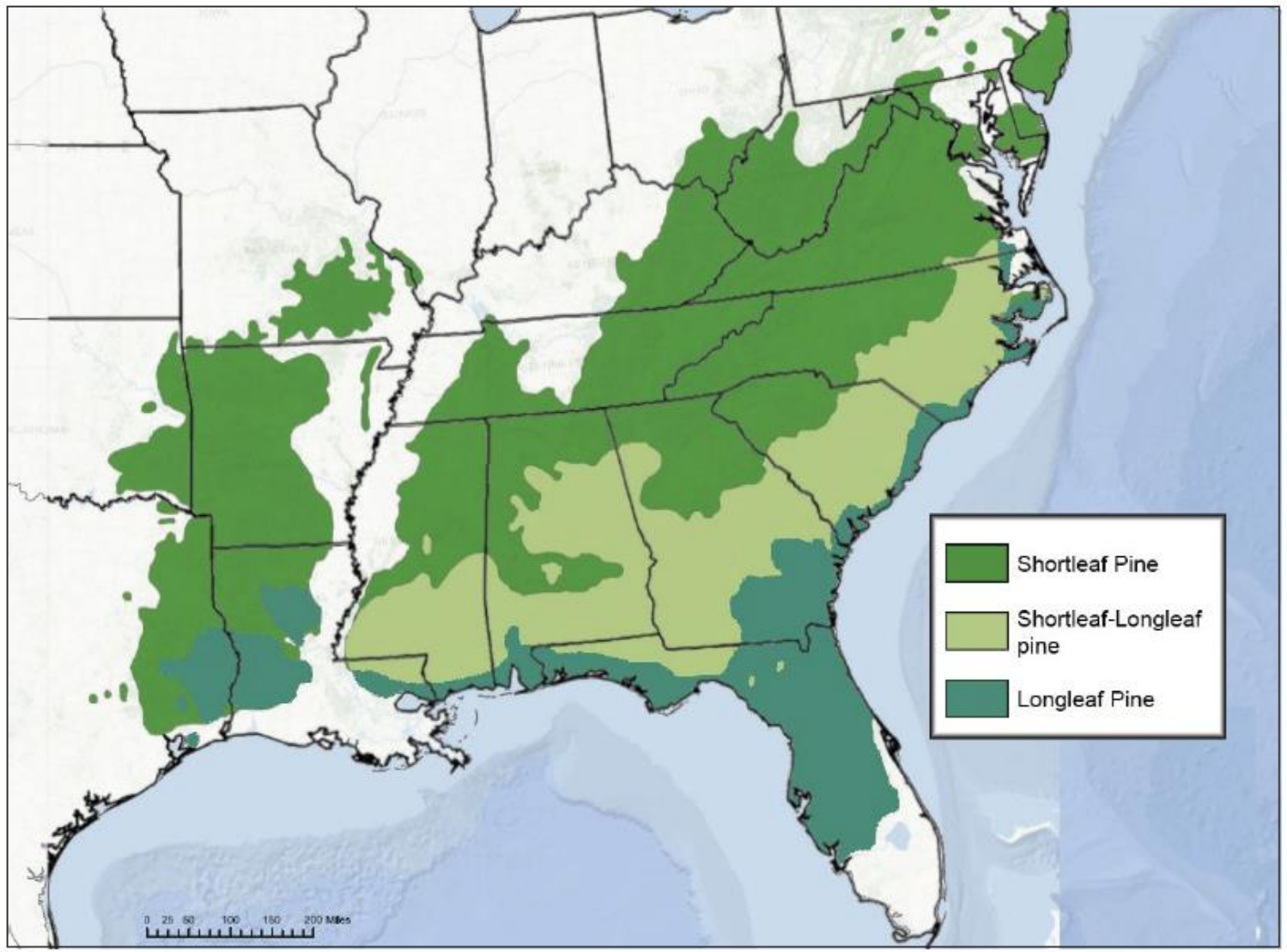
-vigilance with respect to crown dieback

Eroded site supporting mixed pines
Tuskegee NF, near Auburn AL

9. And then there's the issue of "dueling initiatives!"

Within the sympatric range of shortleaf and longleaf pines, which species do we restore?

Psst—both!
Speaks to 'native pine initiative' notion



Distribution of shortleaf pine and longleaf pine
(Shortleaf Pine Restoration Plan, 2016)

10. Lastly—embrace management of mixed species stands!

The research support for managing mixed-species stands is scant at best

Research is needed on underplanting and interplanting shortleaf pine in stands with varying degrees of residual structure

Also need research on natural regeneration methods that develop mixed-species stands

Two-aged shortleaf pine-oak or oak-pine stand
Jessieville RD, Ouachita NF

DISCUSSION

Shortleaf is an iconic southern pine forest type in pure and mixed stands across the region

But it is gradually being lost in stands and landscapes across the South

State record shortleaf pine
Ashley County, AR

Lost to a tornado in April 2009

Photo by DC Bragg, Oct 2007

DISCUSSION

Planting will be required for its restoration, and not much planting is done

Planted shortleaf pine stand
DOB, ~1990
10 cyclic Rx burns
Ouachita NF, Scott County, AR

DISCUSSION

If planting becomes important…

substantial effort will be needed by Feds, States, and private sector to build seed production, and thereby, seedling production, to dramatically expand planting of shortleaf pine

First generation seed orchard
Eastern Ouachita block, shortleaf pine
USFS Seed Orchard, Mt. Ida, Arkansas

Restoration will be relatively straightforward in states west of the Mississippi, especially the Ouachitas of Arkansas and Oklahoma

Thinned and burned shortleaf pine

Oklahoma RD, Ouachita NF

Prescribed burning is critical for restoration of pure or mixed shortleaf pine stands

Operational landscape-scale Rx fire, 2007

Ouachita NF

The primary emphasis in restoration of the diverse shortleaf pine forest types should not be planting 150K ac annually, as we are doing in longleaf pine…..

Rather, the highest priority will be to salvage existing stands that still have some shortleaf pine

Cutting cycle harvest in a shortleaf pine-white oak stand Hymont Road, Pioneer Forest, near Salem MO

A key--managing existing stands that have a shortleaf component

Shortleaf pine in a mixed species overstory stand, with abundant sapling shortleaf pines

Tall Timbers Research Station
Feb 2009

Restoration of mixed pine-hardwood and hardwood-pine stands will be a big part of restoration of shortleaf pine-dominated ecosystems

Silviculturists are not very good at this

Cutting cycle harvest in a shortleaf pine-white oak stand Hymont Road, Pioneer Forest, near Salem MO

Restoration in mixed stands will include mixed-species pine-dominated stands as well

For example-restoration in loblolly-shortleaf mixed pine forests of the Gulf Coastal Plain will be key on family forest lands and Federal lands

Natural loblolly-shortleaf mixed pine type
Felsenthal NWR, Ashley County, AR

An advantage of mixed stands with a shortleaf component—a possible hedge against the stress of late summer drought

Maintaining shortleaf pine as an element of mixed pine stands may have adaptive value under changing climatic conditions

Shortleaf (L) and loblolly (R) pines
Reynolds Research Natural Area
Crossett EF, Ashley County, AR

Photo by JM Guldin, Oct 2007

Finally, strategies and tactics for restoration of shortleaf pine will differ from those used in longleaf pine

But these efforts must be synergistic, not in conflict

Three species of pines in a managed natural stand
Kisatchie NF

Questions??

Shortleaf pine, mixed pine-oak, and oak-pine forests (plus a finger of non-native loblolly plantations) as far as the eye can see!

Looking over Lake Winona, the water supply for the City of Little Rock