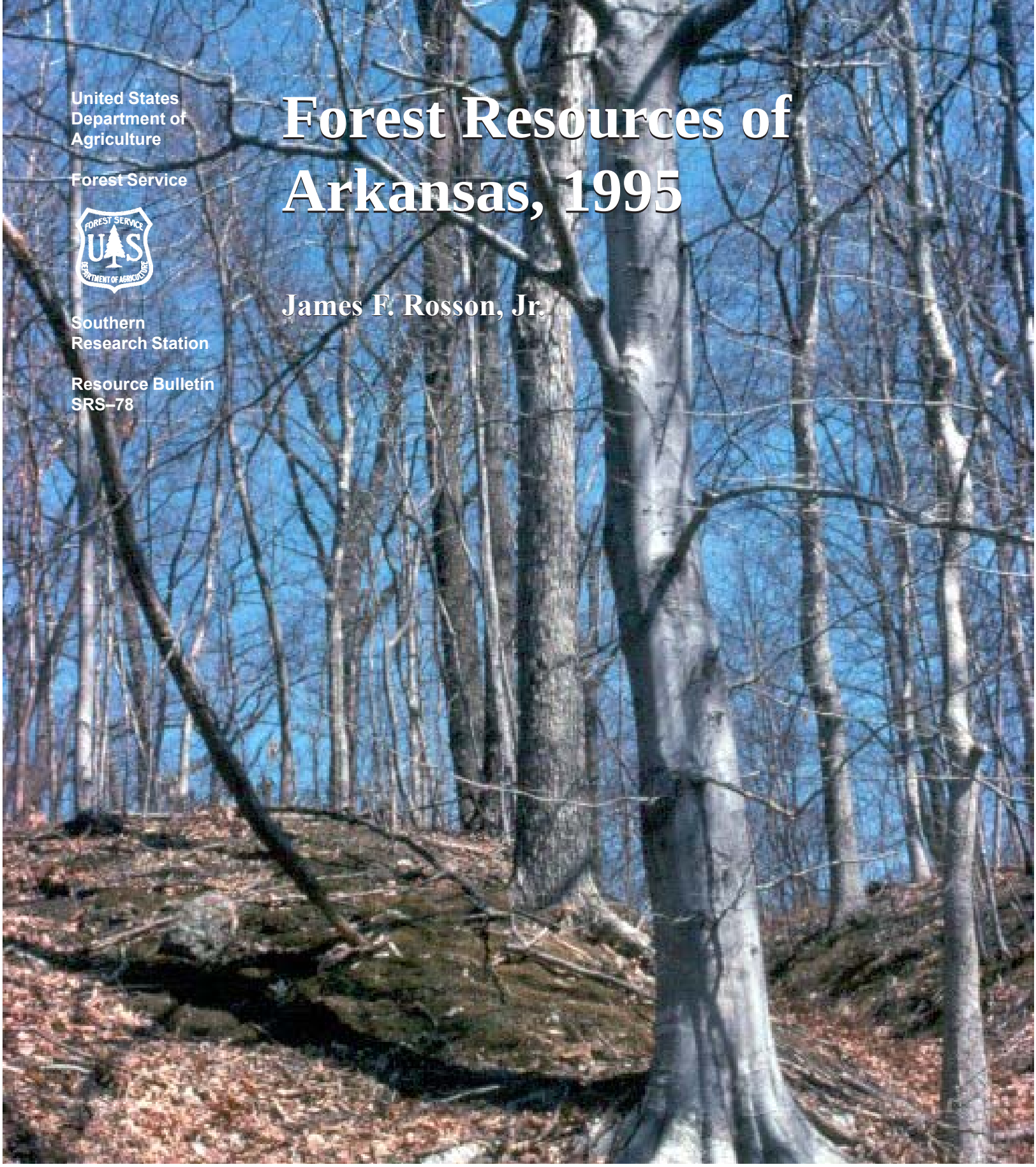

United States
Department of
Agriculture

Forest Service

Forest Resources of Arkansas, 1995

James F. Rosson, Jr.

Southern
Research Station

Resource Bulletin
SRS–78

Cover photograph by Dr. James F. Rosson, Jr.—In the foreground is a 15-inch American beech (*Fagus grandifolia*) growing on shallow soils but near the lower section of the slope, where soil conditions are more mesic. This site is in Madison County, Arkansas, near the western limit of the natural range of beech. Although not common in Arkansas (only 8 trees ≥5.0 inches d.b.h. were tallied on FIA sample plots in Madison County, and only 255 trees ≥5.0 inches d.b.h. were tallied on FIA sample plots across the State) American beech adds much to the diversity of tree flora and provides important mast for wildlife. The large tree behind and slightly to the left of the beech is white oak (*Quercus alba*).

August 2002

Southern Research Station
P.O. Box 2680
Asheville, NC 28802

Forest Resources of Arkansas, 1995

James F. Rosson, Jr., Research Forester

Forest Inventory and Analysis
Starkville, Mississippi

Foreword

This resource bulletin describes the principal findings of the seventh inventory of Arkansas' forest resources. Data on the extent, condition, and classification of forest land and associated timber volumes, growth, removals, and mortality are described and interpreted. Although data on nontimber commodities associated with forests were also collected, evaluations of these data are not included in this report.

At the time of the Arkansas survey, periodic surveys were mandated by the Forest and Rangeland Renewable Resources Planning Act of 1974, the National Forest Management Act of 1976, and the Forest and Rangeland Renewable Resources Research Act of 1978. These surveys are part of a continuing, nationwide undertaking by the regional experiment stations of the U.S. Department of Agriculture, Forest Service. Inventories of the 13 Southern States (Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas and Virginia) and the Commonwealth of Puerto Rico are conducted by the Southern Research Station, Forest Inventory and Analysis Research Work Unit (FIA) operating from its headquarters in Knoxville, TN and from offices in Asheville, NC, and Starkville, MS. The primary objective of these periodic appraisals is to develop and maintain the resource information needed to formulate sound forest policies and programs. More information is available about Forest Service resource inventories in *Forest Service Resource Inventories: An Overview* (U.S. Department of Agriculture, Forest Service 1992).

Tabular data included in FIA reports are designed to provide a comprehensive array of forest resource statistics, but additional data can be obtained for those who require more specialized information. The forest resource data for Southern States can be accessed directly via the Internet at: http://srsfia1.fia.srs.fs.fed.us. Data in a format common to the three FIA units in the Eastern United States (Eastwide Data Base) are also available (Hansen and others 1992). These data may be obtained at the Internet site referenced above. Information concerning any aspect of this survey may be obtained from:

Forest Inventory and Analysis
Southern Research Station
4700 Old Kingston Pike
Knoxville, TN 37919
Phone: 865–862–2000

James H. Perdue
Project Leader

Acknowledgments

The FIA gratefully acknowledges the cooperation and assistance provided to field crews in the collection of field data by the Arkansas Forestry Commission, Georgia-Pacific Corporation, International Paper Company, Anthony Timberlands, Weyerhaeuser Company, and Green Bay Packing Company. Appreciation is also expressed for the cooperation of other public agencies and private landowners in providing access to sample plots.

The following members of the FIA staff completed field measurements in the 1995 survey of Arkansas:

Lance Asherin	Helene Flounders	Randi Paris
Ben Baumgart	Kelly Gouge	Leslie Prewitt
Roger Boyer	Darin Hinesly	Ken Reed
Bobby Claybrook	Eric Johnson	Brian Slagle
John Craig	Mark Kotal	Blaine Tarbell
Lyndell Davidson	Russ Langford	Jennifer Tarbell
James Dexter	Jeff Martin	Jeff Turner
Debbie Ferguson	Tony Olsen	

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[a] All tables in this report are available in Microsoft® Excel workbook files. Upon request, these files will be supplied on 3½-inch diskettes.

The use of trade or firm names in this publication is for reader information and does not imply endorsement by the U.S. Department of Agriculture of any product or service.

Highlights from the Seventh Inventory of Arkansas

Important findings of the seventh forest survey of Arkansas are presented here. Comparisons, unless otherwise noted, are based on estimates dated January 1, 1988, and January 1, 1995.

- Timberland area in Arkansas increased by 1.1 million acres. There were 18.4 million timberland acres at the conclusion of the 1995 survey. A total of 1.8 million nonforest acres reverted to timberland and 603,500 acres of timberland were diverted to nonforest land uses during the survey period.

- The largest ownership category holding Arkansas timberland continued to be nonindustrial private forest (NIPF) ownership, 10.6 million acres (58 percent of all timberland). Public lands had 3.3 million and forest industry 4.5 million acres. Sixty-nine percent of the timberland increase was on NIPF lands, 19 percent was on public lands, and 12 percent was on forest industry land.

- The oak-hickory forest-type group was still the predominant type with 7.1 million acres, even after losing 142,000 acres since the last survey. The loblolly-shortleaf pine forest type group continued to increase (by 885,200 acres) and is closing the gap on the oak-hickory type. There were 5.1 million acres in this type.

- Most of Arkansas' timberland was in the sawtimber size-class, 8.5 million acres. Poletimber ranked second in area (5.5 million acres) followed by the sapling-seedling size-class (4.4 million acres). The largest increase was in sawtimber (1.2 million acres) while sapling-seedling acreage dropped by 431,000 acres.

- The 1995 softwood inventory volume was 9,541.9 million cubic feet, a 1,456.8-million-cubic-foot increase since the 1988 survey.

- The 1995 hardwood inventory volume was 14,242.0 million cubic feet. There was a 1,566.1-million-cubic-foot increase since 1988.

- Softwood net growth was 554.6 million cubic feet per year, a 176.5-million-cubic-foot increase over the last survey.

- Hardwood net growth was 397.2 million cubic feet per year. This was only a very slight increase over the 389.9 million cubic feet per year reported for the 1988 survey.

- Softwood removals were 433.1 million cubic feet per year, a slight increase over the previous survey when they were 409.5 million cubic feet per year. With growth exceeding removals the growth-to-removal ratio was 1.28 to 1.00.

- Hardwood removals were 310.6 million cubic feet per year, up from 280.4 million cubic feet per year in the previous survey. Even with the removals increase, growth exceeded removals resulting in a growth-to-removal ratio of 1.28 to 1.00.

- The timberland area in plantations continued to increase, going from 1.9 million acres in 1988 to 2.6 million acres in 1995. Plantations made up 14 percent of Arkansas timberland. Sixty-one percent of plantations were on forest industry lands.

- There were 1,932.6 million cubic feet of softwood volume on plantations, a 908.5-million-cubic-foot increase since 1988.

- The amount of timberland that underwent commercial harvest decreased from 5.5 million acres in 1988 to 3.9 million acres in 1995.

- Since 1988, approximately 1.6 million acres of timberland underwent some form of intermediate stand treatment (thinning or stand improvement). This was a 331,100-acre decrease from the 1988 survey.

Introduction

This bulletin presents the findings of the seventh forest survey of Arkansas. Field work began in June 1994 and was completed in October 1996. The survey is dated January 1, 1995.

Numerous publications were produced from previous State surveys. Except for the first survey, all other Arkansas surveys were summarized into a document such as this, commonly referred to as a State analytical report. The first survey of Arkansas covered only the areas most highly impacted by harvesting: the Mississippi River Delta, the south and southwest areas, and the Ouachita Mountain area. The north and northwest areas of the State were not surveyed until 1951. Manuscripts from the 1935 survey of Arkansas were numerous (U.S. Department of Agriculture 1937a; U.S. Department of Agriculture 1938a; U.S. Department of Agriculture 1938b; Winters 1939). Additionally, two regional reports included information from the first survey of Arkansas (U.S. Department of Agriculture 1937b; U.S. Department of Agriculture 1937c). The first full survey of the State was done in 1951 (U.S. Department of Agriculture 1953). Other State surveys were completed in 1959 (Sternitzke 1960), 1969 (Van Sickle 1970), 1978 (Van Hees 1980), and 1988 (Beltz and others 1992).

Arkansas is divided into five forest survey units (fig. 1): North Delta, South Delta, Ouachita, Ozark, and Southwest. These subsets of the State facilitate implementation of field work. Additionally, certain benefits are gained in data analysis because the unit boundaries have a reasonably close alignment with physiographic and physiognomic characteristics of the State.

Tables and figures present data for January 1, 1995, as well as estimates of trends. Most of the trend comparisons are made between the surveys of January 1, 1988, and January 1, 1995. The appendix describes survey methods and data reliability, defines terms, lists tree species sampled in the survey, and provides 22 standard tables.

Field work for the seventh survey began in June 1994 and concluded in October 1996. The average elapsed time for the survey was 7.71 years or 7 years and 8 months. During the survey, 3,230 forest plots were visited by two-person field crews; 3,135 of these were on timberland. A total of 58,490 trees greater than or equal to 5.0 inches in diameter at breast height (d.b.h.) were measured. Additionally, 38,850 trees greater than or equal to 1.0 inch but less than 5.0 inches d.b.h. were measured on smaller microplots (see appendix for techniques).

Numerous publications on findings from the seventh survey of Arkansas have already been published: four forest survey unit reports (Rosson and others 1995, Rosson and London 1997, Rosson and others 1997a, 1997b) and a county statistical report (London 1997). Some estimates in this report may not match those previously published due to corrections in the data.

Forest Area

The total land area for Arkansas was 33.328 million acres in 1995 (appendix table 1). This was only slightly different from the 33.330 million acres reported for the 1988 forest survey, a difference of 1,900 acres. This slight difference was due to the use of a new 1990 census (U.S. Department of Commerce, Bureau of the Census 1991) for the area estimates of the 1995 forest survey. The change came about from improvements and corrections in measurements and from refinements of some definitions over those of the previous 1980 census (U.S. Department of Commerce, Bureau of the Census 1981). It had virtually no impact on trend comparisons.

Estimates of Arkansas' original forest cover were 32.0 million acres, almost 96 percent of all land in the State (Davis 1983). By the 1920's (just before the initiation of the forest survey) land clearing had reduced the State's forested area to 22.0 million acres. Approximately 2.0 million acres were in old growth (Davis 1983).

By the time of the first full forest survey of Arkansas in 1951, timberland area had dropped to 19.3 million acres (table I). Timberland area increased to 20.8 million in the 1959 survey, the highest acreage recorded since the initiation of the forest survey in the 1930's. The next two surveys showed timberland decreases culminating in the lowest ever recorded in 1978 (16.7 million acres). Since 1978, timberland acreage increased each survey and was 18.4 million acres by 1995.

The largest impacts in timberland decline were in the North and South Delta units. Timberland area in both units decreased from 4.3 million acres in 1935 to 1.8 million acres in 1978. After the 1978 survey the era of vast clearing of bottomland hardwoods for agricultural land uses had ended. Since the 1978 survey, timberland area in the two Delta units has increased and was 2.1 million acres in 1995.

Figure 1—Survey units of Arkansas.

Table I—Timberland area by survey unit, Arkansas, 1935 to 1995

Forest survey unit	Survey year						
	1935	1951	1959	1969	1978	1988	1995
	Thousand acres						
North Delta	4,317.8[a]	3,497.4	3,249.2	1,975.0	576.5	612.4	725.2
South Delta	[b]	[b]	[b]	[b]	1,252.3	1,284.0	1,385.8
Ouachita	3,376.9	3,391.5	3,552.2	3,319.1	3,238.4	3,173.0	3,403.0
Ozark	[c]	6,113.7	6,995.9	6,267.5	5,217.8	5,729.6	6,009.1
Southwest	6,097.9	6,339.2	6,959.7	6,645.1	6,422.3	6,445.8	6,869.2
All units	[c]	19,341.8	20,757.0	18,206.7	16,707.3	17,244.8	18,392.3

Numbers in rows and columns may not sum to totals due to rounding.

[a] Authors note: the timberland area reported for the Delta in 1935 in table II of the 1988 State report of Arkansas, *Forest Resources of Arkansas* (Beltz and others 1992) was in error. Acreage from bottomland forests in southeast Missouri, western Kentucky, and western Tennessee was accidentally included in that estimate.

[b] South Delta forest area combined with North Delta.

[c] The Ozark region was not surveyed in the first inventory of Arkansas.

All of the forest survey units have increased in timberland area since 1988 (table I). Of the 1.1 million-acre increase, 112,800 acres (10 percent) were in the North Delta, 101,800 acres (9 percent) were in the South Delta, 230,000 acres (20 percent) were in the Ouachita, 279,500 acres (24 percent) were in the Ozark, and 423,400 acres (37 percent) were in the Southwest unit. The largest increase in each unit (as compared to 1988) was in the North Delta, where timberland area increased by 18 percent.

The dynamics of timberland area are complex. Some forest area diverts to a nonforest land use while some nonforest land reverts to a forest land use. Since 1988, 1.8 million acres of nonforest land reverted to a forest condition (table II). In contrast, 603,500 acres diverted to a nonforest land use. The resulting net change was a 1.1 million-acre increase in timberland.

Most of the reverting acres came from lands previously used for agriculture, 1.3 million acres (table II). A total of

Table II—Changes in timberland by forest survey unit, Arkansas, 1988 to 1995

Forest survey unit	Total land	Timberland	Change	Additions			Diversions		
				Total	Agriculture	Other[a]	Total	Agriculture	Other[a]
				Thousand acres					
North Delta	4,640.5	725.2	112.9	119.1	95.2	23.8	-6.2	0.0	-6.2
South Delta	4,580.0	1,385.8	101.8	124.8	93.6	31.2	-23.0	-5.8	-17.3
Ouachita	4,757.2	3,403.0	229.9	310.0	238.5	71.5	-80.1	-40.0	-40.0
Ozark	10,563.5	6,009.1	279.5	657.3	408.6	248.7	-377.8	-263.9	-113.9
Southwest	8,787.1	6,869.2	423.4	539.8	470.6	69.2	-116.4	-52.4	-64.0
All units	33,328.2	18,392.3	1,147.5	1,751.0	1,306.5	444.5	-603.5	-362.0	-241.5

Numbers in rows and columns may not sum to totals due to rounding.
[a] Includes urban, industrial, highway, water, rights-of-way, etc.

444,500 acres came from other land uses such as industrial, urban, water, and rights-of-way. Most of these types of additions were in the Ozark unit.

The diverting acres were almost evenly divided between agriculture land use and other types of land uses, 60 and 40 percent, respectively. Most of the diversions were in the Ozark unit, 377,800 acres, with another 116,400 acres in the Southwest unit. These two units accounted for 82 percent of the diverting timberland.

Arkansas had 231,100 acres classified as productive reserved and 166,700 classified as unproductive (appendix table 1). See the definitions in the appendix to differentiate between these two classes of forest land and timberland. Often, it is difficult to accurately define unproductive forest land in the field. These sites are particularly a problem in northern and northwestern Arkansas, a problem that extends into Oklahoma. A combination of climate and edaphic conditions makes it difficult for some sites to produce 20 cubic feet of timber per acre per year.

Forest Ownership

Slightly over one-half of Arkansas' timberland was held in nonindustrial private forest (NIPF) ownership, 10.6 million acres (58 percent) (table III). Forest industry ranked second with 4.5 million acres (24 percent) followed by public ownership, 3.3 million acres (18 percent).

The largest increase in timberland was in NIPF ownership, a 795,000-acre increase since 1988 (table III). Most of the increase was in the Ozark unit (270,900 acres) followed by the Southwest unit (257,700 acres). The majority of NIPF holdings was also in the Ozark and Southwest units; these two units had 75 percent of all NIPF land in the State.

Most of the forest industry holdings were in the Southwest unit, 3.4 million acres, or 76 percent (fig. 2). This was also the unit where there was an increase in forest industry timberland. The 154,600- acre increase was offset by slight decreases in the other survey units, resulting in a net change in forest industry area of 133,500 acres.

Table III—Area of timberland by forest survey unit, ownership, and change, Arkansas, 1988 to 1995

Forest survey unit	All owners	Public	Change	Forest industry	Change	Nonindustrial private	Change
				Thousand acres			
North Delta	725.2	109.3	28.5	14.1	7.0	601.8	77.5
South Delta	1,385.8	278.1	68.4	227.0	-6.7	880.7	40.2
Ouachita	3,403.0	1,583.9	100.5	679.4	-19.4	1,139.7	148.9
Ozark	6,009.1	1,147.2	10.6	173.9	-2.0	4,688.0	270.9
Southwest	6,869.2	177.1	11.1	3,403.1	154.6	3,289.0	257.7
All units	18,392.3	3,295.7	219.0	4,497.4	133.5	10,599.2	795.0

Numbers in rows and columns may not sum to totals due to rounding.

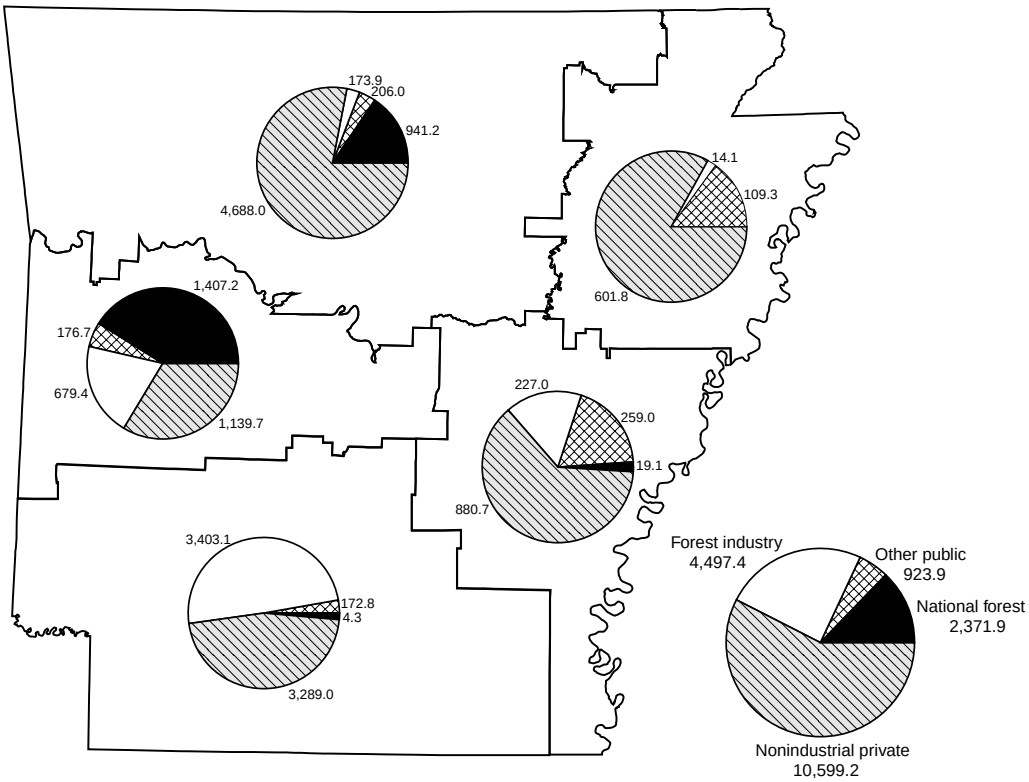

Figure 2—Proportion of timberland, in thousand acres, by ownership, Arkansas, 1995.

All of the survey units had timberland in public ownership, but the majority was in the Ouachita and Ozark survey units. Eighty-three percent of public land was in these two units, most of which was in national forests, 2.3 million acres (fig. 2).

Since the 1988 forest survey, 30 Arkansas counties had gains of more than 20,000 acres of timberland (fig. 3). Five of these counties were in the Delta units, the remaining 25 were interspersed among the other three survey units. Forty-four counties had area changes of less than 20,000 acres per county.

The Southwest unit had the densest concentration of timberland in the State. Here, 10 counties had more than 81 percent of their land area in timberland. Throughout the State, a total of 14 counties had more than 81 percent of their land area in timberland (fig. 4). Union County and Calhoun County in the Southwest unit had the highest density of timberland; both had 92 percent of their land area in timberland.

There were 24 counties with 61 to 80 percent of their land area in timberland and 15 counties with 41 to 60 percent in timberland. The least dense counties were in the Delta units. Nine counties in the North Delta unit had less than 20 percent of land area in timberland. In the South Delta, nine counties had timberland occupying 21 to 40 percent of land area. The least forested county in Arkansas was Mississippi County where only 6 percent of the county was in timberland.

The highest concentration of NIPF ownership was in the northern portion of Arkansas (fig. 5). Altogether, there were 23 counties with more than 81 percent of timberland held by NIPF owners. In the Southwest unit, only Columbia County was in this class. Throughout Arkansas, five counties had 100 percent of timberland in NIPF ownership. There were only four counties with less than 20 percent of timberland in NIPF ownership.

Most of the forest industry ownership was in south Arkansas, encompassing all of the Southwest unit and parts of the Ouachita and South Delta units (fig. 6). The county with the highest concentration of forest industry land was Pike County (80 percent of all timberland). Altogether, there were seven counties with 61 to 80 percent of their timberland in forest industry ownership. Nine counties had 41 to 60 percent in forest industry ownership, 10 counties had 21 to 40 percent, and 49 counties had less

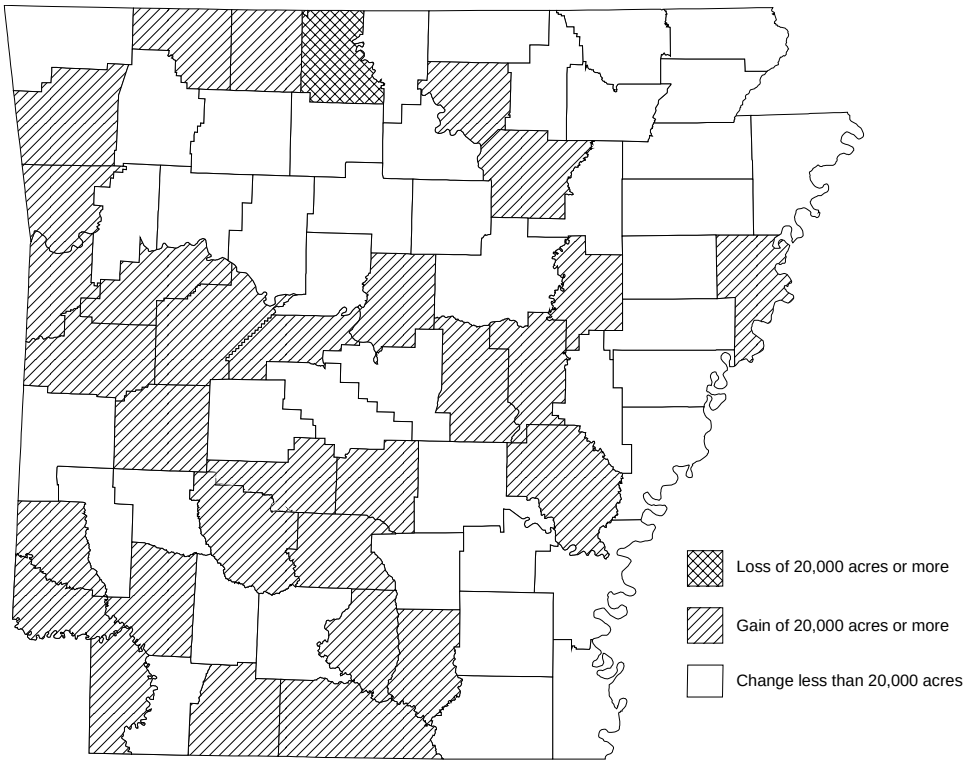

Figure 3—Arkansas counties with gains and losses in timberland, 1988 to 1995.

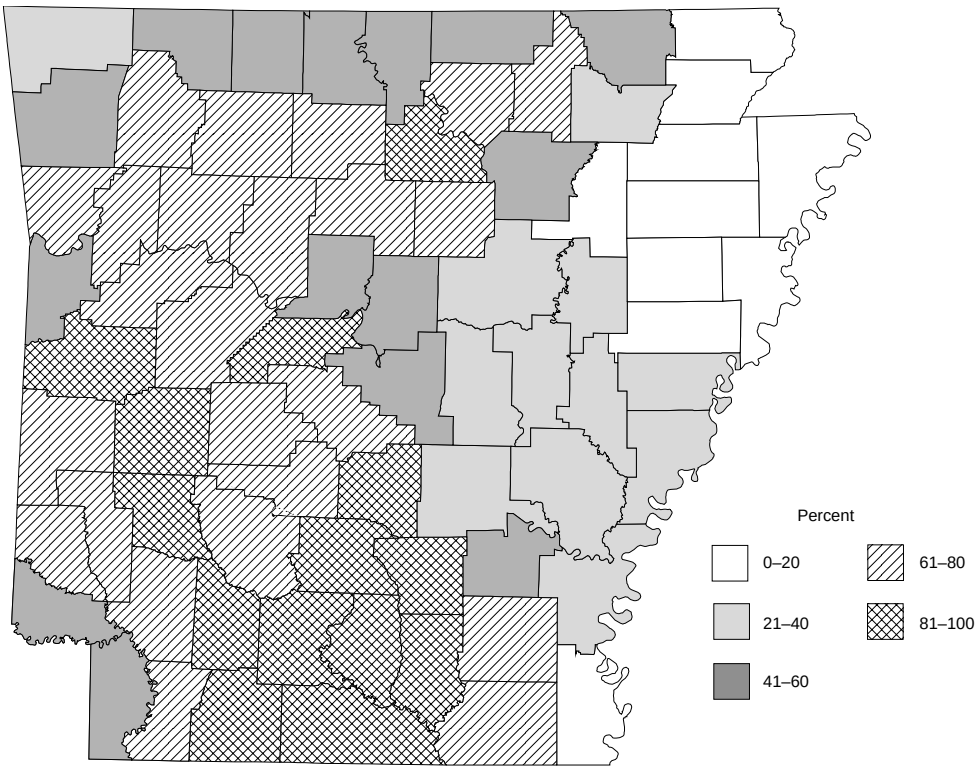

Figure 4—Percentage of county area in timberland, Arkansas, 1995.

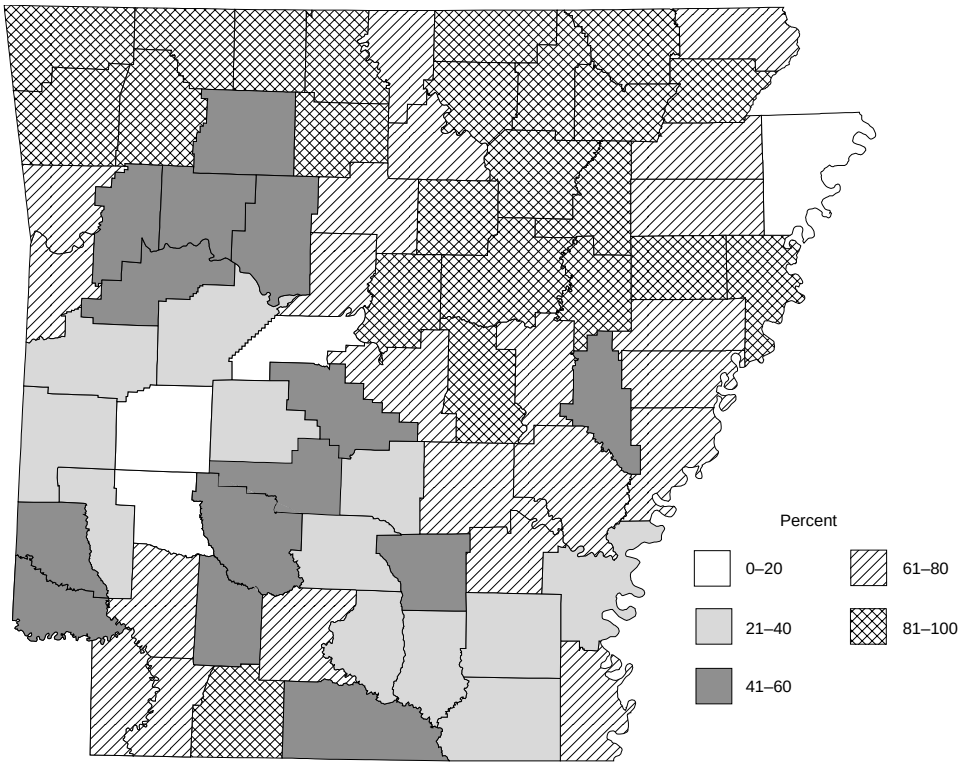

Figure 5—Percentage of county timberland held by nonindustrial private forest landowners, Arkansas, 1995.

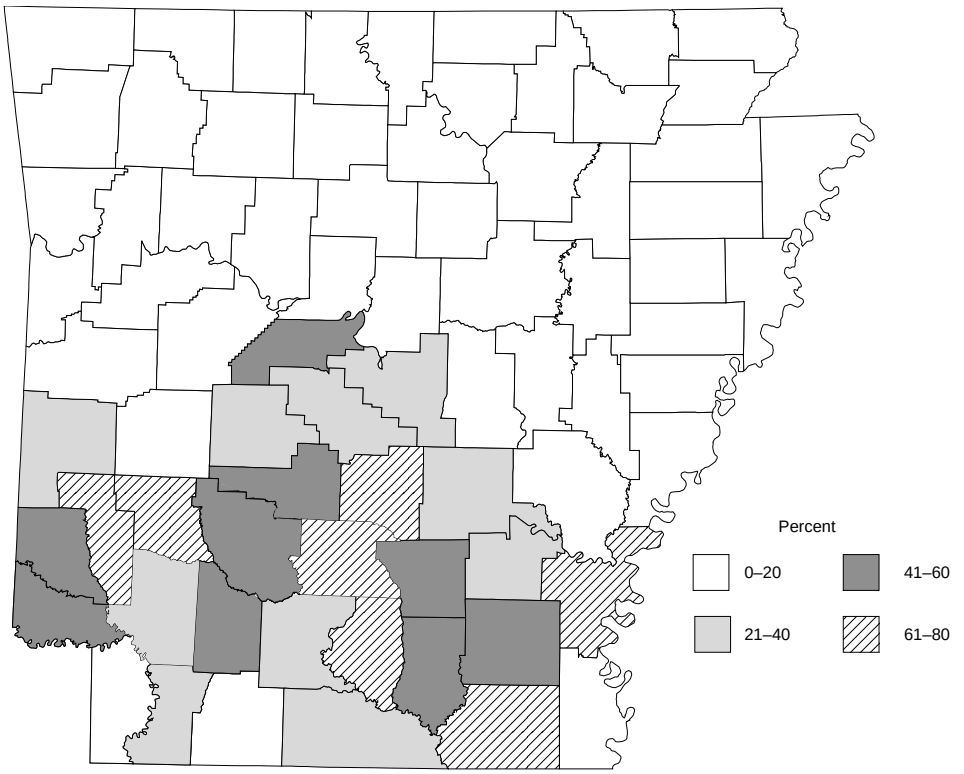

Figure 6—Percentage of county timberland held by forest industries, Arkansas, 1995. There were no counties with more than 80 percent of timberland in forest industry ownership.

than 20 percent. The counties with less than 20 percent in forest industry ownership were in the northern half of the State (fig. 6). Altogether, there were 30 Arkansas counties with no industry holdings.

Forest-Type Groups

The FIA unit aggregates forest types into five forest-type groups to facilitate reporting of results. Each plot was assigned a forest type during computer processing based on the dominance of one, two, or three species according to the relative species majority, or plurality if there was not a majority. The relative stocking assignment for each species was used to rank dominance. Similar forest types were then grouped together into a respective forest-type group.

The dominant forest-type group in Arkansas was oak-hickory (fig. 7). It was dominant only in the Ozark unit but occupies 4.2 million acres there (70 percent of the unit and 23 percent of the State). Ranked second in dominance was the loblolly-shortleaf pine forest-type group. This forest-type group was dominant both in the Ozark and Southwest units. It accounted for 28 percent of the timberland area in the State. The oak-pine forest-type group was ranked third with 3.1 million acres. It was not dominant in any of the survey units, but its largest occupancy was in the Southwest unit. Following closely behind the oak-pine forest-type group was the bottomland hardwoods with 3.0 million acres (16 percent of the State's timberland). This forest-type group was dominant in both the North and South Delta units (fig. 7).

