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# Arkansas's Forests, 2015

James F. Rosson, Jr.



**James F. Rosson, Jr.** is a Research Forester with the U.S. Department of Agriculture, Forest Service, Southern Research Station, Forest Inventory and Analysis Research Work Unit, Knoxville, TN 37919.

Front cover: top left, Elliot's bluestem (*Andropogon elliottii*), Ouachita National Forest, Scott County, AR; top right, a mixed shortleaf pine-oak woodland restoration, Ozark-St. Francis National Forest, Pope County, AR; middle left, shortleaf pine (*Pinus echinata*) shelterwood stands near Nella, Ouachita National Forest, Scott County, AR; bottom left, ice storm atop Mount Magazine, Mount Magazine State Park, Logan County, AR; bottom right, the Buffalo River at Pruitt, Newton County, AR just upstream from Highway 7

Back cover: top left, the Big Bluff downstream from Steel Creek, on the Buffalo River, Newton County, AR; top right, a red-cockaded woodpecker (*Leuconotopicus borealis*) cavity on Felsenthal National Wildlife Refuge, Ashley County, AR; middle right, an active red-cockaded woodpecker (*Leuconotopicus borealis*) cluster, Ouachita National Forest, Scott County, AR; bottom left, a view from Mount Magazine, looking southwest over Blue Mountain Lake, Logan County, AR; bottom right, big bluestem (*Andropogon gerardii*), Ouachita National Forest, Scott County, AR

All photos by James M. Guldin, USDA Forest Service.

ERRATUM (February 2024): A correction was made on page 16, figure 5 caption, last sentence—the number of acres for shortleaf pine was incorrect. The last sentence of figure 5 should read: This map represents 3,401,857 acres of shortleaf pine forest type.

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A shortleaf pine (*Pinus echinata*) summer burn, Ouachita National Forest, Scott County, AR.

### FOREWORD

The U.S. Department of Agriculture Forest Service, Southern Research Station's Forest Inventory and Analysis (FIA) research work unit and cooperating State forestry agencies conduct annual forest inventories of resources in the 13 Southern States (Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, and Virginia), the Commonwealth of Puerto Rico, and the U.S. Virgin Islands. In order to provide more frequent and nationally consistent information on America's forest resources, all research stations and their respective FIA work units conduct annual surveys with a common sample design. These surveys are mandated by law through the Agricultural Research Extension and Education Reform Act of 1998 (Farm Bill) (Public Law 105-185, 105th Congress 23 June 1998) <https://www.nifa.usda.gov/sites/default/files/resource/Agricultural-Research-Extension-and-Education-Reform-Act-of-1998.pdf> and updated in Title VIII of the 2014 Farm Bill. (Public Law 113-79, 113th Congress 7 February 2014) [https://agriculture.house.gov/sites/republicans.agriculture.house.gov/files/pdf/legislation/final\\_agact2014.pdf](https://agriculture.house.gov/sites/republicans.agriculture.house.gov/files/pdf/legislation/final_agact2014.pdf).

The primary objective in conducting these inventories is to gather the resource information needed to formulate sound forest policies, provide information for economic development, develop forest programs, and provide a scientific basis to monitor forest ecosystems. These data are used to provide an overview of forest resources including, but not limited to, forest area, forest ownership, forest type, stand structure, timber volume, growth, removals, mortality, and management activity. An important aspect of

the FIA program is assessing forest resource trends. This report mirrors the tables and figures found in the 2005 and 2010 forest surveys of Arkansas and facilitates resource comparisons between the surveys (Rosson and Rose 2010, 2015).

More detailed information about sampling methodologies used in the annual FIA inventories can be found in *The Enhanced Forest Inventory and Analysis Program—National Sampling Design and Estimation Procedures* (Bechtold and Patterson 2005) and *Sampling and Estimation Documentation for the Enhanced Forest Inventory and Analysis Program: 2022* (Westfall and others 2022).

Data tables included in FIA reports are designed to provide an array of forest resource estimates, but all resource attributes cannot be covered in a single document. Additional tables that supplement this report can be obtained at: <https://www.fs.usda.gov/srsfia/states/arkansas.shtml>. Information about the FIA program can be obtained at: <https://www.fia.fs.usda.gov/tools-data/index.php>.

Additional information about any aspect of Southern Research Station FIA surveys may be obtained from:

Forest Inventory and Analysis Research  
Work Unit  
U.S. Department of Agriculture  
Forest Service  
Southern Research Station  
4700 Old Kingston Pike  
Knoxville, TN 37919  
Telephone: 865-862-2000  
Ausley "Burl" Carraway, III  
Program Manager

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The FIA program would also like to thank the AFC for continued assistance, cooperation, and partnership in fulfilling the FIA mission goals. Also, I would like to acknowledge a special thanks to Darren Spinks and Eric Brixey of the AFC for continued excellent

supervision of Arkansas field crews and in keeping field logistics on track. During this survey cycle, Darren has moved on to assume the Forest Stewardship Coordinator position for the AFC and Eric has moved into the Forest Survey Coordinator position. I wish them the best in their new positions.

Name	Agency <sup>1</sup>	Position Title
Brixey, Eric	AFC	State Inventory Coordinator
Cady, Sarah	AFC	Field Assistant
Cage, Chris	AFC	Field Forester
Clark, Matthew	AFC	Field Forester
Higgins, David	AFC	Field Forester
Jarrell, Brantley	AFC	Field Assistant
Lacy, Chase	AFC	Field Assistant
Martin, Matt	AFC	Field Forester
Richard, Jeremy	AFC	Field Forester
Richard, Wesley	AFC	Field Assistant
Spinks, Darren	AFC	Forest Stewardship Coordinator
Stock, Keith	AFC	Field Forester
Thomas, Jaylan	AFC	Field Forester
Tollett, Brandon	AFC	Field Assistant
Williams, Aaron	AFC	Field Forester
Wright, Robert	AFC	Field Forester
Leveritt, Richard	SRS-FIA	QA/QC
Odom, Shawn	SRS-FIA	QA/QC
Tillman, Kathryn M.	SRS-FIA	Zone Supervisor

SRS-FIA = Southern Research Station (USDA Forest Service), Forest Inventory and Analysis ; QA/QC = Quality Assurance/Quality Control.

<sup>1</sup>AFC = Arkansas Forestry Commission.

