THE SHORTLEAF RESOURCE

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ABSTRACT

Shortleaf pine (*Pinus echinata Mill.*) is found throughout the South and is the second most important southern pine. The area of shortleaf stands has been declining in recent decades and shortleaf pine growing-stock volume decreases are expected in the near future. Shortleaf's decline is the result of management preferences for other pine species and reductions in the area of cutover land and retired agricultural land, once common sources of shortleaf pine acreage in the South. Shortleaf pine management should continue as an important option in regions where other pine species do poorly and on nonindustrial forests.

INTRODUCTION

Shortleaf pine is the most widely distributed of the southern yellow pines, ranging from Texas to New York (U. S. Department of Agriculture, Forest Service, 1965). It ranks second behind loblolly pine (*Pinus taeda L.*) for its contribution to total softwood volume in the South and is important to timber economies throughout most of its range. Shortleaf flourishes across the southern Coastal Plain and is known for its ability to tolerate drier upland sites, making it important in the Highlands and Piedmont province.

This paper summarizes timber statistics compiled from periodic inventories conducted by USDA Forest Service Forest Inventory and Analysis units (Forest Survey). The information was compiled in a cooperative effort between the Southern, Southeastern, North Central, and Northeastern Forest Experiment Stations of the Forest Service, with the goal of providing complete coverage of the shortleaf resource. Most of the data contained in the tables and figures are taken from the most recent surveys of Alabama (Rudis et al. 1984), Arkansas (van Hees 1980), Florida (Bechtold and Knight 1982), Georgia (Sheffield and Knight 1984), southern Illinois (Raile 1987), southern Indiana (Spencer 1969), Kentucky (Kingsley and Powell 1978), Louisiana (Rosson et al. 1986), Mississippi (Murphy 1978), Missouri (Spencer and Essex 1976), North Carolina (Sheffield and Knight 1986), Oklahoma (Murphy 1977), South Carolina (Knight and McClure 1979), Tennessee (Birdsey 1983), Texas (Murphy 1976), and Virginia (Brown 1986). Other States where shortleaf is found as a minor

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forest component are excluded in all but Figures 1 and 3. States where shortleaf is considered rare are Delaware (Ferguson and Mayer 1974a), Maryland (Powell and Kingsley 1980), New Jersey (Ferguson and Mayer 1974b), Ohio (Dennis and Birch 1981), Pennsylvania (Considine and Powell 1980), and West Virginia (Bones 1978). Some supplemental data are limited to the Southern and Southeastern Regions as noted.

Shortleaf's far-reaching range covers several physiographic provinces. The data in this report have been grouped into two broad provinces: the Coastal Plain province and the Highlands and Piedmont province. The Coastal Plain spans the Gulf and Atlantic Coastal Plains and includes the Hilly, Middle, and Flatlands physiographic provinces. Delta provinces along the Mississippi River, where shortleaf is rare, have also been grouped with the Coastal Plain provinces. The Highlands and Piedmont province encompasses the Ouachita Highlands, Ozark Plateaus, Interior Low Plateaus, Appalachian Plateaus, Valley and Ridge, and Blue Ridge provinces along with the Piedmont province, which lies northwest of the Atlantic Coastal Plain extending from Alabama northeastward to New York.

AREA

Forest Survey type classification is based on the relative stocking of pine and hardwood species. The shortleaf pine type is defined as forests in which pine comprises at least 50 percent of the stocking of all live trees, with shortleaf pine the most common pine (U. S. Department of Agriculture, Forest Service 1972). The shortleaf pine type is a sub-type of the loblolly-shortleaf forest type. This major type also includes the loblolly pine type, along with some lesser pine types, and is the predominant forest type of the southern pine region (Barrett 1980). Shortleaf is also an important component in the mixed pine-hardwood or oak-pine forest type. Mixed pine-hardwood stands are defined as those in which pine comprises from 25 to 50 percent of the total stocking. The most common associates of shortleaf pine are loblolly pine, oaks, hickories, and gums.

Shortleaf pine is prevalent across the South, extending into Missouri and eastward into Virginia and Pennsylvania (Figure 1). The distribution map includes all counties having timberland classified as the shortleaf forest type or in which shortleaf pine growing-stock volume[2] is found. As shown, the current distribution of shortleaf pine overextends its natural range as described by Little (1971). Planting efforts during the 1930's through the 1960's have established shortleaf in southwest Indiana and expanded its occurence in Missouri and southern Illinois.