There were some noteworthy changes in areas of the forest-type groups. First, the oak-hickory type decreased by 142,000 acres (table IV). Every unit except the North Delta showed decreases. Second, the biggest change was an 885,200-acre increase in the loblolly-shortleaf forest-type group. Every unit showed an increase, but 81 percent was in the Ouachita and Southwest units. Third, there was a 278,900-acre increase in bottomland hardwoods (oak-gum-cypress and elm-ash-cottonwood forest-type groups) with the biggest addition being in the Southwest unit (118,000 acres). Approximately 41 percent of the bottomland hardwood increase was in the North and South Delta units.

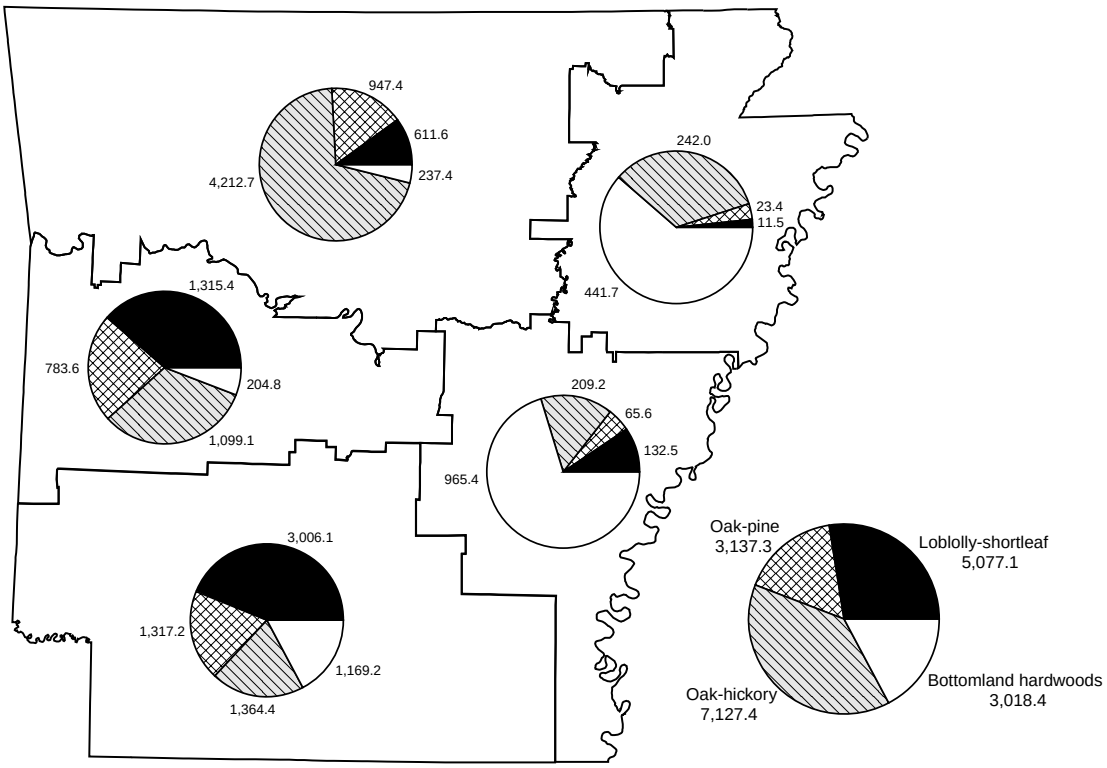

Figure 7—Proportion of timberland, in thousand acres, by forest-type group, Arkansas, 1995. Bottomland hardwoods include the oak-gum-cypress and elm-ash-cottonwood forest-type groups. Not included were 32,100 acres of nontyped timberland.

Table IV—Area of timberland by forest survey unit, forest-type group, and change, Arkansas, 1988 to 1995

Forest survey unit	All types	Loblolly-shortleaf	Change	Oak-pine	Change	Oak-hickory	Change	Oak-gum-cypress	Change	Elm-ash-cottonwood	Change	Nontyped[a]
						Thousand acres						
North Delta	725.2	11.5	11.5	23.4	17.8	242.0	13.4	361.9	21.6	79.8	42.0	6.7
South Delta	1,385.8	132.5	46.1	65.6	25.9	209.2	-33.5	883.1	59.2	82.3	-9.0	13.1
Ouachita	3,403.0	1,315.4	275.2	783.6	-37.8	1,099.1	-20.5	204.8	31.2	0.0	-18.2	0.0
Ozark	6,009.1	611.6	113.8	947.4	182.4	4,212.7	-50.9	194.3	-3.1	43.0	37.3	0.0
Southwest	6,869.2	3,006.1	438.5	1,317.2	-89.7	1,364.4	-50.5	1,147.3	101.3	21.9	16.7	12.3
All units	18,392.3	5,077.1	885.2	3,137.3	98.6	7,127.4	-142.0	2,791.4	210.1	227.0	68.8	32.1

Numbers in rows and columns may not sum due to rounding

[a] No live trees, saplings, and seedlings.

Stand Volume

The total stand volume (all trees greater than or equal to 5.0 inches d.b.h., both live and salvable dead) of Arkansas' seventh forest survey was 23,992.7 million cubic feet. This was a 3,123.5-million-cubic-foot increase (15 percent) over the 1988 survey. The live-tree volume was 23,783.9 million cubic feet while growing-stock volume was 21,686.9 million cubic feet. The proportions of live-tree volume were 40 percent softwood and 60 percent hardwood. In the previous survey, they were 39 and 61 percent, respectively.

Total sawtimber volume was 76,960.7 million board feet. This was a 10,241.4-million-board-foot increase (15 percent) over the 1988 survey. The proportion of softwoods to hardwoods was 51 and 49 percent, respectively; the previous survey showed 50 percent softwood and 50 percent hardwood sawtimber.

Sound wood in cull trees was 1,901.3 million cubic feet. Ninety percent of this rough cull was in the hardwood portion. There were 195.7 million cubic feet in rotten cull trees. Again, a large proportion of this was in hardwoods, 97 percent.

The volume of salvable dead trees was 208.8 million cubic feet, 58 percent in hardwoods and 42 percent in softwoods. The volume estimate of salvable dead trees is considered conservative due to the periodic nature of data collection. Trees may progress from a salvable to nonsalvable state before they are sampled. In all likelihood, most trees are probably salvable at the time of death with the exception of some species of senescent hardwoods.

Softwood Volume

The softwood live-tree volume for Arkansas was 9,541.9 million cubic feet. Only two survey units were dominated by softwoods, the Ouachita and the Southwest units (fig. 8). Those two units had 83 percent of the State's softwood volume. For the entire State, softwoods made up only 40 percent of the total live-tree volume.

Since 1988, the softwood live-tree volume increased by 1,456.8 million cubic feet (18 percent). The increases were highest in the Ouachita, Ozark, and Southwest survey units, 488.5, 306.8, and 587.5 million cubic feet, respectively (table V). Based on the relative amount of softwood volume in the unit, the Ozark unit's increase since 1988 was substantial (34 percent).

Most of the softwood live-tree volume was in NIPF and forest industry ownership, 3,794.8 and 3,525.5 million cubic feet, respectively (table VI). These two ownerships accounted for 77 percent of the softwood volume. Noteworthy was the fact that forest industry owned only 24 percent of Arkansas timberland but had 37 percent of the State's softwood volume. Most of the softwood volume increase also was on forest industry land, 46 percent of the total softwood increase. If increases continue as they have, into the next survey of Arkansas, forest industry owners might have more softwood volume than any other ownership class.

The live-tree softwood volume increase was distributed throughout all the diameter classes up to the 24-inch class

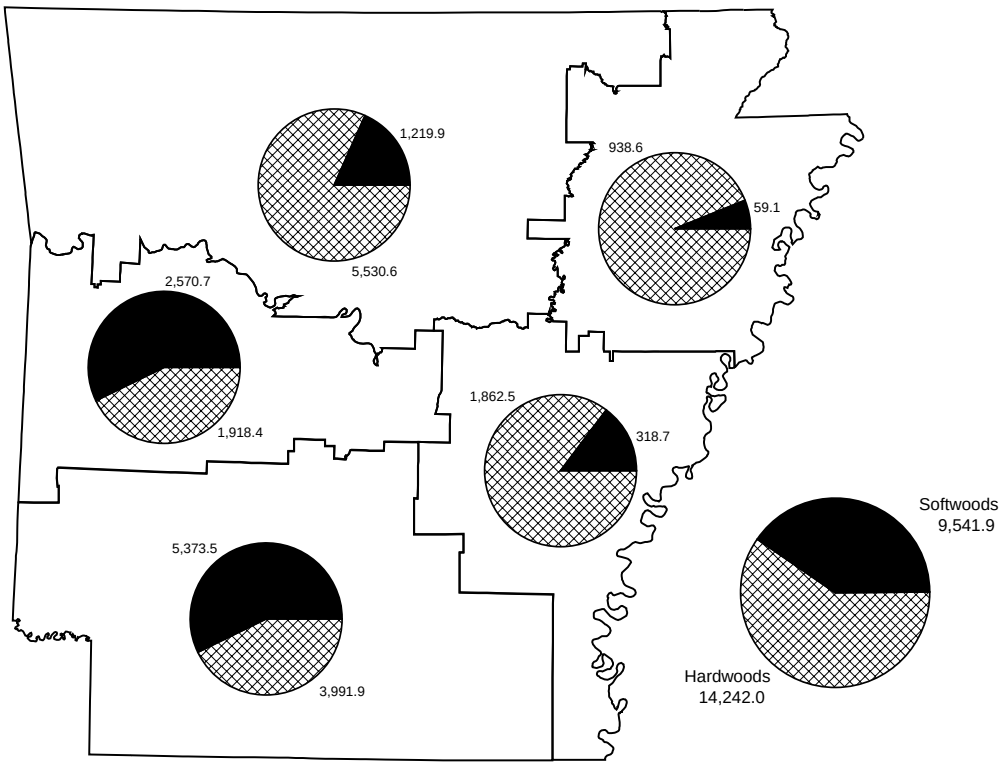

Figure 8—Proportion of live-tree volume, in million cubic feet, by species group, Arkansas, 1995.

Table V—Change in live-tree volume by forest survey unit, Arkansas, 1988 to 1995

Forest survey unit	Softwood		Hardwood	
	Volume	Change	Volume	Change
	Million cubic feet			
North Delta	59.1	17.2	938.6	192.9
South Delta	318.7	56.7	1,862.5	103.5
Ouachita	2,570.7	488.5	1,918.4	326.7
Ozark	1,219.9	306.8	5,530.6	1,041.6
Southwest	5,373.4	587.5	3,991.9	-98.7
All units	9,541.9	1,456.8	14,242.0	1,566.1

Numbers in columns may not sum to totals due to rounding.

Table VI—Change in live-tree volume by ownership class, Arkansas, 1988 to 1995

Ownership class	Softwood		Hardwood	
	Volume	Change	Volume	Change
	Million cubic feet			
National forest	1,927.7	278.1	2,171.3	352.4
Other public	293.9	76.1	1,294.6	335.7
Forest industry	3,525.5	674.2	2,180.9	-146.5
Nonindustrial private	3,794.8	428.3	8,595.2	1,024.5
All classes	9,541.9	1,456.8	14,242.0	1,566.1

Numbers in columns may not sum to totals due to rounding.

(fig. 9). The largest increases were in the 8- through 16-inch diameter classes. No noteworthy change was evident in the 24-inch diameter class and beyond. As illustrated in figure 9, 73 percent of Arkansas softwood live-tree volume was in trees in the 8- through 16-inch diameter class. Only 11 percent of the volume was in trees in the 20-inch diameter class and larger.

The predominant species in softwood volume was loblolly pine (fig. 10). It surpassed shortleaf pine in the 1988 survey and continues to increase at a high rate. Since 1988, loblolly pine volume went from 4,045.0 million cubic feet to 5,100.0 million cubic feet, a 26-percent increase. Shortleaf pine was 1,199.0 million cubic feet less than loblolly pine, a difference that had increased substantially. In 1988, shortleaf pine had only 398.0 million cubic feet less volume than loblolly pine. This trend is likely to continue, given the emphasis on loblolly pine planting activity.

The spatial distribution of Arkansas' live-tree softwood volume is depicted in the effective density graphs of figure 11. A typical pattern, common in States with a history of

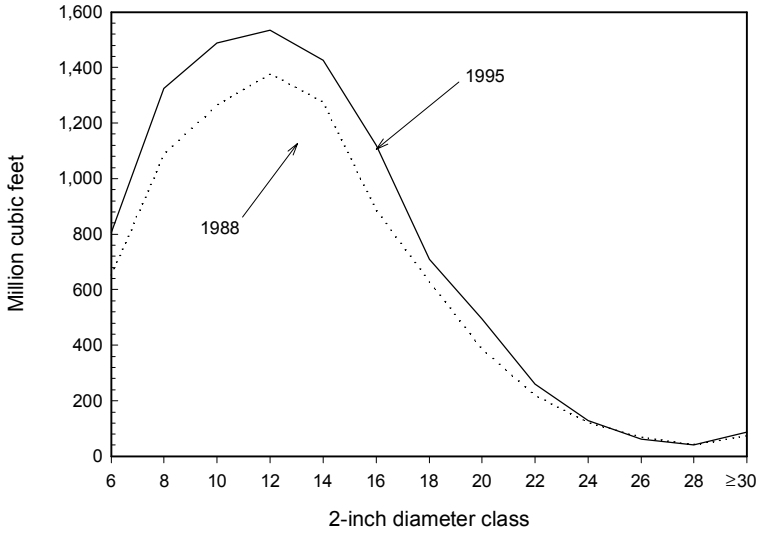

Figure 9—Softwood live-tree volume by 2-inch diameter class, Arkansas, 1988 and 1995.

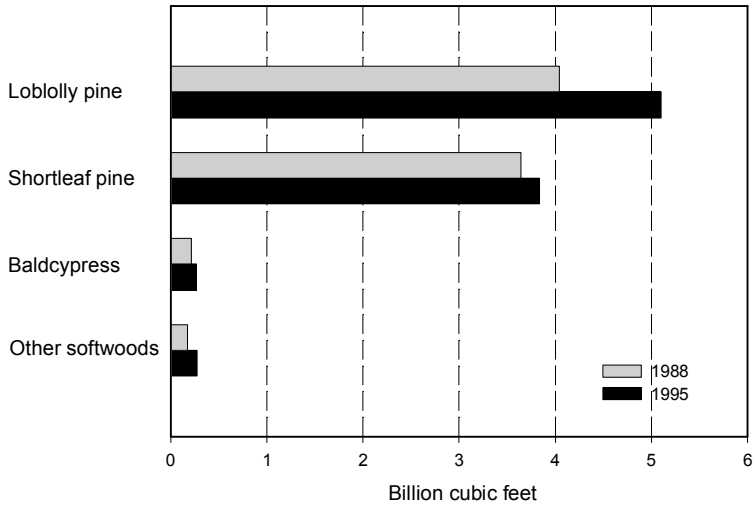

Figure 10—Softwood live-tree volume by species, Arkansas, 1988 and 1995.

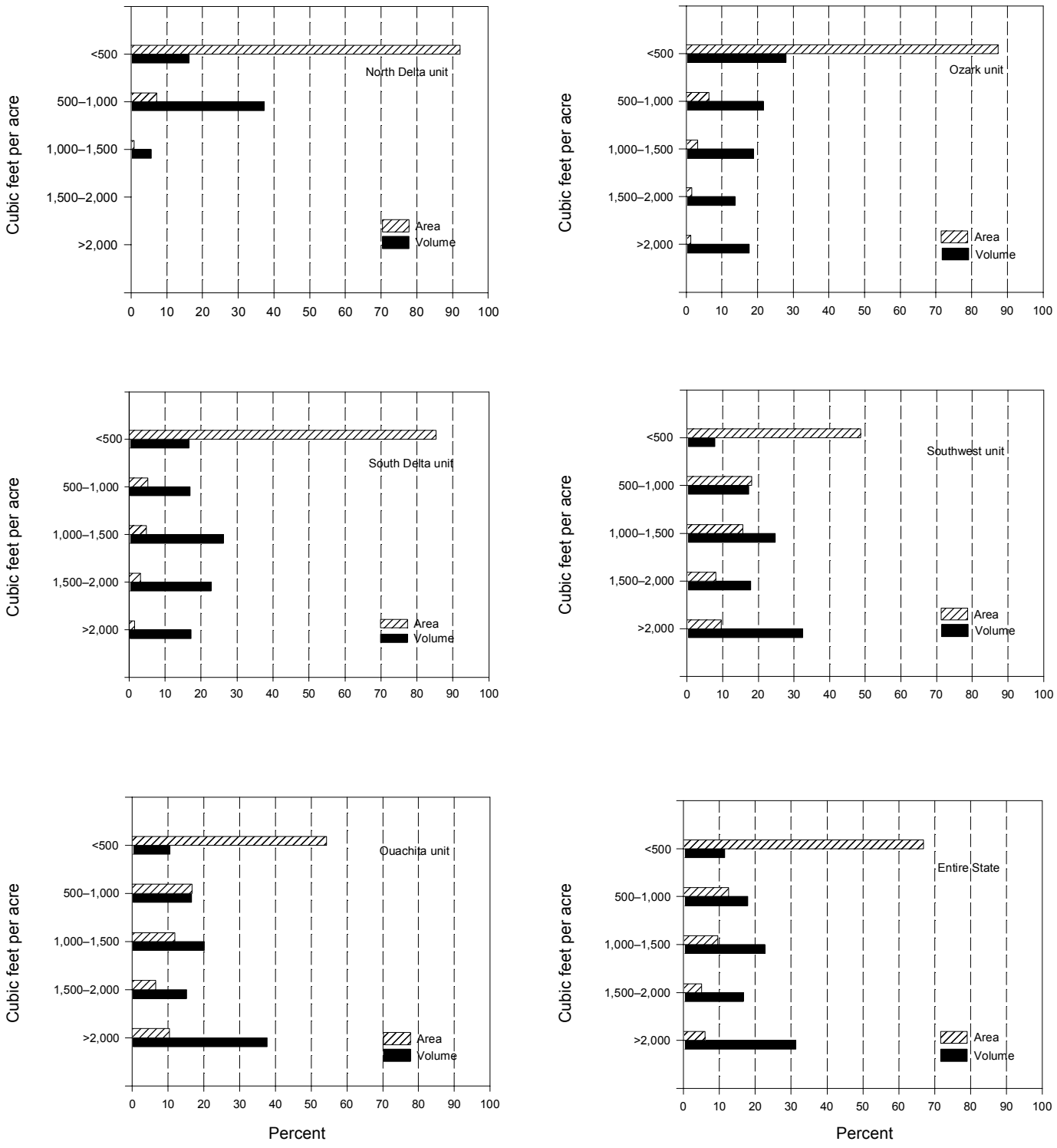

Figure 11—Timberland area and live-tree volume of softwoods by stand-volume class, Arkansas, 1995.

much harvesting disturbance, is that many stands have very little volume per acre and few have higher volumes per acre. For example, Arkansas had approximately 67 percent of its timberland area (12.3 million acres) in stands composed of less than 500 cubic feet of softwood volume per acre. This was a slight improvement over the 1988 survey, where 70 percent of timberland was in stands of less than 500 cubic feet of softwood volume per acre.

Softwood Sawtimber Volume

There were 39,483.9 million board feet of softwood volume in the 1995 inventory (table VII), a 17-percent increase over the 33,614.4 million board feet reported in the 1988 survey. A majority of sawtimber volume was in softwoods, 39,483.9 million board feet, or 51 percent versus 37,476.8 million board feet in hardwoods (fig.12). This was only a slight change from the 1988 inventory, when 50 percent of volume was in softwoods.

Only two of the survey units were dominated by softwood sawtimber, the Ouachita and Southwest (fig. 12). The Southwest unit had a substantial amount of softwood sawtimber, 23,554.8 million board feet (60 percent of the State's volume). As expected, most of the 5,869.5-million-board-foot increase in softwood sawtimber took place in the Ouachita (33 percent) and Southwest (45 percent) units (table VII). The combined increases in those two units surpassed the standing volume in the Ozark unit. This was a dramatic reversal from what was shown in the 1988 survey, where sawtimber volume declined 921.5 million board feet for the State. The Ouachita and Southwest units showed 645.4- and 1,167.7-million-board-foot decreases, respectively.

Table VII—Change in sawtimber volume by forest survey unit, Arkansas, 1988 to 1995

Forest survey unit	Softwood		Hardwood	
	Volume	Change	Volume	Change
	Million board feet [a]			
North Delta	258.5	79.7	2,969.4	605.1
South Delta	1,317.6	274.9	6,555.4	457.8
Ouachita	10,364.5	1,931.2	3,939.6	924.1
Ozark	3,988.6	918.7	12,623.7	2,034.4
Southwest	23,554.8	2,665.0	11,388.7	350.4
All units	39,483.9	5,869.5	37,476.8	4,371.9

Numbers in columns may not sum to totals due to rounding.

[a] International 1/4-inch rule.

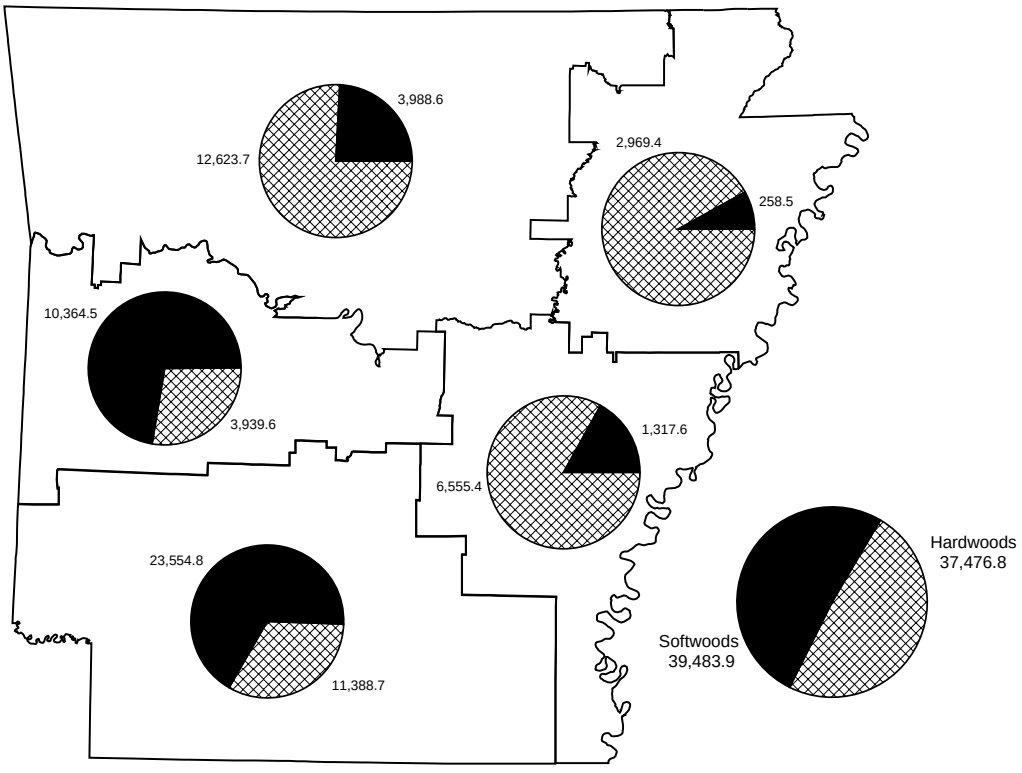

Figure 12—Porportion of sawtimber volume, in million board feet, by species group, Arkansas, 1995.

All ownership categories showed sawtimber increases since the 1988 survey (table VIII). The largest real change was in NIPF land with a 2,240.5-million-board-foot increase. Forest industry land had a 1,768.3-million-board-foot increase while national forests had a 1,416.2-million-board-foot increase. Proportionately, NIPF lands had the largest proportion of the total 5,869.5-million-board-foot increase with 38 percent, forest industry had 30 percent, other public had 8 percent, and national forest had 24 percent. The largest relative increase within each ownership category was other public. Here, sawtimber volume increased by 45 percent since the 1988 survey. Next was national forest with a 20-percent increase. The lowest relative increases were in NIPF and forest industry ownerships, 16- and 15-percent increases, respectively.

The distribution of softwood sawtimber across Arkansas was similar to the live-tree volume distribution. A high proportion of volume was concentrated on relatively few acres of timberland, namely, acreage with more than 9,000 board feet per acre in softwood sawtimber (fig. 13). In the 1995 survey, there were 1.2 million acres of this type of timberland (7 percent of all timberland). These acres had 41 percent of Arkansas' softwood sawtimber volume, 16,327.1 million board feet. This represented a 274,000-acre increase in this volume class since 1988. The total volume in this class also increased by 3,724.2 million board feet.

The high concentration of softwood sawtimber volume was most pronounced in the Ouachita and Southwest units (fig. 13). Together, these two units had 15,122.9 million board feet in the more than 9,000-board-feet-per-acre volume class. This was 93 percent of the softwood sawtimber in this volume class.

The North Delta, South Delta, and Ozark units reflect the presence of very little softwood sawtimber. More than 80 percent of the timberland in these three units had less than 1,000 board feet of softwood sawtimber per acre (fig. 13). This was expected since these areas of the State are not considered important habitat for loblolly and shortleaf pine.

Hardwood Volume

Most of Arkansas' live-tree volume was in hardwoods. A total of 14,242.0 million cubic feet were in hardwoods in the 1995 survey. Three of Arkansas' five survey units were dominated by hardwood volume, the North Delta, South Delta, and Ozark units (fig. 8). Even though the Southwest unit contains the most total volume, the Ozark unit contains the most volume in a specific species group. In the Ozark unit, there were 5,530.6 million cubic feet in hardwoods, whereas the Southwest unit had 5,373.5 million cubic feet in softwoods (fig. 8). This is a large change since the 1988 survey, when the Southwest unit had the most volume in a specific species group. Then, there were 4,785.9 million cubic feet of softwoods in the Southwest unit but only 4,489.0 million cubic feet of hardwoods in the Ozark unit.

Hardwood volume had increased by 1,566.1 million cubic feet since the 1988 survey (table V). This is practically identical to the increase of the 1988 survey when hardwoods, for the State, increased by 1,560.2 million cubic feet.

Every survey unit showed a positive net increase in hardwood volume with the exception of the Southwest (table V). There, volume decreased by 98.7 million cubic feet. Of the 1,664.7-million-cubic-foot increase in the other four survey units, 1,041.6 million cubic feet (63 percent) were in the Ozark unit. The Southwest unit's volume decrease followed years of forest management strongly favoring pine species over hardwoods. The 326.7-million-cubic-foot increase in the Ouachita unit was a continued increase. In the 1988 survey, the increase had been 200.9 million cubic feet. Hardwood volume also continued to

Table VIII—Change in sawtimber volume by ownership class, Arkansas, 1988 to 1995

	Softwood		Hardwood	
Ownership class	Volume	Change	Volume	Change
	Million board feet[a]			
National forest	8,444.5	1,416.2	5,633.8	1,225.1
Other public	1,436.3	444.4	4,250.8	1,129.6
Forest industry	13,624.5	1,768.3	6,615.7	-203.0
Nonindustrial private	15,978.7	2,240.5	20,976.4	2,220.1
All classes	39,483.9	5,869.5	37,476.8	4,371.9

Numbers in columns may not sum to totals due to rounding.

[a] International 1/4-inch rule.

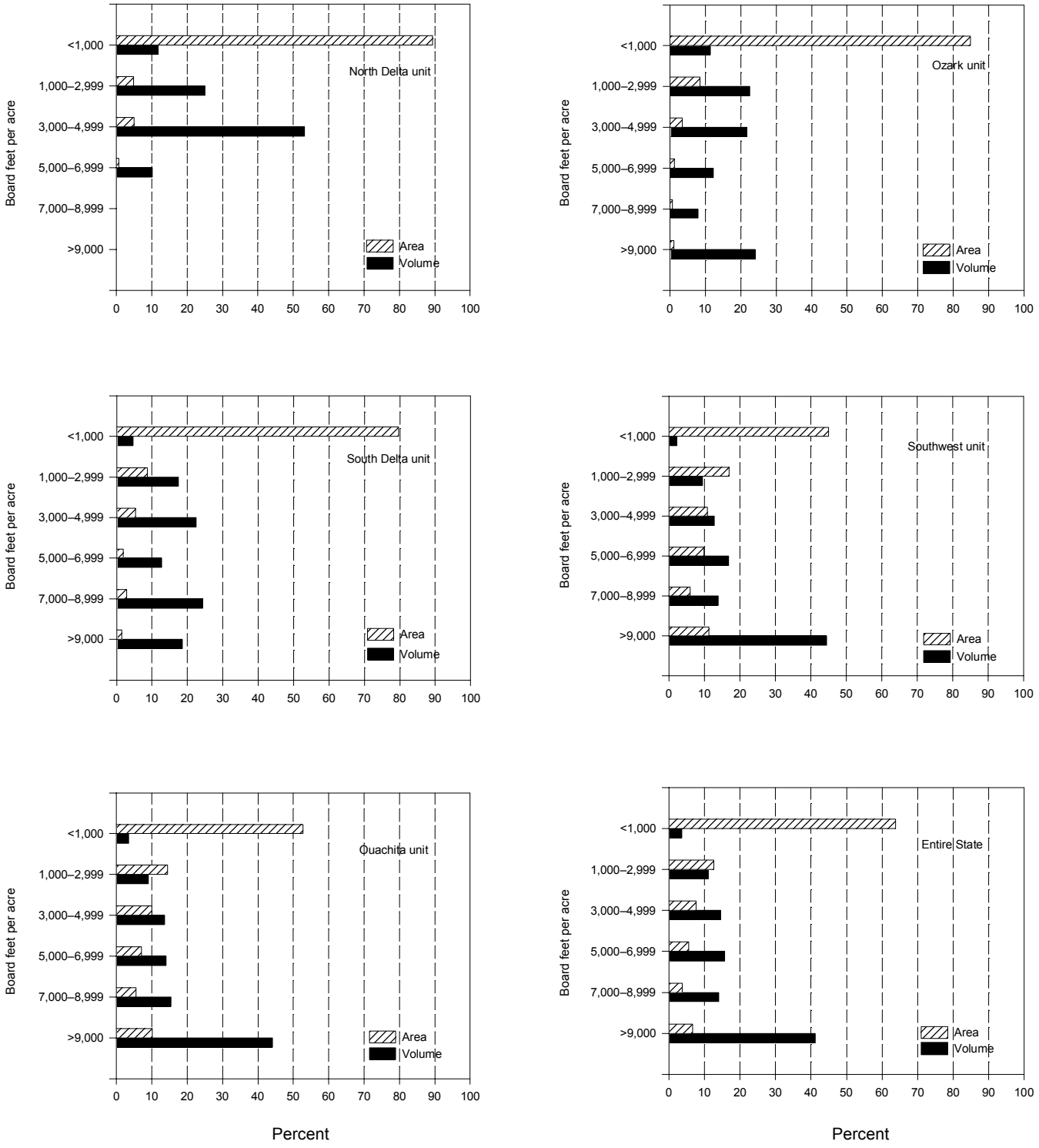

Figure 13—Timberland area and sawtimber volume of softwoods by stand-volume class, Arkansas, 1995.

increase in the two Delta units. However, the South Delta increase was not as high as the increase reported in 1988. Then, 256.8 million cubic feet were added to the inventory versus 103.5 million cubic feet currently.

The distribution of hardwood ownership is in sharp contrast to that of softwoods. Forest industry and NIPF ownerships held an almost equal amount of softwood, 3,525.5 and 3,794.8 million cubic feet, respectively (table IV). By contrast, NIPF held 8,595.2 million cubic feet, or 60 percent, of the hardwood resource. Further, almost equal amounts of hardwood volume were held by national forests and forest industry, 2,171.3 and 2,180.9 million cubic feet, respectively.

Changes in volume by ownership were very similar to those reported in the 1988 survey. All ownerships showed an increase with the exception of forest industry (table VI). There, volume decreased by 146.5 million cubic feet (versus a decrease of 103.9 million cubic feet in 1988). Most of the 1,712.6-million-cubic-foot hardwood increase was in NIPF ownership, 1,024.5 million cubic feet (60 percent). Hardwood volume in public ownership continued to increase with both national forest and other public increases higher than those reported for the 1988 survey.

The large increase in hardwood volume was distributed across the range of diameter classes (fig. 14). Most of the increase was in the 10- through 16-inch diameter classes, 885.3 million cubic feet, or 57 percent of the 1,566.1-million-cubic-foot total hardwood increase. Although not as high as the mid-diameter increase, the volume increases were also evident throughout the larger diameter classes. This is important because it means there was more volume in trees with the potential to move into higher quality grade classes (hardwood grade specifications require a tree to meet qualifying size requirements for the higher grades). In the 1988 survey, every diameter class also had an increase of hardwood live-tree volume. However, there was only a 691.4-million-cubic-foot increase in the 10- through 16-inch diameter class.

There were increases in hardwood volume of all important individual species and all major species groups (fig. 15). Substantial gains were made in the select white oak and other red oak categories. The largest increase of any hardwoods species or species group was the select white oaks. There, volume increased from 1,921.4 million cubic feet in 1988 to 2,378.6 million cubic feet in 1995. An interesting observation about the species group categories is that there was much more volume in the select white oak group than in the other white oak group. In contrast, the other red oak category was more than double the volume of the select red oak category. One reason for this is that in Arkansas, there are many more select white oak species than select red oak species.

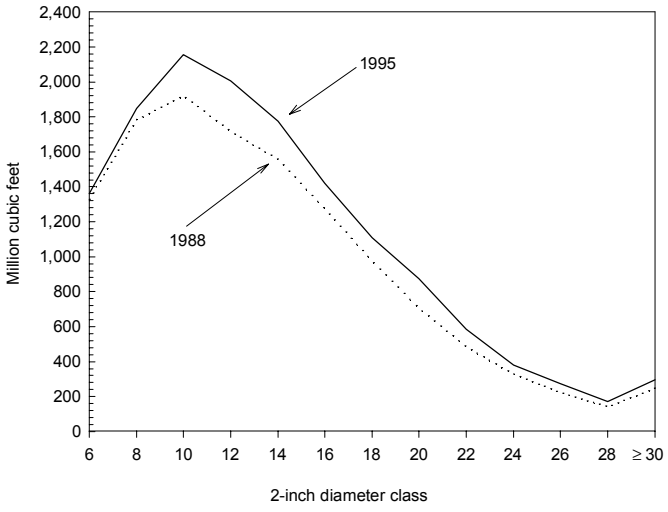

Figure 14—Hardwood live-tree volume by 2-inch diameter class, Arkansas, 1988 and 1995.

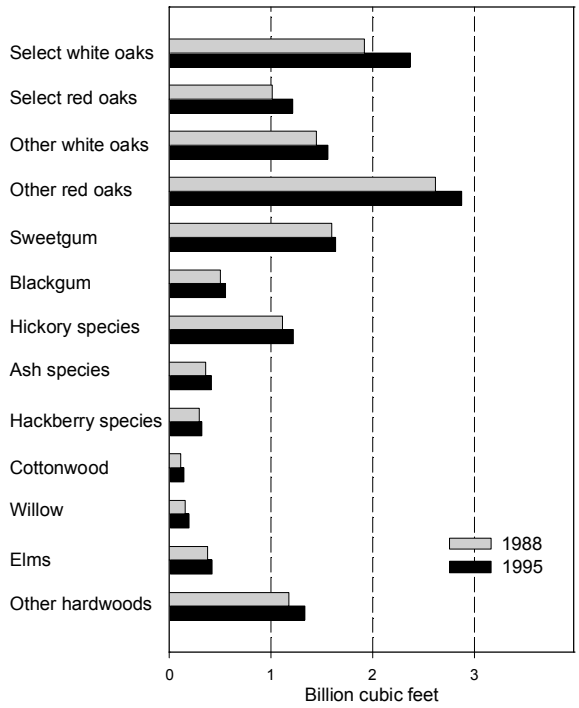

Figure 15—Hardwood live-tree volume by species, Arkansas, 1988 and 1995.