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A shortleaf pine-oak shelterwood stand, Ozark-St. Francis National Forest, Pope County, AR.

## HIGHLIGHTS

Important findings of the 10th forest survey of Arkansas are presented below. Comparisons and trends, unless otherwise noted, are based on estimates between the 2010 and 2015 surveys of Arkansas.

- In 2015, forest land increased by 319,700 acres since the 2010 forest survey. This increase brings the 2015 estimate to 19.0 million acres of forest land across the State.
- In 2015, 56 percent of Arkansas was in forest land which indicated no change since the 2010 survey.
- In 2015, 69 percent of forest land was in nonindustrial private forest (NIPF) ownership, 12 percent in forest industry, 13 percent in national forest, and 6 percent in other public ownership. In 2015, there was a 9-percent increase in NIPF ownership and an 8-percent decrease in forest industry ownership.
- In 2015, oak-hickory was the predominant forest-type group and covered 41 percent of all forest land followed by the loblolly-shortleaf group that covered 31 percent of all forest land. This indicated an increase of 2 percent since 2010.
- In 2015, live-tree volume was 31.6 billion cubic feet for the State, an increase of 8 percent since 2010. In 2015, 41 percent of all live-tree volume was in softwoods and 59 percent in hardwoods. Loblolly and shortleaf pine were the most dominant trees across the State and together accounted for 37 percent of all live-tree volume.
- In 2015, softwood volume was 12.9 billion cubic feet, an increase of 1,703.2 million cubic feet (15 percent) since 2010.
- In 2015, hardwood volume was 18.6 billion cubic feet, an increase of 637.2 million cubic feet (4 percent) since 2010.
- In 2015, sawtimber volume was 106.9 billion board feet, an increase of 10 percent since 2010. In 2015, 49 percent of sawtimber volume was in softwoods and 51 percent in hardwoods.
- In 2015, softwood sawtimber volume was 52.4 billion board feet, an increase of 6.5 billion board feet (14 percent) since 2010.
- In 2015, hardwood sawtimber volume was 54.6 billion board feet, an increase of 3.2 billion board feet (6 percent) since 2010.
- In 2015, live-tree growth on forest land was 1.2 billion cubic feet per year with 68 percent in softwoods and 32 percent in hardwoods. In 2015, loblolly pine led the State in growth with 663.4 million cubic feet per year.
- In 2015, live-tree removals were 693.9 million cubic feet per year with 67 percent in softwoods and 33 percent in hardwoods. In 2015, loblolly pine led the State in removals with 402.6 million cubic feet per year.
- In 2015, live-tree mortality was 370.3 million cubic feet per year with 24 percent in softwoods and 76 percent in hardwoods. In 2015, loblolly and shortleaf pines led in mortality with 43.6 and 38.7 million cubic feet per year, respectively.
- In 2015, there were 3.6 million acres of plantations in Arkansas (19 percent of all forest land), a 328,300-acre increase since 2010.
- In 2015, there were 4.0 billion cubic feet of softwood live-tree volume on plantations, a 1,123.4 million cubic foot increase since 2010. Plantation softwood volume was 31 percent of all live-tree softwood volume in the State.
- In 2015, softwood growth on plantations was 425.4 million cubic feet per year and 54 percent of all softwood live-tree growth in the State.

## Highlights

- In 2015, the basal area of forest land stands across the State averaged 90.4 square feet per acre, an increase from 87.4 square feet per acre in 2010.
- In 2015, 60 percent of upland forest land across Arkansas had more than 50 percent of stand basal area in hardwoods. In contrast, 40 percent was in upland forest land stands with more than 50 percent of basal area in softwoods, which indicated no change since the 2010 survey.
- In 2015, tree mortality was high. There were 3.8 million acres of forest land stands, which lost 10–19 percent of basal area due to some type of tree death. Another 1.7 million acres was in forest land where 20–29 percent of stand basal area was lost to mortality. This was a 210,600- and 209,100-acre increase, respectively, over that reported in the 2010 forest survey.
- In 2015, tree cutting was an important disturbance factor in Arkansas. Since the 2010 survey, 2.5 million acres underwent some form of cutting, a 693,000-acre decrease of forest land that had some type of cutting operation. In 2015, a total of 548,100 acres had more than 70 percent of forest stand basal area removed, a 241,300-acre decrease since 2010.
- In 2015, shortleaf pine appeared to have stabilized in the State and remained the number two ranked tree by volume. Since the 2010 survey, shortleaf pine volume has increased by 4 percent. However, the number of planted shortleaf pine acres dropped from 128,900 acres in 2010 to 80,500 acres in 2015.

## INTRODUCTION

This report presents the findings of the 10th forest survey (cycle 10) of Arkansas (survey year dated 2015). The survey presents estimates based upon the third full cycle of data of the fixed-plot sample design implemented in 2000. Trend information in the report is based on comparisons with cycle 9 data (survey year dated 2010). The 2010 survey estimates have been modified slightly since published in the 2010 report (Rosson and Rose 2015); therefore, some of the 2015 numbers may not match exactly to previously published numbers. The revised 2010 numbers are used for comparisons. More detailed information concerning methods and trends are provided in the methods section of appendix A. Because most of the tables and figures are the same, users are referred to the 2010 report to make detailed comparisons (Rosson and Rose 2015).

Numerous publications have been produced from previous State surveys of Arkansas.

Except for the first survey, all other Arkansas surveys were summarized into a document commonly referred to as a State analytical report. In 1935, the first survey of Arkansas covered only areas most highly affected by harvesting in the early part of the 20th century: 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 (USDA Forest Service 1937b, 1938a, 1938b; Winters 1939). Additionally, two regional reports included information from the first survey of Arkansas (USDA Forest Service 1937a, 1937c). The first full survey was completed for the State of Arkansas in 1951 (USDA Forest Service 1953). Other State surveys were completed in 1959 (Sternitzke 1960), 1968 (Van Sickle 1970), 1978 (Van Hees 1980), 1988 (Beltz and others 1992), 1995 (Rosson 2002), 2005 (Rosson and Rose 2010), and 2010 (Rosson and Rose 2015).



A high angle view of shortleaf pine (*Pinus echinata*) shelterwood stands near Nella, Ouachita National Forest, Scott County, AR.