The area of the shortleaf pine type has been declining steadily over the past 30 years. Its extent prior to that time can only be surmised since very few records exist. Early information on the shortleaf pine type is further

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[2] The volume of sound wood in the bole of shortleaf trees 5.0 inches d.b.h. and larger from a 1-foot stump to a minimum 4.0-inch top diameter outside bark, or to a point where the central stem breaks into limbs. Trees that are unmerchantable for saw logs (currently or potentially) because of defect or rot are excluded.

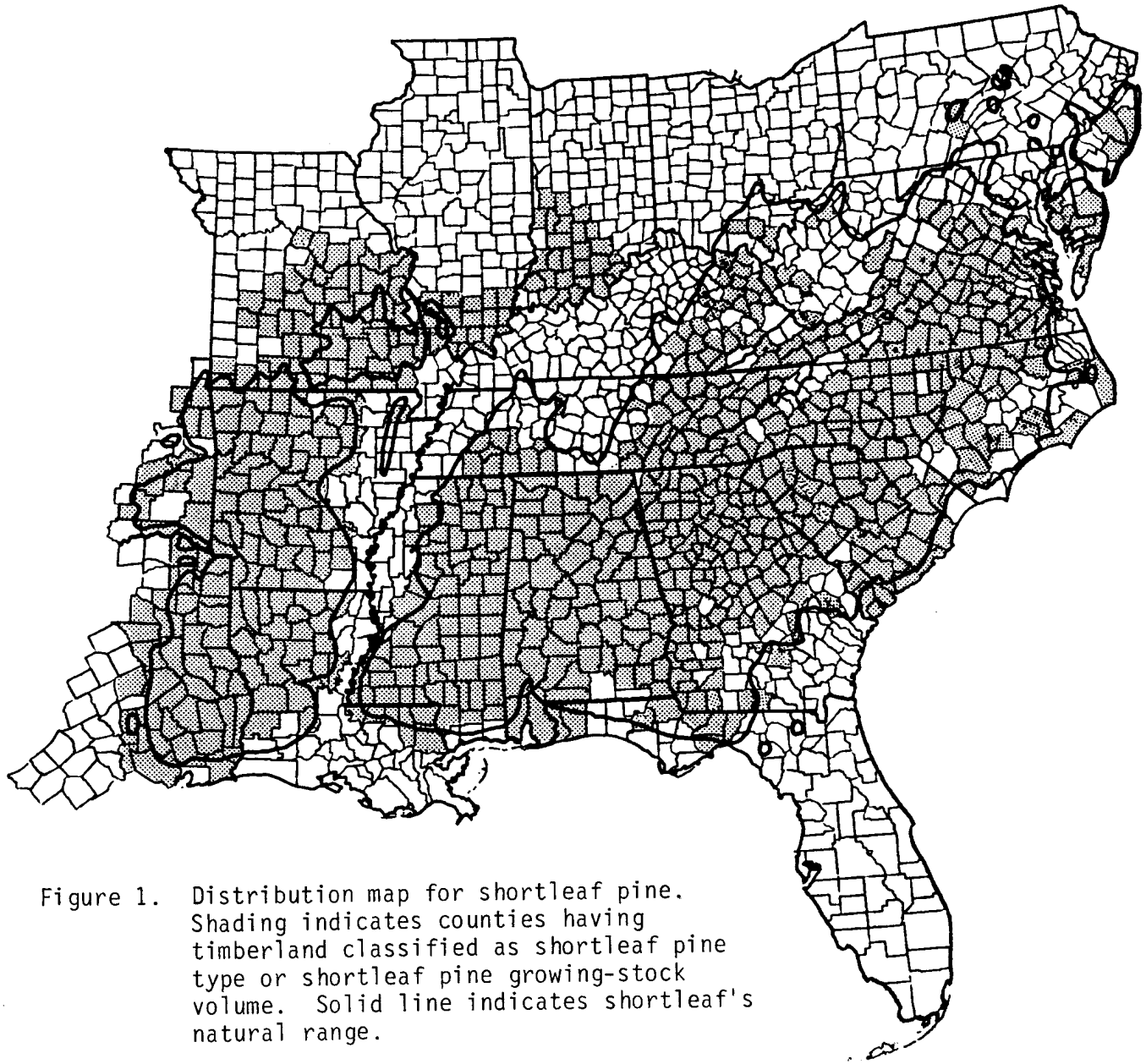

Figure 1. Distribution map for shortleaf pine. Shading indicates counties having timberland classified as shortleaf pine type or shortleaf pine growing-stock volume. Solid line indicates shortleaf's natural range.

limited since some Forest Survey records do not distinguish shortleaf from the loblolly-shortleaf forest type. An estimate based on the current distribution and trends observed over the last 20 years indicates that the shortleaf type may have occupied 16 to 17 million acres in the early 1950's. This most likely represents a peak. In the first half of the century, shortleaf expanded by populating cutover virgin forest comprised of pines mixed with hardwoods and sparsely stocked second-growth acreage that was burned repeatedly by wildfire. During the late 1940's and 1950's, additional acreage became available from retired agricultural lands (Boyce and Knight 1979).