The 14,242.0 million cubic feet of hardwood volume is not evenly distributed across the State's 18.4 million acres of timberland. Figure 16 illustrates this point where 47 percent of timberland (8.7 million acres) is composed of stands with less than 500 cubic feet per acre in hardwood volume. In contrast, only 8 percent of timberland (1.4 million acres) is in forest stands containing more than 2,000 cubic feet per acre in hardwood volume (fig. 16). In addition, 12.7 million acres (69 percent) of Arkansas timberland has less than 1,000 cubic feet per acre in hardwoods. Even in the Ozark unit, a unit composed mostly of hardwood species, 31 percent of the timberland had less than 500 cubic feet per acre in hardwoods, while another 31 percent had more than 500 but less than 1,000 cubic feet per acre. The North and South Delta, also predominantly hardwood units, were somewhat different than the other three units in the amounts of timberland with lower levels of hardwood volume. Both had a fairly even distribution of all stand-volume classes. This was because there was relatively little timberland in the two lowest stand-volume classes, 47 and 44 percent, respectively, as compared to the other units and the State total, where the amount of timberland in those stand-volume classes exceeded 60 percent.

The spatial distribution of hardwood volume was slightly different than that of softwoods. Except in the two Delta units, the volume was more evenly distributed among stand-volume classes (fig. 16). In the North Delta, 45 percent of the hardwood volume was in the highest volume class, while in the South Delta unit, 53 percent of hardwood volume was in this class. Across the entire State, 27 percent of hardwood volume (3,774.1 million cubic feet) was on only 8 percent of timberland (1,431.7 million cubic feet).

Hardwood Sawtimber Volume

In proportion of hardwood versus softwood sawtimber volume, Arkansas is a softwood State, but by only a slight margin—51 percent in softwoods to 49 percent in hardwoods. However, regionally, three of Arkansas' survey units were dominated by hardwood sawtimber, the North and South Delta and the Ozark unit (fig. 12). These units contained 22,148.5 million board feet of hardwood sawtimber, 59 percent of the State's total hardwood sawtimber volume. The Ozark unit held more hardwood sawtimber volume than any of the other survey units, slightly edging out the Southwest unit by 1,235.0 million board feet (fig. 12).

Since the 1988 survey, Arkansas' hardwood sawtimber volume increased by 4,371.9 million board feet (a 13-percent increase). Every survey unit had increases, but the most substantial increase was in the Ozark unit. The smallest increase was in the Southwest unit (table VII). Forty-seven percent of the total hardwood sawtimber increase was in the Ozark unit. The Southwest unit was still affected by many years of hardwood exclusion by forest managers. Hardwood sawtimber volume in the Southwest increased by only 350.4 million board feet, or 3 percent. This was down, substantially, from the 1,328.0-million-board-foot increase reported in the 1988 survey.

Most of the increase in hardwood sawtimber occurred in NIPF ownership (table VIII). There, volume increased by 2,220.1 million board feet (12 percent). However, this was substantially less than the 4,998.9-million-board-foot increase reported in 1988. All ownerships showed increases except forest industry, which went from a 399.4-million-board-foot gain in 1988 to a 203.0-million-board-foot loss in 1995. Both public ownership categories continued to show substantial hardwood sawtimber gains, 1,225.1 million board feet for national forests and 1,129.6 million board feet for other public timberland. National forest gains were slightly less than those shown in the 1988 survey, while other public volume increases were slightly higher.

There is relatively little timberland in Arkansas with 9,000 or more board feet of hardwood sawtimber volume per acre (fig. 17). However, 26 percent (9,887.5 million board feet) of the State's hardwood sawtimber occurs in this stand-volume class, and this is on only 4 percent of the State's total timberland (783,600 acres). In contrast, there are 10.2 million acres of timberland (56 percent) with less than 1,000 board feet of hardwood sawtimber per acre. The Ouachita and Ozark units have very little timberland with more than 9,000 board feet of hardwood sawtimber volume per acre, 48,200 (1 percent) and 162,200 acres (3 percent), respectively. Even though the Ozark unit is comprised of mostly hardwood sawtimber volume (fig. 12), very little of that volume is in stands in the higher stand-volume classes (fig. 17). Twenty-five percent (3,151.0 million board feet) of the sawtimber volume is in the 1,000- to 3,000-board-feet-per-acre stand-volume class, 22 percent is in the 3,000- to 5,000-board-feet-per-acre class, and 21 percent is in the 5,000- to 7,000-board-feet-per-acre class. The Ouachita unit is similar—34 percent (1,350.2 million board feet) of volume is on 22 percent of timberland (timberland in the

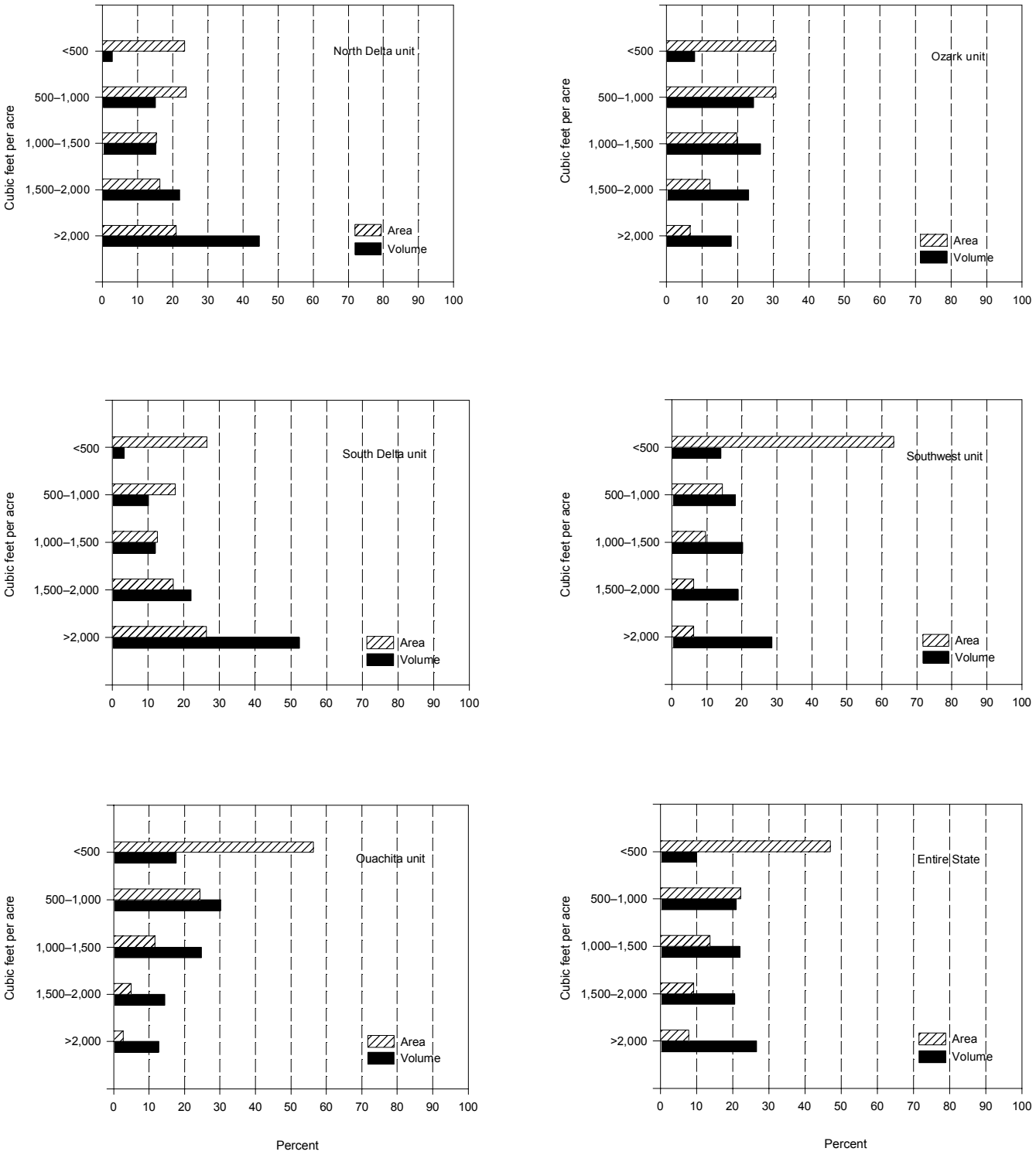

Figure 16—Timberland area and live-tree volume of hardwoods by stand-volume class, Arkansas, 1995.

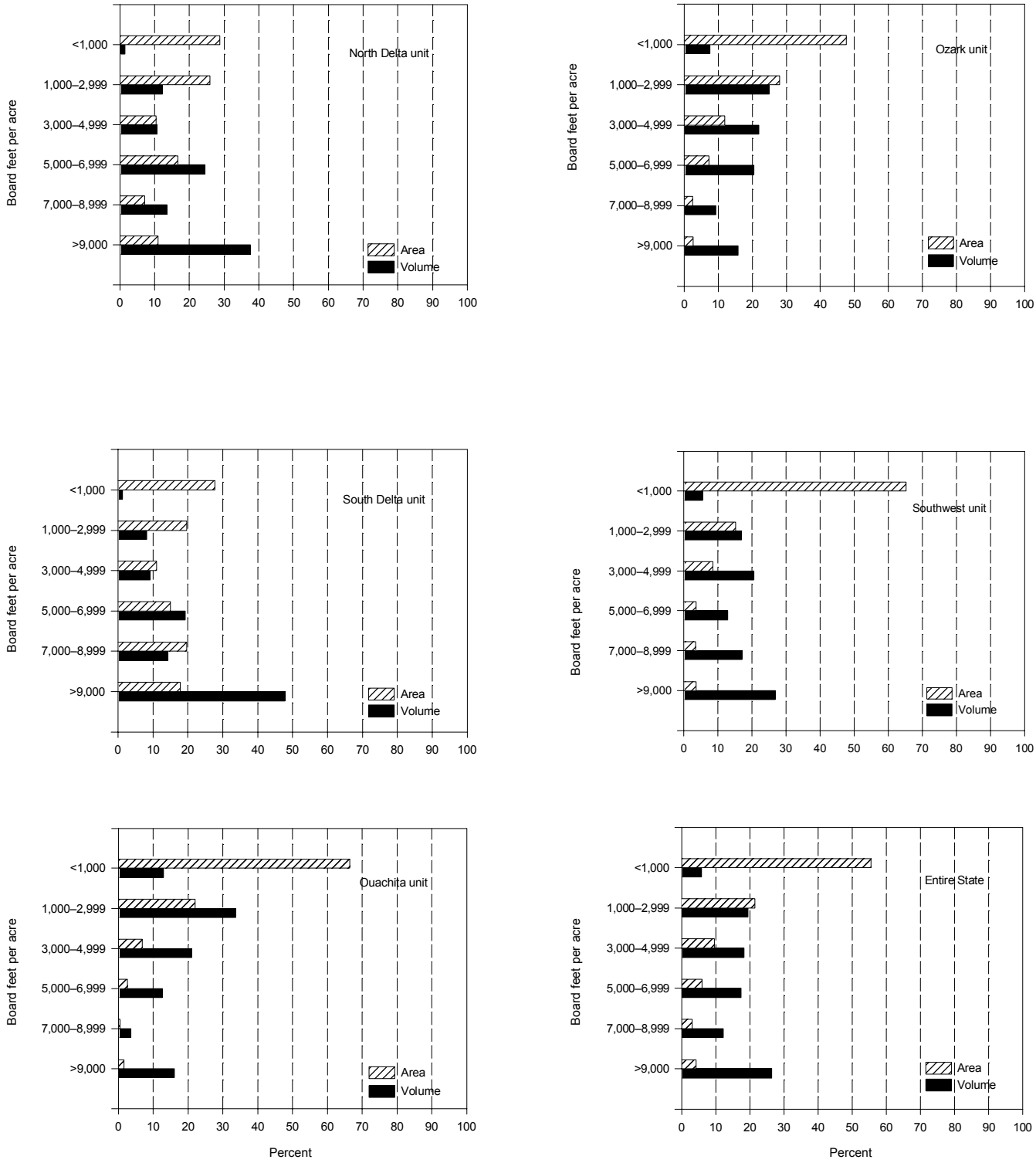

Figure 17—Timberland area and sawtimber volume of hardwoods by stand-volume class, Arkansas, 1995.

1,000- to 3,000-board-feet-per-acre stand-volume class). Normally, little volume is in the higher stand-volume classes in these two survey units because the hardwood trees are, on average, shorter than elsewhere in Arkansas, primarily because of restrictive habitat conditions. This is in contrast to the other survey units where the plurality of hardwood sawtimber volume is in the stand-volume class of more than 9,000 board feet per acre. In the North Delta, 38 percent (1,116.4 million board feet) of hardwood sawtimber is in this class, while in the South Delta, 48 percent (3,136.6 million board feet) is in the same class.

Stand Structure

Stand Size

Shifts and resulting trends in stand-size class can be complex. Since the 1988 survey some poletimber-sized stands grew into sawtimber size, while some reverted to sapling-seedling sized stands because of cutting or natural disturbance. Likewise, some sawtimber-sized stands may have reverted to poletimber as a result of thinning or partial harvest, or to sapling-seedling following clearcut harvest. Many stands remained in the same size class. However, many stands may have shifted size class without a resultant change in the amount of timberland in a particular size class. This is because as one stand moves into another size class (either through growth or decline), a stand moving from another size class may take its place. These types of stand dynamics are complex and more difficult to track. A survey showing no change in area of the three stand-size classes may in reality have had a high degree of stand dynamics taking place.

Most of Arkansas' timberland was in sawtimber-sized stands. In 1995 there were 8.5 million acres in this stand-size class (fig. 18). Poletimber-sized stands occupied 5.5 million acres, and sapling-seedling-sized stands occupied 4.4 million acres. The unit with the most timberland in sawtimber was the Southwest, 3.4 million acres, or 50 percent of all timberland in the unit. Proportionately, the Delta units had the most timberland in sawtimber stands, 55 percent for the North Delta and 64 percent for the South Delta.

The largest change in any particular stand size occurred in sawtimber-sized stands, an increase of 1.2 million acres since 1988 (table IX). Most of this increase occurred in the

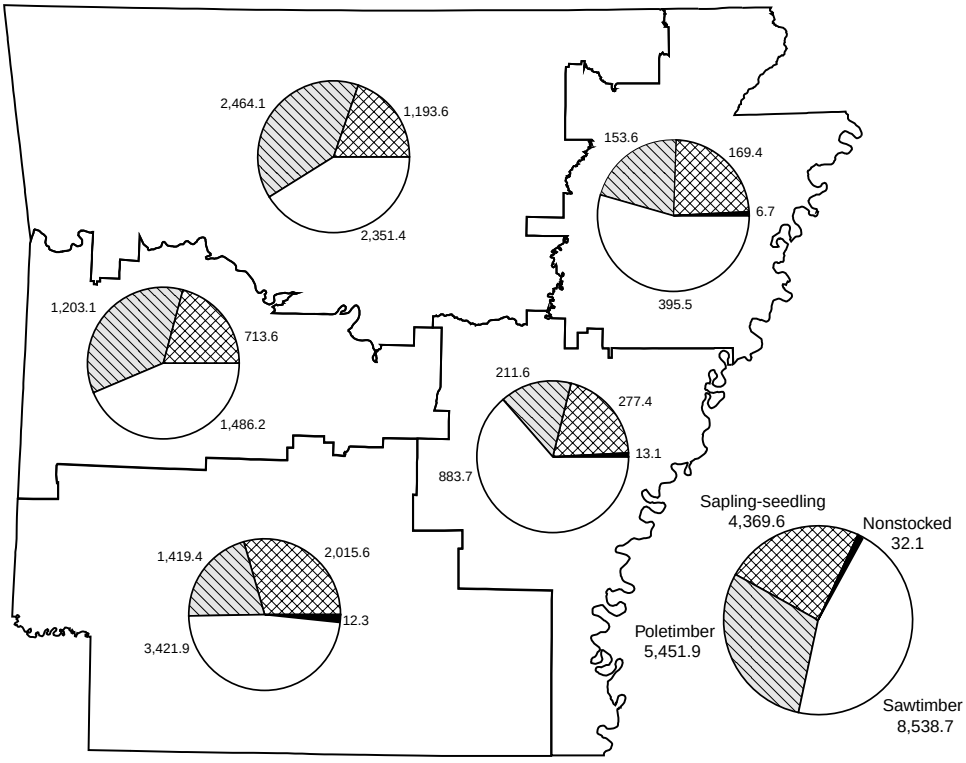

Figure 18—Proportion of timberland, in thousand acres, by stand-size class, Arkansas, 1995.

Table IX—Change in timberland by forest survey unit and stand-size class, Arkansas, 1988 to 1995

Forest survey unit	Sawtimber		Poletimber		Sapling-seedling		Nonstocked	
	Area	Change	Area	Change	Area	Change	Area	Change
	Thousand acres							
North Delta	395.5	71.8	153.6	3.6	169.4	36.8	6.7	0.6
South Delta	883.7	32.3	211.6	18.1	277.4	38.3	13.1	13.1
Ouachita	1,486.2	297.0	1,203.1	190.8	713.6	-257.9	0.0	0.0
Ozark	2,351.4	544.9	2,464.1	59.4	1,193.6	-324.8	0.0	0.0
Southwest	3,421.9	237.8	1,419.4	102.0	2,015.6	76.5	12.3	7.0
All units	8,538.7	1,183.8	5,451.9	374.1	4,369.6	-431.0	32.1	20.6

Numbers in columns may not sum to totals due to rounding.

Ozark unit, 544,900 acres (46 percent of the increase). Poletimber-sized stands increased by 374,100 acres, mostly in the Ouachita and Southwest units.

The only size class to decrease in area was the sapling-seedling size class, 431,000 acres since 1988. However, the decline was only in the Ozark (324,800 acres) and Ouachita units (257,900 acres). This 582,700-acre total decline was offset, somewhat, by a 151,600-acre increase in the other three units (table IX).

The trend analysis of stand-size class is further complicated by diversion and addition acreage. If diversion/addition area is left out of the analysis and only land that was in forest in both 1988 and 1995 is included, the outcome changes slightly. For example, instead of decreasing by 431,000 acres, the sapling-seedling-size class would decrease 1.1 million acres because most additional acreage contains sapling-seedling-size class stands. If the new area were not added to the inventory, the data would show maturing sapling-seedling stands moving into poletimber size and maturing poletimber moving into sawtimber. Only clearcut harvested acres would be left to restore the sapling-seedling-size class, and that would not be enough to maintain the previous area in that size class. This explanation helps illustrate the maturing and dynamic nature of Arkansas' forest structure.

The 1.1 million-acre increase in sawtimber-sized stands was a very noteworthy change from the 1988 survey. Between 1978 and 1988, sawtimber-sized stands changed little (a decrease of 4,000 acres). Decreases in the North Delta, Ouachita, and Southwest Survey units were offset by a slight increase in the South Delta unit and a very large increase in the Ozark unit.

Most of the real increase in sawtimber-sized stands was on NIPF ownership (table X), where the area included an additional 425,200 acres or 36 percent of the total sawtimber increase. The other ownerships also showed increases. National forest increased by 316,900 acres, other public lands by 143,100 acres, and forest industry by 298,500 acres. Especially noteworthy was the increase on public-owned forests. Over the 1988 to 1995 survey period, other public ownership had the largest relative increase in sawtimber stands, 30 percent, followed closely by national forests with 28 percent. Forest industry and NIPF followed with 17 and 11 percent increases, respectively.

The most noteworthy changes between surveys were in forest industry and national forest ownerships. Trends in sawtimber-sized stands on the former went from a decrease of 401,400 acres to an increase of 298,500. Similarly, national forest ownership went from a modest 52,900-acre increase in 1988 to a 316,900-acre increase in 1995.

Table X—Change in timberland by ownership and stand-size classes, Arkansas, 1988 to 1995

Ownership class	Sawtimber		Poletimber		Sapling-seedling		Nonstocked	
	Area	Change	Area	Change	Area	Change	Area	Change
	Thousand acres							
National forest	1,453.0	316.9	679.6	-168.5	239.3	-74.3	0.0	0.0
Other public	626.4	143.1	160.4	1.4	137.0	0.2	0.0	0.0
Forest industry	2,089.0	298.5	1,164.3	267.5	1,236.8	-434.4	7.3	1.9
Nonindustrial private	4,370.2	425.2	3,447.7	273.7	2,756.5	77.4	24.8	18.7
All classes	8,538.7	1,183.8	5,451.9	374.1	4,369.6	-431.0	32.1	20.6

Numbers in columns may not sum to totals due to rounding.

A decrease in national forest harvesting levels allowed many poletimber-sized stands to grow into sawtimber size. In a slightly different fashion, the forest industry, which had converted natural stands to pine plantations (particularly in the Southwest unit) saw an increasing maturity of those stands. Fast-growing loblolly pines grow into sawtimber-size trees very quickly on good sites.

Poletimber-sized stands increased by 374,100 acres, mostly on forest industry (267,500 acres) and NIPF (273,700 acres) ownerships (table X). National forest poletimber-sized stands decreased by 168,500 acres. It appears that stand dynamics slowed on national forest lands as smaller-sized stands matured into sawtimber-sized stands. Sapling-seedling-sized stands also decreased by 74,300 acres. This trend is expected to continue with reduced harvest levels of national forest timber.

Basal Area

Total stand basal area of Arkansas' forests was 84.6 square feet per acre in 1995. This was a slight increase over the 80.1 square feet per acre reported in 1988 but almost the same as reported in 1978, 83.8 square feet per acre.

With 89.9 square feet per acre, the South Delta had the highest basal area. This was slightly lower than the 92.6 square feet per acre reported for the unit in 1988, but still the highest basal area of any survey unit in the last three surveys. The lowest basal area reported in the three most recent surveys was 75.6 square feet per acre for the Ozark unit in 1978.

The highest basal area of any ownership class was national forests with 101.3 square feet per acre, followed by other public ownership at 97.1 square feet per acre, and 82.4 and 80.4 square feet per acre for forest industry and NIPF ownerships, respectively. With so much timberland acreage in the forest industry and NIPF components, the higher stand basal area of public-owned lands had little influence on the overall State average.

The distribution of basal area over the range of diameter classes helps illustrate and define the status and stage of development of forest stand structure. Traditionally, forest stands are considered in terms of three types of diameter distributions: the bell-shaped curve, the reverse-j shaped curve, or the multimodal curve (Baker 1950, Smith 1986). There may be many variations of these curves, also (Nyland 1996). The usual application of forest stand-distribution curves is in describing stand structure over smaller, more homogeneous areas (Nyland 1996, Oliver and Larsen 1990). However, such curves also may be used to depict the overall status of forest stand structure over large areas by aggregating all forest stands together. This concept is slightly different from usual applications because the analysis involves grouping all forest stands into one distribution curve, i.e., grouping sapling-seedling-, poletimber-, and sawtimber-sized stands together. The resulting curves, one for the entire State and one for each survey unit, help reveal the successional stage (or status) and trends of the State's forests (fig. 19).

A graph for the entire State shows the reverse-j-shaped curve for all timberland (fig. 19). This curve depicts a forest with a substantial amount of basal area in the smaller diameter classes, but decreasing amounts in the larger diameter classes. Such a curve is common where replacement of disturbed (mainly by harvesting) forest is ongoing (as evidenced by the higher basal areas in the smaller diameter ranges).

Since 1988, basal area had increased in every diameter class except for the 4-inch class. Most of the real increase was in the 6- through 12-inch diameter classes, while the largest relative increases were in the 20-, 22-, and 29-inch (and larger) diameter classes. The increases across all diameter classes mean Arkansas' forests were maturing beyond levels apparent in the 1978 and 1988 surveys, i.e., the trees were larger and older.

More detailed information is present in the basal area distributions of individual survey units (fig. 19). Both Delta units show a reverse-j-shaped curve that tends slightly toward the bell shape. The stands there are not as heavily disturbed as upland stands, so basal areas are lower in the smaller diameter ranges and higher in the larger diameters. The upland survey units show a stronger reverse-j-shaped distribution. The Ouachita and Ozark units had the highest relative increases in the larger diameter ranges, mainly due disturbed as upland stands, so basal areas are lower in the smaller diameter ranges and higher in the larger diameters. The upland survey units show a stronger reverse-j-shaped distribution. The Ouachita and Ozark units had the highest relative increases in the larger diameter ranges, mainly due to the extent of national forests there. Substantial replacement has gone on in the smaller diameter ranges, especially in the Ouachita unit, which had three diameter classes (6-, 8-, and 10-inch) approaching 14 square feet per acre. This indicates that a large proportion of these stands was in poletimber and very young and immature sawtimber size classes.

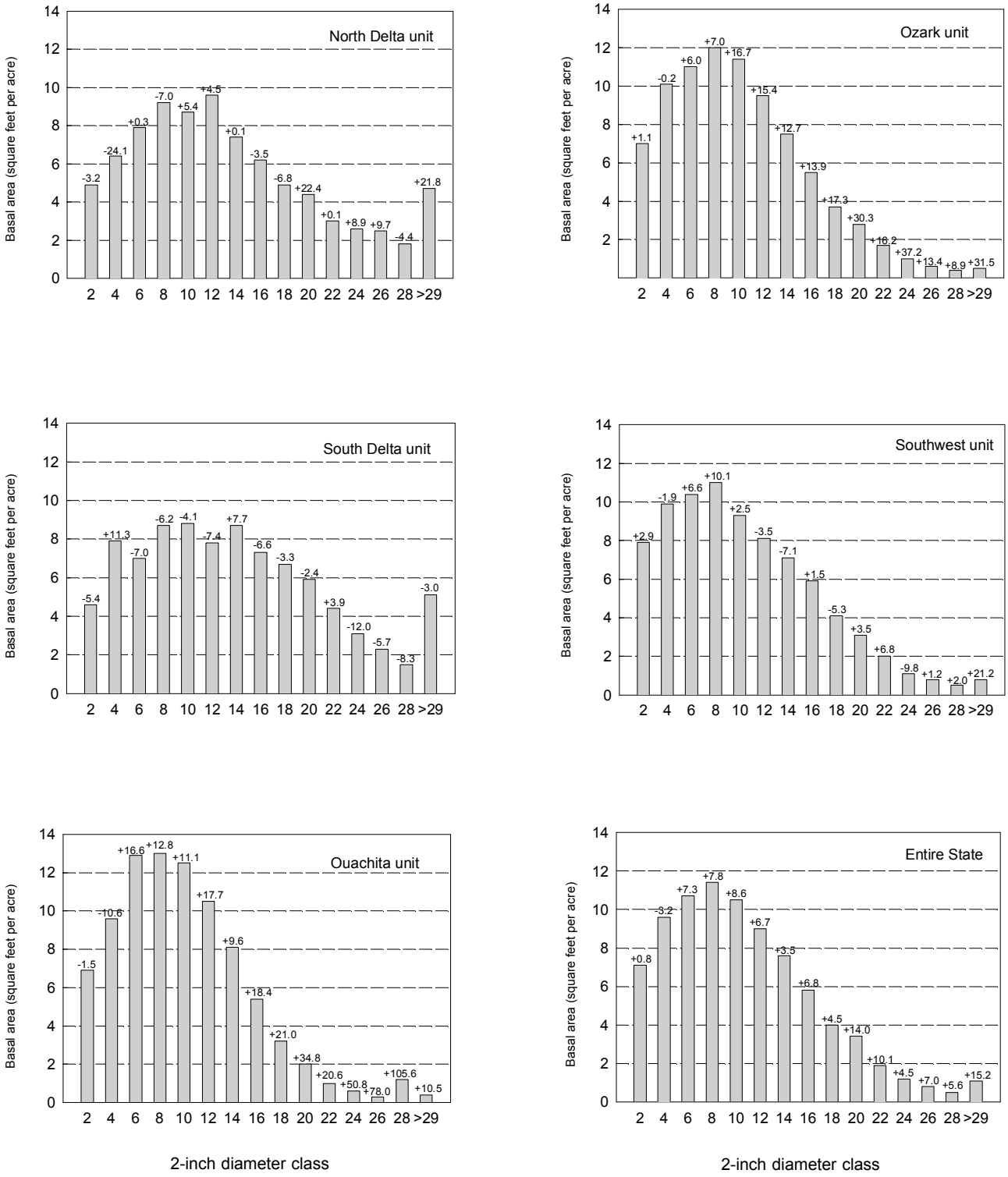

Figure 19—Basal area of all live trees by diameter class, Arkansas, 1995. Numbers above bars are percentage changes since the 1988 survey.

The basal area distribution curves also illustrate the relative size (and development stage) of trees in the sawtimber size class. When discussing the size class of stands by the FIA categories (sapling-seedling, poletimber, and sawtimber) it can be misleading to assume that sawtimber-sized stands are composed of large dominant trees. By definition, pine sawtimber is trees greater than or equal to 9.0 inches d.b.h., while hardwood sawtimber is trees greater than or equal to 11.0 inches d.b.h. For example, the Ouachita unit had much of its basal area in the 4- through 14-inch diameter classes. By definition, the small end of the pine sawtimber threshold begins in the 10-inch diameter class and hardwood sawtimber begins in the 12-inch diameter class. Although most of the Ouachita unit's area was in sawtimber, most of these sawtimber stands were composed of smaller-diameter (and immature) sawtimber trees of that class.

Tables XI through XIV illustrate timberland distribution by discrete basal area classes. Trends were examined by survey unit, ownership, stand size, and forest-type group. The largest increase in timberland area in any class was 531,300 acres in the 101- to 120-square-feet-per-acre class. Notable increases also occurred in the 61- to 80- and the 121- to 140-square-feet-per-acre classes. Three classes decreased in area: the 0- to 20-, the 21- to 40-, and the 41- to 60-square-feet-per-acre classes, by 250,700, 177,400, and 121,600 acres, respectively. Most Arkansas timberland was in the mid-basal-area ranges (61- through 120-square feet per acre)—11.0 million acres or 60 percent of the total. However, a sizeable amount of timberland was in stands of more than 120 square feet per acre—3.0 million acres or 16 percent of the total timberland.

The Ozark and Southwest survey units had the most timberland with substantial increases in basal area. The largest increase in the Ozark unit was the 101- to 120-square-feet-per-acre class (271,400 acres) (table XI). This was followed closely by a 267,400-acre increase in the 61- to 80-square-feet-per-acre class in the Southwest unit. In the basal area classes that had decreases, the largest decrease in acreage was the 0- to 20-square-feet-per-acre class (171,600 acres) in the Ouachita unit. This was followed closely by the 166,200-acre decrease in the 41- to 60-square-feet-per-acre class of the Ozark unit.

Trends in the basal area classes showed that the largest change of any class was in NIPF ownership (table XII), where timberland in the 101- to 120-square-feet-per-acre class increased by 348,000 acres. This was 65 percent of the increase in this class. Another sizeable increase was on forest industry land in the 61- to 80-square-feet-per-acre class. Also noteworthy was the 161,300-acre increase in the 121- to 140-square-feet-per-acre class on public lands. In the 1995 survey, 26 percent of public land was in timberland stands of more than 120 square feet per acre. Eighteen percent of forest industry timberland was in this class, along with 13 percent of NIPF. The change on public lands was substantial. In the 1988 survey, only 18 percent of timberland was in this class. The change was much smaller on forest industry and NIPF lands, at 15 and 12 percent, respectively. Forest industry also had the most sizeable decreases of area in the small basal area ranges—a total of 274,800 acres in the 0- to 20-square-feet-per-acre class and 188,100 acres in the 21- to 40-square-feet-per-acre class (table XII).

Most of the area increase in the upper levels of stand basal area was in sawtimber-sized stands, particularly in classes over 120 square feet per acre (table XIII). However, there was a 247,400-acre increase in sawtimber stands of 61 to 80 square feet per acre. In contrast, most of the decreases in area were in the lower ranges of basal area classes and in the sapling-seedling component. The lack of relationship between basal area and tree size (and stand size) is most evident in table XIV. High basal areas may not necessarily mean large trees, they also may mean high tree density. For example, in sapling-seedling stands there was a modest amount of timberland area in basal area classes greater than 81 square feet per acre. By contrast, there were some sawtimber stands in basal area classes below 41 square feet per acre.

The largest changes among basal area classes by forest type groups were in oak-hickory (table XIV), e.g., a 312,900-acre decrease in the 41- to 60-square-feet-per-acre class and a 293,300-acre increase in the 101- to 120-square-feet-per-acre class. Other notable shifts occurred in the loblolly-shortleaf pine forest type group, where most forestry-related operations take place. Two classes with the largest increases were the 61- to 80- and 81- to 100-square-feet-per-acre classes, where 487,400 acres of loblolly-shortleaf pine forest type group were added. Other notable shifts were a 293,300-acre increase in the 101- to 120-square-feet-per-acre class of the oak-hickory forest type group, and a 312,900-acre decrease of the same type group in the 41- to 60-square-feet-per-acre class.

Tables XV and XVI show estimates and trends for live-tree and board-foot volumes, respectively, by basal area classes

Table XI—Area of timberland by forest survey unit and basal-area class of live trees, Arkansas, 1988 to 1995

Forest survey unit	Basal-area class (*square feet per acre*)															
	> 140		121–140		101–120		81–100		61–80		41–60		21–40		0–20	
	1988	1995	1988	1995	1988	1995	1988	1995	1988	1995	1988	1995	1988	1995	1988	1995
	Thousand acres															
North Delta	44.7	55.9	73.3	79.6	95.9	137.2	106.1	150.8	124.6	122.4	107.7	71.3	47.9	28.1	12.1	80.0
South Delta	107.6	142.8	146.1	174.1	268.6	293.0	328.0	232.1	181.8	210.4	116.1	144.1	75.9	116.5	59.9	72.7
Ouachita	179.9	214.2	304.2	421.7	531.5	664.8	626.9	713.0	498.2	611.7	423.8	375.9	293.3	258.0	315.3	143.7
Ozark	74.3	227.8	342.8	517.5	837.9	1,109.3	1,481.5	1,568.4	1,451.4	1,404.8	824.6	658.4	431.2	311.5	285.9	211.4
Southwest	453.9	498.6	678.5	678.3	1,106.7	1,167.6	1,197.7	1,275.9	1,087.8	1,355.2	683.0	784.0	563.6	520.3	674.7	589.3
All units	860.3	1,139.2	1,545.0	1,871.1	2,840.6	3,371.9	3,740.2	3,940.2	3,343.8	3,704.5	2,155.2	2,033.6	1,411.9	1,234.5	1,347.9	1,097.2

Numbers in columns may not sum to totals due to rounding.

Table XII—Area of timberland by ownership and basal-area classes of live trees, Arkansas, 1988 to 1995

Ownership class	Basal-area class (*square feet per acre*)															
	> 140		121–140		101–120		81–100		61–80		41–60		21–40		0–20	
	1988	1995	1988	1995	1988	1995	1988	1995	1988	1995	1988	1995	1988	1995	1988	1995
	Thousand acres															
Public	215.3	344.7	353.5	514.8	758.8	851.7	780.5	729.4	501.3	533.7	220.9	128.5	95.2	114.5	151.3	78.5
Forest industry	243.8	311.3	423.1	489.4	629.5	720.1	716.7	812.1	705.4	947.0	504.9	539.9	492.8	304.7	647.7	372.9
Nonindustrial private	401.2	483.2	768.4	867.0	1,452.2	1,800.2	2,243.1	2,398.7	2,137.1	2,223.9	1,429.4	1,365.1	823.9	815.3	548.9	645.8
All classes	860.3	1,139.2	1,545.0	1,871.1	2,840.6	3,371.9	3,740.2	3,940.2	3,343.8	3,704.5	2,155.2	2,033.6	1,411.9	1,234.5	1,347.9	1,097.2

Numbers in columns may not sum to totals due to rounding.