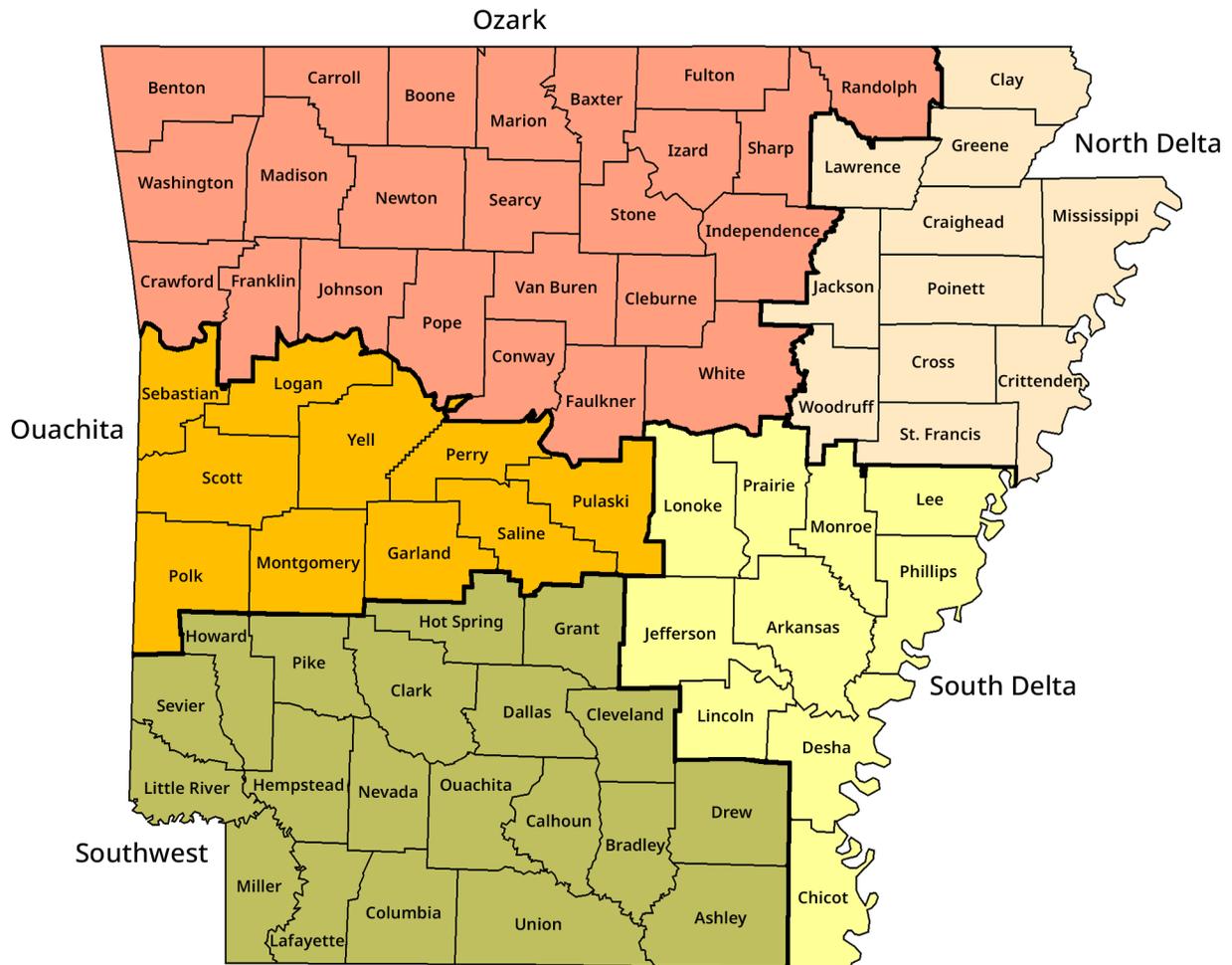


Figure 1—Forest survey units in Arkansas, 2015.

Arkansas’s 75 counties were divided into five forest survey units (fig. 1): North Delta (11 counties), South Delta (10 counties), Ouachita (10 counties), Ozark (24 counties), and Southwest (20 counties). In addition to their close alignment with physiographic and physiognomic features of the State, the units facilitate certain processes in data analysis (an increase in the homogeneity of the data within each survey unit decreases the variance).

Field work began on October 26, 2010 and was completed on December 31, 2015. The survey was dated 2015. During the 2015 survey, 5,679 sample plots were visited by field crews and there were 4,619 forest conditions identified on 3,565 sample plots. A total of 73,958 live trees  $\geq 5.0$  inches in diameter at breast height (d.b.h.) were measured on forest land sample

plots. Additionally, 20,265 live sapling-sized trees  $\geq 1.0$  inch but  $< 5.0$  inches d.b.h. were measured on smaller sample plot microplots (see appendix A for techniques).

The tables and figures throughout the report show estimates for the 2015 survey and revised estimates from the 2010 survey. An important element of this report is the detailed comparisons of the 2010 survey with the 2015 survey. Most of the tables and figures are the same in both reports, facilitating direct comparisons. Estimates were derived from data processed and posted on March 22, 2018 for both the 2010 and 2015 surveys. The appendix describes survey methods and data reliability, defines terms, and lists tree species sampled in the survey.

## PHYSIOGRAPHY

The total earth cover inside the State boundary of Arkansas is 34.0 million acres (U.S. Department of Commerce, Bureau of the Census 2011). In area, it is the 29th largest of the 50 States. Arkansas is situated close to the western edge (limit) of tree cover for the eastern deciduous forest and many species do not exist beyond the western State line. The landscape across the State is very diverse, ranging from lowlands in the south, deltaic expanses along the Mississippi River, and mountains and highlands to the west and north. The highest point in Arkansas is Magazine Mountain at 2,753 feet above sea level; the lowest point is the Ouachita River at 55 feet above sea level at the Louisiana State line. The mean elevation of Arkansas

is 650 feet above sea level. Major rivers are the Arkansas River, Mississippi River, White River, and Ouachita River. Major lakes are Lake Ouachita and Bull Shoals Lake, both artificial impoundments on the Ouachita and White Rivers, respectively.