Recent declines have been most rapid in the Southeastern region, where the acreage of shortleaf pine type went from 7 million acres in the early 1950's to 3 million acres in the late 1970's and is currently estimated to be just under 2 million acres. In the South Central region, shortleaf occupied 9 to 10 million acres around 1950 and dropped to 7 million toward the end of the 1970's. It is currently estimated to cover about 6 million acres. Data for the North Central Region indicate sharp declines for shortleaf stands and mixed pine-hardwood stands containing high proportions of shortleaf.

Major reasons for the decrease in the area of shortleaf stands include declines in sources of new stands that were prevalent in the past and the replacement of mature stands with plantations of other southern pines that exhibit more rapid growth over the first 20 years of life. Management recommendations for planting other species also affect shortleaf stands infected with littleleaf disease (*Phytophthora cinnamomi Rands*), which occurs most often on poorly drained sites with heavy soils (Hepting 1971). Other reasons include shifts from the pure pine type to mixed pine-hardwoods or hardwood types, clearing of shortleaf stands for agricultural crops and pastureland, urbanization, and losses to manmade lakes. The area of shortleaf stands will probably continue to shrink until sites capable of supporting pines that exhibit faster initial growth are converted to plantations. Shortleaf will continue to be a common associate of loblolly in stands managed naturally in the Coastal Plain and Piedmont Regions. In the Interior Highlands of West Gulf States, shortleaf will predominate where natural stand management is practiced and where owners decide to perpetuate shortleaf rather than introduce loblolly as a planted species.

Upland hardwood is the most abundant forest type in the region where shortleaf is found, while pine types are second in abundance (Table 1). The shortleaf type ranks fourth behind the loblolly, slash, and longleaf types, occupying 9.4 million acres or 14 percent of the pine type acreage and only 4 percent of the total timberland base. Shortleaf stands are most prevalent in the Highlands and Piedmont province and are especially important there because they contribute over one-fourth of the pine type acreage of that province.

For reasons discussed earlier, the bulk of the shortleaf forest (94 percent) originated from natural seeding. Planting of shortleaf is somewhat rare, but has been done in regions where cold, ice, and drought are common because shortleaf outperforms loblolly under these conditions (Williston and Balmer 1980).

Shortleaf forests are common in 16 States (Table 2). Arkansas contains the highest concentration with 2.0 million acres or 21 percent of the total shortleaf area.

Table 1.--Area of timberland where shortleaf pine is commonly found, by forest type and broad physiographic province.

Forest type	Total	Broad physiographic province: Highlands and Piedmont	Broad physiographic province: Coastal plain
	- - - - - - - - -Thousand acres- - - - - - - - -		
Shortleaf pine:			
Natural	8,829.8	4,972.2	3,857.6
Plantation	545.2	305.7	239.5
Other pine	55,195.3	14,937.5	40,257.8
Mixed pine-hardwood	29,246.0	11,525.2	17,720.8
Upland hardwood	83,767.3	61,409.3	22,358.0
Bottomland hardwood	33,409.3	6,756.3	26,653.0
All types	210,992.9	99,906.2	111,086.7

Table 2.--Area of timberland classified as shortleaf pine type, by State.

State	Area of shortleaf pine type	State	Area of shortleaf pine type
	-Thousand acres-		-Thousand acres-
Alabama	899.4	Missouri	116.0
Arkansas	1,983.7	North Carolina	502.9
Florida	37.2	Oklahoma	765.0
Georgia	914.7	South Carolina	655.9
Illinois	45.5	Tennessee	271.3
Indiana	53.7	Texas	1,236.8
Kentucky	128.5	Virginia	146.5
Louisiana	304.2		
Mississippi	1,313.7	All States	9,375.0

Table 3.--Area of timberland classified as shortleaf pine type, by ownership class and broad physiographic province.