Table XIII—Area of timberland by stand-size and basal-area classes of live trees, Arkansas, 1988 to 1995

Stand-size class	Basal-area class (*square feet per acre*)															
	> 140		121–140		101–120		81–100		61–80		41–60		21–40		0–20	
	1988	1995	1988	1995	1988	1995	1988	1995	1988	1995	1988	1995	1988	1995	1988	1995
	Thousand acres															
Sawtimber	593.1	832.7	1,131.5	1,324.5	1,796.9	2,130.8	1,994.9	2,162.1	1,279.0	1,526.4	476.6	529.0	82.8	33.1	0.0	0.0
Poletimber	262.0	294.5	386.3	499.3	961.0	1,173.7	1,478.8	1,491.0	1,349.1	1,397.8	544.8	526.4	95.8	69.1	0.0	0.0
Sapling-seedling	5.2	12.0	27.1	47.3	82.7	67.4	266.5	287.1	715.7	780.3	1,133.8	978.2	1,233.3	1,132.2	1,336.4	1,065.1
Nonstocked	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.4	32.1
All classes	860.3	1,139.2	1,545.0	1,871.1	2,840.6	3,371.9	3,740.2	3,940.2	3,343.8	3,704.5	2,155.2	2,033.6	1,411.9	1,234.5	1,347.9	1,097.2

Numbers in columns may not sum to totals due to rounding.

Table XIV—Area of timberland by forest-type group and basal-area class of live trees, Arkansas, 1988 to 1995

Forest-type group	Basal-area class (*square feet per acre*)															
	> 140		121–140		101–120		81–100		61–80		41–60		21–40		0–20	
	1988	1995	1988	1995	1988	1995	1988	1995	1988	1995	1988	1995	1988	1995	1988	1995
	Thousand acres															
Loblolly-shortleaf	464.4	573.8	525.4	655.7	796.5	956.7	728.1	941.4	650.4	924.5	398.0	498.2	245.3	271.5	383.9	255.2
Oak-pine	66.3	92.7	305.7	332.6	545.3	540.1	610.2	644.6	551.6	672.2	427.9	477.6	268.3	239.5	263.3	138.0
Oak-hickory	87.7	149.8	342.4	501.4	982.2	1,275.5	1,790.3	1,747.9	1,710.8	1,618.2	1,104.9	792.0	666.0	516.5	585.0	526.1
Oak-gum-cypress[a]	241.9	322.9	371.5	381.5	516.5	599.6	611.6	606.3	431.0	489.7	224.4	265.7	232.4	206.9	104.2	145.8
Nontyped	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.4	32.1
All groups	860.3	1,139.2	1,545.0	1,871.1	2,840.6	3,371.9	3,740.2	3,940.2	3,343.8	3,704.5	2,155.2	2,033.6	1,411.9	1,234.5	1,347.9	1,097.2

Numbers in columns may not sum to totals due to rounding.

[a] Includes elm-ash-cottonwood type.

and survey units. Live-tree volume was low in the smaller basal area classes and increased as basal area increased. Volume peaked in the 81- to 120-square-feet-per-acre basal area classes and declined slightly, moving toward the higher basal area classes (table XV). The basal area class with the highest volume was the 101- to 120-square-feet-per-acre class with 5,933.5 million cubic feet. This was also the class with the largest increase in volume—962.6 million cubic feet. The greatest increases were in the Ouachita and Ozark units, 288.8 and 539.4 million cubic feet, respectively. Together, these two survey units accounted for 86 percent of the volume increase in this basal area class. There was also a sizeable volume increase in the 140-square-feet-per-acre basal area class. Live-tree volume in that class increased by 818.5 million cubic feet. The largest proportion of this increase (49 percent) came from the Ozark unit. The remainder of the increase was spread fairly evenly over the remaining survey units.

The pattern of board-foot volume was slightly different from live-tree volume. The basal area class with the highest volume was the 101- to 120-square-feet-per-acre class, with 19,458.6 million board feet (table XVI). This was 25 percent of total board-foot volume. However, the basal area class with the largest increase was the class with more than 140 square feet per acre. Total board-foot volume increased there by 3,197.3 million board feet. The largest increase was in the Ozark unit followed by the South Delta and Southwest units, with 1,348.4, 689.8, and 627.0 million board feet, respectively. The 101- to 120-square-feet-per-acre basal area class also had a noteworthy increase in sawtimber volume, 2,768.7 million board feet. Most of this increase came from the Ozark unit, 1,205.4 million board feet, or 44 percent of the total increase. The other unit with a sizeable increase was the Ouachita (1,016.2 million board feet). Together these two units accounted for 80 percent of the sawtimber volume increase in this basal area class.

Species Distribution

The occurrence and spatial distribution of many species across the Arkansas landscape was aggregated, usually to a specific region of the State. This is because of the need for a species to satisfy specific growing requirements that are available only in certain habitats. Therefore, some species show, by varying degrees, specific affinity for any one particular area of the State than other species.

Figure 20 illustrates the distribution of four important Arkansas softwoods. The maps show the relative

Table XV—Volume of all live trees by forest survey unit and basal-area class of live trees, Arkansas, 1988 to 1995

Forest survey unit	Basal-area class (*square feet per acre*)															
	> 140		121–140		101–120		81–100		61–80		41–60		21–40		0–20	
	1988	1995	1988	1995	1988	1995	1988	1995	1988	1995	1988	1995	1988	1995	1988	1995
	Million cubic feet															
North Delta	129.3	191.2	173.8	201.8	164.8	241.5	131.7	217.2	116.2	98.7	59.8	33.7	11.8	9.0	0.0	4.6
South Delta	317.2	447.7	339.5	421.6	535.3	593.8	520.5	366.0	194.9	209.5	74.9	99.5	33.0	40.2	5.7	2.9
Ouachita	551.8	634.3	704.8	955.2	879.6	1,168.4	804.3	908.0	413.2	520.6	237.4	227.0	70.5	64.6	12.4	11.1
Ozark	169.9	567.8	613.3	1,013.8	1,238.2	1,777.6	1,701.1	1,761.7	1,138.0	1,180.8	404.6	353.7	120.0	82.2	17.0	12.9
Southwest	1,240.2	1,386.0	1,641.1	1,512.7	2,153.0	2,152.3	1,837.3	1,927.3	1,208.9	1,519.0	537.6	644.1	206.2	182.8	52.2	41.1
All units	2,408.5	3,227.0	3,472.5	4,105.2	4,970.9	5,933.5	4,994.8	5,180.1	3,071.3	3,528.6	1,314.3	1,358.1	441.5	378.9	87.2	72.6

Numbers in columns may not sum to totals due to rounding.

Table XVI—Volume of all sawtimber by forest survey unit and basal area class of live trees, Arkansas, 1988 to 1995

Forest survey unit	Basal-area class (*square feet per acre*)															
	> 140		121–140		101–120		81–100		61–80		41–60		21–40		0–20	
	1988	1995	1988	1995	1988	1995	1988	1995	1988	1995	1988	1995	1988	1995	1988	1995
	Million board feet[a]															
North Delta	470.3	771.2	652.0	723.5	547.0	774.7	429.1	669.1	264.3	201.7	153.7	60.3	26.7	23.9	0.0	3.4
South Delta	1,043.8	1,733.6	1,286.8	1,564.9	1,941.6	2,199.5	1,918.0	1,323.9	574.5	624.7	251.6	291.3	112.1	131.9	11.9	3.3
Ouachita	2,056.1	2,287.1	2,502.8	3,400.6	2,812.4	3,828.6	2,260.8	2,732.0	1,131.2	1,439.2	556.5	476.7	109.6	116.1	19.5	23.8
Ozark	467.1	1,815.5	1,921.5	2,912.2	3,451.9	4,657.3	4,204.1	3,998.6	2,642.4	2,412.1	725.0	655.5	216.4	131.6	30.7	29.3
Southwest	4,331.4	4,958.4	6,230.7	5,625.6	7,937.0	7,998.5	6,526.8	7,353.3	4,274.7	5,691.9	1,884.0	2,562.1	600.3	620.8	143.3	132.9
All units	8,368.6	11,565.9	12,593.8	14,226.8	16,689.9	19,458.6	15,338.8	16,076.9	8,887.0	10,369.6	3,570.8	4,045.8	1,065.1	1,024.4	205.3	192.7

Numbers in columns may not sum to totals due to rounding.

[a] International 1/4-inch rule.

occurrence of loblolly pine, shortleaf pine, eastern redcedar, and baldcypress, all plotted using volume as the importance value. In order for a species to be represented in any particular county, there needed to be a minimum amount of volume for that species. For example, for one dot to be placed in a county for loblolly pine there had to be a minimum of 5.0 million cubic feet in that county. For two dots, 10.0 million cubic feet were needed and so on. The dots were placed randomly in each county so location accuracy was not present at the county level of scale. However, there was adequate accuracy at the regional (survey unit) and State levels of scale to portray specific species distributions.

Although their ranges overlap, the four softwoods represented in figure 20 display specific affinities for particular habitats in Arkansas. Shortleaf pine had its greatest concentration in the Ouachita Mountains. This is the focal point of highest volume density for this species across its entire botanical range. Loblolly pine shows its strongest affinity for the Coastal Plain. Although present up into the Ouachita Mountains, it is markedly less common there. Eastern redcedar has a strong presence in the Ouachita and Boston Mountains and outward on to the Ozark Plateaus. It is much less common on the Coastal Plains and Mississippi floodplain. Baldcypress shows a strong affinity for the Mississippi floodplain and tributaries on the Coastal Plain leading to the floodplain.

Figure 21 illustrates the distribution of eight important hardwoods across the Arkansas landscape, seven of which are oaks. Sweetgum, the only non-oak mapped, shows its strongest affinity for the Coastal Plain, although it is present in a variety of habitats including the Mississippi floodplain, Ouachita Mountains, and Boston Mountains. It becomes noticeably absent on the Ozark Plateaus in the northwest portion of the State. Three oaks display a distribution across all major Arkansas habitats: white oak, southern red oak, and post oak. Of these, white oak shows two areas of obvious high-volume concentrations. These are the Ouachita Mountains and Boston Mountains. Southern red oak is spread fairly evenly across the State,

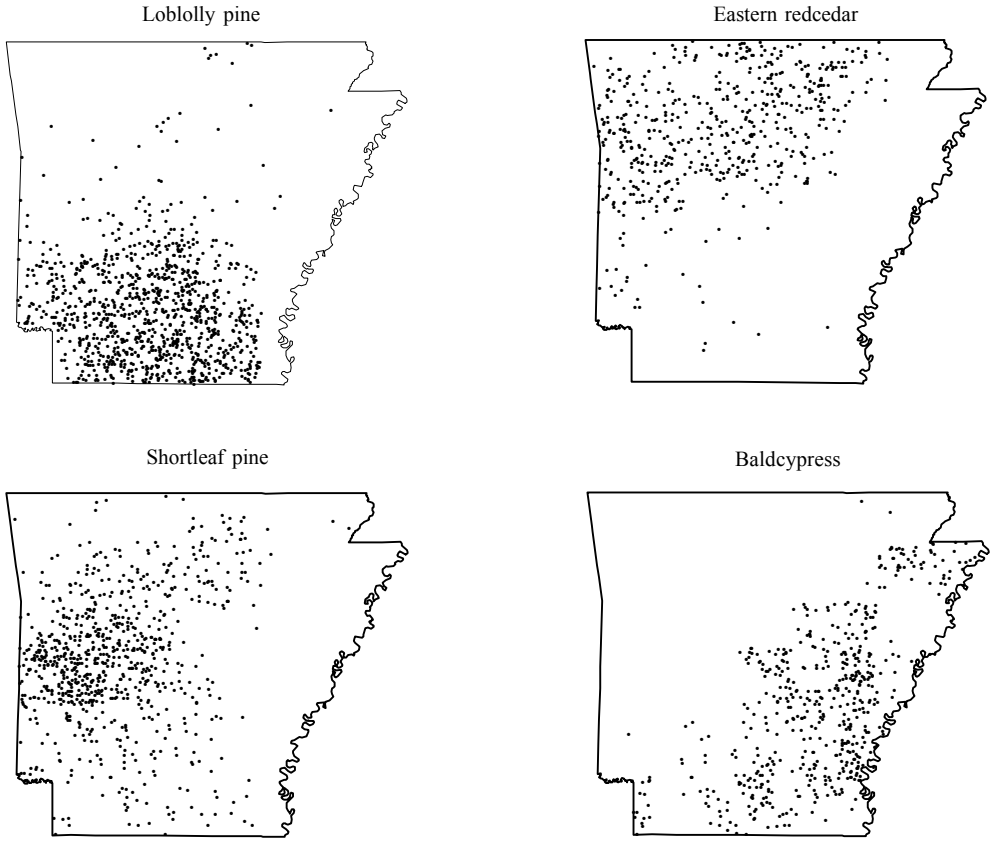

Figure 20—Distribution of four important pines and softwoods, Arkansas, 1995. For loblolly pine and shortleaf pine, each dot represents 5,000,000 cubic feet. For eastern redcedar and baldcypress, each dot represents 500,000 cubic feet.

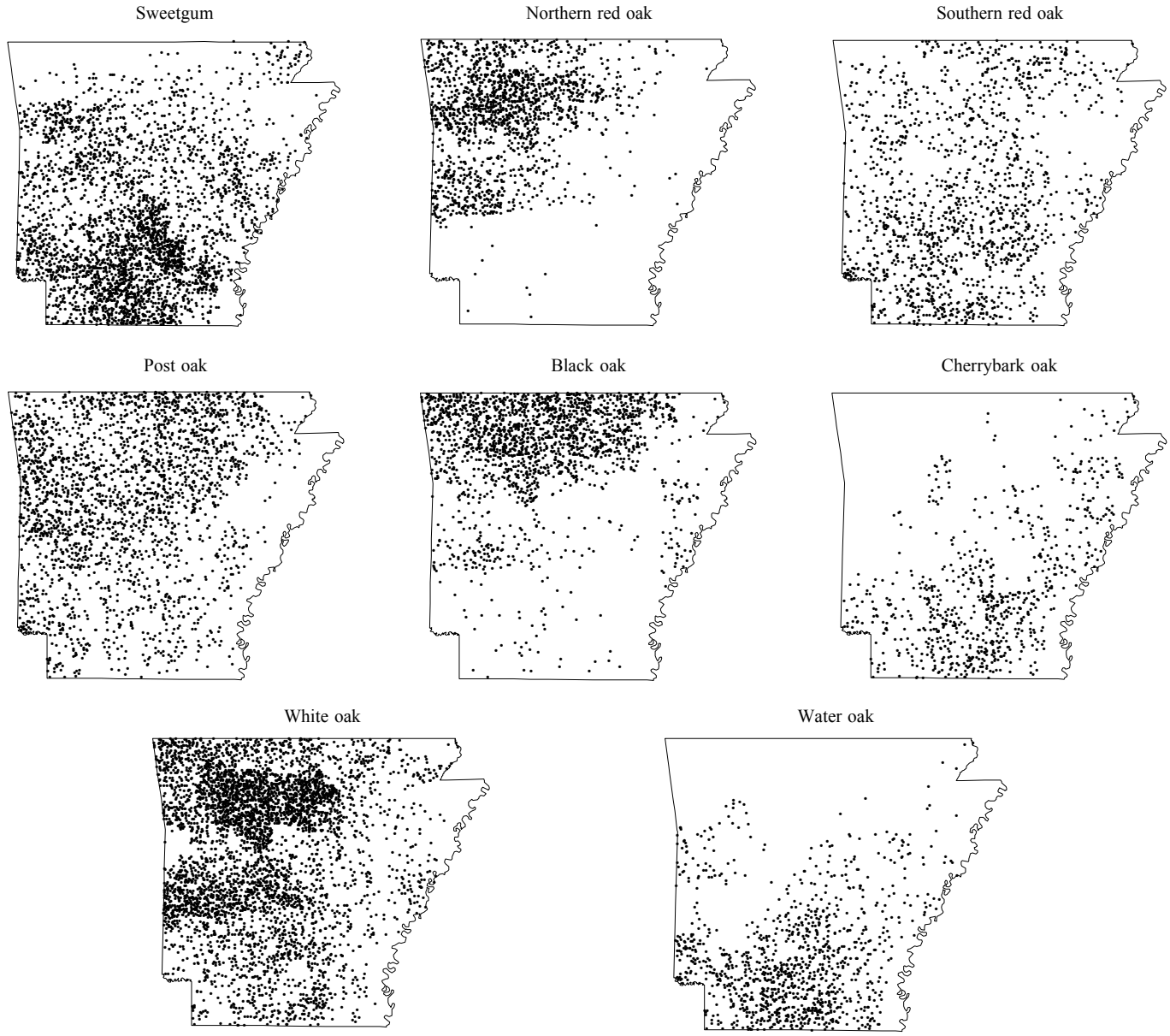

Figure 21—Distribution of eight important hardwoods, Arkansas, 1995. Each dot represents 500,000 cubic feet.

but careful observation shows perhaps a very slight affinity for the Coastal Plain. The same can be said of post oak except that its affinity is more toward the Ouachita Mountains, Boston Mountains, and Ozark Plateaus. The remaining four oaks (cherrybark, water, black, and northern red oaks) display specific affinities for certain habitat types in Arkansas. Cherrybark oak and water oak are confined mostly to the Coastal Plain and Mississippi floodplain. They occur in the mountains with water oak having a slightly stronger presence there. Northern red oak has an affinity for the west and northwest sections of the State. Its strongest affinity and development is in the Boston Mountains. Black oak's strongest affinity is in the Boston Mountains and north onto the Ozark Plateaus. It also has a more modest presence in the Ouachita Mountains and on Crowleys Ridge on the Mississippi floodplain.

Species Importance

The dominant tree (by volume) in the State continues to be loblolly pine (table XVIIa) (note that volume in this table includes all trees 1.0 inch d.b.h. and greater). This was the second survey in which loblolly pine led all other species after surpassing shortleaf pine in the 1988 survey. Shortleaf pine, the second-ranking species, actually was falling even further behind loblolly in 1995, because the increase in loblolly pine volume outpaced the increase in shortleaf pine. In 1988, shortleaf volume was 3,993.6 million cubic feet; in 1995 it was 4,201.1 million cubic feet. Loblolly pine volume went from 4,576.7 to 5,726.8 cubic feet in the same period.

After shortleaf pine, the next 12 species in rank were hardwoods. White oak was the dominant hardwood in the State with 2,490.4 million cubic feet; sweetgum was next followed by post oak, black oak, northern red oak, southern red oak, black hickory, water oak, blackgum, willow oak, winged elm, and mockernut hickory (1,938.4, 1,367.8, 1,026.1, 854.7, 801.7, 772.0, 603.1, 565.0, 501.0, 463.2, and 445.1 million cubic feet, respectively). Altogether, these first 14 species contributed 21,756.4 million cubic feet of volume (77 percent of the total). The dominance of loblolly and shortleaf pine in Arkansas is obvious; together they represent 46 percent of the volume of the first 14 species and 35 percent of the total volume in the State.

There are 64 species in the ranking list that individually contribute less than 100.0 million cubic feet of volume (table XVIIa). For example, American beech contributes 97.3 million cubic feet, common persimmon 93.2 million cubic feet, and so on.

Above this level are 37 species whose individual volumes are more than 100.0 million cubic feet. The 64 lower ranked species make up 5 percent of Arkansas' total volume while the 37 upper ranked species made up 95 percent. This organizational structure of species composites is typical of most State-level surveys, where a few species play a dominant role and all the other species are of much lesser influence (or importance).

By individual unit, sweetgum was the dominant species in the North Delta, sugarberry in the South Delta, shortleaf pine in the Ouachita, white oak in the Ozark, and loblolly pine in the Southwest (table XVIIb, c, d, e, f, respectively). With the exceptions of the Ouachita and Southwest units, the leading hardwood species in the other units were not nearly as dominant as loblolly pine or shortleaf pine in their respective units.

Even though loblolly pine was the dominant tree in Arkansas, it was dominant in only one survey unit, the Southwest (table XVIIf). There were 5,061.6 million cubic feet in loblolly pine (88 percent of its total State volume). However, it still ranked second in the South Delta unit and third in the Ouachita unit.

Change in Number of Trees

Another way to gauge the trends of Arkansas' forest resources is by analysis of changes in tree numbers. By comparing the total number of trees by diameter class between the 1988 and 1995 surveys, forest structural shifts may be revealed (fig. 22).

The most notable change was that across the entire spectrum of diameter classes, only two diameter classes had a decline in the number of softwoods (the 26- and 28-inch diameter classes). All the other classes had sizeable increases with only the 4- and 24-inch diameter classes being slightly below a 10-percent increase. This means that Arkansas' forests are currently much better stocked with softwoods across all diameters than they were in the previous survey.

The large increases in the current survey made up for significant softwood decreases recorded in the 1988 survey. Substantial reductions were noted in 1988 in the 16-inch classes and smaller while substantial gains were noted in the larger classes. The current analysis indicates stocking levels are recovering from reductions in the smaller diameters with continued increases in numbers in the larger diameters.

Hardwoods showed no decreases in any diameter class since the 1988 survey but the increases were not as dramatic as those in softwoods, especially in the smaller diameter classes. There, the increases were only 1 percent in the 4-inch and 3 percent in both the 6- and 8-inch diameter classes. This may mean fewer opportunities for increases in the small hardwood sawtimber population in the short term. However, increases in hardwood numbers were 10 percent or higher in the 10-inch and higher diameter classes. This indicates adequate numbers to further increase the stocking of large hardwoods in Arkansas' forest in the future.

Table XVIIa—Ranking of tree species[a] (by volume) for the State, Arkansas, 1995

Species	Volume[b]	Species	Volume[b]
Loblolly pine	5,726.8	Honey locust	38.2
Shortleaf pine	4,201.1	Red mulberry	38.2
White oak	2,490.4	Silver maple	37.6
Sweetgum	1,938.4	Water-elm	37.2
Post oak	1,367.8	Sweetbay	36.8
Black oak	1,026.1	River birch	33.3
Northern red oak	854.7	Eastern redbud	31.5
Southern red oak	801.7	Swamp tupelo	29.1
Black hickory	772.0	Serviceberry	29.8
Water oak	603.1	American basswood	24.5
Blackgum	565.0	Black locust	22.5
Willow oak	501.0	Florida maple	19.0
Winged elm	463.2	Water locust	15.5
Mockernut hickory	445.1	Hawthorns spp.	14.6
Eastern redcedar	432.0	Plums and cherries[c]	12.6
Red maple	413.9	Yellow-poplar	12.2
Cherrybark oak	396.8	Bur oak	9.3
Overcup oak	382.9	Other species[d]	6.9
Green ash	345.8	Cucumbertree	6.5
Sugarberry	324.5	Osage-orange	6.4
Baldcypress	275.8	Pin oak	5.8
Flowering dogwood	270.7	Shellbark hickory	4.2
Willow spp.	203.4	Bumelia spp.	4.0
Nuttall oak	199.0	September elm	3.2
American elm	182.9	Delta post oak	3.2
Shagbark hickory	174.5	Laurel oak	3.1
White ash	162.1	White mulberry	3.1
Water hickory	159.4	Bigleaf magnolia	2.8
Pignut hickory	151.2	Sparkleberry	2.6
Ironwood	147.8	Nutmeg hickory	1.7
Blackjack oak	147.2	Sourwood	1.6
Cottonwood	145.1	Durand oak	1.5
Black cherry	128.9	Pumpkin ash	1.4
Bluebeech	124.0	Buckeye spp.	1.1
American sycamore	112.7	Ailanthus	0.8
Water tupelo	109.6	Chinaberry	0.7
Sugar maple	107.6	Chinkapin spp.	0.7
American beech	97.3	Shingle oak	0.6
Common persimmon	93.2	Blue ash	0.6
American holly	93.1	Royal Paulownia	0.4
Bitternut hickory	89.1	Butternut	0.4
Boxelder	76.1	Redbay	0.3
Swamp chestnut oak	64.9	Ohio buckeye	0.2
Slippery elm	64.9	Allegheny chinkapin	0.2
Chinkapin oak	64.1	Rock elm	0.1
Sassafras	59.7	Apple spp.	0.1
Pecan	53.2	White basswood	[e]
Shumard oak	47.3	Smoketree	[e]
Black walnut	43.1	Tung-oil tree	[e]
Hackberry	41.8	Kentucky coffeetree	[e]
Cedar elm	39.9		

[a] Scientific names can be cross referenced in species list in appendix.

[b] Values are net cubic-foot volume in million cubic feet for all live trees = 1.0 inch in diameter at breast height.

[c] Other than black cherry.

[d] Other species includes noncommercial and unidentified species.

[e] Volume > 0.0 but < 0.1 million cubic feet.

Table XVIIb—Ranking of tree species[a] (by volume) for the North Delta forest survey unit, Arkansas, 1995

Species	Volume[b]	Species	Volume[b]
Sweetgum	82.3	Water locust	5.0
Willow spp.	68.9	Silver maple	4.6
Green ash	67.6	Black cherry	3.5
Overcup oak	65.5	Flowering dogwood	2.8
Cottonwood	63.0	Loblolly pine	2.7
Post oak	57.9	Bur oak	2.6
Willow oak	56.8	Bitternut hickory	2.6
White oak	50.8	Cedar elm	2.6
Nuttall oak	48.8	Florida maple	2.6
Cherrybark oak	45.6	Bluebeech	1.9
Baldcypress	44.2	River birch	1.8
Sugarberry	33.3	Red mulberry	1.7
Water tupelo	32.1	Ironwood	1.4
Red maple	29.2	Pumpkin ash	1.4
American elm	28.7	Pecan	1.4
Southern red oak	28.4	Sassafras	1.3
Black oak	27.5	Hawthorn spp.	1.2
Winged elm	26.9	Blackjack oak	1.1
Water hickory	25.4	White ash	1.1
Mockernut hickory	18.4	Sourwood	1.0
Water oak	18.3	Shellbark hickory	0.8
Common persimmon	18.0	Sugar maple	0.8
Black hickory	16.2	Laurel oak	0.7
Pignut hickory	12.7	Delta post oak	0.7
Shagbark hickory	11.1	September elm	0.5
Shortleaf pine	10.7	Black walnut	0.4
Boxelder	10.3	Hackberry	0.4
Blackgum	10.0	Shumard oak	0.3
Water-elm	8.5	Other species[c]	0.3
American sycamore	7.6	Plums and cherries[d]	0.2
Swamp chestnut oak	7.5	Chinkapin oak	0.2
American beech	6.7	Sparkleberry	0.2
Honey locust	6.6	Eastern redbud	0.1
Eastern redcedar	6.5	Buckeye spp.	0.1
Slippery elm	6.3	Serviceberry	0.1
Yellow-poplar	5.5	Bumelia spp.	[e]
Northern red oak	5.3	Black locust	[e]

[a] Scientific names can be cross referenced in species list in appendix.

[b] Values are net cubic-foot volume in million cubic feet for all live trees = 1.0 inch in diameter at breast height.

[c] Other species includes noncommercial and unidentified species.

[d] Other than black cherry.

[e] Volume > 0.0 but < 0.1 million cubic feet.

Table XVIIc—Ranking of tree species[a] (by volume) for the South Delta forest survey unit, Arkansas, 1995

Species	Volume[b]	Species	Volume[b]
Sugarberry	207.6	Swamp tupelo	8.4
Loblolly pine	203.0	Swamp chestnut oak	7.9
Sweetgum	176.7	Ironwood	6.1
Overcup oak	165.3	Yellow-poplar	5.5
Green ash	125.2	Bluebeech	4.9
Baldcypress	117.3	American beech	4.9
Willow spp.	110.1	Water locust	4.8
Nuttall oak	95.0	Black cherry	4.7
Southern red oak	94.9	Bitternut hickory	4.4
Water hickory	93.1	Black hickory	4.3
Willow oak	89.1	Sassafras	4.3
White oak	88.1	Silver maple	4.1
Water tupelo	68.2	Northern red oak	3.8
Cherrybark oak	63.8	Red mulberry	3.6
Post oak	55.5	Eastern redbud	2.9
Water oak	55.6	Sugar maple	2.6
Cottonwood	49.4	Blackjack oak	2.5
American elm	46.8	White ash	2.4
Mockernut hickory	41.7	Eastern redcedar	2.2
Pecan	41.4	Other species[c]	1.5
Shortleaf pine	38.4	Pin oak	1.3
Boxelder	36.7	Plums and cherries[d]	1.1
American sycamore	35.1	River birch	0.9
Cedar elm	27.5	Hawthorn spp.	0.8
Winged elm	25.8	Black walnut	0.7
Common persimmon	22.8	Cucumbertree	0.5
Red maple	21.4	Bumelia spp.	0.5
Shagbark hickory	20.9	September elm	0.5
Black oak	20.4	Osage-orange	0.4
Blackgum	19.8	Delta post oak	0.4
Pignut hickory	19.1	Black locust	0.3
Water-elm	18.2	Buckeye spp.	0.3
Shumard oak	14.1	Shellbark hickory	0.1
Honey locust	13.6	Chinaberry	0.1
Slippery elm	12.4	Sparkleberry	0.1
Hackberry	12.2	American holly	[e]
Flowering dogwood	8.5	American basswood	[e]

[a] Scientific names can be cross referenced in species list in appendix.

[b] Values are net cubic-foot volume in million cubic feet for all live trees = 1.0 inch in diameter at breast height.

[c] Other species includes noncommercial and unidentified species.

[d] Other than black cherry.

[e] Volume > 0.0 but < 0.1 million cubic feet.

Table XVIId—Ranking of tree species[a] (by volume) for the Ouachita forest survey unit, Arkansas, 1995

Species	Volume[b]	Species	Volume[b]
Shortleaf pine	2,359.7	Boxelder	5.4
White oak	569.4	Slippery elm	5.4
Loblolly pine	327.8	Serviceberry	5.0
Post oak	306.6	American basswood	4.6
Sweetgum	247.4	Plums and cherries[c]	3.6
Northern red oak	210.7	Hawthorn spp.	3.5
Black hickory	140.0	Pin oak	3.1
Winged elm	108.7	Bitternut hickory	2.7
Southern red oak	104.7	Pecan	2.6
Blackgum	94.1	American beech	2.3
Black oak	87.6	Cedar elm	2.2
Mockernut hickory	83.2	Chinkapin oak	2.1
Eastern redcedar	69.6	Sassafras	1.9
Willow oak	66.5	Eastern redbud	1.9
Red maple	58.6	Nuttall oak	1.6
Water oak	51.3	Other species[d]	1.5
Ironwood	43.9	Black locust	1.5
Flowering dogwood	39.7	Florida maple	1.5
Green ash	35.1	Water-elm	1.3
Black cherry	33.6	Black walnut	1.1
Blackjack oak	30.0	Honey locust	1.0
Pignut hickory	23.0	Hackberry	1.0
Baldcypress	20.3	American holly	0.6
American elm	19.5	Cottonwood	0.6
Shagbark hickory	16.0	Sparkleberry	0.6
White ash	15.0	Willow spp.	0.5
Sugarberry	14.5	White mulberry	0.5
Cherrybark oak	11.6	Laurel oak	0.4
Bluebeech	10.7	Osage-orange	0.2
American sycamore	9.5	Bur oak	0.1
River birch	9.3	Swamp chestnut oak	0.1
Red mulberry	9.1	Bumelia spp.	0.1
Silver maple	7.3	Sugar maple	[e]
Shumard oak	6.6	Tung-oil tree	[e]
Overcup oak	6.0	Kentucky coffeetree	[e]
Common persimmon	5.8	Buckeye spp.	[e]

[a] Scientific names can be cross referenced in species list in appendix.

[b] Values are net cubic-foot volume in million cubic feet for all live trees = 1.0 inch in diameter at breast height.

[c] Other than black cherry.

[d] Other species includes noncommercial and unidentified species.

[e] Volume > 0.0 but < 0.1 million cubic feet.

Table XVIIe—Ranking of tree species[a] (by volume) for the Ozark forest survey unit, Arkansas, 1995

Species	Volume[b]	Species	Volume[b]
White oak	1,337.4	Red mulberry	14.7
Shortleaf pine	988.1	Overcup oak	14.7
Black oak	861.7	Silver maple	13.5
Post oak	723.3	Honey locust	13.1
Northern red oak	628.9	Florida maple	12.3
Black hickory	563.1	Shumard oak	11.7
Eastern redcedar	333.6	Willow spp.	9.9
Sweetgum	262.6	Baldcypress	9.3
Blackgum	243.8	Bluebeech	7.5
Southern red oak	217.9	Cucumbertree	6.0
Mockernut hickory	189.5	Pecan	5.7
Winged elm	175.0	Water hickory	5.6
Flowering dogwood	167.4	River birch	5.6
Loblolly pine	131.7	Bur oak	3.3
White ash	106.1	Bumelia spp.	3.0
Blackjack oak	104.9	Water locust	3.0
Red maple	104.5	Plums and cherries[c]	2.9
Sugar maple	104.3	Cedar elm	2.5
Shagbark hickory	87.7	Other species[d]	2.5
Bitternut hickory	74.2	Bigleaf magnolia	2.3
Chinkapin oak	58.7	September elm	2.3
Black cherry	55.7	Swamp chestnut oak	1.6
American sycamore	43.2	White mulberry	1.6
American elm	40.2	Hawthorn spp.	1.4
Black walnut	38.2	Osage-orange	1.4
Sassafras	35.4	Yellow-poplar	1.2
Willow oak	33.5	Pin oak	1.0
American beech	32.5	Sparkleberry	1.0
Green ash	32.4	Ailanthus	0.8
Common persimmon	28.9	Buckeye spp.	0.7
Cherrybark oak	24.6	Shingle oak	0.6
Cottonwood	24.0	Blue ash	0.6
Ironwood	23.1	Sourwood	0.6
Sugarberry	22.8	Chinkapin spp.	0.4
Eastern redbud	21.7	Royal Paulownia	0.4
Pignut hickory	21.6	Butternut	0.4
Serviceberry	20.7	Shellbark hickory	0.3
Swamp tupelo	20.6	Ohio buckeye	0.2
Black locust	20.4	American holly	0.2
Slippery elm	19.3	Rock elm	0.1
Nuttall oak	18.9	Apple spp.	0.1
Hackberry	18.6	White basswood	[e]
Water oak	17.6	Smoketree	[e]
Boxelder	15.9	Water tupelo	[e]
American basswood	15.2		

[a] Scientific names can be cross referenced in species list in appendix.

[b] Values are net cubic-foot volume in million cubic feet for all live trees = 1.0 inch in diameter at breast height.

[c] Other than black cherry.

[d] Other species includes noncommercial and unidentified species.

[e] Volume > 0.0 but < 0.1 million cubic feet.