This diverse landscape is situated on three physiographic provinces: (1) the Coastal Plain, (2) the Ouachita, and (3) the Ozark. Six physiographic sections were adapted from Fenneman (1938). These sections occur on the three provinces (fig. 2). The section boundaries are similar to the Forest Inventory and Analysis (FIA) unit boundaries (fig. 1). The Salem/Springfield Plateaus, Boston Mountains, and Arkansas Valley sections are closely aligned with the FIA Ozark unit; the Ouachita Mountains section is aligned with

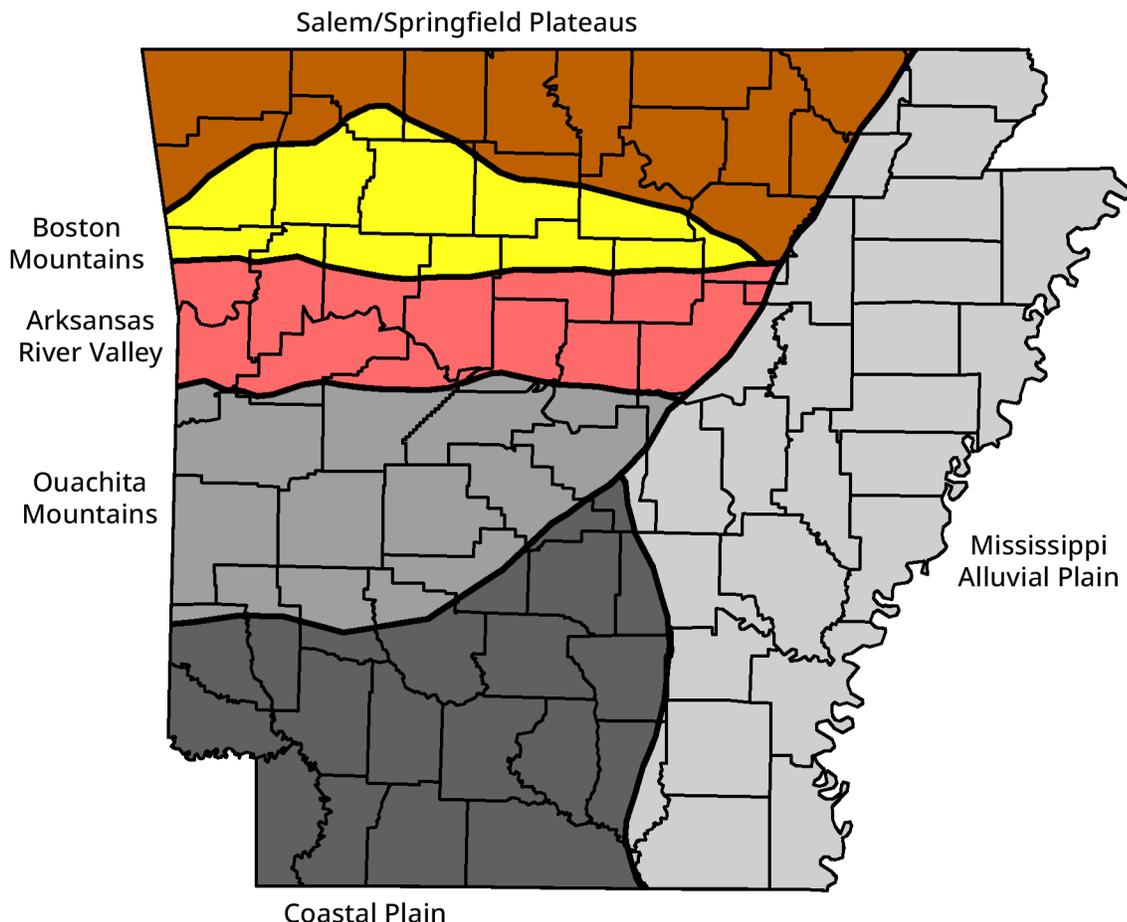


Figure 2—Physiographic sections of the Ozark, Ouachita, and Coastal Plain provinces of Arkansas. The Ozark province includes Salem/Springfield Plateaus and Boston Mountains sections; the Ouachita province includes Arkansas River Valley and Ouachita Mountains sections; the Coastal Plain province includes the Mississippi Alluvial Plain and West Coastal Plain sections. Source: Fenneman (1938).

the Ouachita unit; the west Gulf Coastal Plain section aligns with the Southwest unit; and the Mississippi Alluvial Plain section aligns with the North Delta and South Delta units. Because of past and continuous geological evolution and development, these regions have influenced the forest vegetation cover that occupied these lands in 2015. This section was adapted from Arkansas' Forests, 2005 (Rosson and Rose 2010).

## FOREST AREA

In the 2010 census, the total surface area inside the Arkansas State boundary was 34.0 million acres (U.S. Department of Commerce, Bureau of the Census 2011). The total land area for Arkansas was 33.3 million acres, the difference between total surface area and total land being the exclusion of bodies of water with minimum size arbitrarily set by definition (see definition of [census water](#) in glossary). In addition, FIA defines bodies of water between 1 and 4.5 acres in size, and streams 30 to 200 feet in width, as noncensus water (a type of nonforest land). This additional nonforest area, 157,500 acres, was included in table 1 to demonstrate additivity of all land categories (nonforest

land + noncensus water + unproductive forest + reserved forest + timberland) to 33.4 million acres (table 1).

There were 19.0 million acres of forest land in Arkansas identified by the 2015 forest survey; this was 4.9 million acres more than in lands classed as nonforest (table 1). Total forest land was comprised of three components: timberland, reserved forest, and woodland (unproductive forest). The largest component was the timberland category with 18.5 million acres, followed by the reserved forest category with 507,100 acres. Forest land previously classed as productive forest land switched to a reserved class because of a FIA land-use definition change, i.e., U.S. Fish and Wildlife lands automatically became classed as reserved lands. This was most notable in the South Delta, North Delta, and Southwest survey units. These units showed no reserved land in the 2010 forest survey. There were 40,300 acres of woodland (unproductive forest) in the Ouachita and Ozark units. A combination of site characteristics (shallow nutrient-poor soils, southern exposures, high summer temperatures, and low levels of precipitation) were the primary reasons for unproductive forests in these two units.