Ownership class	Total	Broad physiographic province: Highlands and Piedmont	Broad physiographic province: Coastal Plain
	- - - - - - - - - -Thousand acres- - - - - - - - - -		
Public	1,649.9	1,251.4	398.5
Forest Industry[1]	2,147.7	990.1	1,157.6
Other private	5,577.4	3,036.4	2,541.0
Total	9,375.0	5,277.9	4,097.1

1 Includes land under long-term lease.

As with most forest resources in the east, the shortleaf type is largely controlled by nonindustrial private owners who have 59 percent of the acreage (Table 3). Forest industry owns 23 percent of the shortleaf type. Comparison with statistics for the loblolly pine type indicate forest industry lands support 34 percent of the total loblolly forest, reflecting a preference for loblolly (McWilliams and Birdsey 1984; Sheffield and Knight 1982). Public owners have 18 percent of the shortleaf type and only 7 percent of the loblolly type.

Shortleaf forests tend to be found on productive sites (Table 4). Forest Survey assesses site productivity in terms of the potential yield in cubic feet per acre of mean annual growth at the culmination of the increment in fully-stocked natural stands. Eighty percent of the area of shortleaf stands tallied were on sites capable of growing 85 cubic feet or more per acre per year.

The distribution of shortleaf acreage by stand-size class is 17 percent in sapling-seedling, 30 percent in poletimber, and 53 percent in sawtimber stands; however, the size-class distribution varies by ownership and physiographic province (Figure 2). Nonindustrial acreage of the Highlands and Piedmont province contains equal proportions of poletimber and sawtimber stands (both 39 percent), while the distribution of the Coastal Plain province is more like the overall average. Forest industry stands include higher percentages of sawtimber in both provinces. Public acreage also tends to be more mature, especially on the Coastal Plain where 80 percent of the stands are sawtimber size.

Table 4.--Area of timberland classified as shortleaf pine type, by site class[1] and broad physiographic province.

Site class	Total	Broad physiographic province: Highlands and Piedmont	Broad physiographic province: Coastal Plain
	- - - - - - - - Thousand acres - - - - - - - -		
165 ft^3 or more	1,112.4	519.1	593.3
120-164 ft^3	1,829.8	896.8	933.0
85-119 ft^3	4,511.5	2,037.3	2,474.2
50-84 ft^3	1,634.3	1,561.0	73.3
less than 50 ft^3	287.0	263.7	23.3
All classes	9,375.0	5,277.9	4,097.1

[1] A classification of forest land based on potential yield in cubic feet per acre of mean annual growth at culmination of the increment in fully stocked natural stands.

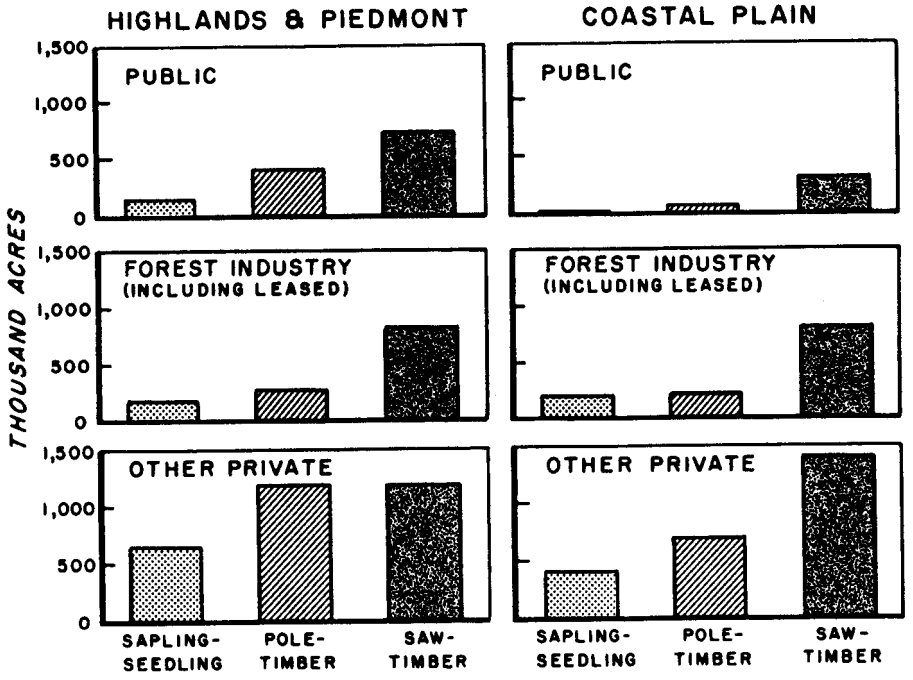

Figure 2. Area of timberland classified as shortleaf pine type, by stand-size class, ownership class, and broad physiographic province.