Table XVIIf—Ranking of tree species[a] (by volume) for the Southwest forest survey unit, Arkansas, 1995

Species	Volume[b]	Species	Volume[b]
Loblolly pine	5,061.6	Hackberry	9.6
Sweetgum	1,169.4	Water-elm	9.3
Shortleaf pine	804.2	Water tupelo	9.2
Water oak	460.3	Red mulberry	9.1
White oak	444.7	Blackjack oak	8.6
Southern red oak	355.8	Silver maple	8.1
Willow oak	255.1	Cottonwood	8.1
Cherrybark oak	251.2	Boxelder	7.7
Post oak	224.2	Hawthorn spp.	7.6
Red maple	200.1	Northern red oak	6.0
Blackgum	197.4	Cedar elm	5.2
Overcup oak	131.5	Bitternut hickory	5.2
Winged elm	126.9	Eastern redbud	5.1
Mockernut hickory	112.3	Plums and cherries[c]	4.8
Bluebeech	99.0	American basswood	4.8
American holly	92.2	Osage-orange	4.3
Green ash	85.5	Honey locust	3.9
Baldcypress	84.8	Bur oak	3.2
Pignut hickory	74.7	Chinkapin oak	3.2
Ironwood	73.3	Shellbark hickory	2.9
Flowering dogwood	52.3	Water locust	2.7
American beech	50.9	Florida maple	2.7
Black hickory	48.3	Black walnut	2.6
Swamp chestnut oak	47.8	Delta post oak	2.2
American elm	47.7	Pecan	2.1
Sugarberry	46.2	Laurel oak	2.0
Shagbark hickory	38.7	Nutmeg hickory	1.7
White ash	37.5	Durand oak	1.5
Sweetbay	36.8	Other species[d]	1.2
Water hickory	35.3	Serviceberry	1.1
Nuttall oak	34.8	White mulberry	1.0
Black cherry	31.4	Sparkleberry	0.9
Black oak	28.9	Chinaberry	0.6
Slippery elm	21.4	Bigleaf magnolia	0.5
Eastern redcedar	20.1	Bumelia spp.	0.4
Common persimmon	17.6	Pin oak	0.4
American sycamore	17.3	Redbay	0.3
Sassafras	16.8	Black locust	0.3
River birch	15.7	Chinkapin spp.	0.2
Shumard oak	14.7	Allegheny chinkapin	0.2
Willow spp.	13.9	Buckeye spp.	[e]

[a] Scientific names can be cross referenced in species list in appendix.

[b] Values are net cubic-foot volume in million cubic feet for all live trees = 1.0 inch in diameter at breast height.

[c] Other than black cherry.

[d] Other species includes noncommercial and unidentified species.

[e] Volume > 0.0 but < 0.1 million cubic feet.

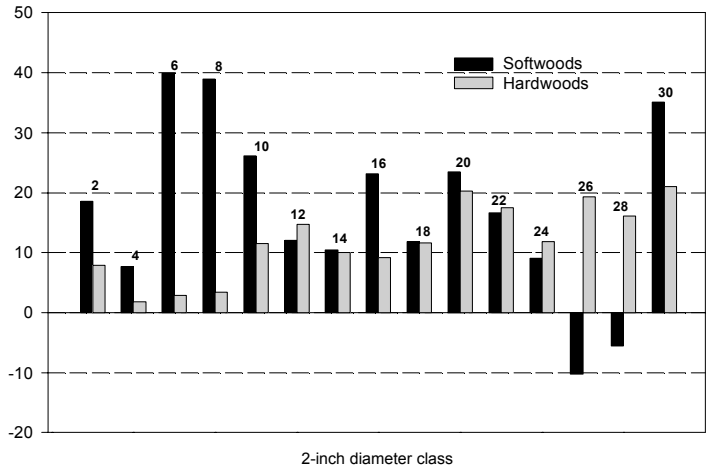

Figure 22—Percentage change in number of live trees between 1988 and 1995, Arkansas.

The current survey shows a reversal in the trends of small diameter hardwoods that were evident in 1988. Then, hardwood numbers were decreasing in the 2-, 4-, and 6-inch diameter classes. However, in the very large diameter classes, increases have been slower than the previous inventory indicated. The mid-diameter classes show increases much higher than those reported for 1988. These continued increases across the range of diameters can only mean improvement in the stocking levels of Arkansas' forests.

The changes in number of trees may impact forest composition. Recent concerns in Arkansas and elsewhere in the South have been the replacement of hardwood forests with mostly pine, mainly through regenerating harvested lands by means of either natural or artificial regeneration. Because of economic benefits, forest industry has strongly favored pine over hardwood for many years, especially in Arkansas' Southwest survey unit.

To address the concern over decreasing acres of hardwood stands, figures 23 and 24 illustrate the area of timberland by stand proportions of softwood versus hardwood. Figure 23 includes all timberland stands, while figure 24 excludes bottomland hardwood stands. Upon first examination, figure 23 shows an increase in stands composed of more than 90 percent hardwoods, by about 172,400 acres. However, closer examination reveals that this was because of an increase in the area of bottomland hardwoods. Excluding bottomland hardwoods from the analysis shows that the area of upland stands composed of more than 90 percent hardwoods actually decreased slightly, as did the 85-percent class (fig. 24). Together, these two classes declined by 106,700 acres. In contrast, stands composed of more than 80 percent softwoods increased by 649,300 acres.

An even closer examination showed that most changes in composition took place in the Southwest unit. Here, there was an increase of 516,600 acres in stands composed of more than 80 percent softwoods. However, there was also a 138,900-acre decrease in stands composed of more than 80 percent hardwoods. It is likely that most of the 423,400-acre increase in timberland in the Southwest unit came in as softwood stands. One other area of substantial change in this unit was in stands composed of 45 percent hardwoods and 55 percent softwoods—these stands decreased by 190,100 acres since the 1988 survey.

There was evidence in the 1995 survey that upland hardwood stands (more than 80 percent hardwood) declined by 106,700 acres. However, these declines were offset by a 218,000-acre increase in stands composed of more than 60 percent but less than 80 percent hardwood. It should be noted that this level of hardwood (versus softwood) composition is approaching that of a mixed-stand classification. Regardless, this is a turnaround from the 1988 survey when there was a 687,900-acre increase in timberland composed of stands made up of more than 80 percent hardwood. A large portion of this (455,100 acres) was in stands of more than 90 percent hardwood. That survey also showed a 377,300-acre increase in stands composed of more than 80 percent softwood. Countering these increases was a 465,400-acre decrease in the 70 to 80, 50 to 60, and 30 to 40 percent hardwood classes.

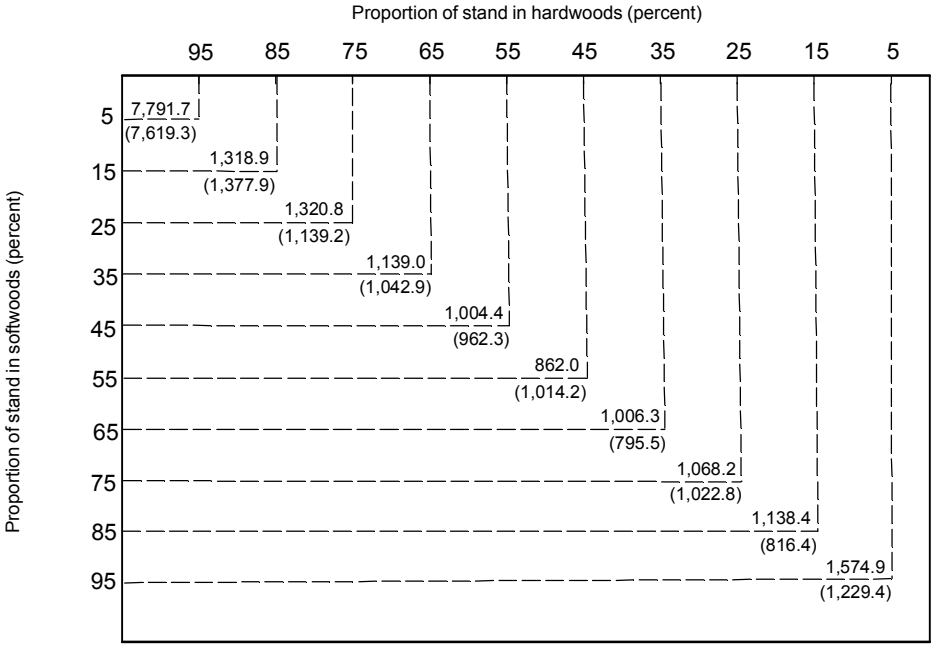

Figure 23—Area of timberland by proportion of stand in softwoods and hardwoods, Arkansas, 1995. The percentage values are the midpoints of the deciles. Thus 85 percent includes values 80 percent or greater but less than 90 percent. Area is in thousand acres; the acreage enclosed in parentheses is from the 1988 survey. Proportions are based on basal area, and only stands with trees 1.0 inch or larger in diameter at breast height are included.

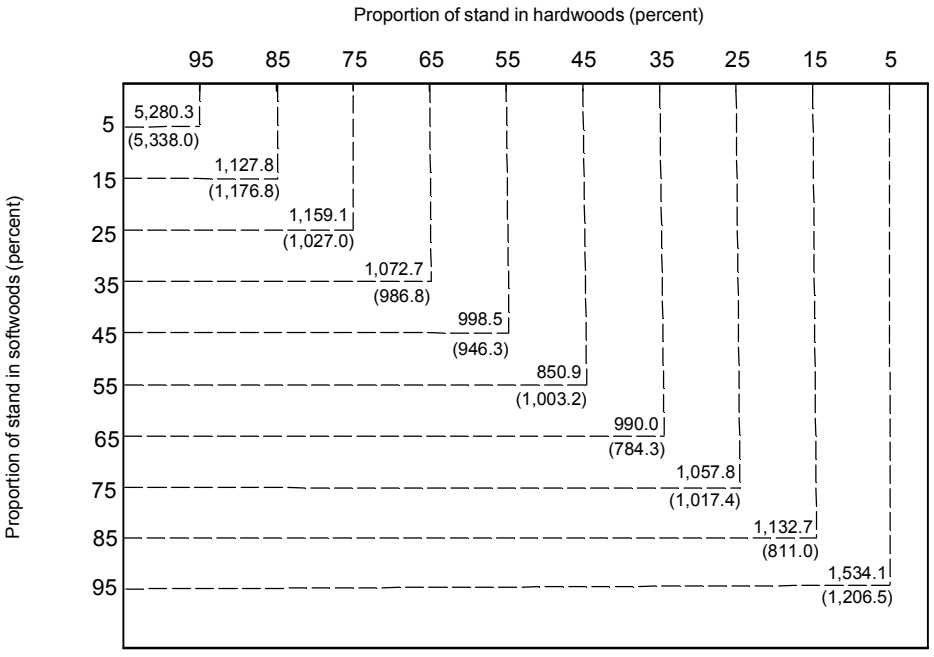

Figure 24—Area of upland timberland by proportion of stand in softwoods and hardwoods, Arkansas, 1995. The percentage values are the midpoints of the deciles. Thus 85 percent includes values 80 percent or greater but less than 90 percent. Area is in thousand acres; the acreage enclosed in parentheses is from the 1988 survey. Proportions are based on basal area, and only upland stands with trees 1.0 inch or larger in diameter at breast height are included.

Growth, Removals, and Mortality

In the forest survey of Arkansas, three major components of change in the timber inventory were monitored: growth, removals, and mortality. Complex interactions among these components resulted in a decrease or increase in inventory. Because of the dynamic nature of these components, estimates were given as the periodic annual average, i.e., the average over the survey period and not over the life of sampled trees (see Inventory Methods in the appendix for methodology).

One problem with successive large-scale forest surveys is in getting the initial survey volume (survey at time 1), plus growth (the growth between the initial survey and the second survey), to equal the volume of the second survey. A portion of this problem was corrected by using a plot-growth method described by Van Deusen and others (1986). However, this resolved only the problem inherent in variable-radius plot sampling (see Inventory Methods in the appendix).

The second portion of the growth balance problem concerns the assignment of the area weighting factor (commonly called the expansion factor). The expansion factor is the amount of timberland area that each 3- by 3-mile sample plot represents. Multiplying the per-acre estimate of volume (or growth, removals, mortality) by the expansion factor expands the estimate to the number of timberland acres the plot represents. However, a problem occurs when the plot population (number of sample plots) of the initial survey differs substantially from the plot population of the second survey. This is usually a result of plots diverting (from forest to nonforest) or reverting (from nonforest to forest) since the initial survey. If this happens, the magnitude of the difference between expansion factors for the initial and second surveys becomes very large. Therefore, because these expansion factors (labeled resurveyed expansion factor for time 1 growth and expansion factor for time 2 volume) differ widely (depending on differences in the plot population), it is not possible to balance the growth of the initial survey inventory with the inventory of the second survey.

Currently, there is not a solution for this type of imbalance problem. Manipulating expansion factors to solve the growth imbalance problem would create imbalance problems when the plot populations do not change substantially between surveys. The expansion factor problem occurs regardless of the sample plot design, whether variable-radius or fixed-area.

With the 1.1 million-acre increase in Arkansas' timberland area, the plot population changed enough to cause a slight growth imbalance. The following documentation is offered to show the computation of this imbalance. The time 2 volume, derived by growing the initial survey volume, is computed by the following formula:

time 2 volume = volume at time 1
+ (annual volume of net growth
x elapsed time)
- (annual volume of removals
x elapsed time).

This derived time 2 volume is compared with the new volume from the time 2 inventory. Any difference is considered an imbalance. The average elapsed time for the survey was 7.71 years. This was derived by adding the elapsed time for each plot between the time 1 and time 2 inventories and dividing by the total number of plots (this included forested plots measured at time 1 and time 2, only). For example, total live-tree volume for time 2 (computed by growth) was:

time 2 volume = 20,761.0 + (951.8 x 7.71)
- (743.7 x 7.71)
= 22,365.4 million cubic feet.

Comparing this with the volume from the new survey (23,783.9 million cubic feet) resulted in a difference of 1,418.5 million cubic feet, a minus 5.96-percent imbalance. Considering the large increase in timberland area (and plot population) in the 1995 survey, this was expected. The growth imbalance for softwoods and hardwoods was 5.45 and 6.31 percent, respectively.

Growth-to-removal ratios and removal-to-growth ratios were used to illustrate relationships between growth and removals. If growth exceeded the amount of removals (see definitions in appendix), the ratio was shown as growth-to-removal. If removals exceeded growth, the ratio was shown as removal-to-growth. The ratios are reversed because if the ratio were always shown in a growth-to-removal format, when removals exceed growth the ratio would always be confined between 0.00 and 1.00. In the literature, all ratios usually are expressed in a growth-to-removal format. This could be misleading when comparing magnitudes of ratios. For example, a removal-to-growth ratio of 3.50 to 1.00 would be 0.29 to 1.00 when expressed in a growth-to-removal format. If removals were doubled, the ratio would become 7.00 to 1.00 in a removal-to-growth format, but 0.14 to 1.00 in a growth-to-removal format. The latter does

not clearly illustrate the relative magnitude of the ratio. Switching between formats is easily done by using the ratio's reciprocal.

Softwoods

Gross growth for all live softwoods greater than or equal to 5.0 inches d.b.h. was 603.7 million cubic feet per year (table XVIII). Net growth was 554.6 million cubic feet per year. These estimates represent substantial increases over those reported for the 1988 survey. Gross growth increased by 185.5 million cubic feet per year while net growth increased by 176.5 million cubic feet per year, a 44- and 47-percent increase, respectively.

Most of the softwood net growth came from the Southwest unit, 377.2 million cubic feet per year (68 percent of all growth) followed by the Ouachita unit, 102.0 million cubic

Table XVIII—Components of annual change in the volume of live trees by forest survey unit and species group, Arkansas, 1988 to 1995

Forest survey unit and species group	Survivor growth[a]	Growth component						
		Ingrowth[b]	Growth on removals	Growth on mortality	Mortality	Timberland removals	Land-clearing removals	Net change[c]
				Million cubic feet				
North Delta								
Softwood	1.3	0.1	0.0	0.0	0.1	0.3	0.1	0.9
Hardwood	38.8	3.2	1.4	1.3	8.4	15.1	1.0	20.3
Total	40.0	3.3	1.5	1.3	8.5	15.3	1.1	21.2
South Delta								
Softwood	14.7	2.2	1.5	0.4	1.7	8.8	0.0	8.3
Hardwood	64.5	4.8	3.9	2.5	25.8	43.2	2.1	4.6
Total	79.2	7.1	5.4	2.8	27.4	52.0	2.1	12.9
Ouachita								
Softwood	73.7	26.9	9.5	1.0	9.1	55.9	3.6	42.4
Hardwood	51.6	9.2	2.0	0.9	12.2	19.0	6.4	26.1
Total	125.3	36.1	11.6	1.8	21.4	75.0	10.0	68.5
Ozark								
Softwood	45.2	10.7	4.3	0.5	3.6	29.0	3.5	24.7
Hardwood	153.6	19.9	5.0	3.3	35.6	42.7	16.0	87.6
Total	198.9	30.7	9.2	3.8	39.1	71.6	19.5	112.3
Southwest								
Softwood	260.5	76.6	68.1	6.6	34.6	325.6	6.4	45.2
Hardwood	117.0	20.1	17.6	3.7	45.2	156.5	8.6	-51.9
Total	377.6	96.6	85.7	10.2	79.8	482.2	14.9	-6.8
All units								
Softwood	395.4	116.5	83.4	8.4	49.1	419.5	13.6	121.5
Hardwood	425.5	57.2	30.0	11.6	127.1	276.5	34.1	86.6
Total	821.0	173.7	113.3	20.0	176.2	696.0	47.7	208.1

Numbers in rows and columns may not sum to totals due to rounding.

[a] Includes nongrowth trees.

[b] Includes ongrowth trees.

[c] Net change = (survivor growth + ingrowth + growth on removals + growth on mortality) - (mortality + timberland removals + land-clearing removals).

feet per year (18 percent). Because the Ozark and Delta units are predominantly hardwood forests, together they contributed only 14 percent of softwood growth (table XVIII).

Even though forest industry owns only 24 percent of timberland in Arkansas, their lands contributed 51 percent of softwood net growth (283.5 million cubic feet per year). This was followed closely by NIPF lands, 208.4 million cubic feet per year (38 percent of total softwood growth). Together, these two ownerships accounted for 89 percent of softwood net growth in the State (table XIX). The proportions of growth between these two ownerships has widened since the 1988 survey. Then, forest industry growth was 169.9 and NIPF was 160.3 million cubic feet per year, 45 and 42 percent, respectively. The proportion decreased in NIPF and increased in forest industry.

Softwood gross growth on plantations was 206.6 million cubic feet per year; net growth was 195.6 million cubic feet per year (table XX). This was 35 percent of all softwood net growth in the State and also a substantial increase over the 73.6 million cubic feet per year reported in 1988. Seventy-four percent of the softwood growth on plantations was on forest industry lands (145.0 million cubic feet per year).

Table XIX—Components of annual change in the volume of live trees by ownership class and species group, Arkansas, 1988 to 1995

Ownership class and species group	Survivor growth[a]	Growth component						
		Ingrowth[b]	Growth on removals	Growth on mortality	Mortality	Timberland removals	Land-clearing removals	Net change[c]
		Million cubic feet						
National forest								
Softwood	46.2	6.3	3.1	0.4	6.5	29.6	0.0	19.9
Hardwood	50.2	5.7	0.7	0.7	12.3	7.4	0.5	37.1
Total	96.4	12.0	3.8	1.1	18.8	37.0	0.5	56.9
Other public								
Softwood	12.8	0.7	0.7	0.1	1.0	4.9	1.2	7.3
Hardwood	39.1	2.8	0.3	1.0	12.9	4.7	5.1	20.5
Total	51.9	3.6	1.0	1.2	13.9	9.6	6.3	27.8
Forest industry								
Softwood	172.3	77.4	47.2	3.9	17.3	210.9	0.0	72.5
Hardwood	63.2	10.6	9.7	3.3	31.9	84.6	0.6	-30.4
Total	235.4	88.0	56.9	7.1	49.3	295.4	0.6	42.2
Nonindustrial private								
Softwood	164.2	32.1	32.4	4.0	24.3	174.2	12.4	21.8
Hardwood	273.0	38.1	19.2	6.6	70.0	179.8	27.8	59.4
Total	437.2	70.2	51.6	10.6	94.3	354.0	40.2	81.2
All classes								
Softwood	395.4	116.5	83.4	8.4	49.1	419.5	13.6	121.5
Hardwood	425.5	57.2	30.0	11.6	127.1	276.5	34.1	86.6
Total	821.0	173.7	113.3	20.0	176.2	696.0	47.7	208.1

Numbers in rows and columns may not sum to totals due to rounding.

[a] Includes nongrowth trees.

[b] Includes ongrowth trees.

[c] Net change = (survivor growth + ingrowth + growth on removals + growth on mortality) - (mortality + timberland removals + land-clearing removals).

Table XX—Components of annual change in the volume of live trees in plantations by ownership class and species group, Arkansas, 1988 to 1995

Ownership class and species group	Survivor growth[a]	Growth component						
		Ingrowth[b]	Growth on removals	Growth on mortality	Mortality	Timberland removals	Land-clearing removals	Net change[c]
	Million cubic feet							
National forest								
Softwood	5.2	3.1	0.6	0.0	0.7	6.8	0.0	1.3
Hardwood	1.9	0.4	0.2	0.0	0.6	1.8	0.0	0.1
Total	7.1	3.5	0.8	0.1	1.3	8.6	0.0	1.4
Other public								
Softwood	2.7	0.1	0.0	0.0	0.0	0.0	0.0	2.9
Hardwood	0.4	0.1	0.0	0.0	0.0	0.0	0.0	0.5
Total	3.1	0.2	0.0	0.0	0.0	0.0	0.0	3.4
Forest industry								
Softwood	56.1	67.5	23.3	1.4	3.3	67.6	0.0	77.5
Hardwood	4.3	2.0	2.2	0.4	2.1	16.2	0.0	-9.4
Total	60.5	69.5	25.6	1.8	5.4	83.8	0.0	68.1
Nonindustrial private								
Softwood	23.7	15.3	6.5	1.0	6.9	27.1	1.0	11.4
Hardwood	4.8	1.4	0.9	0.2	1.7	9.4	0.0	-3.9
Total	28.5	16.7	7.4	1.2	8.6	36.5	1.0	7.6
All classes								
Softwood	87.7	86.0	30.5	2.4	11.0	101.5	1.0	93.1
Hardwood	11.4	3.9	3.3	0.6	4.4	27.5	0.0	-12.6
Total	99.1	89.9	33.8	3.0	15.4	129.0	1.0	80.5

Numbers in rows and columns may not sum to totals due to rounding.

[a] Includes nongrowth trees.

[b] Includes ongrowth trees.

[c] Net change = (survivor growth + ingrowth + growth on removals + growth on mortality) - (mortality + timberland removals + land-clearing removals).

Mortality of softwoods has increased, from 40.1 million cubic feet per year in 1988 to 49.1 million cubic feet per year in the current survey. Seventy percent of the mortality was in the Southwest unit (table XVIII). Even though forest industry has most of the softwood growth, NIPF lands had most of the mortality, 24.3 versus 17.3 million cubic feet per year (table XIX). Softwood mortality on plantations was 11.0 million cubic feet per year, up from 5.1 million cubic feet in 1988 (table XX). It was expected that softwood mortality would increase as Arkansas' plantations became older.

Softwood live-tree removals for the 1995 survey were 433.1 million cubic feet per year (table XVIII). This was a slight increase over the 409.5 million cubic feet per year reported in1988. The net change to the inventory was a positive 121.5 million cubic feet per year. This was a big turnaround from the minus 31.3 million cubic feet per year for 1988. The reason for this shift was not because removals had increased, but because the growth increase was much larger than the removals increase (net growth increased from 378.1 million cubic feet per year in 1988 to 554.6 million cubic feet per year in 1995). The Ouachita and Southwest units both have gone from a negative net change in 1988 to a positive net change currently. Forest industry lands had a minus 52.1-million-cubic-foot-per-year net change in 1988; their net change currently is a positive 75.1 million cubic feet per year. Plantations also reversed

their net change, from minus 44.9 million cubic feet per year to a positive 93.1 million cubic feet per year.

The positive net changes also mean that growth is exceeding removals. Currently, the softwood growth-to-removal ratio for Arkansas is 1.28 to 1.00.This is a very favorable turnaround from the 1.08 to 1.00 removal-to-growth ratio from the last survey. Most of the negative drain on the softwood resource came from forest industry ownership in the prior survey (minus 52.1 million cubic feet per year) resulting in a removal-to-growth ratio of 1.31 to 1.00. This has been reversed in the current survey to a growth-to-removal ratio of 1.34 to 1.00.

Softwood Sawtimber

Gross growth for softwood sawtimber was 2,585.8 million board feet per year. Net growth was 2,419.1 million board feet per year (table XXI). Both of these were substantial increases over the 1988 survey, 660.1 (34 percent) and

Table XXI—Components of annual change in the volume of sawtimber by forest survey unit and species group, Arkansas, 1988 to 1995

Forest survey unit and species group	Survivor growth[a]	Growth component							
		Ingrowth[b]	Growth on removals	Growth on mortality	Cull increment	Mortality	Timberland removals	Land-clearing removals	Net change[c]
	Million board feet[d]								
North Delta									
Softwood	5.8	1.3	0.1	0.1	-0.9	0.6	1.0	0.0	4.7
Hardwood	112.0	37.4	8.9	1.2	6.0	18.0	71.9	2.6	72.9
Total	117.8	38.7	9.0	1.2	5.1	18.7	73.0	2.6	77.7
South Delta									
Softwood	53.6	24.2	7.1	2.4	1.0	6.9	38.7	0.0	42.6
Hardwood	224.7	62.2	19.4	8.6	-6.0	78.9	183.8	5.0	41.2
Total	278.4	86.4	26.5	11.0	-5.0	85.8	222.6	5.0	83.8
Ouachita									
Softwood	260.8	137.2	33.5	1.0	-0.1	24.5	227.3	12.2	168.4
Hardwood	91.2	69.4	6.0	1.1	-1.7	21.7	49.3	9.5	85.5
Total	352.0	206.6	39.5	2.1	-1.8	46.2	276.5	21.7	254.0
Ozark									
Softwood	122.0	70.4	22.1	0.1	0.7	6.8	119.1	8.7	80.7
Hardwood	258.1	196.3	21.4	1.4	-55.5	64.5	158.2	33.0	165.9
Total	380.0	266.8	43.5	1.4	-54.8	71.3	277.3	41.7	246.7
Southwest									
Softwood	1,078.8	434.2	292.9	21.2	16.3	127.9	1,469.1	22.5	223.7
Hardwood	320.2	145.3	66.0	6.9	4.8	116.1	442.0	25.4	-40.2
Total	1,399.1	579.5	358.9	28.1	21.1	244.1	1,911.1	47.9	183.5
All units									
Softwood	1,521.1	667.3	355.8	24.7	16.9	166.7	1,855.4	43.4	520.2
Hardwood	1,006.2	510.6	121.7	19.2	-52.4	299.4	905.2	75.4	325.3
Total	2,527.3	1,177.9	477.5	43.8	-35.4	466.1	2,760.5	118.9	845.6

Numbers in rows and columns may not sum to totals due to rounding.

[a] Includes nongrowth trees.

[b] Includes ongrowth trees.

[c] Net change = (survivor growth + ingrowth + growth on removals + growth on mortality + cull increment) - (mortality + timberland removals + land-clearing removals).

[d] International 1/4-inch rule.

596.4 (33 percent) million board feet per year respectively. Most of the softwood sawtimber net growth was in the Southwest unit, 1,715.5 million board feet per year, 71 percent of all softwood sawtimber net growth in the State. Next in rank was the Ouachita unit with 407.9 million board feet per year, but far behind the Southwest unit. It accounted for only 17 percent of the softwood growth in Arkansas.

Forest industry lands led all other ownerships in sawtimber growth with 1,069.8 million board feet per year (table XXII). This, however, was only slightly more than the 1,024.6 million board feet per year on NIPF lands. National forest sawtimber growth was 249.8 million board feet per year, only 10 percent of all softwood sawtimber net growth in the State.

Sawtimber growth on plantations was 441.6 million board feet per year (table XXIII). This was only 18 percent of all softwood sawtimber growth in Arkansas. Most of this plantation growth was on forest industry lands, 278.4 million board feet per year (63 percent of softwood sawtimber growth on plantations). The NIPF ownership accounted for 124.5 million board feet per year (28 percent of softwood sawtimber plantation growth). The growth on plantations has increased substantially since 1988. At that survey, softwood sawtimber growth was 269.0 million board feet per year. Most of the increase (to 441.6 million board feet per year, currently) was on forest industry lands. Here, growth increased by 138.3 million board feet per acre per year versus only a 15.3 million-board-foot-per-acre increase on NIPF lands.

Table XXII—Components of annual change in the volume of sawtimber by ownership class and species group, Arkansas, 1988 to 1995

Ownership class and species group	Survivor growth[a]	Growth component							Net change[c]
		Ingrowth[b]	Growth on removals	Growth on mortality	Cull increment	Mortality	Timberland removals	Land-clearing removals	
	Million board feet[d]								
National forest									
Softwood	172.7	79.6	15.5	0.2	-0.1	18.1	136.7	0.0	113.0
Hardwood	105.9	68.7	1.9	-0.2	0.5	22.6	18.0	0.1	136.0
Total	278.5	148.3	17.4	0.0	0.4	40.7	154.8	0.1	249.1
Other public									
Softwood	67.1	8.0	4.8	1.1	-1.0	4.8	23.5	5.1	46.5
Hardwood	114.4	40.3	2.0	1.5	-5.7	34.0	21.9	14.7	81.9
Total	181.5	48.3	6.9	2.5	-6.8	38.9	45.4	19.8	128.4
Forest industry									
Softwood	584.6	348.0	174.5	9.4	9.4	56.1	912.0	0.0	157.8
Hardwood	197.7	76.0	33.4	7.5	-7.8	92.6	261.6	0.5	-47.9
Total	782.3	424.0	207.9	16.9	1.6	148.7	1,173.6	0.5	109.9
Nonindustrial private									
Softwood	696.8	231.8	160.9	14.0	8.7	87.6	783.1	38.4	203.0
Hardwood	588.2	325.6	84.3	10.4	-39.4	150.2	603.6	60.1	155.3
Total	1,285.0	557.4	245.2	24.4	-30.7	237.8	1,386.8	98.5	358.2
All owners									
Softwood	1,521.1	667.3	355.8	24.7	16.9	166.7	1,855.4	43.4	520.2
Hardwood	1,006.2	510.6	121.7	19.2	-52.4	299.4	905.2	75.4	325.3
Total	2,527.3	1,177.9	477.5	43.8	-35.4	466.1	2,760.5	118.9	845.6

Numbers in rows and columns may not sum to totals due to rounding.

[a] Includes nongrowth trees.

[b] Includes ongrowth trees.

[c] Net change = (survivor growth + ingrowth + growth on removals + growth on mortality + cull increment) - (mortality + timberland removals + land-clearing removals).

[d] International 1/4-inch rule.

Table XXIII—Components of annual change in the volume of sawtimber in plantations by ownership and species group, Arkansas, 1988 to 1995

Ownership class and species group	Survivor growth[a]	Growth component							
		Ingrowth[b]	Growth on removals	Growth on mortality	Cull increment	Mortality	Timberland removals	Land-clearing removals	Net change[c]
	Million board feet[d]								
National forest									
Softwood	11.5	7.7	2.7	0.0	-0.3	1.6	30.2	0.0	-10.3
Hardwood	3.2	3.1	0.1	0.0	0.2	0.8	1.7	0.0	4.0
Total	14.7	10.7	2.8	0.0	-0.1	2.4	31.9	0.0	-6.3
Other public									
Softwood	17.9	1.0	0.0	0.0	0.0	0.0	0.0	0.0	18.9
Hardwood	0.1	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.7
Total	18.0	1.5	0.0	0.0	0.0	0.0	0.0	0.0	19.5
Forest industry									
Softwood	59.6	166.6	57.3	1.4	1.1	7.6	213.8	0.0	64.5
Hardwood	5.3	4.6	3.9	0.2	-1.0	2.4	27.6	0.0	-17.0
Total	64.9	171.2	61.2	1.6	0.1	10.0	241.4	0.0	47.5
Nonindustrial private									
Softwood	79.6	46.5	24.0	3.7	0.5	29.8	114.8	2.0	7.8
Hardwood	9.9	8.1	4.0	0.3	0.6	2.7	24.7	0.0	-4.5
Total	89.5	54.6	28.0	4.0	1.1	32.5	139.4	2.0	3.3
All classes									
Softwood	168.5	221.7	84.0	5.1	1.3	39.0	358.8	2.0	80.9
Hardwood	18.5	16.4	8.0	0.5	-0.3	5.9	54.0	0.0	-16.9
Total	187.1	238.1	92.0	5.6	1.0	44.9	412.7	2.0	64.0

Numbers in rows and columns may not sum to totals due to rounding.

[a] Includes nongrowth trees.

[b] Includes ongrowth trees.

[c] Net change = (survivor growth + ingrowth + growth on removals + growth on mortality + cull increment) - (mortality + timberland removals + land-clearing removals).

[d] International 1/4-inch rule.

Total softwood sawtimber removals for the State have remained steady since the last survey, currently 1,898.8 versus 1,882.5 million board feet per year in 1988. Because growth has increased substantially since 1988, the net change to the inventory has gone from a minus 59.7 million board feet per year to a positive 520.2 million board feet per acre per year. Seventy-nine percent of the softwood sawtimber removals were from the Southwest unit, 1,491.6 million board feet per year (table XXI). With the large increase in growth, the Southwest unit has gone from a minus 101.3 to a positive 223.7 million board-feet-per-year addition to the Arkansas inventory, a substantial reversal between 1988 and 1995.

Most removals came from forest industry lands, 912.0 million board feet per year, but NIPF was close behind with 821.5 million board feet per year. Of note is that removals on forest industry lands decreased by 187.5 million board feet per year while removals increased on NIPF lands by 219.9 million board feet per year. Removals also decreased slightly on national forest land but increased on other public lands (table XXII).

The biggest reversal of net change was on forest industry land, from a minus 337.2 million board feet per year in 1988 to a plus 157.8 million board feet per year, currently. There was little difference in the net change on NIPF lands between surveys.

Removals on plantations totaled 360.8 million board feet per year. Most of the removals were on forest industry land, 213.8 million board feet per year, followed by 116.8 million board feet per year on NIPF lands. The net changes to the inventory were all positive with the exception of national forests. There, the net change was minus 10.3 million board feet per year, most likely the result of phasing out plantation establishments on national forest lands (table XXIII).

The growth-to-removal ratios for softwood sawtimber have improved since the 1988 survey. For the State total, softwood sawtimber went from a removal-to-growth ratio of 1.03 to 1.00 to a growth-to-removal ratio of 1.27 to 1.00. In more detail, the Southwest unit went from a removal-to-growth ratio of 1.08 to 1.00 to a growth-to-removal ratio of 1.15 to 1.00. Forest industry lands went from a removal-to-growth ratio of 1.44 to 1.00 to a growth-to-removal ratio of 1.17 to 1.00, the biggest turnaround of any analysis strata. Finally, plantations had a reversal of a removal-to-growth ratio of 1.97 to 1.00 to a growth-to-removal ratio of 1.22 to 1.00.

Hardwoods

Hardwood gross growth for all live trees was 524.3 million cubic feet per year; net growth was 397.2 million cubic feet per year. Both of these figures were only slightly lower than their respective 1988 estimates. Most of the net growth took place in the Ozark unit (table XVIII). Net growth per year was 146.2 million cubic feet in this unit (37 percent of all hardwood net growth). This was followed closely by the Southwest unit (second in rank) with 113.2 million cubic feet per year (28 percent).

The growth of hardwoods by ownership stands in contrast to the softwood resource situation. Most of the net growth was in NIPF ownerships, 266.9 million cubic feet per year (67 percent of all hardwood net growth). Only 54.9 million cubic feet per year of hardwood growth occurred on forest industry lands. Hardwood net growth has declined from the 80.5 million cubic feet per year reported in 1988.