**Table 1**—Area by survey unit and land class, Arkansas, 2015

Survey unit	Total land area <sup>1</sup>	Total forest land <sup>2</sup>	Land class				
			Timberland	Reserved forest	Unproductive forest	Noncensus water <sup>3</sup>	Nonforest
~ ~ ~ ~ ~ thousand acres ~ ~ ~ ~ ~							
South Delta	4,635.8	1,472.9	1,297.9	175.0	0.0	23.1	3,139.7
North Delta	4,660.6	805.2	767.5	37.6	0.0	28.5	3,827.0
Southwest	8,774.6	6,945.2	6,849.2	96.0	0.0	36.6	1,792.8
Ouachita	4,735.8	3,448.5	3,375.2	45.7	27.6	22.9	1,264.5
Ozark	10,569.3	6,368.0	6,202.5	152.8	12.7	46.6	4,154.8
<b>All units</b>	<b>33,376.1</b>	<b>19,039.8</b>	<b>18,492.4</b>	<b>507.1</b>	<b>40.3</b>	<b>157.5</b>	<b>14,178.8</b>

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

0.0 = no sample for the cell or a value >0.0 but <0.05.

<sup>1</sup> Total land area = total forest land+noncensus water+nonforest. Does not include 658,000 acres of census water (as defined by FIA). Total spatial area of Arkansas = 34,034,100 acres.

<sup>2</sup> Total forest land = timberland+reserved forest+unproductive forest.

<sup>3</sup> Water defined by FIA as nonforest water (but classed by the census as land).

The estimate of Arkansas’s original forest cover was 32.0 million acres with almost 96 percent of all land in the State covered by forest (Davis 1983). In sharp contrast, forests in 2015 covered only 57 percent of Arkansas’s land area. By the 1920s (just before the first forest survey) land clearing had already reduced the State’s forested area to 22.0 million acres and approximately 2.0 million acres were estimated to be in old growth across the State (Davis 1983).

In 2015, the Southwest and Ozark units held the majority of the 19.0 million acres of forest land in Arkansas (table 2). In the Southwest unit, forest land area increased the most, while the Ozark unit showed a slight decrease.

The two Delta survey units continued to have the smallest amounts of forest land in Arkansas (table 2). In the North Delta survey unit, forest land accounted for only 17 percent of the total land area with 805,200 acres. This amount represented 4 percent of all forest land in Arkansas, which indicated there was no change since 2010. Forest lands covered a slightly larger amount (1.5 million acres) in the South Delta unit. Compared to 2010, this was 32 percent of the total land in the unit, but only 8 percent of the total forest land in the State. These two units are still rebounding from the conversion of forest land to an agriculture use that took place between



A shortleaf pine-oak shelterwood stand, Ozark-St. Francis National Forest, Pope County, AR.

1890 and 1980. Between the mid-1960s and late 1970s, cropland was converted to take advantage of high spikes in soybean prices. As a result, this practice left lands in forest that had soils with poor drainage characteristics and lands within levee systems that were unprotected. However, a portion of the cleared forest land was not suitable for sustainable crop production; some of these lands may naturally revert back to forest land, some have already been planted in trees, and others are available for restoration efforts. Over the past 40 years, lands converted back to forest have been in small increments. In addition, recent interest in biofuel production may target some of these sites for fiber production. Two species, switchgrass and cottonwood, were of high interest in this endeavor.

The proportion of land area in forest land in Arkansas’s 75 counties ranged from 5 percent to 97 percent. Two counties, Dallas and Grant, had >96 percent of their respective land in forest. Throughout the State, a total of 21 counties had >75 percent of their land area in forest land (fig. 3). In the Southwest unit, forest land area increased most, while the Ozark unit showed a very slight decrease. The Southwest unit had the densest concentration of forest land in the State. Here, 12 counties had >75 percent of their land area in forest land, which was one more than in the 2010 forest survey. In comparison to the Southwest