VOLUME

The distribution of shortleaf pine growing-stock volume highlights major shortleaf timbersheds (Figure 3). The primary shortleaf timbershed is found west of the Mississippi River in the Ouachita Highlands of Arkansas and Oklahoma and extends southward across northwestern Louisiana and well into Texas (Braun 1950). Shortleaf's abundance is also apparent in Mississippi and the Piedmont regions of Alabama, Georgia, South Carolina, North Carolina, and Virginia. When compared to an earlier map of shortleaf volume (U. S. Department of Agriculture, Forest Service 1969), the distribution appears more dense in northern Mississippi and more sparse in the Piedmont. Increases are apparent in southern Illinois, southern Indiana, and Ohio.

Results of the two most recent survey cycles of the South Central and Southeast Regions show an increase in the volume of shortleaf growing stock of only 1 percent. This trend is contrasted by significant increases in the volume of loblolly pine over the same period. The distribution of shortleaf volume by diameter class for the two survey cycles reveals that declines have occurred in the 6-and 8-inch diameter classes along with increases in the larger diameters (Figure 4). This situation characterizes a maturing forest that is not being replenished following harvest.

The current inventory shows the volume of shortleaf growing stock to be 19 billion cubic feet (Table 5). Shortleaf is found in all the major forest types within its range. Half of the shortleaf volume is in the pure type. Mixed pine-hardwoods contribute 22 percent of the shortleaf volume. Softwood volumes in these stands average 60 percent of the total volume per acre. Other pine types contain 19 percent, and hardwood types contain 10 percent of the shortleaf volume.

Two-thirds of the shortleaf growing-stock volume is concentrated in the five top-ranking States of Arkansas, Texas, Mississippi, Alabama, and Georgia respectively (Table 6). These states have a similar share of the 69 billion board feet of shortleaf sawtimber volume[3]. States not shown in Table 6 that contain minor shortleaf volumes include Maryland (3.0 MMCF, 6.8 MMBF), New Jersey (22.8 MMCF, 65.4 MMBF), Ohio (20.6 MMCF, 87.3 MMBF), and West Virginia (14.9 MMCF, 50.7 MMBF).

GROWTH AND REMOVALS

The total periodic annual growth of shortleaf pine growing stock is 1 billion cubic feet based on the most recent surveys of States where shortleaf is commonly found (Table 7). Periodic annual removals from growing stock also total 1 billion cubic feet, indicating a growth-to-removals ratio of 1.0. Removals include the volume of all trees removed from the inventory by

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[3] The volume of sound wood in the saw-log portion of shortleaf trees 9.0 inches in d.b.h. and larger, from a 1-foot stump to a minimum 7.0-inch top diameter and containing at least one 12-foot saw log. Sawtimber volume is expressed in board feet International Rule, 1/4 inch kerf.