The removals for Arkansas' hardwoods were 310.6 million cubic feet per year, 30.2 million cubic feet per year higher than in 1988. Net change in the inventory for the State was plus 86.6 million cubic feet per year. Most of these removals occurred in the Southwest unit, 165.1 million cubic feet (53 percent of all hardwood removals in the State). This unit had a minus net change of 13.5 million cubic feet per year in 1988, and this has increased to minus 51.9 million cubic feet per year in the current inventory. The Southwest unit was the only unit with a negative net change in hardwood growth in the 1995 survey (table XVIII).

Even though most of the hardwood removals came from NIPF ownership (207.6 million cubic feet per year or 67 percent), this ownership's net change was still a positive 59.4 million-cubic-foot-per-year addition to the hardwood inventory. The only ownership with a negative net change in the hardwood inventory was forest industry. Here, the net change was minus 30.4 million cubic feet per year, slightly higher than it was in 1988 (minus 23.6 million cubic feet per year). Only 17.7 million cubic feet per year of hardwood removals came from public lands. This was only 6 percent of the State's hardwood removals for 1995.

While Arkansas hardwood removals have increased for the current survey period, hardwood net growth was still higher for the State than removals, resulting in a growth-to-removal ratio of 1.28 to 1.00. However, the Southwest unit had a removal-to-growth ratio of 1.46 to 1.00. This was the only unit where hardwood removals exceeded growth. The NIPF ownership had a growth-to-removal ratio of 1.29 to 1.00, while the forest industry ownership had a removal-to-growth ratio of 1.54 to 1.00. Public ownership played only a very small role in the hardwood removal situation. This resulted in a very high growth-to-removal ratio on public lands, 4.25 to 1.00.

Hardwood Sawtimber

Hardwood sawtimber gross growth was 1,605.3 million board feet per year; net growth was 1,305.9 million board feet per year. Both of these growth estimates were decreases from the 1988 survey, when gross growth was 1,741.5 million and net growth was 1,492.6 million board feet per year. The unit with the highest hardwood sawtimber growth was the Southwest, with 427.1 million board feet per year. Ranked next was the Ozark unit and then the South Delta, with 357.2 and 230.0 million board feet per year, respectively (table XXI).

Most of the hardwood sawtimber net growth came from the NIPF ownership, 818.9 million board feet per year (63 percent of all hardwood net growth). Forest industry lands were a distant second with 214.2 million board feet per year. Both of these estimates were decreases from the 1988 survey when NIPF lands were 905.5 million and forest

industry lands were 311.2 million board feet per year (table XXII).

Mortality in hardwood sawtimber was 299.4 million board feet per year, a 50.5-million-board-foot-per-year increase. Fifty percent of hardwood mortality was on NIPF lands. The increase in mortality accounted for approximately half of the reduction in hardwood sawtimber net growth (table XXII).

Hardwood sawtimber removals were 980.6 million board feet per year, a 173.7-million-board-feet-per-year increase over the 1988 survey. Most of the removals took place in the Southwest unit, 467.4 million board feet per year. Both the Ozark and South Delta units had sizeable amounts of removals, 191.2 and 188.8 million board feet per year, respectively (table XXI). Sixty-eight percent of removals were on NIPF lands (table XXII). The next sizeable amount of removals was on forest industry lands, 262.1 million board feet per year (27 percent of all hardwood sawtimber removals). The net change to the inventory was a plus 325.3 million board feet per year. Although still positive, this was a 360.3-million-board-foot decline from the previous survey. Only one survey unit had a negative net change to the inventory, the Southwest unit, with a minus 40.2 million board feet per year. This is a reversal since the 1988 survey when the net change was plus 82.7 million board feet per year.

The hardwood sawtimber growth-to-removal ratio was 1.33 to 1.00, a substantial decline from the 1.85 to 1.00 ratio in 1988. By region, only the Southwest unit had removals exceeding growth; the removal-to-growth ratio was 1.09 to 1.00. By ownership, only forest industry lands had removals exceeding growth; the removal-to-growth ratio was 1.22 to 1.00.

Plantations

Plantation area totaled 2.6 million acres in 1995. In the plantation assessment for Arkansas, all forest land that was classified as a plantation in 1988 and had no commercial harvest activity by 1995 was defined as a plantation. Also included were new plantations in the 1995 survey. The reasoning for this approach is that plantation assessment in the field becomes more difficult as plantations age. This is because the characteristic tree rows may become obscure as pines die and hardwoods encroach on the site (Rosson 1995b).

The 1995 estimate of plantation area is a 648,600-acre increase since the 1988 survey. Most of the plantations are in the Southwest unit, 1.6 million acres (63 percent of all plantations in the State). Other sizeable amounts of plantation acreage were in the Ouachita unit (592,900 acres) and the Ozark unit (241,300) acres.

The predominant forest-type group in plantations was the loblolly-shortleaf pine type (1.9 million acres) (table XXIV). The survey showed 399,400, 208,500, and 18,000 acres of oak-pine, oak-hickory, and bottomland hardwoods, respectively. These probably were failed plantations where softwood stocking was surpassed by hardwood stocking, allowing the stand classification to go to a hardwood type, i.e., the hardwood stocking was higher than the pine stocking. The field assessment did identify hardwood plantations. During the 1995 survey, only 6,200 acres (1 sample plot) were identified as such, lending further support to the low-stocked plantation issue mentioned above.

Table XXIV—Area of timberland on plantations by ownership class and forest-type group, Arkansas, 1995

Ownership class	All types	Forest-type group			
		Loblolly-shortleaf	Oak-pine	Oak-hickory	Bottomland hardwoods[a]
		Thousand acres			
Public	253.3	172.5	63.3	17.5	0.0
Forest industry	1,558.2	1,258.9	196.5	90.4	12.4
Nonindustrial private	753.4	507.7	139.6	100.5	5.6
All classes	2,565.0	1,939.1	399.4	208.5	18.0

Numbers in rows and columns may not sum to totals due to rounding.

[a] Includes oak-gum-cypress and elm-ash-cottonwood types.

The overwhelming majority of plantations were on forest industry lands, 1.6 million acres (61 percent of all plantations in Arkansas) (table XXIV). Public lands had 253,300 acres and NIPF lands 753,400 acres of plantations. Since 1988, plantations on public lands increased only slightly (by 51,300 acres) while NIPF plantations increased by 285,900 acres and forest industry plantations increased by 311,300 acres. The proportions of timberland in plantations by ownership group showed that 8 percent of public lands, 35 percent of forest industry lands, and 7 percent of NIPF lands had established plantations.

Most of Arkansas' plantations were 11 to 20 years old (table XXV). There were 935,200 acres in this age class. Most of these acres were on forest industry lands (77 percent). There was a big shift in plantation age classes since 1988. In that survey, there were 845,100 acres of plantations in the 0- to 10-year age class, and 420,900 acres in the 11- to 20-year age class. In 1995 there were 635,500 and 935,200 acres in those respective age classes.

The stocking condition of Arkansas' plantations is shown in table XXVI. A total of 762,400 acres were classed as understocked (less than 60 percent stocking). Even though the acreage in this condition is the same between surveys (777,900 for 1988 versus 762,400 for 1995) the proportion of acreage has improved. In 1988, 41 percent of the plantation area was understocked. The 1995 survey had improved to where only 30 percent of plantations were understocked.

Table XXV—Area of timberland on plantations by ownership and age classes, Arkansas, 1995

		Age class (*years*)[a]						
Ownership class	All classes	5	15	25	35	45	46–92	Mixed age[b]
		Thousand acres						
Public	253.3	71.6	51.8	0.0	18.6	0.0	26.8	84.5
Forest industry	1,558.2	342.1	719.4	173.0	52.9	11.5	0.0	259.4
Nonindustrial private	753.4	221.8	164.0	44.2	23.5	17.3	5.3	277.3
All classes	2,565.0	635.5	935.2	217.2	95.0	28.8	32.1	621.1

Numbers in rows and columns may not sum to totals due to rounding.

[a] Values are midpoints of 10-year ranges, i.e., 5 = 0–10 years, 15 = 11–20 years, etc.

[b] Stand structure disturbed to the point where no single age class could be defined, i.e., two or more strata > 10 years difference in age.

Table XXVI—Softwood stocking on plantations by ownership and stocking classes, Arkansas, 1995

		Stocking class (*percent*)				
Ownership class	All classes	< 30	30–59	60–89	90–119	>120
		Thousand acres				
Public	253.3	28.2	68.3	69.9	70.6	16.2
Forest industry	1,558.2	103.6	272.3	445.9	467.2	269.2
Nonindustrial private	753.4	92.4	197.6	201.8	187.4	74.3
All classes	2,565.0	224.2	538.2	717.6	725.2	359.7

Numbers in rows and columns may not sum to totals due to rounding.

There were 1,932.6 million cubic feet of softwood live-tree volume on plantations in 1995 (table XXVII). This was 20 percent of all softwood volume in the State. In 1988, there were 1,024.1 million cubic feet of softwood volume on plantations; this was 13 percent of the total softwood volume of that year's survey. Both the amounts and proportions of volume have increased substantially since the previous survey. Most of the plantation volume was on forest industry lands, 1,156.5 million cubic feet (60 percent of plantation softwood volume). Also, most of the volume was in the smaller tree classes (5.0 to 9.9 d.b.h.). Here there was 1,092.4 million cubic feet (57 percent of plantation volume), while very little volume was in trees greater than 15.0 inches d.b.h.—only 254.5 million cubic feet (13 percent of plantation volume).

Forestry activity has also increased on plantations since 1988. Although commercial harvests have dropped from 231,200 acres in 1988 to 179,400 acres in 1995, thinning and stand improvement operations increased substantially, from 484,900 acres to 705,300 acres currently (table XXVIII). Most of the treatments were on forest industry lands (66 percent). A total of 884,600 acres had some form of treatment or harvest (34 percent of all plantations).

Table XXVII—Softwood live tree volume on plantations by ownership and diameter classes, Arkansas, 1995

		Diameter class (*inches at breast height*)			
Ownership class	All classes	5.0–9.9	10.0–14.9	15.0–19.9	>20
		Million cubic feet			
Public	232.9	90.4	76.9	50.0	15.6
Forest industry	1,156.5	773.7	310.3	62.8	9.6
Nonindustrial private	543.2	228.3	198.5	98.0	18.4
All classes	1,932.6	1,092.4	585.7	210.8	43.7

Numbers in rows and columns may not sum to totals due to rounding.

Table XXVIII—Area of timberland on plantations by ownership class and treatment, Arkansas, 1995

		Treatment	
Ownership class	All treatments	Commercial harvest[a]	Thinning/stand improvement[b]
		Thousand acres	
Public	92.8	11.8	81.0
Forest industry	581.5	91.1	490.4
Nonindustrial private	210.2	76.4	133.8
All classes	884.6	179.4	705.3

Numbers in rows and columns may not sum to totals due to rounding.

[a] Includes all types of commercial harvests.

[b] Includes all types of stand treatment except natural disturbance.

Disturbance

Harvesting

Between 1988 and 1995, 3.9 million acres of Arkansas timberland underwent some form of commercial harvest (table XXIX). In this case, a commercial harvest was that in which the current stand rotation featured in management was finalized. After the harvest a new stand will be featured in management. Oftentimes it may be difficult for data collection personnel to discern between a partial harvest and a thinning operation because the definition and distinction in the field are not always clear.

Four major groups of harvest were recognized in the survey: partial harvests, seed tree/shelterwood harvests, clearcut harvests, and salvage harvests. Most of the commercial harvesting activity was in partial harvests, 2.9 million acres (74 percent of all harvests). Ranked next were clearcuts, seed tree/shelterwood, and salvage harvests, with 734,000, 192,400, and 79,700 acres, respectively.

Most of the harvesting was done on NIPF and forest industry lands (table XXIX). There were 2.3 million acres harvested on NIPF lands and 1.3 million acres on forest

Table XXIX—Area of timberland by forest-type group prior to harvesting, ownership, and harvesting activity, Arkansas, 1995

Forest-type group and ownership class	All classes	Commercial harvesting activity				
		None	Partial	Seed tree/ shelterwood	Clearcut	Salvage cut
		Thousand acres				
Loblolly-shortleaf pine						
Public	817.7	709.6	48.0	5.6	37.8	16.7
Forest industry	2,046.7	1,428.3	408.3	68.7	136.3	5.1
Nonindustrial private	1,456.1	838.2	435.7	39.7	130.0	12.4
All classes	4,320.5	2,976.1	891.9	114.1	304.1	34.3
Oak-pine						
Public	512.9	484.8	5.2	0.0	5.4	17.4
Forest industry	948.2	616.5	227.6	17.6	81.1	5.5
Nonindustrial private	1,671.0	1,148.3	452.2	11.8	58.7	0.0
All classes	3,132.2	2,249.7	685.1	29.3	145.3	22.9
Oak-hickory						
Public	1,372.2	1,326.9	32.5	0.0	12.8	0.0
Forest industry	802.7	591.7	127.2	6.5	72.2	5.1
Nonindustrial private	5,107.5	4,271.1	667.8	28.7	122.4	17.4
All classes	7,282.5	6,189.7	827.6	35.2	207.4	22.5
Bottomland hardwoods[a]						
Public	523.7	486.4	32.5	0.0	4.7	0.0
Forest industry	656.8	486.7	137.1	7.3	25.6	0.0
Nonindustrial private	1,548.8	1,209.7	285.8	6.5	46.9	0.0
All classes	2,729.3	2,182.9	455.4	13.8	77.2	0.0
Nontyped						
Public	0.0	0.0	0.0	0.0	0.0	0.0
Forest industry	5.7	5.7	0.0	0.0	0.0	0.0
Nonindustrial private	0.0	0.0	0.0	0.0	0.0	0.0
All classes	5.7	5.7	0.0	0.0	0.0	0.0
All groups						
Public	3,226.6	3,007.7	118.3	5.6	60.8	34.2
Forest industry	4,460.1	3,128.9	900.3	100.1	315.2	15.7
Nonindustrial private	9,783.4	7,467.3	1,841.5	86.7	358.0	29.8
All classes	17,470.1	13,604.0	2,860.0	192.4	734.0	79.7

Numbers in rows and columns may not sum to totals due to rounding.

[a] Includes oak-gum-cypress and elm-ash-cottonwood forest-type groups.

industry lands. Only 218,900 acres of public lands showed harvesting activity. The proportions of timberland harvested were substantially different among ownerships. Only 7 percent of public lands showed commercial harvest activity while the proportions on forest industry and NIPF lands were much higher, 30 and 24 percent, respectively.

Clearcut harvests were almost equally divided among forest industry and NIPF ownerships. A total of 358,000 acres were clearcut on NIPF lands while 315,200 acres were clearcut on forest industry lands. However, the proportion of timberland that was clearcut was much higher on forest industry lands than on NIPF lands, 7 percent versus 4 percent, respectively. Only 60,800 acres were clearcut on public lands, or 2 percent of all public lands.

Most harvesting activity was in the loblolly-shortleaf pine forest-type group, 1.3 million acres. Ranked next in amount of timberland acreage harvested was the oak-hickory forest-type group with 1.1 million acres. These two forest-type groups also had the same rankings in clearcut harvests, 304,100 acres in the loblolly-shortleaf type and 207,400 acres in the oak-hickory type. Together, these two forest-type groups accounted for 70 percent of clearcut harvesting.

There was a substantial change in the amount of acreage harvested in 1988 and 1995. Total harvested timberland in 1988 was 5.5 million acres; in 1995, harvested acreage had dropped to 3.9 million acres. The declines occurred in every harvest category. Partial harvests declined by 908,800 acres, seed tree/shelterwood harvests by 119,200 acres, and clearcuts by 650,300 acres. The largest decrease was in clearcuts on forest industry lands; there the decrease totaled 522,500 acres.

The harvesting activity was spread throughout the survey period (tables XXX and XXXI). Peak years of all types of harvests were 1991 through 1994 (table XXX). Clearcut harvests were spread more evenly throughout the period (table XXXI). The assignment of harvest year is derived from a field estimate based upon time since cutting occurred, therefore the error of the estimate is smallest on newly harvested trees and may become increasingly large as the length of time since cutting increases (Rosson 1994). Additionally, plot work completed at the end of a survey period may not include the entire growing season, and the estimate of the most recently harvested plots may be smaller than they actually are.

Table XXX—Area of timberland commercially harvested by year of harvest and ownership class, Arkansas, 1989 to 1995[a]

Year of harvest	All classes	Ownership class			
		National forest	Other public	Forest industry	Nonindustrial private
			Thousand acres		
1989	202.3	16.1	5.9	41.5	138.8
1990	303.5	15.7	0.0	139.8	148.1
1991	666.1	5.4	16.4	290.3	353.9
1992	876.7	11.8	35.9	304.5	524.6
1993	792.2	17.3	5.1	319.0	450.7
1994	621.0	27.4	11.3	190.1	392.1
1995	265.6	45.7	0.0	40.7	179.3
1996[b]	126.7	4.8	0.0	5.3	116.6
All years	3,854.2	144.3	74.6	1,331.2	2,304.1

Numbers in rows and columns may not sum to totals due to rounding.

[a] Modified from Rosson. Current stand characteristics of Arkansas timberland harvested between 1978 and 1995. Manuscript in preparation. Timberland totaling 11,900 acres was not included in this table because of overlap in dates with the 1988 survey.

[b] Some sample plots were measured in the 1996 growing season.

Table XXXI—Area of clearcut upland timberland by year of harvest and forest-type group, Arkansas, 1989 to 1995[a]

Year of harvest	All types	Forest-type group[b]		
		Loblolly-shortleaf pine	Oak-pine	Oak-hickory
		Thousand acres		
1989	57.9	17.3	11.4	29.2
1990	73.2	40.3	16.3	16.6
1991	105	58.5	19.2	27.3
1992	138.3	58.1	34.6	45.6
1993	111.8	39.9	28.6	43.2
1994	106.9	67.2	12.1	27.7
1995	51.4	16.8	23.1	11.5
1996[c]	12.2	5.9	0.0	6.3
All years	656.8	304.1	145.3	207.4

Numbers in rows and columns may not sum to totals due to rounding.

[a] Modified from Rosson. Current stand characteristics of Arkansas timberland harvested between 1978 and 1995. Manuscript in preparation.

[b] Forest-type group prior to harvest.

[c] Some sample plots were measured in the 1996 growing season.

Management

Three types of stand management activity were assessed in the survey: thinning operations, stand improvement operations, and site preparation operations (table XXXII). These assessments were made by data collection personnel at the time of the sample plot visit. As with identification of the types of harvest operations, identifying specific management activities can also be difficult at times in the field. Of the three assessments, stand improvement identification was probably most difficult.

Between 1988 and 1995, 2.0 million acres underwent some forest management activity. Most activity was in stand improvements (844,600 acres) followed by thinning operations (773,600 acres). The third category, site preparations, had 416,500 acres.

Since 1988, the amount of activity in each category dropped. The largest decline was in site preparation operations, by 510,500 acres. Next was stand improvements, dropping by 282,100 acres. The smallest decline was in thinning operations. Here, acreage decreased by 49,000 acres. The decline in site preparation acreage seems reasonable and follows the decline in harvested acreage, especially clearcuts, which declined by 522,500 acres since 1988.

In every management activity category, most activity took place on forest industry lands (table XXXII). A total of 61 percent of thinnings were on forest industry lands, as were 53 percent of stand improvement operations and 64 percent of site preparation activity.

Most of the management activity was done in the loblolly-shortleaf pine forest-type group. There were 611,300 acres thinned in this type (79 percent of all thinnings done in Arkansas). The majority of stand improvements were also done in this type, 514,300 acres (61 percent of all stand improvement). Forty-four percent of site preparations were done in the loblolly-shortleaf pine forest-type group. It is likely that many of the oak-pine and oak-hickory forest-type group stands were converted to pine plantations after the site preparation work. However, an accurate assessment of this cannot be done until the next survey of Arkansas. Unfortunately, there is little management activity in the hardwood component of Arkansas' forests, compared to the softwood component. Note that very little thinning is done in the oak-hickory and bottomland hardwood forest-type groups, 43,900 and 9,500 acres, respectively. The same low

Table XXXII—Area of timberland by forest-type group and ownership prior to activity, and management activity, Arkansas, 1995

Forest-type group and ownership	All classes	Management activity			
		None	Thinning operation	Stand improvement	Site preparation
		Thousand acres			
Loblolly-shortleaf pine					
Public	817.7	617.8	77.1	95.1	27.7
Forest industry	2,046.7	1,235.0	401.2	296.4	114.0
Nonindustrial private	1,456.1	1,157.4	133.0	122.8	42.9
All classes	4,320.5	3,010.3	611.3	514.3	184.6
Oak-pine					
Public	512.9	472.2	12.5	28.3	0.0
Forest industry	948.2	718.0	63.1	86.7	80.5
Nonindustrial private	1,671.0	1,588.5	33.4	30.5	18.7
All classes	3,132.2	2,778.7	108.9	145.5	99.2
Oak-hickory					
Public	1,372.2	1,317.5	10.7	32.5	11.5
Forest industry	802.7	673.7	5.8	61.8	61.4
Nonindustrial private	5,107.5	4,954.1	27.4	78.1	48.0
All classes	7,282.5	6,945.3	43.9	172.4	120.8
Bottomland hardwoods[a]					
Public	523.7	519.0	4.7	0.0	0.0
Forest industry	656.8	645.9	4.8	0.0	6.1
Nonindustrial private	1,548.8	1,536.4	0.0	12.4	0.0
All classes	2,729.3	2,701.3	9.5	12.4	6.1
Nontyped					
Public	0.0	0.0	0.0	0.0	0.0
Forest industry	5.7	0.0	0.0	0.0	5.7
Nonindustrial private	0.0	0.0	0.0	0.0	0.0
All classes	5.7	0.0	0.0	0.0	5.7
All groups					
Public	3,226.6	2,926.5	105.0	155.9	39.2
Forest industry	4,460.1	3,272.6	474.8	444.9	267.7
Nonindustrial private	9,783.4	9,236.4	193.7	243.8	109.5
All classes	17,470.1	15,435.5	773.6	844.6	416.5

Numbers in rows and columns may not sum to totals due to rounding.
[a] Includes oak-gum-cypress and elm-ash-cottonwood forest-type groups.

level of activity is evident in stand improvements, except that in upland hardwoods, stand improvement may mean conversion to or management favoring softwoods.

The ratio of clearcut timberland to site-prepared timberland was 1.76 to 1.00 in the State. The highest ratio was on NIPF lands, 3.27 to 1.00; the lowest ratio was 1.18 to 1.00 on forest industry lands. When comparing these two extremes in ratios, it would seem prudent to take steps to ensure that prompt and adequate regeneration occurs on NIPF lands. Often times, regeneration on such lands is left to natural means but often, an inadequate seed source lengthens the regeneration period to many years longer than necessary.

Treatment Opportunities

Several stand-treatment opportunities for Arkansas' timberland are given in table XXXIII. These estimates were derived by application of a model and were not made by data collection personnel while visiting sample plots. Therefore, it is important that users are aware of the plot-level parameters used in the model, and what some of the important stand-level thresholds are that were used in defining the treatment opportunity classes. The important plot-level parameters included the following: the stocking level of growing-stock trees, amount of cull, species groups, stand-size classes, amount of volume, and amount of damage. The threshold levels for the various treatment classes are subjective but do help give an indication of possible alternatives that could be used to improve Arkansas' timberland resource.

Table XXXIII—Area of timberland by forest-type group, ownership class, and treatment opportunity, Arkansas, 1995

Forest-type group and ownership class	All classes	Type of treatment: No treatment	Stand establishment: Regenerate	Stand establishment: Stand conversion	Intermediate treatment: Thin seedlings and saplings	Intermediate treatment: Thin poletimber	Intermediate treatment: Other stocking control	Final harvest: Regeneration cut	Final harvest: Salvage cut
					Thousand acres				
Loblolly-shortleaf pine									
Public	919.8	548.7	23.9	0.0	0.0	44.0	63.1	240.2	0.0
Forest industry	2,450.4	1,748.6	74.4	0.0	0.0	381.1	108.5	137.9	0.0
Nonindustrial private	1,706.9	1,104.0	111.7	0.0	6.0	108.6	114.1	262.4	0.0
All classes	5,077.1	3,401.3	210.0	0.0	6.0	533.7	285.7	640.5	0.0
Oak-pine									
Public	546.2	355.1	47.3	0.0	0.0	16.2	77.5	50.1	0.0
Forest industry	736.0	441.7	86.7	0.0	0.0	23.8	160.0	23.8	0.0
Nonindustrial private	1,855.0	1,050.6	361.3	0.0	6.5	35.1	354.6	47.0	0.0
All classes	3,137.3	1,847.4	495.3	0.0	6.5	75.1	592.1	120.9	0.0
Oak-hickory									
Public	1,276.1	856.2	172.7	0.0	0.0	33.4	147.7	60.8	5.3
Forest industry	568.4	279.8	148.1	0.0	16.2	11.6	106.5	6.2	0.0
Nonindustrial private	5,282.9	2,720.2	1,575.8	20.4	5.6	104.5	796.8	53.9	5.8
All classes	7,127.4	3,856.3	1,896.6	20.4	21.7	149.5	1,051.0	120.8	11.1
Bottomland hardwoods[a]									
Public	553.6	350.5	101.5	0.0	0.0	0.0	16.0	80.6	5.1
Forest industry	735.3	500.4	148.6	4.8	0.0	6.1	35.0	35.0	5.4
Nonindustrial private	1,729.5	1,030.2	482.8	5.9	5.6	17.4	74.2	84.1	29.4
All classes	3,018.4	1,881.0	732.9	10.6	5.6	23.5	125.3	199.6	39.9
Nontyped									
Public	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Forest industry	7.3	0.0	7.3	0.0	0.0	0.0	0.0	0.0	0.0
Nonindustrial private	24.8	0.0	24.8	0.0	0.0	0.0	0.0	0.0	0.0
All classes	32.1	0.0	32.1	0.0	0.0	0.0	0.0	0.0	0.0
All groups									
Public	3,295.7	2,110.4	345.3	0.0	0.0	93.6	304.4	431.6	10.4
Forest industry	4,497.4	2,970.5	465.1	4.8	16.2	422.6	410.0	202.8	5.4
Nonindustrial private	10,599.2	5,905.1	2,556.5	26.3	23.6	265.6	1,339.7	447.4	35.1
All classes	18,392.3	10,986.0	3,366.8	31.0	39.7	781.8	2,054.1	1,081.8	51.0

Numbers in rows and columns may not sum to totals due to rounding.

[a] Includes oak-gum-cypress and elm-ash-cottonwood forest-type groups.

In the 1995 survey, a total of 11.0 million acres of Arkansas timberland were deemed adequately stocked, of a desirable species composition, and having limited damage with little cull volume (table XXXIII). No treatment was specified for this acreage. This left 7.4 million acres of timberland in need of some form of treatment. In the 1988 survey, 10.2 million acres were judged to be in no need of treatment. This left 7.1 million acres eligible for treatment in 1988, slightly less than the current estimate.

The largest segment of timberland in Arkansas that was classed as being in need of treatment was in areas where there was inadequate stand stocking or regeneration. Approximately 3.4 million acres were understocked to the point that additional regeneration efforts would be needed to bring stand stocking up to a suitable level in a relatively short amount of time. The model to derive this estimate used the following criteria. A stand had to be less than 50-percent stocked with growing-stock trees, or greater than 50- but less than 60-percent stocked with growing-stock trees, while the stocking of rough and rotten trees in these stands had to be greater than 30 percent. Many times, harvested or recently regenerated stands will be less than 50-percent stocked. With the high amount of harvesting activity during the survey period it was not unusual for this estimate to be so high. Most of this acreage was on NIPF lands, 2.6 million acres (76 percent of all timberland needing regeneration). In addition, the oak-hickory forest-type group and bottomland hardwoods had the highest acreage in need of regeneration, 1.9 million and 732,900 acres, respectively (table XXXIII).

Three subcategories of intermediate treatment were considered: precommercial thinning (sapling-seedling size trees), poletimber thinning, and other stocking control. Sapling-seedling stands greater than 150-percent stocked with growing-stock trees were considered in need of thinning. Only 39,700 acres were in this condition. Poletimber stands greater than 110-percent stocked were considered suitable for a thinning operation. There were 781,800 acres of this type. Most of the sapling-seedling and poletimber stands in need of thinning were forest industry owned, 438,800 acres. In addition, most of the acreage needing thinning was in the loblolly-shortleaf forest-type group, 539,700 acres (66 percent of all timberland needing thinning).

The third subcategory of intermediate treatment was other stocking control. These were stands that were smaller than the sawtimber-size class, had more than 110-percent stocking, and had more than 30 percent of that stocking composed of rough and rotten trees. There were 2.1 million acres of Arkansas timberland in this condition. Most of these stands were on NIPF lands, 1.3 million acres (65 percent of all timberland in this treatment class). The oak-pine and oak-hickory forest-type groups had the most timberland in this class, 1.6 million acres (80 percent of the treatment class). The hardwood forest-type groups had the most acreage in this class because of the 30 percent stocking threshold for rough and rotten trees. Hardwoods are much more likely to incur diseases, pathogens, or other agents that directly or indirectly lead to an increase in cull and result in classification as rough or rotten. There was no change in the amount of timberland in this treatment class since the 1988 survey. Then, 2.1 million acres were also in this class.

The last treatment category considered was that of final harvest. This consisted of two subcategories, regeneration cuts and salvage cuts. A regeneration cut (commercial harvest) was prescribed for stands of sawtimber size with more than 110-percent stocking in growing-stock trees and more than 5,000 board feet per acre. There were 1.1 million acres in this category. Interestingly, most of this type timberland was on NIPF and public lands, 447,400 and 431,600 acres respectively. In addition, most of this treatment class was in the loblolly-shortleaf pine forest-type group, 640,500 acres. The second ranking forest-type group was the bottomland hardwoods, 199,600 acres. The new regeneration cut estimate was 182,400 acres more than in 1988. Most of the increase was on public lands; the increase here was 179,700 acres. Salvage cuts are prescribed for poletimber and sawtimber stands where more than 80 percent of the stocking is made up of trees with a cull deduction due to disease, insect, or other naturally occurring injury. There were only 51,000 acres that qualified for a salvage harvest.

A note of caution is needed in the interpretation of the treatment opportunities table for Arkansas (table XXXIII). The model was developed for natural stands across the range of conditions in the Midsouth States. The stocking parameters may not apply equally well to all conditions, especially those that depart markedly from the Midsouth average. In northwest Arkansas (the Ozark unit), natural stand and growth conditions are such that average stocking conditions for the Midsouth States may distort realistic applications. For example, it may not be likely that many stands in northwest Arkansas reach 5,000 board feet per acre (to qualify for harvesting in the model). Therefore, many stands in this area that might normally be harvested under real conditions (a lower volume threshold) would not be included in the regeneration cut category in table XXXIII.

Conclusions

Arkansas has probably one of the most diverse land types of any State in the South. It has a multitude of site and habitat types and ownership objectives. For example, the Southwest unit lies on the Coastal Plain and contains some of the best sites for loblolly pine in the United States. Because of this, forestry management practices are intensive and heavily influenced by forest industry ownership. The mountainous region in the western part of the State is home to one of the largest national forests in the East. This has also been the site of the Forest Service pilot project for ecosystem management implementation, emphasizing reduced and alternative harvesting practices. This area is also the heart of the shortleaf pine distribution. Nowhere in the United States is the occurrence and volume of shortleaf pine more concentrated. The northwest area of Arkansas takes on an even different forest profile. Here, forest stands take on characteristics of forests to the west, such as those of Oklahoma, Texas, and north into southwest Missouri. In these regions, oaks predominate, and tree morphology is changed, i.e., trees are shorter and growth rates are much slower. Tree spacing is wider and in some cases the forest takes on a savanna-like appearance. In northwest Arkansas, the NIPF owner predominates and there is little influence from forest industry. The remaining major region of Arkansas to be discussed is the broad expanse of the Mississippi River Delta. Once the site of some of the most productive bottomland hardwood forests in the United States, the area forests have been reduced to less than half of their former areal extent. Recent surveys have shown the area rebounding from its lowest level in 1978 (1.8 million acres) to 2.1 million acres in 1995. However, this is still less than half of the 4.3 million acres reported for the 1935 survey. Hopefully, reversion of nonforest land (mostly marginal agriculture lands) will continue, and the bottomland hardwood forests in the Mississippi River Delta will continue to be an important component of the State's forestry future.

When evaluating forest resource trends and dynamics, two primary sources of information are usually analyzed. The first is the area of the land base and changes in the land base, i.e., the amount of land that is classed as timberland and the amount of land diverting from or reverting to timberland over time. The second important source of resource information deals with forest stand dynamics, i.e., changes in basal area, density, species composition, volume, growth, removals, and mortality. These stand population components are all affected by either disturbance (from natural or anthropogenic sources) or lack of disturbance. In the case of the latter, stand dynamics would be brought about by the natural progress of succession or stand development. This includes the following stages: stand initiation, stem exclusion, understory reinitiation, and old growth (Oliver and Larson 1990). However, few timberland stands in Arkansas likely will progress to the old-growth stage because of the degree of disturbance occurring in the State. Succession to the old-growth stage could take well over 100 to 150 years for most forest types.

Since the 1988 survey, the amount of land base in Arkansas classified as timberland has increased dramatically. A total of 603,500 acres of timberland diverted to a nonforest condition, but 1.8 million acres reverted from a nonforest to forest condition. The net result was a 1.1-million-acre increase in timberland. This was a positive contribution to the forest resource situation in Arkansas because this new timberland will be contributing to the forest resource base in the near future. However, it will take time and a substantial financial effort to get this land into a productive state. It is uncertain how much more of Arkansas' land base may revert to timberland. Historically, since the FIA survey has been in place, the highest amount of timberland recorded for Arkansas was in the 1959 survey, 20.8 million acres. Much of the timberland losses since then were from bottomland hardwood types, primarily from the North and South Delta units. Some of these converted sites were marginal for agriculture production and have since reverted back to timberland. However, it will be many years before these sites will return to a productive state.

In comparison to other recently completed Midsouth surveys, Arkansas ranked second behind the leader, Mississippi, in the increase of timberland. Mississippi timberland area increased by 1.6 million acres (Rosson 2001b). East Texas and east Oklahoma both had moderate increases in timberland, 202,700 and 154,300 acres, respectively (Rosson 2000, Rosson 2001a). Alabama timberland increased by 273,100 acres (McWilliams 1992). Louisiana was the only State recently surveyed that showed a loss of timberland area, and that loss was very small, 89,600 acres (Rosson 1995a).

Arkansas' standing live tree volume was 23,783.9 million cubic feet and 76,960.7 million board feet of sawtimber. Compared to other recent Midsouth surveys, Arkansas ranked near the top. East Texas had 14,229.0 million cubic feet of live-tree volume and 50,711.6 million board feet of sawtimber (Rosson 2000); east Oklahoma had 3,913.3 million cubic feet live-tree volume and 8,011.6 million board feet of sawtimber (Rosson 2001a); Mississippi had

22,649.2 million cubic feet live-tree volume and 77,189.9 million board feet (Rosson 2001b); Louisiana had 20,738.3 million cubic feet of live-tree volume and 75,525.6 million board feet of sawtimber (Rosson 1995a).

Stocking levels in Arkansas' forests have continued to improve. Since the 1988 survey, basal area has increased, from 80.1 to 84.6 square feet per acre. Only one recently surveyed Midsouth State exceeded Arkansas' basal area, and that was Louisiana with 85.4 square feet per acre (Rosson 1995a). Basal areas of other recent State surveys were 75.6, 75.1, and 74.4 square feet per acre for east Texas (Rosson 2000), east Oklahoma (Rosson 2001a), and Mississippi (Rosson 2001b), respectively.