**Table 2**—Area of forest land by survey unit, year of survey, and change, Arkansas 2010 and 2015

Survey unit	Year		Change
	2010	2015	
	~~~~~ thousand acres ~~~~~		
South Delta	1,389.1	1,472.9	83.8
North Delta	768.0	805.2	37.2
Southwest	6,811.5	6,945.2	133.7
Ouachita	3,373.9	3,448.5	74.6
Ozark	6,377.7	6,368.0	-9.7
All units	18,720.1	19,039.8	319.7

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

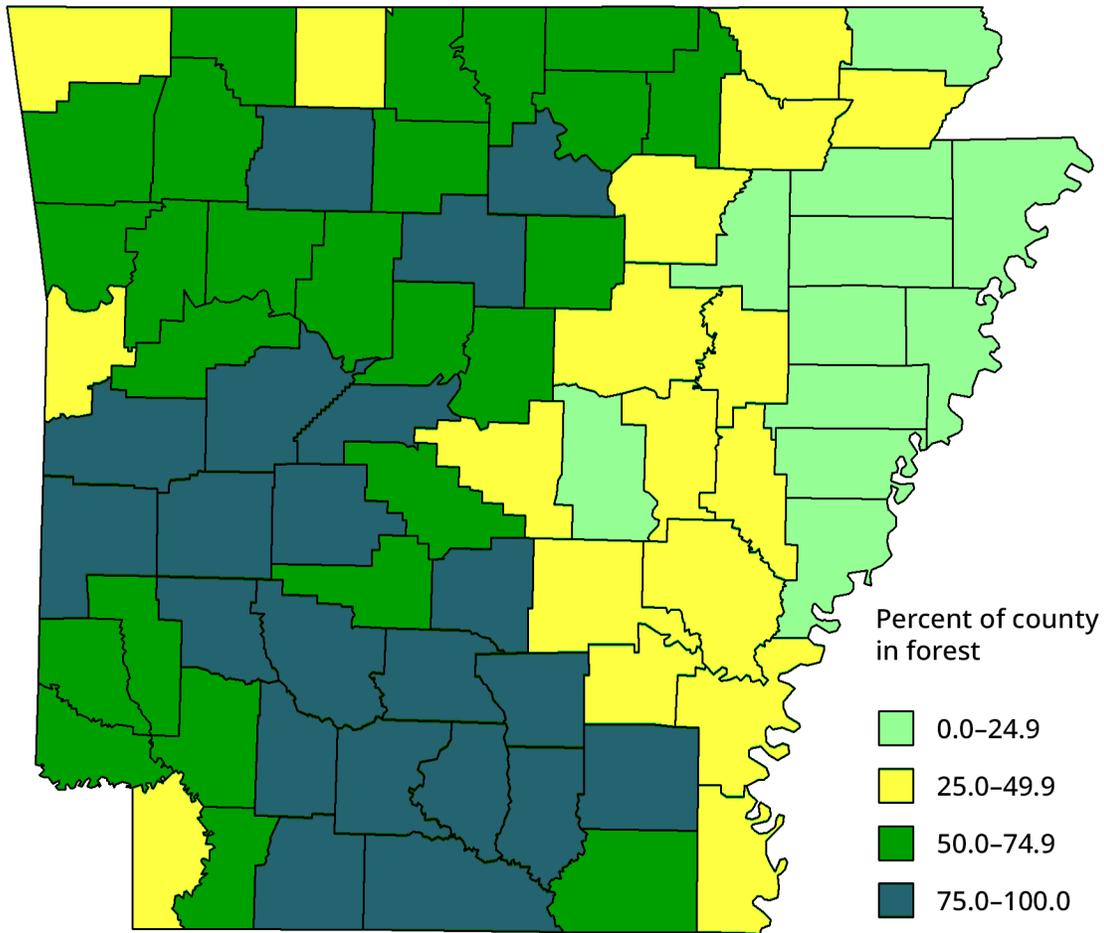


Figure 3—Percent of county area in forest land, Arkansas, 2015.

unit, the Ouachita unit had six counties and the Ozark unit had only three counties with >75 percent in forest land. Of all counties in the State, three counties (Dallas, Grant, and Union in the Southwest unit) had densities >90 percent. Dallas County had the highest forest land density in the State with >97 percent of its land area in forest land.

In 2015, there were 11 least densely forested counties in the two Delta units with <25 percent of their county land area in forest land. Eight counties in the North Delta unit had <25 percent of land area in forest land. In the South Delta unit, three counties had forest land that was <25 percent of total land area in their respective county. The least densely forested county in Arkansas was Mississippi County where only 5 percent of the county was in forest land. In the

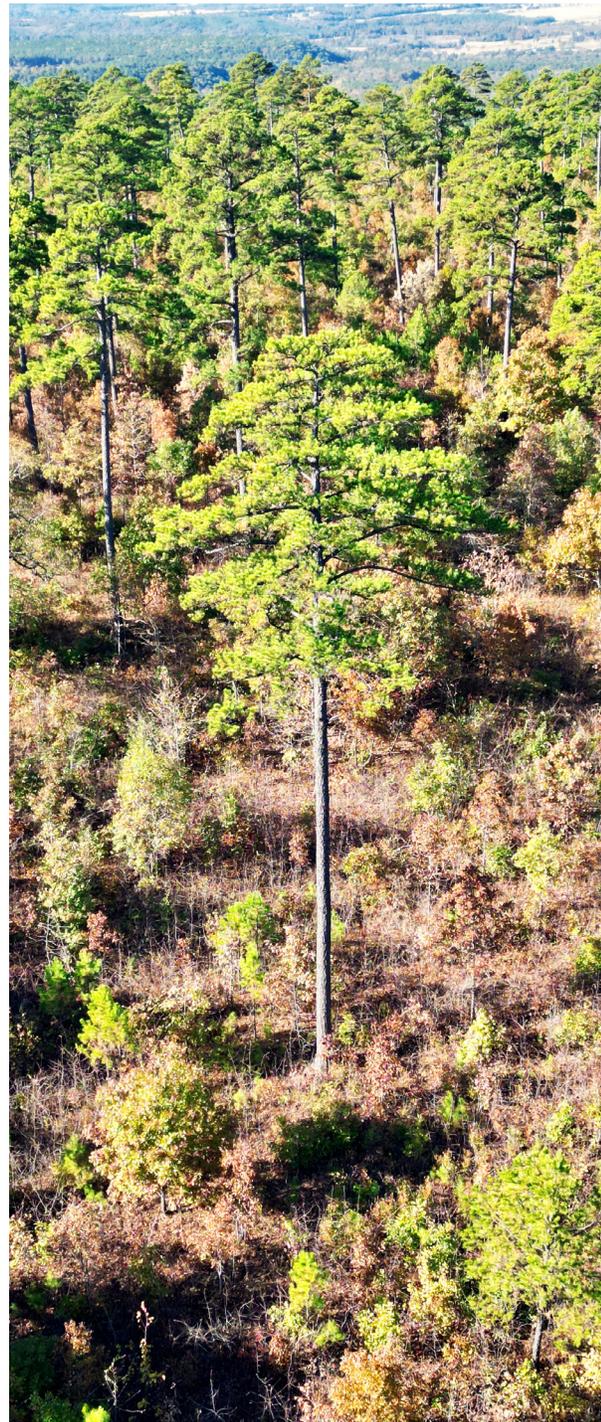
future, opportunities may avail to return abandoned or unproductive agriculture land to forest in many counties of the two Delta units. As discussed previously, much of the cleared forest land was of marginal value in crop production and would be far more economically viable and ecologically sustainable if converted back to bottomland hardwood forests.

Statewide, forest land has increased by 319,700 acres since the 2010 forest survey (table 2). The Southwest unit accounted for 42 percent of the overall increase in 2015 (133,700 acres). However, on a relative basis, the largest increase was in the North Delta unit with a 6-percent increase (37,200 acres). The lowest relative increase was in the Ozark unit with less than a 1 percent decline (-9,700 acres) in forest land.

As previously mentioned, the overall net change between 2010 and 2015 was 319,700 acres; however, not all of the Arkansas counties increased in forest land. Of Arkansas’s 75 counties, 51 counties had increases and 24 counties had decreases (table 3). Forest land increased by  $\geq 15,000$  acres in seven counties. One county, Union, increased by more than 25,000 acres in forest land. A total of 146,200 acres of forest land were lost in 24 counties. This, combined with a 465,900-acre gain in forest land in the 51 counties that had increases, resulted in the net increase of 319,700 acres.

**Table 3**—Area of forest land by county, year of survey, change, and percent of total forest (2015), Arkansas, 2010 and 2015

County	Year		Change	Total forest land (2015)
	2010	2015		
	~~~ thousand acres ~~~			percent
Arkansas	191.5	194.9	3.4	1.0
Ashley	400.9	416.9	16.0	2.2
Baxter	221.6	229.1	7.4	1.2
Benton	219.7	230.8	11.2	1.2
Boone	170.7	163.9	-6.9	0.9
Bradley	354.6	364.2	9.6	1.9
Calhoun	350.1	353.9	3.8	1.9
Carroll	205.3	210.9	5.6	1.1
Chicot	122.6	134.2	11.6	0.7
Clark	458.1	460.4	2.3	2.4
Clay	70.8	72.0	1.2	0.4
Cleburne	288.6	271.3	-17.3	1.4
Cleveland	317.5	329.5	11.9	1.7
Columbia	431.5	439.5	7.9	2.3
Conway	199.8	192.2	-7.5	1.0



Shortleaf pine-oak shelterwood stand, Ozark-St. Francis National Forest, Pope County, AR.