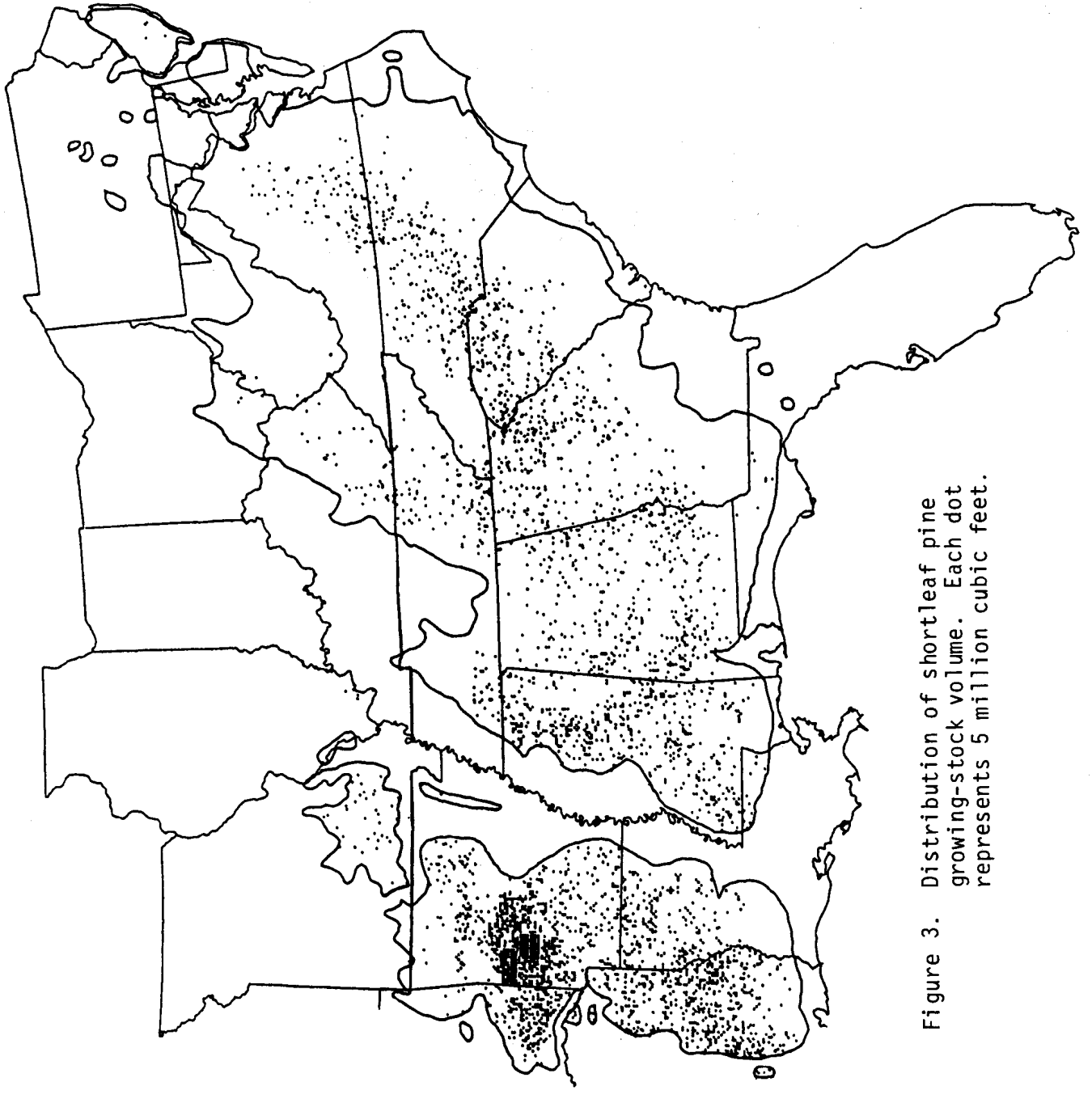

Figure 3. Distribution of shortleaf pine growing-stock volume. Each dot represents 5 million cubic feet.

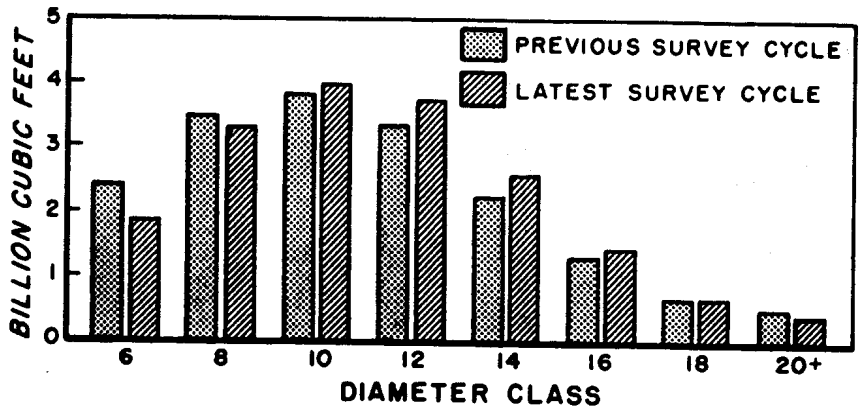

Figure 4.--Volume of shortleaf growing stock on timberland, by period and diameter class, South Central and Southeast Regions.

Table 5.--Volume of shortleaf pine growing stock on timberland, by forest type and broad physiographic province.

Forest type	Total	Broad physiographic province	
		Highlands and Piedmont	Coastal Plain
	- - - - - - - -Million cubic feet- - - - - - - -		
Shortleaf pine	9,431.1	5,254.5	4,176.6
Other pine	3,592.9	1,327.3	2,265.6
Mixed pine-hardwood	4,177.4	2,147.8	2,029.6
Upland hardwood	1,815.9	1,180.3	635.6
Bottomland hardwood	34.9	14.9	20.0
All types	19,052.2	9,924.8	9,127.4

Table 6.--Volume of shortleaf pine growing stock and sawtimber on timberland, by State.