An additional indicator of stocking condition and levels is the area of timberland according to sawtimber volume per acre. A benchmark for southern forests has been that a managed forest probably should culminate at around 10,000 board feet per acre (Walker 1991). A slightly lower threshold of 5,000 board feet per acre of sawtimber was used arbitrarily in this paper to mark the limit where stands have entered the lower dimensional level of sawlog size. The other two stand thresholds (classes) used were those stands containing 1,500 to 5,000 board feet per acre and those with less than 1,500 board feet per acre. Arkansas had 6.1 million acres of timberland with more than 5,000 board feet per acre. This was an increase of 1.3 million acres over the 1988 survey. A total of 5.6 million acres were in stands of 1,500 to 5,000 board feet per acre and 6.7 million acres were in stands with less than 1,500 board feet per acre. Of the States recently surveyed, Arkansas had the most timberland in the largest sawtimber class, only slightly edging out Louisiana (6.0 million acres) (Rosson 1995a). However, when analyzing the proportion of a State's timberland with more than 5,000 board feet per acre, Arkansas was second behind Louisiana, 33 percent for the former versus 44 percent for the latter (Rosson 1995a). Mississippi (Rosson 2001b), east Texas (Rosson 2000), and east Oklahoma (Rosson 2001a) followed with 31, 30, and 8 percent of their respective timberlands composed of stands with more than 5,000 board feet per acre, respectively.

The balance between growth and removals for softwoods improved dramatically since the 1988 survey in Arkansas. In 1988, removals exceeded growth and the removals-to-growth ratio was 1.08 to 1.00; by 1995 that had reversed, and the growth-to-removals ratio was 1.28 to 1.00. Compared to other States, Louisiana had the highest softwood removal-to-growth ratio, 1.27 to 1.00 (Rosson 1995a); east Texas was 1.01 to 1.00 (Rosson 2000); Mississippi was 1.12 to 1.00 (Rosson 2001b). East Oklahoma was the only other recently surveyed State where softwood growth exceeded removals. Its growth-to-removal ratio was 2.07 to 1.00 (Rosson 2001a).

Arkansas timberland had a positive situation regarding the hardwood balance between growth and removals. Continuing from the previous survey, hardwood growth exceeded removals by 1.28 to 1.00. Only one recently surveyed State showed removals exceeding growth; that was Mississippi with a removal-to-growth ratio of 1.07 to 1.00 (Rosson 2001b). The other States showed growth exceeding removals, 1.14, 2.72, and 1.11 to 1.00 for Louisiana (Rosson 1995a), east Oklahoma (Rosson 2001a), and east Texas (Rosson 2000), respectively.

Plantation forestry is playing an ever-increasing role in Arkansas forestry. The commitment is almost entirely in softwood production. Since 1988, Arkansas' plantation area has increased by 648,600 acres, bringing the amount of land under this type of management regime to 2.6 million acres. Although plantations have been criticized for many things, they do help get cutover lands back into production quickly and help take the pressure off other natural stands to be involved in cutting cycles to help meet surges in product demands. This can be accomplished by concentrating intensively managed softwood production on the fewer acres designated for this purpose.

One unanswered question is how much of Arkansas timberland should be in plantation management. Currently, 14 percent of Arkansas timberland is in forest plantations. Other recently surveyed States showed 22 percent for east Texas (Rosson 2000), 13 percent for east Oklahoma (Rosson 2001a), 20 percent for Louisiana (Rosson 1995a), and 23 percent for Mississippi (Rosson 2001b). Compared to other States, it would seem that Arkansas could expand its plantation acreage. However, this may not be possible because the best sites for softwood plantation establishment are in the Southwest unit and the proportion of timberland in plantations there is already 24 percent. In 1988, the proportion of timberland in plantations in this unit was 19 percent.

One area that may be of concern is the number of plantation acres in an understocked condition. Arkansas had 762,400 acres with less than 60 percent stocking. A total of 224,200 acres were less than 30 percent stocked. These data imply that it will take these types of stands much longer to

become fully stocked, adding to more lengthy regeneration cycles or volume shortfalls. It is important that new plantations are fully stocked quickly, to meet management objectives and quickly address plantation failures. A 60-percent stocking level for seedlings would equal 360 trees per acre, while a 30-percent level would equal 180 seedlings per acre. Planting at 700 trees per acre is considered a stocking density that gives managers the most variety of options, whether it is economically, ecologically, or product-value oriented (Schultz 1997). However, it should be noted that planting densities will vary, based on management goals, and oftentimes will be lower than the optimum suggested above. Because of this, it is difficult for FIA to ascertain with certainty whether or not a plantation failure has occurred or that the low seedling (or sapling) density of the plantation sampled was planned.

Most plantings are not as successful as desired. Baldwin (1989) has presented evidence that, on average, 60 to 70 percent of hand- or machine-planted seedlings survive and become established. A study by Steinbeck (1990) showed that seedling survival on conservation reserve plantings averaged 65 to 76 percent. Finally, a study of plantings on 250,000 acres over 25 years across the South showed survival for loblolly and slash pines averaged 71 percent (Schultz 1975). With these survival rates in mind, it is even more important that initial stocking levels of plantations are high enough and are maintained at optimum levels throughout the stand-establishment phase in order to ensure optimum volume levels and highest quality products at the time of final harvest.

The amount of timberland affected by harvesting has declined since the 1988 survey. In 1988, 5.5 million acres were harvested; by 1995, only 3.9 million acres were harvested, a 650,300-acre decline. On an annual basis (total harvested area divided by the survey time period), harvesting averaged 501,400 acres per year in the current survey period versus 584,800 acres per year in the prior survey period. During this same period, however, the amount of volume removed on this harvested timberland actually increased, going from 689.9 million to 743.7 million cubic feet per year, a 53.8-million-cubic-foot-per-year increase. The reason this is even possible is because the timberland that underwent harvesting between 1988 and 1995 had higher per-acre volumes than the previous survey cycle. This situation is illustrated in figure 13, where the amount of timberland in various volume-per-acre classes is shown. For example, it becomes clear that the volume on 2 acres with 9,000 board feet per acre is equivalent to the volume of 9 acres with 2,000 board feet per acre.

The proportion of harvested timberland to total timberland in the current survey of Arkansas was 21 percent. Compared to other recently surveyed Midsouth States, Arkansas ranked second just behind east Oklahoma (at 13 percent). The proportions of east Texas (Rosson 2000), Mississippi (Rosson 2001b), and Louisiana (Rosson 1995a) were 28, 30, and 32 percent, respectively. Arkansas is in a favorable position to retain this fairly low harvest proportion in the future, mainly because of the increase in inventory volume during the current survey.

The last forest survey of Arkansas in the 20th century revealed many positive attributes about the State's resource situation. Timberland area has increased, along with increases in both the softwood and hardwood inventories. Additionally, examination of several stand parameters revealed a maturing of forest stands across the State. Arkansas is now in a good position to move forward into the next century while having the capability to respond to changing perceptions in forestry.

Prior to the 1960's, most forestland managers and owners had commodity output as their primary goal. But as individual participation (family farms) in agriculture declined and society realized a higher standard of living, much more leisure time became available. With this came more and more demands for delivery of noncommodity values from forest resources. The forestry profession responded with the concept of multiple-use management. However, with the environmental awareness of the 1970's and 1980's, societal demands assigned greater and greater values to noncommodity benefits.

In response to these new societal perceptions, an important transition in forestry began taking place in North America in the 1990's. The new forest management philosophy became known by various names, such as new perspectives management, ecosystem management, and sustainable forestry. This was an answer to societal interests that included visualizing the forest as a dynamic system that provides a multitude of benefits across a wide spectrum of society. It recognizes both the ecological and utilitarian values of forests and gives higher priority to maintaining their health, diversity, and productivity (Kessler and others 1992, Salwasser and Pfister 1994). Based on information

from the latest survey, Arkansas is in a good position to respond to these concerns.

Meffe and Carroll (1994) have outlined five basic principles of conservation management. They are: (1) critical ecological processes must be maintained, (2) goals and objectives must come from an ecological understanding of the system, (3) external threats must be minimized and external benefits maximized, (4) evolutionary processes must be conserved, and (5) management must be adaptive and minimally intrusive. Mindful of these principles, forest managers can provide Arkansas with a long, healthy, and productive forestry future. Suggestions for important first steps in addressing these concepts might be getting away from single-species plantations (multiple target species), ensuring timely regeneration after harvest (by leaving adequate seed sources or planting as soon as possible after harvest), and taking steps to maintain optimum stocking throughout stand initiation and stand establishment.

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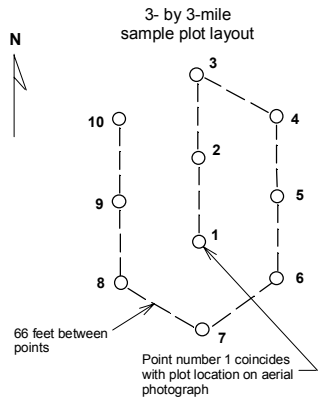
Appendix

Inventory Methods

Forest resource statistics were obtained by a two-phase sampling method employing a forest or nonforest classification system using aerial photographs (to determine forest area) and on-the-ground measurements of trees at permanent sample locations (to determine tree and stand parameters). Inventory volume and area statistics are required to give precise estimates at the State level to one standard error of the total, equal to one percent per million acres of forest land and to five percent per billion cubic feet of volume.

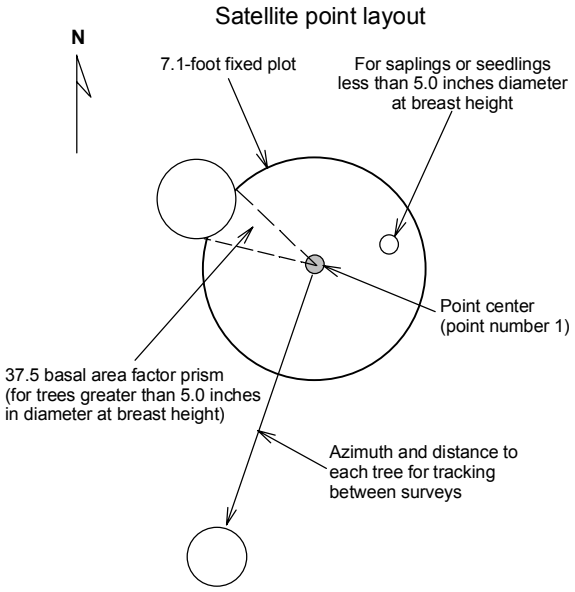
The estimate of timberland area was based on interpreting dot grid counts, overlaid on recent aerial photographs with each dot classified as forest or nonforest. Each dot represented approximately 230 acres. The forest or nonforest estimate was then adjusted by ground-truth checks at all permanent sample locations. Permanent sample locations consisted of two types of plots: intensification plots (used only as ground truths for forest and nonforest classifications), and 3- by 3-mile plots (plots on a 3- by 3-mile square grid) where tree measurements and plot characteristics were recorded. The proportion of dots classified as forest was applied to U.S. Census land area data to develop an estimate of forest area in individual counties. Appropriate expansion factors (the timberland area each plot represents) for each forested 3- by 3-mile plot were assigned. The expansion factor was dependent on the number of forested plots in a county, but averaged 5,760 acres per plot for the State.

Each forested 3- by 3-mile sample plot consisted of 10 satellite points spread over an area of approximately one acre (appendix fig. 1). This design improved portrayal of stand conditions by eliminating the effect that vegetation clumping and open gaps would cause if only one point or a fixed plot were used at each location.



Appendix figure 1—Configuration of the 10 satellite points at a sample location, Arkansas, 1995.

At each forested sample plot, trees 5.0 inches in d.b.h. and larger were selected with a 37.5-basal-area-factor prism at each of the 10 satellite points. Therefore, each tree selected with the prism represented 3.75 square feet of basal area per acre at each satellite point. Trees less than 5.0 but greater than or equal to 1.0 inch in d.b.h. were tallied on a 1/275-acre circular fixed plot centered at the first three satellite points (appendix fig. 2).



Appendix figure 2—Configuration of a satellite point, Arkansas, 1995.

Volumes in Arkansas were derived from measurements of trees on forested sample locations. These measurements included d.b.h., bark thickness, total height, bole length, log length, and four upper-stem diameters. Smalian's formula was used to compute volume. In addition, volume equations were developed to estimate the volume for trees not surviving the measurement period or for past volumes of new sample trees.

Data collection at each forested location also included estimates of site productivity, stand origin, slope, aspect, disturbance, management, and nontimber resources. Ownership information was obtained for each plot from county tax assessors' records and contact with landowners. Personnel from public agencies and other knowledgeable

people were consulted when classifying absentee farmers, individuals, corporations, or lessors.

Components of inventory volume change (growth, removals, and mortality) were estimated from tally tree data on remeasured sample plots. The remeasurement of sample plots allowed tracking of the history and volume change of each tally tree over time. This information was then used in assigning tally tree volumes and changes in volume to one of nine components of change: survivor growth, nongrowth, ingrowth, ongrowth, growth on removals, growth on mortality, mortality, timberland removals, and land-clearing removals. These components were then combined to estimate gross growth, net growth, and net change using a Beers and Miller approach (1964), as modified by Van Deusen and others (1986).

Estimates of timberland area, volume, growth, removals, and mortality were based on the application of essentially the same inventory techniques to each survey measurement. However, there were important differences between the methods used in the 1988 and 1995 inventories. In many cases, improvements in methodology for deriving current estimates can raise concerns about reported trends between survey periods. Because such differences might discourage comparisons between 1988 and 1995 results, the major differences in procedures are documented in the following paragraphs.

First, to account for changes in a new definition of growing stock, trees classed as rough culls in1978 and cut in 1988 were changed to a growing-stock class (tree class 20). This procedure was not implemented in the 1995 survey because complete information pertinent to the new definition was collected in 1988. If a live tree classed as rough cull in the 1988 survey was cut and utilized by the time of the remeasurement in 1995, its tree class remained a rough cull. This change in procedure will affect direct comparisons of growing-stock growth, removals, and mortality. Therefore trend information for growing-stock trees in such cases was uncertain.

Second, a decrease in the utilizable volume allowance was used to classify trees as growing stock or cull. In the 1995 survey, at least one-third of the volume in the sawlog section (or prospective volume, in the case of smaller-than-sawtimber size trees) had to be utilizable. In previous surveys of Arkansas, one-half the volume had to be utilizable. In previous inventories in the Midsouth States, few trees have been affected where this change has been implemented. Thus, the subsequent effect on estimation of growing-stock trends was small.

Third, the land area base provided by the U.S. Census Bureau has changed. Because the timberland area is determined by summarizing forest versus nonforest dot counts on aerial photographs (in each county) and then applying the resulting proportions to the Census Bureau land base, a change in the land base between measurement periods will affect area trends. The 1988 survey used the 1980 U.S. Census Bureau land area estimates; the 1995 survey used the 1990 Census Bureau estimates. Much of the change is due to the Census Bureau's new definition of the water classification; a small portion of area previously classified as land is now classified as water. Because the land area estimates between 1980 and 1990 decreased only 1,900 acres for the State, the effect on timberland area trends will be negligible.

Users interested in trend analysis of growing-stock volume, growth, removals, and mortality should be aware of the impact of the growing-stock definition change; incompatibility arises from trees that were cut or died, affecting growth, removals, and mortality estimates. The magnitude was probably small but not possible to define with certainty.

Growing-stock comparisons between the 1988 and 1995 data sets were probably valid for most broad applications. In a more rigorous analysis, or where postdefined strata are selected (resulting in smaller data sets) and analyzed, one should determine that the changes are real and not due to definition or procedural changes. In such instances, the comparisons between surveys should be done using all live trees. This procedure eliminates any uncertainties caused by the growing-stock definition changes. Finally, to further enhance trend analysis, a slight improvement in precision was made in the 1988 volume estimates by using all the tree bole measurements from the 1995 survey to develop new volume coefficients for use where needed. Because of the change in the growing-stock standard and the improved volume coefficients, estimates for the reprocessed 1988 data may differ slightly from those previously published.

Some area and volume estimates in this bulletin may not match those published in *Forest Statistics for Arkansas Counties–1995* (London 1997). This is because some minor corrections have been made to the data since release of that publication.

Statistical Reliability

A relative standard of accuracy has been incorporated into the forest survey. This standard satisfies user demands, minimizes human and instrumental sources of error, and keeps costs within prescribed limits. The two primary types of error are measurement error and sampling error.

There are three elements of measurement error: (1) biased error, caused by instruments not properly calibrated; (2) compensating error, caused by instruments of moderate precision; and (3) accidental error, caused by human error in measuring and compiling. All of these are held to a minimum by a system that incorporates training, check plots, and editing and checking for consistency. Each new field person is trained for 3 to 4 months under the guidance of an experienced field person. Field work is checked by supervisors. Editing checks in the office screen out logical and keypunching errors for all plots. It is not possible to determine measurement error statistically, but the FIA holds it to a minimum through training, experienced supervision, and emphasis on careful work.

Sampling error is associated with the natural and expected deviation of the sample from the true population mean. This deviation is susceptible to a mathematical evaluation of the probability of error. Sampling errors for State totals in appendix table 1 are based on one standard error. That is,

Appendix table 1—Sampling errors, at one standard error, for estimates of total timberland area[a] (1995), volume[b], average net annual growth[b] (1988 to 1995), and average annual removals[b] (1988 to 1995), and average annual mortality[b] (1988 to 1995), Arkansas

Item	Component total	Units	Percent sampling error
Timberland area	18,392.3	Thousand acres	0.3
Total live trees			
Volume	23,783.9	Million cubic feet	1.3
Average net annual growth	951.8	Million cubic feet	1.9
Average annual removals	743.7	Million cubic feet	3.7
Average annual mortality	176.2	Million cubic feet	3.9
Total sawtimber			
Volume	76,960.7	Million board feet[c]	1.9
Average net annual growth	3,725.0	Million board feet[c]	2.5
Average annual removals	2,879.4	Million board feet[c]	4.3
Average annual mortality	466.1	Million board feet[c]	6.8
Softwood live trees			
Volume	9,541.9	Million cubic feet	2.6
Average net annual growth	554.6	Million cubic feet	3.1
Average annual removals	433.1	Million cubic feet	5.0
Average annual mortality	49.1	Million cubic feet	9.9
Softwood sawtimber			
Volume	39,483.9	Million board feet[c]	3.2
Average net annual growth	2,419.1	Million board feet[c]	3.4
Average annual removals	1,898.8	Million board feet[c]	5.6
Average annual mortality	166.7	Million board feet[c]	15.0
Hardwood live trees			
Volume	14,242.0	Million cubic feet	1.8
Average net annual growth	397.2	Million cubic feet	2.7
Average annual removals	310.6	Million cubic feet	5.1
Average annual mortality	127.1	Million cubic feet	4.2
Hardwood sawtimber			
Volume	37,476.8	Million board feet[c]	2.8
Average net annual growth	1,305.9	Million board feet[c]	4.0
Average annual removals	980.6	Million board feet[c]	6.2
Average annual mortality	299.4	Million board feet[c]	6.5

[a] By binomial formula.

[b] By random sampling formula.

[c] International 1/4-inch rule.

the chances are two out of three that, if the results of a 100-percent census were known, the sample results would be within the limits indicated.

Estimates smaller than State totals will have proportionally larger sampling errors. The smaller the area examined, the larger the sampling error. In addition, as area or volume totals are stratified by forest type, species, diameter class, ownership, or other subunits, the sampling error increases and is greatest for the smallest divisions. The magnitude of this increase is depicted in appendix table 2, which shows the sampling error to which the estimates are liable, two chances out of three.

Appendix table 2—Sampling error approximations to which estimates are liable at one standard error, Arkansas, 1995[a]

		Live trees				Sawtimber			
Sampling error	Timberland area	Volume	Average net annual growth	Average annual removals	Average annual mortality	Volume	Average net annual growth	Average annual removals	Average annual mortality
Percent	*Thousand acres*	*Million cubic feet*				*Million board feet*[b]			
1.0	1,655.30								
2.0	413.8	10,048.70	859			69,457.00			
3.0	183.9	4,466.10	381.8			30,869.80	2,586.80		
4.0	103.5	2,512.20	214.8	636.3	167.7	17,364.30	1,455.10		
5.0	66.2	1,607.80	137.4	407.3	107.3	11,113.10	931.3	2,129.30	
10.0	16.6	401.9	34.4	101.8	26.8	2,778.30	232.8	532.3	215.5
15.0	7.4	178.6	15.3	45.3	11.9	1,234.80	103.5	236.6	95.8
20.0	4.1	100.5	8.6	25.5	6.7	694.6	58.2	133.1	53.9
25.0	2.7	64.3	5.5	16.3	4.3	444.5	37.3	85.2	34.5

[a] Components for given sampling error derived by ratio approximation.

[b] International 1/4-inch rule.

Definitions

Average annual mortality. Average annual sound-wood volume of growing-stock or live trees that died from natural causes during the intersurvey period.

Average annual removals. Average net annual volume of growing-stock or live trees removed from the inventory by harvesting, cultural operations (such as timber stand improvement), land clearing, or changes in land use during the intersurvey period.

Average net annual growth. Average net annual volume increase of growing-stock or live trees during the intersurvey period.

Basal area. The area in square feet of the cross section at breast height of a single tree or of all the trees in a stand, usually expressed in square feet per acre.

Classes of trees used in growth computations

Ingrowth trees. Submerchantable-and-in at time 1 (previous inventory) and merchantable-and-in at time 2 (current inventory).

Mortality trees. Merchantable-and-in at time 1 and dead prior to time 2.

Nongrowth trees. Merchantable-and-out at time 1 and merchantable-and-in at time 2; included with survivor growth for growth computation.

Ongrowth trees. Submerchantable-and-out at time 1 and merchantable-and-in at time 2; included with ingrowth component for growth computation.

Removal trees. Merchantable-and-in at time 1 and removed prior to time 2.

Survivor trees. Merchantable-and-in at time 1 and time 2.

Commercial species. Tree species currently or potentially suitable for industrial wood products.

Cull increment. The change in growing-stock volume due to growing-stock, rough, or rotten trees changing tree class between surveys.

Cull trees. Rough or rotten trees.

D.b.h. (diameter at breast height). Tree diameter in inches, outside bark, at 4.5 feet above the ground (breast height).

Diameter class. A classification of trees based on tree d.b.h. Two-inch diameter classes are commonly used by Forest Inventory and Analysis, with the even inch as the approximate midpoint for a class. For example, the 6-inch class includes trees 5.0-6.9 inches in d.b.h.

D.o.b. (diameter outside bark). Stem diameter including bark.

Forest industry land. Land owned by companies or individuals operating wood-using plants (either primary or secondary).

Forest land. Land at least 10 percent stocked (10 percent canopy stocking is equivalent to 16.7 percent sample plot stocking) by forest trees of any size, or formerly having such tree cover, and not currently developed for nonforest uses. Minimum area considered for classification is 1 acre. Forest land is divided into timberland, reserved timberland, and woodland.

Forest-type group. A grouping of several detailed forest types. The grouping is based upon forest types with similar physiographic and physiognomic characteristics.

Elm-ash-cottonwood. Forests in which elms, ashes, or cottonwoods, singly or in combination, comprise a plurality of the stocking. Common associates include willow, sycamore, American beech, and maples.

Loblolly-shortleaf pine. Forests in which pines (except longleaf and slash pines) and eastern redcedar, singly or in combination, comprise a plurality of the stocking. Common associates include oaks, hickories, and gums.

Oak-gum-cypress. Bottomland forests in which tupelo, blackgum, sweetgum, oaks, or baldcypress, singly or in combination, comprise a plurality of the stocking, except where pines comprise 25 percent or more but less than 50 percent, in which case the stand would be classified oak-pine. Common associates include cottonwoods, willow, ashes, elms, hackberries, and maples.

Oak-hickory. Forests in which upland oaks or hickories, singly or in combination, comprise a plurality of the stocking, except where pines comprise 25 percent or greater but less than 50 percent, in which case the stand would be classified oak-pine. Common associates include yellow-poplar, elms, maples, and black walnut.

Oak-pine. Forests in which hardwoods (usually upland oaks) comprise a plurality of the stocking, but in which softwoods, except baldcypress, comprise 25 percent or greater but less than 50 percent of the stocking. Common associates include gums, hickories, and yellow-poplar.

Gross growth. Total annual increase in stand volume computed on growing-stock trees or live trees 5.0 inches or greater in d.b.h. Gross growth equals survivor growth, plus ingrowth, plus nongrowth, plus ongrowth, plus growth on removals, plus growth on mortality, plus cull increment (cull increment used only for growing-stock computations).

Growing-stock trees. Living trees of commercial species classified as sawtimber, poletimber, saplings, and seedlings. Trees must contain at least one 12-foot or two 8-foot logs in the saw-log portion, currently or potentially (if too small to qualify), to be classed as growing stock. The log(s) must meet dimension and merchantability standards to qualify. Trees must also have, currently or potentially, one-third of the gross board-foot volume in sound wood.

Hardwoods. Dicotyledonous trees, usually broad-leaved and deciduous.

Live trees. All living trees. Included are all size classes, all tree classes, and both commercial and noncommercial species.

Log grades. A classification of logs based on external characteristics as indicators of quality or value.

Mortality. Number or sound-wood volume of growing-stock or live trees that died from natural causes during a specified period.

National forest land. Federal land that has been legally designated as national forest or purchase units and other land under the administration of the U.S. Department of Agriculture, Forest Service, including experimental areas.

Natural stands. Stands with no evidence of artificial regeneration, including those stands established by seed-tree regeneration methods.

Net change. Increase or decrease in stand volume computed on growing-stock trees or live trees 5.0 or more inches in d.b.h. Net change is equal to net growth minus removals.

Net growth. Increase in stand volume computed on growing-stock trees or live trees 5.0 inches or more in d.b.h. Net growth is equal to gross growth minus mortality.

NIPF. Abbreviation for nonindustrial private forest land, including corporate and individual ownerships.

Noncommercial species. Tree species of typically small size, poor form, or inferior quality that normally do not develop into trees suitable for industrial wood products.

Nonindustrial private forest land (corporate). Land privately owned by corporations other than forest industries and incorporated farms.

Nonindustrial private forest land (individual). Land privately owned by individuals other than forest indu**stries or farmers.**

Nonstocked stands. Stands less than 10 percent (canopy) or 16.7 percent (sample plot) stocked with live trees (see Stocking definition).

Nontyped. Timberland currently with no trees or occupied by live trees or seedlings where plot stocking is less than 16.7 percent.

Other Federal land. Federal land other than national forests.

Other public land. All Federal land, other than national forest land, and all State, county, and municipal lands.

Plantations. Forest stands that currently show evidence of being planted or artificially seeded. In this bulletin, stands that were classified as plantations in the previous survey and which had no commercial harvesting activity between survey periods were left classified as plantations. This definition is slightly different from that used in the usual representation of Forest Inventory and Analysis data. In that

situation, the field person decides if a plantation is still present (based upon visible evidence).

Poletimber-size trees. Softwoods 5.0 inches or larger but less than 9.0 inches in d.b.h., and hardwoods 5.0 inches or larger but less than 11.0 inches in d.b.h.

Poletimber stands. Stands at least 10 percent (canopy) stocked with live trees, with half or more of this stocking in sawtimber or poletimber trees, with poletimber stocking exceeding that of sawtimber stocking (see Stocking definition).

Productive-reserved forest land. (see: Reserved timberland).

Removals. The net volume of growing-stock or live trees removed from the inventory by harvesting, cultural operations (such as timber stand improvement), land clearing, or changes in land use.

Reserved timberland. Public timberland withdrawn from timber utilization through statute or administrative designation.

Rotten trees. Live trees of commercial species that do not contain at least one 12-foot saw log, or two noncontiguous saw logs, each 8 feet or longer, now or prospectively, primarily because less than one-third of the gross board-foot tree volume is in sound material (see Growing-stock trees).

Rough trees. Live trees of commercial species that are unmerchantable for saw logs, currently or potentially, because of roughness or poor form in the saw-log section. Also included are all live trees of noncommercial species (see Growing-stock trees).

Salvable dead trees. Standing or downed dead trees that were formerly growing stock and are considered merchantable. Trees must be 5.0 inches in d.b.h. or larger to qualify. If sawtimber size, a tree must have one 12-foot or two 8-foot logs meeting minimum log-grade standards and one-third of gross board-foot-volume sound for softwoods and at least one-half sound for hardwoods. If poletimber size, a tree must have at least one-half of its volume sound.

Sapling-seedling stands. Stands at least 10 percent (canopy) stocked with live trees, with more than half of this stocking in saplings or seedlings (see Stocking definition).

Sapling-size trees. Trees 1.0 inch or larger but less than 5.0 inches in d.b.h.

Saw-log portion. That portion of the bole of a sawtimber tree between a 1-foot stump and the saw-log top.

Saw-log top. The point on the bole of a sawtimber tree above which a saw log cannot be produced. The minimum saw-log top is 7.0 inches d.o.b. for softwoods and 9.0 inches d.o.b. for hardwoods.

Sawtimber-size trees. Softwoods 9.0 inches or larger in d.b.h. and hardwoods 11.0 inches or larger in d.b.h.

Sawtimber stands. Stands at least 10 percent (canopy) stocked with live trees, with half or more of this stocking in sawtimber or poletimber trees, and with sawtimber stocking at least equal to poletimber stocking.

Seedling-size trees. Trees less than 1.0 inch in d.b.h. and taller than 1 foot for hardwoods, taller than 6 inches for softwoods, and less than 0.5 inch in diameter at ground level for longleaf pine.

Select red oaks. A group of several red oak species that includes cherrybark, Shumard, and northern red oaks. Other red oak species are included in the "other red oaks" group.

Select white oaks. A group of several white oak species that includes white, swamp chestnut, swamp white, chinkapin, Durand, and bur oaks. Other white oak species are included in the "other white oaks" group.

Site class. A classification of forest land in terms of potential capacity to grow crops of industrial wood.

Softwoods. Coniferous trees, usually evergreen, having leaves that are needles or scalelike.

State, county, and municipal land. Land owned by States, counties, and local public agencies or municipalities, or land leased to these governmental units for 50 years or more.

Stocking. Stocking is a measure of the extent to which growth potential of the site is used by trees or preempted by vegetative cover. Stocking is determined by comparing the stand density in terms of number of trees or basal area with

a specified standard. Therefore, full stocking is 100 percent of the stocking standard. Note that 10 percent canopy stocking is approximately equal to 16.7 percent sample-plot stocking.

The following tabulation shows the stocking density standard in terms of trees per acre by size class required for full stocking.

D.b.h. class	Trees per acre
Inches	
Seedlings	600
2	560
4	460
6	340
8	240
10	155
12	115
14	90
16	72
18	60
20	51
22	42
24	36
26	31
28	27
30	24

Stocking categories are arbitrarily defined as follows:

Optimally stocked. Stands 61 to 100 percent stocked with growing-stock trees. Such stands are growing toward a fully stocked condition (the ideal space required for each tree increases with age). Optimum growth and bole form occur in this range.

Overstocked. Stands greater than 100 percent stocked with growing-stock trees. These stands become stagnant and mortality of individuals increases as stocking levels rise above 100 percent.

Understocked. Stands 0 to 60 percent stocked with growing-stock trees. Such stands will take a very long time to reach full stocking. Meanwhile, poor bole form will result, and much of the productive growth will occur on heavy limbs instead of on the bole.

Timberland. Forest land that is producing, or is capable of producing 20 cubic feet of industrial wood per acre per year and is not withdrawn from timber utilization. Timberland is synonymous with "commercial forest land" in prior reports.

Tree grade. A classification of the saw-log portion of sawtimber trees based on: (1) the grade of the butt log or (2) the ability to produce at least one 12-foot or two 8-foot logs in the upper section of the saw-log portion.

Upper-stem portion. That part of the main stem of a sawtimber tree above the saw-log top to a d.o.b. of 4.0 inches or to the point where the main stem breaks into limbs.

Volume of cull. The cubic-foot volume of sound wood in rough-and-rotten trees at least 5.0 inches in d.b.h. from a 1-foot stump to a minimum 4.0-inch top d.o.b. of the central stem or to the point where the central stem breaks into limbs.

Volume of growing stock. The cubic-foot volume of sound wood in growing-stock trees 5.0 inches or greater in d.b.h., from a 1-foot stump to a minimum 4.0-inch top d.o.b. of the central stem or to the point where the central stem breaks into limbs.

Volume of live trees. The cubic-foot volume of sound wood in growing-stock, rough, and rotten trees 5.0 inches or greater in d.b.h. from a 1-foot stump to a minimum 4.0-inch top d.o.b. of the central stem or to the point where the central stem breaks into limbs.

Volume of saw-log portion. The cubic-foot volume of sound wood in the saw-log portion of sawtimber trees. Volume is the net result after deductions for rot, sweep, and other defects that affect use for lumber.

Volume of sawtimber. The board-foot volume (International 1/4-inch rule) of sound wood in the saw-log portion of sawtimber trees. Volume is the net result after deductions for rot, sweep, and other defects that affect use for lumber.

Volume of timber. The cubic-foot volume of sound wood in growing-stock, rough, rotten, and salvable dead trees 5.0 inches or greater in d.b.h. from a 1-foot stump to a minimum 4.0-inch top d.o.b. of the central stem or to the point where the central stem breaks into limbs.

Woodland. Forest land incapable of producing 20 cubic feet of industrial wood per acre per year.

Conversion Factors

Metric equivalents of units used in this report
1 acre = 4,046.86 square meters or 0.404686 hectare
1 cubic foot = 0.028317 cubic meter
1 inch = 2.54 centimeters or 0.0254 meter
Breast height = 1.4 meters above the ground
1 square foot = 929.03 square centimeters or 0.0929 square
1 square foot per acre basal area = 0.229568 square meter per hectare
1 pound = 0.454 kilogram
1 ton = 0.907 metric ton

Species List[a]

Commercial Species

Scientific Name[b]	Common name
Softwoods	
Juniperus virginiana	Eastern redcedar
Pinus echinata	Shortleaf pine
P. taeda	Loblolly pine
Taxodium distichum	Baldcypress
Hardwoods	
Acer barbatum	Florida maple
A. negundo	Boxelder
A. rubrum	Red maple
A. saccharinum	Silver maple
A. saccharum	Sugar maple
Aesculus glabra	Ohio buckeye
Betula nigra	River birch
Carya aquatica	Water hickory
C. cordiformis	Bitternut hickory
C. glabra	Pignut hickory
C. illinoensis	Pecan
C. laciniosa	Shellbark hickory
C. myristiciformis	Nutmeg hickory
C. ovata	Shagbark hickory
C. texana	Black hickory
C. tomentosa	Mockernut hickory
Castanea pumila	Allegheny chinkapin
Celtis laevigata	Sugarberry
C. occidentalis	Hackberry
Cornus florida	Flowering dogwood
Diospyros virginiana	Common persimmon
Fagus grandifolia	American beech
Fraxinus americana	White ash
F. pennsylvanica	Green ash
F. profunda	Pumpkin ash
F. quadrangulata	Blue ash
Gleditsia aquatica	Waterlocust
G. triacanthos	Honeylocust
Gymnocladus dioicus	Kentucky coffeetree
Ilex opaca	American holly
Juglans cinerea	Butternut
Juglans nigra	Black walnut
Liquidambar styraciflua	Sweetgum
Liriodendron tulipifera	Yellow-poplar
Maclura pomifera	Osage-orange
Magnolia acuminata	Cucumbertree
M. virginiana	Sweetbay
Morus rubra	Red mulberry
Nyssa aquatica	Water tupelo
N. sylvatica	Blackgum
N. sylvatica var. *biflora*	Swamp tupelo
Persea borbonia	Redbay
Platanus occidentalis	American sycamore
Populus deltoides	Eastern cottonwood
Prunus serotina	Black cherry
Quercus alba	White oak
Q. durandii	Durand oak
Q. falcata	Southern red oak
Q. falcata var. *pagodifolia*	Cherrybark oak
Q. imbricaria	Shingle oak
Q. laurifolia	Laurel oak
Q. lyrata	Overcup oak
Q. macrocarpa	Bur oak
Q. michauxii	Swamp chestnut oak
Q. muehlenbergii	Chinkapin oak
Q. nigra	Water oak
Q. nuttallii	Nuttall oak
Q. palustris	Pin oak
Q. phellos	Willow oak
Q. rubra	Northern red oak
Q. shumardii	Shumard oak
Q. stellata	Post oak
Q. stellata var. *paludosa*	Delta post oak
Q. velutina	Black oak
Robinia pseudoacacia	Black locust
Salix spp.	Willow
Sassafras albidum	Sassafras
Tilia americana	American basswood
T. heterophylla	White basswood
Ulmus alata	Winged elm
U. americana	American elm
U. crassifolia	Cedar elm
U. rubra	Slippery elm
U. serotina	September elm
U. thomasii	Rock elm

Commercial Species

Scientific Name[b]	Common name
Hardwoods (continued)	

Noncommercial Species

Aesculus spp.	Other buckeyes
Ailanthus altissima	Tree-of-heaven
Aleurites fordii	Tung-oil-tree
Amelanchier spp.	Serviceberry
Bumelia spp.	Chittamwood
Carpinus caroliniana	American hornbeam
Castanea spp.	Chinkapin
Cercis canadensis	Eastern redbud
Cotinus obovatus	American smoketree
Crataegus spp.	Hawthorn
Magnolia macrophylla	Bigleaf magnolia
Malus spp.	Apple
Melia azedarach	Chinaberry
Morus alba	White mulberry
Ostrya virginiana	Eastern hophornbeam
Oxydendrum arboreum	Sourwood
Paulownia tomentosa	Royal paulownia
Planera aquatica	Water-elm
Prunus spp.	Plums, cherries, (other than black cherry)
Quercus marilandica	Blackjack oak
Vaccinium arboreum	Sparkleberry

[a] Scientific and common names of tree species ≥1.0 inch in d.b.h. occurring in the FIA sample, Arkansas, 1995.
[b] Nomenclature (Little 1979).