## Forest Area

**Table 3**—Area of forest land by county, year of survey, change, and percent of total forest (2015), Arkansas, 2010 and 2015 (continued)

County	Year			Total forest land (2015)
	2010	2015	Change	
	~~~ thousand acres ~~~			percent
<b>Craighead</b>	57.9	57.0	-0.9	0.3
<b>Crawford</b>	209.2	233.1	23.9	1.2
<b>Crittenden</b>	38.6	45.3	6.7	0.2
<b>Cross</b>	50.0	52.2	2.2	0.3
<b>Dallas</b>	400.3	411.5	11.2	2.2
<b>Desha</b>	151.4	156.5	5.1	0.8
<b>Drew</b>	397.9	416.1	18.2	2.2
<b>Faulkner</b>	213.6	216.1	2.4	1.1
<b>Franklin</b>	223.1	219.5	-3.6	1.2
<b>Fulton</b>	234.5	253.4	18.9	1.3
<b>Garland</b>	379.9	391.0	11.1	2.1
<b>Grant</b>	392.0	391.8	-0.3	2.1
<b>Greene</b>	102.7	99.9	-2.8	0.5
<b>Hempstead</b>	299.7	299.3	-0.4	1.6
<b>Hot Spring</b>	251.3	253.4	2.1	1.3
<b>Howard</b>	284.1	283.2	-0.9	1.5
<b>Independence</b>	225.9	215.4	-10.4	1.1
<b>Izard</b>	253.5	241.7	-11.7	1.3
<b>Jackson</b>	71.9	68.1	-3.8	0.4
<b>Jefferson</b>	198.0	212.6	14.6	1.1
<b>Johnson</b>	300.8	311.4	10.6	1.6
<b>Lafayette</b>	206.1	209.2	3.1	1.1
<b>Lawrence</b>	84.9	95.5	10.5	0.5
<b>Lee</b>	91.3	93.2	1.9	0.5
<b>Lincoln</b>	142.7	149.6	6.9	0.8
<b>Little River</b>	184.8	192.7	7.9	1.0
<b>Logan</b>	261.0	260.7	-0.2	1.4
<b>Lonoke</b>	116.4	123.8	7.4	0.7
<b>Madison</b>	326.5	333.9	7.4	1.8
<b>Marion</b>	247.9	253.1	5.2	1.3
<b>Miller</b>	207.8	201.3	-6.5	1.1

**Table 3**—Area of forest land by county, year of survey, change, and percent of total forest (2015), Arkansas, 2010 and 2015 (continued)

County	Year			Total forest land (2015)
	2010	2015	Change	
	~~~ thousand acres ~~~			percent
<b>Mississippi</b>	28.9	28.0	-0.9	0.1
<b>Monroe</b>	174.8	183.6	8.8	1.0
<b>Montgomery</b>	403.1	415.5	12.4	2.2
<b>Nevada</b>	324.3	327.6	3.3	1.7
<b>Newton</b>	440.3	412.9	-27.4	2.2
<b>Ouachita</b>	406.3	404.4	-1.9	2.1
<b>Perry</b>	267.1	279.0	11.9	1.5
<b>Phillips</b>	94.6	105.4	10.8	0.6
<b>Pike</b>	297.6	308.6	11.0	1.6
<b>Poinsett</b>	67.8	76.5	8.7	0.4
<b>Polk</b>	423.2	442.4	19.2	2.3
<b>Pope</b>	383.2	391.6	8.4	2.1
<b>Prairie</b>	105.8	119.2	13.4	0.6
<b>Pulaski</b>	228.3	234.2	5.9	1.2
<b>Randolph</b>	181.1	196.0	14.9	1.0
<b>Saint Francis</b>	79.8	93.3	13.5	0.5
<b>Saline</b>	311.5	327.2	15.7	1.7
<b>Scott</b>	460.7	461.2	0.5	2.4
<b>Searcy</b>	287.2	284.7	-2.5	1.5
<b>Sebastian</b>	158.1	158.1	0.0	0.8
<b>Sevier</b>	238.5	248.9	10.4	1.3
<b>Sharp</b>	259.1	257.7	-1.4	1.4
<b>Stone</b>	346.7	332.9	-13.8	1.7
<b>Union</b>	607.9	632.9	25.0	3.3
<b>Van Buren</b>	355.3	348.5	-6.9	1.8
<b>Washington</b>	331.2	322.9	-8.4	1.7
<b>White</b>	252.9	245.0	-7.9	1.3
<b>Woodruff</b>	114.6	117.3	2.7	0.6
<b>Yell</b>	481.0	479.1	-1.9	2.5
<b>All counties</b>	18,720.1	19,039.8	319.7	100.0

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

**Table 4**—Changes in forest land by forest survey unit, Arkansas, 2010–2015

Survey unit	Change <sup>1</sup>	Total additions	Additions		Total diversions	Diversions	
			Agriculture <sup>2</sup>	Other <sup>3</sup>		Agriculture <sup>2</sup>	Other <sup>3</sup>
----- thousand acres -----							
South Delta	53.9	76.6	41.3	35.3	-22.6	-1.4	-21.2
North Delta	57.9	70.9	52.5	18.4	-13.0	-0.8	-12.2
Southwest	33.6	101.6	67.3	34.3	-68.0	-31.5	-36.5
Ouachita	36.0	86.9	33.1	53.8	-50.9	-9.5	-41.3
Ozark	24.8	202.4	153.6	48.8	-177.6	-113.2	-64.4
<b>All units</b>	<b>206.2</b>	<b>538.4</b>	<b>347.8</b>	<b>190.6</b>	<b>-332.1</b>	<b>-156.4</b>	<b>-175.6</b>

Note: The net changes from diversions and additions in this table do not equal the real change in forest land area between the 2010 and 2015 surveys because of an incomplete remeasure of all plots and the difference in area expansion factors between 2010 and 2015 (see methods section in appendix A)

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

<sup>1</sup> Change is the difference between diversions (a loss) and additions (a gain) of forest land.