State	Volume of shortleaf pine growing stock	Volume of shortleaf pine sawtimber
	- -Million cubic feet- -	- -Million board feet- -
Alabama	2,051.2	7,180.2
Arkansas	4,088.5	16,843.4
Florida	52.8	189.1
Georgia	1,690.7	4,961.6
Illinois	63.5	193.7
Indiana	42.4	133.1
Kentucky	226.9	592.6
Louisiana	1,141.4	4,701.2
Mississippi	2,391.3	8,619.4
Missouri	303.5	1,032.4
North Carolina	1,336.7	4,166.9
Oklahoma	939.8	3,275.5
South Carolina	1,016.3	2,596.1
Tennessee	664.3	2,403.2
Texas	2,539.6	10,582.2
Virginia	503.3	1,497.1
All States	19,052.2	68,967.7

harvesting, cultural treatments, landclearing, and changes in land use --whether the tree was utilized or not. A growth-to-removals ratio of unity indicates that the shortleaf ecosystem has reached the limit of its capability for expansion of harvest without reducing growing-stock inventories. A comparable ratio for the loblolly pine ecosystem is 1.3. Some regions with ratios less than the overall average will undergo reductions in shortleaf inventories in the near future.

STAND STRUCTURE

Changes in the shortleaf stand table underlie trends in volume. Recent surveys have shown declines in the number of shortleaf trees throughout most of the South (Table 8). Especially important for shortleaf inventories is the status of saplings (trees from 1.0 to 4.9 inches d.b.h) since they represent future ingrowth. Major declines in the number of shortleaf saplings are evident in all States of the South Central and Southeastern Regions. Substantial decreases are also found well into higher diameter classes in both physiographic provinces. These conditions foretell reductions in shortleaf inventory volumes in the future. The situation seems most severe in States with more recent inventories, making forthcoming survey results especially important for monitoring the shortleaf ecosystem.

Table 7.--Periodic annual growth and removals of shortleaf pine growing stock on timberland, by State[1].

State	Periodic annual growth	Periodic annual removals	Growth-to-removals ratio
	- - - - Million cubic feet - - - -		
Alabama	130.9	129.0	1.0
Arkansas	173.5	219.2	0.8
Florida	4.3	2.0	2.2
Georgia	81.4	111.1	0.7
Illinois	1.8	1.4	1.3
Indiana	1.1	.1	11.0
Kentucky	10.4	3.8	2.7
Louisiana	74.7	56.5	1.3
Mississippi	138.2	142.4	1.0
Missouri	10.7	6.8	1.6
North Carolina	31.4	63.5	0.5
Oklahoma	52.7	44.1	1.2
South Carolina	61.3	42.4	1.4
Tennessee	55.5	22.6	2.5
Texas	133.1	130.7	1.0
Virginia	9.4	30.6	0.3
All States	970.4	1,006.2	1.0

[1] Based on the most recent surveys conducted over the past ten years.

HARVESTING AND REGENERATION

A critical factor affecting the future of shortleaf pine is the current status of regeneration on harvested shortleaf timberland. Forest Survey has collected information on harvesting and regeneration during the most recent surveys of Alabama, Florida, Georgia, Louisiana, North Carolina, South Carolina, and Virginia. Pine regeneration on harvested acreage can be considered successful if harvested pine stands remain in pine forest types. Harvesting as used here refers to stands that were clearcut. Regenerating to the mixed pine-hardwood forest type should also be considered successful since young pine stands often contain considerable hardwood stocking.

Data for pure stands of shortleaf indicate that nearly two-thirds of the harvest area was regenerated to pine and mixed pine-hardwood types; however, only 8 percent remained as shortleaf pine stands (Figure 5). Public owners succeeded in regenerating the highest proportion of harvested shortleaf stands (86 percent). Six percent of their stands remained in the shortleaf type. Nearly three-fourths of forest industry shortleaf forest was regenerated but only 2 percent to the shortleaf type. Nonindustrial owners were least

Table 8.--Percentage change in number of all live shortleaf pine trees, by broad physiographic province, State, and diameter class, South Central and Southeast Regions.