Index of Detailed Tables

Table 1—Area by land class, Arkansas, 1995

Land class	Area
	Thousand acres
Forest land	
Timberland	18,392.3
Reserved timberland	231.1
Woodland	166.7
Total	18,790.0
Nonforest land	
Cropland[a]	9,950.4
Other	4,587.8
Total	14,538.2
All classes[b]	33,328.2

Numbers in column may not sum to total due to rounding.

[a] U.S. Department of Commerce, Bureau of the Census, 1987.

[b] U.S. Department of Commerce, Bureau of the Census, 1990.

Table 2—Area of timberland by ownership class, Arkansas, 1995

Ownership class	Area
	Thousand acres
Public	
National forest	2,371.9
Other Federal	462.6
State	393.8
County	67.4
Total	3,295.7
Private	
Forest industry	4,497.4
Miscellaneous private	
Individual	9,522.2
Corporate	1,076.9
Total	15,096.5
All classes	18,392.3

Numbers in column may not sum to totals due to rounding.

Table 3—Area of timberland by stand-size and ownership classes, Arkansas, 1995

		Ownership class			
Stand-size class	All classes	National forest	Other public	Forest industry	Nonindustrial private
		Thousand acres			
Sawtimber	8,538.7	1,453.0	626.4	2,089.0	4,370.3
Poletimber stands	5,451.9	679.6	160.4	1,164.3	3,447.7
Sapling-seedling	4,369.6	239.3	137.0	1,236.8	2,756.5
Nonstocked	32.1	0.0	0.0	7.3	24.8
All classes	18,392.3	2,371.9	923.9	4,497.4	10,599.1

Numbers in rows and columns may not sum to totals due to rounding.

Table 4—Area of timberland by stand-volume and ownership classes, Arkansas, 1995

Stand-volume class	All classes	Ownership class			
		National forest	Other public	Forest industry	Nonindustrial private
Board feet[a] */acre*		*Thousand acres*			
Less than 1,500	6,685.6	409.0	211.5	1,549.3	4,515.9
1,500–5,000	5,633.3	764.6	221.5	1,287.5	3,359.7
5,000 or more	6,073.3	1,198.3	490.9	1,660.6	2,723.6
All classes	18,392.2	2,371.9	923.9	4,497.4	10,599.1

Numbers in rows and columns may not sum to totals due to rounding.

[a] International 1/4-inch rule.

Table 5—Area of timberland by percent growing-stock trees and cull trees, Arkansas, 1995

Growing-stock trees	Cull trees (*percent stocking*)							
	Total	0–10	10–20	20–30	30–40	40–50	50–60	60+
Percent stocking				*Thousand acres*				
0–10	111.3	26.3	6.6	12.4	17.6	13.2	5.4	29.9
10–20	128.4	11.6	0.0	10.7	6.9	22.0	19.7	57.6
20–30	317.4	5.8	27.4	10.6	31.7	53.0	72.3	116.6
30–40	608.4	40.6	23.8	62.1	79.6	92.5	107.1	202.7
40–50	1,046.7	33.2	38.5	112.6	213.6	230.0	209.3	209.4
50–60	1,580.3	49.0	168.9	302.6	322.9	397.4	198.6	141.0
60–70	2,313.9	219.3	354.2	527.0	547.6	438.9	153.3	73.8
70–80	2,733.8	301.3	684.1	736.5	609.5	295.7	68.1	38.5
80–90	2,705.2	369.0	751.9	897.6	527.0	119.8	28.5	11.4
90–100	2,464.2	483.8	958.1	725.5	235.8	55.7	5.3	0.0
100–110	1,829.2	590.0	778.0	343.6	100.5	11.9	5.1	0.0
110–120	1,283.3	535.4	541.1	182.6	18.3	5.9	0.0	0.0
120–130	642.1	418.7	184.3	27.6	11.5	0.0	0.0	0.0
130–140	400.8	261.2	120.8	18.8	0.0	0.0	0.0	0.0
140–150	151.2	125.9	25.2	0.0	0.0	0.0	0.0	0.0
150–160	70.3	70.3	0.0	0.0	0.0	0.0	0.0	0.0
>160	5.6	5.6	0.0	0.0	0.0	0.0	0.0	0.0
Total	18,392.3	3,547.2	4,662.8	3,970.1	2,722.6	1,736.1	872.6	880.9

Numbers in rows and columns may not sum to totals due to rounding.

Table 6—Average basal area of live trees on timberland by ownership and tree classes, species, and tree-size class, Arkansas, 1995

Ownership and tree class	All species	Softwood			Hardwood		
		Sapling-seedling	Poletimber	Sawtimber	Sapling-seedling	Poletimber	Sawtimber
	Square feet per acre						
National forest							
Growing stock	81.2	2.9	8.4	23.5	4.9	19.8	21.6
Rough and rotten	20.1	1.0	0.8	0.2	8.4	4.5	5.3
Total	101.3	3.9	9.2	23.7	13.3	24.3	26.9
Other public							
Growing stock	75.4	0.9	2.1	9.7	4.0	18.1	40.6
Rough and rotten	21.7	0.3	0.1	0.6	6.7	6.2	7.8
Total	97.1	1.3	2.2	10.3	10.7	24.3	48.4
Forest industry							
Growing stock	68.4	5.9	16.3	22.0	4.4	8.3	11.4
Rough and rotten	14.0	0.9	0.7	0.4	6.8	3.1	2.1
Total	82.4	6.8	17.0	22.4	11.2	11.4	13.6
Nonindustrial private							
Growing stock	59.5	2.5	5.0	10.1	5.3	17.6	19.1
Rough and rotten	20.9	0.7	0.5	0.5	8.0	5.2	6.1
Total	80.4	3.2	5.4	10.6	13.3	22.9	25.3
All classes							
Growing stock	65.3	3.3	8.0	14.7	5.0	15.7	18.6
Rough and rotten	19.3	0.8	0.5	0.4	7.7	4.7	5.1
Total	84.6	4.1	8.6	15.2	12.7	20.3	23.8

Numbers in rows and columns may not sum to totals due to rounding.

Table 7—Area of timberland by site and ownership classes, Arkansas, 1995

Site class	All classes	Ownership class			
		National forest	Other public	Forest industry	Nonindustrial private
Ft^3/acre/year		*Thousand acres*			
≥165	873.3	0.0	102.0	322.1	449.3
120 to 164	2,578.3	61.0	129.0	997.1	1,391.2
85 to 119	5,061.9	373.8	325.9	1,842.9	2,519.2
50 to 84	7,122.8	1,528.4	263.4	1,212.1	4,118.9
<49	2,755.9	408.6	103.6	123.1	2,120.5
All classes	18,392.3	2,371.9	923.9	4,497.4	10,599.1

Numbers in rows and columns may not sum to totals due to rounding.

Table 8—Area of timberland by forest-type group and ownership classes, Arkansas, 1995

Forest-type group	All classes	Ownership class			
		National forest	Other public	Forest industry	Nonindustrial private
		Thousand acres			
Loblolly-shortleaf pine	5,077.1	831.8	88.0	2,450.4	1,706.9
Oak-pine	3,137.3	453.6	92.6	736.0	1,855.1
Oak-hickory	7,127.4	1,074.6	201.5	568.4	5,283.0
Oak-gum-cypress	2,791.4	11.9	499.5	694.0	1,586.1
Elm-ash-cottonwood	227.0	0.0	42.3	41.3	143.4
Nontyped	32.1	0.0	0.0	7.3	24.8
All groups	18,392.3	2,371.9	923.9	4,497.4	10,599.1

Numbers in rows and columns may not sum to totals due to rounding.

Table 9—Area of noncommercial forest land by forest-type group, Arkansas, 1995

Forest-type group	All areas	Noncommercial forest land	
		Productive-reserved areas	Unproductive areas
		Thousand acres	
Loblolly-shortleaf pine	93.7	36.5	57.2
Oak-pine	69.0	36.9	32.2
Oak-hickory	231.5	154.3	77.2
Bottomland hardwood	3.5	3.5	0.0
All groups	397.8	231.1	166.6

Numbers in rows and columns may not sum to totals due to rounding.

Table 10—Number of growing-stock trees on timberland by species and diameter class, Arkansas, 1995

Species	All classes	Diameter class (*inches at breast height*) 5.0–6.9	7.0–8.9	9.0–10.9	11.0–12.9	13.0–14.9	15.0–16.9	17.0–18.9	19.0–20.9	21.0–28.9	29.0 and larger
					Thousand trees						
Softwood											
Shortleaf pine	292,324	85,770	72,193	53,438	38,278	24,183	11,198	4,641	1,851	772	0
Loblolly pine	533,415	230,456	147,396	64,519	37,710	22,569	14,699	7,568	4,743	3,627	129
Redcedar	54,127	28,458	16,717	5,281	2,082	1,146	285	100	43	16	0
Cypress	10,053	1,943	2,233	1,075	949	1,143	790	639	375	658	248
Total softwoods	889,919	346,626	238,538	124,312	79,019	49,042	26,972	12,948	7,012	5,072	378
Hardwood											
Select white oaks[a]	219,122	81,156	56,057	37,240	18,530	11,654	6,511	3,762	2,070	2,039	104
Select red oaks[b]	75,382	18,626	16,865	13,991	9,127	6,428	3,580	2,456	1,907	2,121	282
Other white oaks	150,807	55,259	39,833	25,346	12,186	7,773	4,319	2,253	1,641	1,953	243
Other red oaks	193,883	55,990	40,645	34,831	21,296	15,357	9,754	6,376	4,222	4,791	622
Sweet pecan	2,540	511	728	410	191	338	149	46	45	108	12
Water hickory	7,347	1,144	1,769	1,398	1,006	750	390	332	139	351	68
Other hickories	164,012	78,174	42,350	21,733	11,415	5,517	2,575	1,158	601	467	21
Persimmon	8,669	5,096	1,951	1,115	373	98	36	0	0	0	0
Hard maples	8,770	4,038	2,213	1,344	583	207	192	107	59	29	0
Soft maples	22,508	12,675	5,558	2,158	913	510	309	178	82	117	7
Boxelder	3,757	1,386	876	778	275	171	96	97	19	59	0
Beech	3,466	1,403	202	335	475	244	76	207	224	259	40
Sweetgum	141,718	56,869	34,791	20,910	11,922	7,747	4,639	2,370	1,292	1,109	68
Blackgum	40,619	18,340	8,381	5,042	3,664	1,952	1,549	895	323	440	33
Other gums/tupelos	9,766	2,273	3,155	1,656	840	624	423	371	189	208	28
White ash	11,511	5,479	2,088	1,618	1,028	551	376	172	102	74	23
Other ashes	22,444	7,767	5,532	3,672	1,690	1,507	907	548	338	463	20
Sycamore	5,638	1,886	925	790	546	568	317	204	110	277	15
Cottonwood	2,430	424	248	89	88	69	206	243	305	567	189
Basswoods	1,608	776	132	197	242	132	65	25	9	30	0
Yellow-poplar	271	44	31	0	35	4	40	50	29	31	7
Magnolias	352	150	65	0	57	25	19	0	31	4	0
Sweetbay	1,596	587	335	232	218	128	30	38	11	17	0
Willow	8,572	2,525	1,443	1,093	901	572	438	441	418	657	85
Black walnut	3,294	667	1,088	733	386	195	101	59	52	13	0
Black cherry	8,576	4,138	2,240	1,281	351	232	154	71	58	50	0
American elm	14,036	5,714	3,165	2,479	1,107	715	507	127	93	125	5
Other elms	40,800	24,227	9,106	4,053	1,730	711	488	227	140	118	0
River birch	1,852	272	596	200	308	160	177	63	21	49	5
Hackberries	19,274	5,728	3,588	3,563	1,999	1,761	850	916	481	373	15
Black locust	1,468	638	398	138	198	30	54	13	0	0	0
Other locusts	3,173	842	1,096	386	387	184	124	91	19	38	7
Sassafras	1,849	1,117	360	175	120	20	28	3	27	0	0
Dogwood	1,701	1,701	0	0	0	0	0	0	0	0	0
Holly	4,285	3,002	647	404	114	64	29	24	0	0	0
Other commercial	1,904	1,273	363	170	52	0	38	0	0	8	0
Total hardwoods	1,209,000	461,900	288,820	189,559	104,353	66,999	39,545	23,922	15,057	16,946	1,899
All species	2,098,919	808,526	527,358	313,871	183,372	116,041	66,516	36,870	22,069	22,018	2,277

Numbers in rows and columns may not sum to totals due to rounding.

[a] Includes white, swamp chestnut, swamp white, chinkapin, and bur oaks.

[b] Includes cherrybark, northern red, and Shumard oaks.

Table 11—Volume of timber on timberland by class of timber and by softwoods and hardwoods, Arkansas, 1995

Class of timber	All species	Softwood	Hardwood
	Million cubic feet		
Sawtimber trees			
Saw-log portion	12,647.0	6,367.4	6,279.6
Upper-stem portion	2,502.9	953.5	1,549.4
Total	15,149.9	7,320.9	7,829.0
Poletimber trees	6,537.0	2,021.1	4,515.9
All growing stock	21,686.9	9,342.0	12,344.9
Rough trees	1,901.3	193.3	1,708.0
Rotten trees	195.7	6.5	189.2
Salvable dead trees	208.8	88.7	120.1
All classes	23,992.7	9,630.6	14,362.1

Numbers in rows and columns may not sum to totals due to rounding.

Table 12—Volume of growing stock and sawtimber on timberland by ownership class and by softwoods and hardwoods, Arkansas, 1995

	Growing stock			Sawtimber		
Ownership class	All species	Softwood	Hardwood	All species	Softwood	Hardwood
	Million cubic feet			*Million board feet*[a]		
National forest	3,837.1	1,895.2	1,941.9	14,078.3	8,444.5	5,633.8
Other public	1,439.6	284.0	1,155.6	5,687.1	1,436.3	4,250.8
Forest industry	5,394.4	3,471.6	1,922.8	20,240.2	13,624.5	6,615.7
Nonindustrial private	11,015.7	3,691.2	7,324.4	36,955.1	15,978.6	20,976.5
All classes	21,686.9	9,342.0	12,344.9	76,960.7	39,483.9	37,476.8

Numbers in rows and columns may not sum to totals due to rounding.

[a] International 1/4-inch rule

Table 13—Volume of growing stock on timberland by species and diameter class, Arkansas, 1995

Species	All classes	Diameter class (*inches at breast height*) 5.0–6.9	7.0–8.9	9.0–10.9	11.0–12.9	13.0–14.9	15.0–16.9	17.0–18.9	19.0–20.9	21.0–28.9	29.0 and larger
					Million cubic feet						
Softwood											
Shortleaf pine	3,840.6	217.0	477.7	698.3	791.9	734.8	467.1	256.6	128.4	68.6	0.0
Loblolly pine	5,024.8	463.3	716.0	705.6	704.3	652.0	626.0	422.3	344.0	366.3	25.0
Redcedar	229.5	58.1	73.4	43.4	24.7	18.7	6.2	2.7	1.6	0.7	0.0
Cypress	247.2	4.2	11.4	11.9	14.9	28.6	25.5	29.2	21.1	50.3	50.1
Total softwoods	9,342.0	742.6	1,278.5	1,459.2	1,535.9	1,434.0	1,124.9	710.8	495.1	485.9	75.1
Hardwood											
Select white oaks[a]	2,154.5	211.0	333.2	400.2	321.1	278.3	203.8	152.9	103.9	139.9	10.1
Select red oaks[b]	1,105.9	48.4	95.5	141.2	147.1	153.2	114.7	102.1	100.5	165.1	38.0
Other white oaks	1,280.8	123.0	192.3	224.2	165.5	151.6	113.5	76.2	74.2	129.2	31.1
Other red oaks	2,628.0	130.4	218.3	343.7	348.8	359.0	309.6	265.0	216.2	358.6	78.5
Sweet pecan	45.7	1.0	4.6	5.0	3.6	9.3	5.4	2.3	2.6	9.4	2.5
Water hickory	135.9	2.0	10.9	13.2	16.7	18.3	12.9	14.4	7.3	28.0	12.3
Other hickories	1,071.7	156.2	201.5	198.7	180.4	127.6	82.5	50.7	32.6	37.9	3.6
Persimmon	43.6	11.6	11.0	11.0	7.0	2.0	1.0	0.0	0.0	0.0	0.0
Hard maples	62.6	9.2	12.8	13.3	8.9	4.3	5.5	4.1	2.9	1.7	0.0
Soft maples	135.5	30.4	30.5	20.8	14.0	12.1	9.3	6.5	3.6	7.3	1.1
Boxelder	33.7	4.1	5.6	6.9	4.0	3.2	2.8	3.2	1.1	2.8	0.0
Beech	64.5	2.7	1.1	2.9	8.1	4.7	2.3	9.2	11.3	17.4	5.0
Sweetgum	1,510.4	128.2	202.1	241.5	235.1	219.9	178.9	122.4	81.9	92.1	8.4
Blackgum	353.0	39.3	41.1	47.3	56.4	40.7	45.1	35.1	15.4	28.3	4.1
Other gums/tupelos	111.4	5.7	17.2	15.8	12.6	13.3	11.8	13.4	7.9	11.6	2.2
White ash	94.7	12.4	10.5	15.0	14.6	11.4	11.4	6.4	5.5	4.9	2.6
Other ashes	252.0	17.7	33.4	39.7	28.8	34.3	26.3	23.1	16.7	30.2	1.7
Sycamore	98.4	5.0	6.0	9.3	11.0	14.3	11.2	8.5	6.5	23.8	2.8
Cottonwood	142.7	0.9	0.7	0.6	1.9	2.3	7.4	12.1	21.1	62.1	33.6
Basswoods	20.2	1.4	0.6	2.2	4.3	3.4	2.7	1.3	0.8	3.5	0.0
Yellow-poplar	11.4	0.1	0.1	0.0	0.7	0.1	1.7	2.4	1.8	3.1	1.3
Magnolias	5.6	0.3	0.4	0.0	1.1	0.6	0.8	0.0	1.9	0.3	0.0
Sweetbay	16.3	1.5	2.2	2.5	4.2	2.9	0.8	1.2	0.3	0.7	0.0
Willow	170.9	5.2	10.3	11.3	15.8	14.4	12.5	18.0	23.2	51.2	9.0
Black walnut	30.6	1.7	5.2	6.7	5.4	4.4	3.1	1.9	1.9	0.4	0.0
Black cherry	59.2	10.6	12.7	12.3	5.3	4.7	5.1	2.8	2.3	3.3	0.0
American elm	119.3	12.9	16.1	24.3	17.9	15.1	15.1	5.4	3.8	8.1	0.6
Other elms	226.5	53.4	47.9	39.4	28.4	16.7	15.5	10.1	7.5	7.7	0.0
River birch	27.5	1.0	4.1	2.3	5.4	3.6	5.1	2.3	0.9	2.7	0.3
Hackberries	251.9	13.0	18.3	34.0	29.0	41.1	26.9	36.8	25.5	26.3	0.9
Black locust	10.3	1.8	2.4	1.0	2.8	0.6	1.3	0.4	0.0	0.0	0.0
Other locusts	33.0	1.8	6.5	3.6	5.6	4.2	3.5	3.6	0.9	2.3	1.1
Sassafras	10.3	2.5	2.2	1.7	1.6	0.4	0.7	0.1	1.1	0.0	0.0
Dogwood	2.9	2.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Holly	16.9	6.1	3.1	3.4	1.5	1.4	0.5	0.9	0.0	0.0	0.0
Other commercial	7.1	2.4	1.6	1.0	0.8	0.0	1.0	0.0	0.0	0.2	0.0
Total hardwoods	12,344.9	1,058.0	1,561.9	1,895.9	1,715.3	1,573.3	1,251.5	994.9	783.0	1,260.1	250.9
All species	21,686.9	1,800.7	2,840.4	3,355.2	3,251.1	3,007.3	2,376.4	1,705.6	1,278.1	1,746.0	326.0

Numbers in rows and columns may not sum to totals due to rounding.

[a] Includes white, swamp chestnut, swamp white, chinkapin, and bur oaks.

[b] Includes cherrybark, northern red, and Shumard oaks.

Table 14—Volume of sawtimber on timberland by species and diameter class, Arkansas, 1995

Species	All classes	Diameter class (*inches at breast height*) 9.0–11.0	11.0–12.9	13.0–14.9	15.0–16.9	17.0–18.9	19.0–20.9	21.0–28.9	29.0 and larger
				Million board feet[a]					
Softwood									
Shortleaf pine	17,005.3	3,230.2	4,214.7	4,130.4	2,710.7	1,528.3	778.8	412.1	0.0
Loblolly pine	20,915.5	2,930.2	3,585.4	3,624.2	3,681.4	2,532.7	2,104.8	2,292.9	163.9
Redcedar	410.7	168.2	103.5	84.1	29.4	13.4	8.1	4.0	0.0
Cypress	1,152.4	41.9	60.3	134.0	126.1	148.6	110.9	265.1	265.5
Total softwoods	39,483.9	6,370.5	7,963.9	7,972.7	6,547.5	4,223.1	3,002.6	2,974.2	429.4
Hardwood									
Select white oaks[b]	5,699.6	0.0	1,323.4	1,296.9	989.4	774.0	542.6	720.2	53.0
Select red oaks[c]	4,044.5	0.0	601.5	725.1	567.1	527.0	536.3	885.6	201.9
Other white oaks	3,473.1	0.0	655.3	670.1	551.7	378.1	373.1	674.9	169.9
Other red oaks	9,228.5	0.0	1,364.7	1,650.7	1,510.5	1,328.3	1,111.9	1,859.6	402.7
Sweet pecan	184.3	0.0	15.3	45.5	29.3	12.3	14.2	53.2	14.6
Water hickory	558.1	0.0	64.3	90.9	67.6	72.9	39.3	153.6	69.6
Other hickories	2,427.4	0.0	742.2	601.7	414.1	263.5	175.8	208.9	21.1
Persimmon	43.3	0.0	29.3	9.1	4.9	0.0	0.0	0.0	0.0
Hard maples	127.8	0.0	36.8	19.5	28.0	19.6	15.1	8.8	0.0
Soft maples	240.0	0.0	51.4	51.9	45.8	30.3	16.7	37.9	6.0
Boxelder	75.1	0.0	15.0	12.4	14.5	14.3	5.2	13.7	0.0
Beech	277.3	0.0	32.7	20.6	10.2	45.4	56.7	88.0	23.7
Sweetgum	4,591.2	0.0	922.4	1,058.4	934.1	672.7	451.1	510.4	42.3
Blackgum	1,062.7	0.0	218.6	180.6	223.1	184.5	81.5	150.4	23.9
Other gums/tupelos	296.8	0.0	38.9	48.8	49.9	59.1	36.7	54.0	9.4
White ash	261.1	0.0	58.3	51.9	53.4	29.3	31.0	25.2	12.0
Other ashes	731.0	0.0	101.9	145.5	120.3	119.0	85.2	151.2	7.9
Sycamore	385.6	0.0	43.0	62.4	56.3	42.7	33.3	132.3	15.5
Cottonwood	801.4	0.0	8.2	13.2	37.4	66.8	122.9	367.7	185.1
Basswood	83.0	0.0	18.8	16.5	15.5	6.8	4.8	20.6	0.0
Yellow-poplar	64.5	0.0	3.1	0.6	9.4	13.9	9.7	19.2	8.6
Magnolia	24.7	0.0	4.9	2.7	4.3	0.0	10.8	1.9	0.0
Sweetbay	42.1	0.0	16.2	13.0	3.1	5.2	1.5	3.1	0.0
Willow	744.2	0.0	64.3	71.2	58.4	103.0	126.8	281.5	39.0
Black walnut	75.2	0.0	21.3	20.3	14.7	9.3	8.6	1.0	0.0
Black cherry	108.0	0.0	21.0	19.3	27.6	13.7	11.8	14.5	0.0
American elm	306.7	0.0	74.0	71.7	71.2	27.3	18.8	41.6	2.2
Other elms	389.5	0.0	114.6	75.5	71.5	52.1	38.3	37.6	0.0
River birch	94.9	0.0	21.9	17.7	24.6	12.2	4.1	12.7	1.6
Hackberries	876.1	0.0	109.3	188.3	127.5	178.8	131.1	138.0	3.1
Black locust	22.5	0.0	11.8	2.8	5.8	2.1	0.0	0.0	0.0
Other locusts	91.1	0.0	19.5	17.5	15.2	17.3	4.7	10.9	6.0
Sassafras	17.1	0.0	6.4	1.4	3.0	0.6	5.7	0.0	0.0
Holly	19.8	0.0	6.5	6.6	2.5	4.2	0.0	0.0	0.0
Other commercial	8.5	0.0	3.0	0.0	4.7	0.0	0.0	0.8	0.0
Total hardwoods	37,476.8	0.0	6,839.8	7,280.4	6,166.8	5,086.3	4,105.3	6,679.0	1,319.2
All species	76,960.7	6,370.5	14,803.7	15,253.1	12,714.3	9,309.3	7,107.9	9,653.2	1,748.6

Numbers in rows and columns may not sum to totals due to rounding.

[a] International 1/4-inch rule.

[b] Includes white, swamp chestnut, swamp white, chinkapin, and bur oaks.

[c] Includes cherrybark, northern red, and Shumard oaks.

Table 15—Volume of sawtimber on timberland by species and tree grade, Arkansas, 1995

Species	All grades	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5
			Million board feet[a]			
Softwood						
Yellow pines	37,920.8	13,196.1	8,344.3	16,174.4	0.0	205.9
Cypress	1,152.4	371.0	211.4	402.9	0.0	167.1
Redcedar	410.7	395.3	0.0	0.0	0.0	15.4
Total softwoods	39,483.9	13,962.5	8,555.7	16,577.3	0.0	388.4
Hardwood						
Select white and red oaks[b]	9,744.1	2,187.7	2,295.7	3,567.2	1,125.9	567.6
Other white and red oaks	12,701.6	2,234.7	2,821.9	4,398.2	2,373.8	872.9
Hickories	3,169.8	433.4	674.7	1,399.5	492.6	169.5
Hard maples	127.8	3.7	12.0	64.9	27.1	20.3
Sweetgum	4,591.2	979.8	1,452.9	1,566.0	310.6	282.0
Tupelo and blackgum	1,359.5	303.2	324.0	513.1	36.8	182.4
Ash, walnut, and black cherry	1,175.3	378.2	295.2	337.3	29.3	135.3
Yellow-poplar	64.5	19.4	27.8	8.1	3.2	6.0
Other hardwoods	4,542.9	1,062.9	906.9	1,479.1	635.2	458.8
Total hardwoods	37,476.8	7,602.9	8,811.0	13,333.5	5,034.5	2,694.9
All species	76,960.7	21,565.4	17,366.7	29,910.8	5,034.5	3,083.3

Numbers in rows and columns may not sum to totals due to rounding.

[a] International 1/4-inch rule.

[b] Includes white, swamp chestnut, swamp white, chinkapin, bur, cherrybark, northern red, and Shumard oaks.

Table 16—Average net annual growth and average annual removals of growing stock on timberland, by species, Arkansas, 1988 to 1995

Species	Average net annual growth	Average annual removals
	Million cubic feet	
Softwood		
Yellow pines	530.0	419.5
Other softwoods	16.1	5.7
Total softwoods	546.2	425.2
Hardwood		
Select white and red oaks[a]	112.6	53.3
Other white and red oaks	107.6	105.3
Hickories	26.8	21.8
Sweetgum	1.4	0.6
Tupelo and blackgum	43.4	54.8
Ash, walnut, and black cherry	14.9	10.2
Yellow-poplar	0.3	0.1
Other hardwoods	43.2	34.4
Total hardwoods	350.2	280.4
All species	896.4	705.6

Numbers in columns may not sum to totals due to rounding.

[a] Includes white, swamp chestnut, swamp white, chinkapin, bur, cherrybark, northern red, and Shumard oaks.

Table 17—Average net annual growth and average annual removals of growing stock on timberland by ownership class and by softwoods and hardwoods, Arkansas, 1988 to 1995

Ownership class	Average net annual growth			Average annual removals		
	All species	Softwood	Hardwood	All species	Softwood	Hardwood
	Million cubic feet					
National forest	94.8	48.9	94.9	36.1	29.2	6.9
Other public	40.6	12.9	40.6	15.5	6.1	9.4
Forest industry	327.9	279.4	328.0	283.4	206.1	77.3
Nonindustrial private	433.0	205.1	433.1	370.6	183.8	186.8
All classes	896.4	546.2	896.4	705.6	425.2	280.4

Numbers in rows and columns may not sum to totals due to rounding.

Table 18—Average net annual growth and average annual removals of sawtimber on timberland by species, Arkansas, 1988 to 1995

Species	Average net annual growth	Average annual removals
	Million board feet [a]	
Softwood		
Yellow pines	2,367.8	1,883.9
Other softwoods	51.3	14.9
Total softwoods	2,419.0	1,898.8
Hardwood		
Select white and red oaks[b]	411.7	200.8
Other white and red oaks	415.6	385.4
Hickories	80.2	71.9
Hard maples	3.5	1.6
Sweetgum	175.6	164.5
Ash, walnut, and black cherry	51.6	34.7
Yellow-poplar	2.5	0.6
Other hardwoods	165.3	120.8
Total hardwoods	1,306.0	980.2
All species	3,725.0	2,879.0

Numbers in columns may not sum to totals due to rounding.

[a] International 1/4-inch rule.

[b] Includes white, swamp chestnut, white swamp, chinkapin, bur, cherrybark, northern red, and Shumard oaks.

Table 19—Average net annual growth and average annual removals of sawtimber on timberland by ownership class and by softwoods and hardwoods, Arkansas, 1988 to 1995

Ownership class	Average net annual growth			Average annual removals		
	All species	Softwood	Hardwood	All species	Softwood	Hardwood
	Million board feet[a]					
National forest	403.9	249.7	154.2	154.9	136.7	18.2
Other public	193.6	75.0	118.5	65.2	28.6	36.6
Forest industry	1,284.0	1,069.8	214.2	1,174.1	912.0	262.1
Nonindustrial private	1,843.5	1,024.5	819.0	1,484.8	821.5	663.3
All classes	3,725.0	2,419.0	1,306.0	2,879.0	1,898.8	980.2

Numbers in rows and columns may not sum to totals due to rounding.

[a] International 1/4-inch rule.

Table 20—Average annual mortality of growing stock and sawtimber on timberland by species, Arkansas, 1988 to 1995

Species	Average annual mortality	
	Growing stock	Sawtimber
	Million cubic feet	*Million board feet*[a]
Softwood		
Yellow pines	44.0	165.1
Other softwoods	1.0	1.6
Total softwoods	45.0	166.7
Hardwood		
Select white and red oaks[b]	12.3	37.7
Other white and red oaks	31.2	95.2
Hickories	9.0	27.1
Hard maples	0.3	1.7
Sweetgum	13.5	47.0
Ash, walnut, and black cherry	3.7	9.3
Other hardwoods	25.6	81.4
Total hardwoods	95.7	299.4
All species	140.7	466.1

Numbers in columns may not sum to totals due to rounding.

[a] International 1/4-inch rule.

[b] Includes white, swamp chestnut, swamp white, chinkapin, bur, cherrybark, northern red, and Shumard oaks.

Table 21—Average annual mortality of growing stock and sawtimber on timberland by ownership class and by softwoods and hardwoods, Arkansas, 1988 to 1995

Ownership class	Average annual mortality					
	Growing stock			Sawtimber		
	All species	Softwood	Hardwood	All species	Softwood	Hardwood
	Million cubic feet			*Million board feet*[a]		
National forest	13.8	5.6	8.3	40.7	18.1	22.6
Other public	11.6	1.0	10.6	38.9	4.8	34.0
Forest industry	42.1	16.2	25.9	148.7	56.1	92.6
Nonindustrial private	73.2	22.2	50.9	237.8	87.6	150.2
All classes	140.7	45.0	95.7	466.1	166.7	299.4

Numbers in rows and columns may not sum to totals due to rounding.

[a] International 1/4-inch rule.

Table 22—Average annual mortality of growing stock and sawtimber on timberland by cause of death and by softwoods and hardwoods, Arkansas, 1988 to 1995

Cause of death	Average annual mortality					
	Growing stock			Sawtimber		
	All species	Softwood	Hardwood	All species	Softwood	Hardwood
	Million cubic feet			*Million board feet*[a]		
Bark beetles	13.7	13.7	0.0	67.6	67.6	0.0
Other insects	0.2	0.0	0.1	0.4	0.2	0.2
Disease	88.2	18.6	69.5	276.4	60.9	215.5
Fire	1.7	0.3	1.4	1.8	0.9	0.8
Beaver	3.0	0.1	2.9	11.1	0.4	10.7
Other animals	0.1	0.0	0.1	0.0	0.0	0.0
Weather	28.1	10.3	17.8	99.5	35.6	63.9
Suppression	3.0	1.6	1.4	0.4	0.0	0.4
Other	2.8	0.4	2.5	8.8	1.1	7.7
All causes	140.7	45.0	95.7	466.1	166.7	299.4

Numbers in rows and columns may not sum to totals due to rounding.

[a] International 1/4-inch rule.

Rosson, James F., Jr. 2002. Forest resources of Arkansas, 1995. Resour. Bull. SRS–78. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 82 p.

The principal findings of the seventh forest survey of Arkansas and changes that have occurred since the previous survey are presented. Topics examined include forest area, ownership, forest-type groups, stand structure, basal area, timber volume, growth, removals, mortality, harvesting, and management activity.

Keywords: Forest dynamics, forest inventory, forest plantations, forest productivity, forest survey, forest trends, large-scale sample, species distribution.

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