Broad physiographic province and State	Period of change	Diameter class (inches at breast height)							
		2	4	6	8	10	12	14	16+
		Percent							
Highlands and Piedmont:									
Alabama	1972-1982	-70	-46	-54	-24	-20	- 8	+ 4	+ 8
Arkansas	1969-1978	- 8	-13	-16	- 2	0	+15	+ 37	+23
Georgia	1972-1982	-61	-50	-41	-21	-17	- 9	- 1	+ 4
North Carolina	1974-1984	-62	-53	-42	-26	-18	0	+ 3	+ 4
Oklahoma	1966-1976	- 9	0	+11	+22	+46	+43	+ 31	+54
South Carolina	1968-1978	-26	-31	-14	+ 7	+24	+24	+ 13	+25
Virginia	1976-1985	-57	-36	-45	-35	-29	-16	- 19	+16
Tennessee	1970-1980	-59	-40	-39	-16	+ 4	+53	+ 28	+14
Coastal plain:									
Alabama	1972-1982	-59	-40	-39	-29	-24	-17	+ 65	0
Arkansas	1969-1978	-12	-16	-28	-29	-16	- 6	+ 7	+ 3
Florida	1970-1980	-53	-36	+34	+27	+34	+87	+186	+31
Georgia	1972-1982	-68	-52	-25	- 9	-12	-12	0	+31
Louisiana	1974-1984	-52	-44	-37	-27	- 9	- 5	+ 9	- 9
Mississippi	1967-1977	-31	-20	-13	+12	+21	+48	+ 51	+54
North Carolina	1974-1984	-60	-71	-71	-38	-23	+ 3	+ 27	+16
South Carolina	1968-1978	-27	-14	-20	-12	+34	+24	+ 4	+64
Virginia	1976-1985	-51	-29	-50	-56	-27	-56	- 37	-20
Texas	1965-1975	-22	-33	+ 4	+ 9	+34	+37	+ 28	- 6

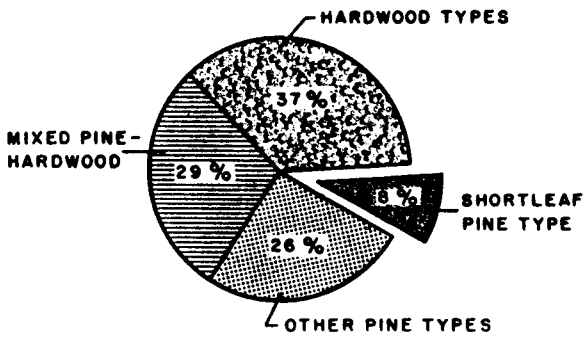

Figure 5.--Status of shortleaf pine type acreage harvested annually based on surveys of Alabama 1972-1982, Florida 1970-1980, Georgia 1972-1982, Louisiana 1974-1984, North Carolina 1974-1984, South Carolina 1968-1978, and Virginia 1976-1985.

successful at establishing pine regeneration on harvested shortleaf acreage but most successful at regenerating to the shortleaf type. Fifty-seven percent of the harvested nonindustrial stands were regenerated with 12 percent remaining as pure shortleaf stands. This relatively high percentage of regeneration to the shortleaf type indicates these owners rely more heavily on natural methods of regeneration than planting or seeding of other pine species. Upcoming survey results for the top three shortleaf States of Arkansas, Texas, and Mississippi should provide valuable information on the regeneration of harvested shortleaf acreage.

CONCLUSIONS

The foregoing analysis confirms what may have been suspected concerning the destiny of shortleaf pine in the near future. Prior to the 1950's, shortleaf proliferated by naturally seeding onto cutover and burned sites and abandoned farmlands. These pure stands of shortleaf and shortleaf mixed with hardwoods have matured and are currently being harvested. Harvested stands are regenerated primarily to loblolly where feasible on intensively managed land (Lambeth et al. 1984; Wells and Rink 1984), and are often left to regenerate naturally on other timberland. This has caused decreases in the area of the shortleaf type and a peak in shortleaf inventory volumes. Information on forest drain, stand structure, and regeneration indicate that shortleaf inventories will fall in coming years. Shortleaf volume is currently 22 percent of the total volume of the four major southern pines compared to a 57 percent share for loblolly. Slash pine and longleaf pine account for 14 percent and 7 percent respectively. Information from the previous survey cycle showed shortleaf with 24 percent and loblolly with 54 percent. While shortleaf's portion has dropped slightly, it should maintain its relative position as second behind loblolly. Shortleaf pine will continue to be an important component in naturally managed pine stands and in mixed pine-hardwood and hardwood stands on unmanaged sites.

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PROCEEDINGS

of

Symposium on the Shortleaf Pine Ecosystem

LITTLE ROCK, ARKANSAS

MARCH 31 - APRIL 2, 1986

Edited by

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Southern Forest Experiment Station
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