<sup>2</sup> Agriculture includes cropland, pasture, idle farmland, orchards, Christmas tree plantations, maintained wildlife openings, and rangeland.

<sup>3</sup> Other includes business, manufacturing, residential, rights-of-way (roads, railways, power/oil/gas lines, and canals), recreation areas (parks, skiing, golf courses, etc.), mining, and water.

In 2015, most of the changes in forest land and nonforest land area were driven by additions or diversions to agriculture. The 347,800-acre addition of forest land from agriculture land was offset somewhat by the 156,400 acres of forest land that was cleared and put into agriculture use. Therefore, the overall net change for this land use was a 191,400-acre increase (table 4). In land uses other than agriculture, there was a fairly even balance between diversions and additions. Here, the net change was a 15,000-acre increase in forest land (table 4).

Regionally in 2015, most of the additions and diversions to and from agriculture land occurred in the Ozark unit, the same as in the 2010 survey. The additions and diversions in the “other” land use category were distributed more evenly among the five forest survey units. For more detailed diversions and additions comparisons between the 2010 and 2015 surveys, users are referred to table 4 in Rosson and Rose (2015).

## FOREST-TYPE GROUPS

For the Arkansas forest survey, the FIA program aggregated forest types into six forest-type groups (FTG) as part of data reduction to summarize results. A forest

type was derived by computer algorithm for each plot (or plot condition if more than one condition per plot was present) during data processing. This forest type was based on the relative dominance of each species present (or plurality if there was not a majority present). The relative stocking assignment for each species was used to rank their dominance and assign a respective forest type name, usually based upon the dominant first, second, or third species. Similar forest types were then grouped together into larger aggregations called a forest-type group. For example, plots that were dominant with shortleaf pine and other plots that were dominant with loblolly pine were aggregated together into the loblolly-shortleaf pine FTG (Rosson and Rose 2015).

With the exception of suppressed trees, the dominant and codominant trees are the most likely to be disturbed or removed from a stand, either naturally or through cutting. Therefore, forest type classification was sensitive to disturbances of dominant and codominant trees on a sample plot. There were five potential reasons for shifts in forest type acreage across Arkansas. First, selective cutting of pine, without ensuring adequate pine regeneration, could result in a shift of pine forest types toward the hardwood

## Forest-Type Groups

**Table 5**—Area of forest land by survey unit, forest-type group, and change, Arkansas 2010–2015

Survey unit	Total 2015	Forest-type group															
		Loblolly-shortleaf		Eastern red cedar		Oak-pine		Oak-hickory		Oak-gum-cypress		Elm-ash-cottonwood		Misc. hardwood		Nonstocked	
		2015	Change	2015	Change	2015	Change	2015	Change	2015	Change	2015	Change	2015	Change	2015	Change
~~~~~ thousand acres ~~~~~																	
<b>South Delta</b>	1,472.9	177.8	-1.7	0.0	0.0	24.3	11.0	272.9	2.0	561.1	32.8	379.3	13.9	5.8	5.8	51.6	20.0
<b>North Delta</b>	805.2	19.4	0.9	8.0	3.9	16.6	7.1	286.6	11.2	286.0	-1.8	176.4	15.0	0.0	-3.4	12.3	4.3
<b>Southwest</b>	6,945.2	3,804.2	360.6	1.7	0.1	726.0	-167.5	1,316.2	12.6	874.8	-84.2	152.7	3.8	7.9	-2.6	61.9	10.9
<b>Ouachita</b>	3,448.5	1,359.8	-11.6	55.3	4.4	529.7	-22.6	1,236.9	43.5	139.2	26.0	103.6	21.3	7.4	-0.1	16.5	13.6
<b>Ozark</b>	6,368.0	497.0	15.6	237.0	-6.7	596.2	-36.0	4,693.3	26.0	160.6	-2.3	162.5	28.4	4.4	-16.3	17.1	-18.4
<b>All units</b>	19,039.8	5,858.2	363.8	301.9	1.6	1,892.7	-208.0	7,805.9	95.4	2,021.7	-29.5	974.4	82.4	25.6	-16.6	159.3	30.5

Numbers in rows and columns may not sum to totals due to rounding.  
0.0 = no sample for the cell or a value >0.0 but <0.05.

types. Second, clearcutting a forest stand (especially those with substantial hardwoods) and replanting with pine could increase the pine types. Third, diversion or additions of forest land acreage could show a respective decline or increase in a particular type; so, losses or gains of forest land area must be considered when portraying forest type shifts. Fourth, fire activity could shift types toward pine while fire suppression could shift types toward hardwood, especially in younger stands or those stands with substantial advanced regeneration. Fifth, since forest type classification is an artificial classification system, forest types are not always separate and discrete entities. Rather, they may merge and flow into each other, sometimes with considerable overlap, forming, in these instances, a continuum. Since type categories are defined by discrete boundaries, a slight shift of species dominance across these arbitrary thresholds may give a false impression of dramatic changes in forest type acreage between surveys (Rosson and Rose 2015).

In 2015, the dominant FTG in Arkansas was oak-hickory, covering 7.8 million acres of forest land and reflected a 95,400-acre increase since the 2010 forest survey (table 5). In 2015, 60 percent of the oak-hickory FTG was in the Ozark unit (table 5). The oak-hickory

FTG covered 4.7 million acres, or 74 percent of the Ozark unit forest lands, which indicated very little change since the 2010 forest survey.

Ranked second in dominance was the loblolly-shortleaf pine FTG that covered 5.9 million acres of forest land (table 5). This FTG was dominant both in the Southwest and Ouachita units where shortleaf pine was the dominant species in the Ouachita Mountains and loblolly pine was dominant on the Coastal Plain. This FTG made up 31 percent of the forest land area in the State. In the Southwest unit, there were 3.8 million acres of the loblolly-shortleaf FTG that covered 55 percent of total forest land. Forest industry operations were most active in the Southwest unit and the establishment and management of loblolly pine plantations dominated forestry activity. In the Ouachita unit, there were 1.4 million acres of the loblolly-shortleaf FTG that covered 39 percent of total forest land (table 5). The loblolly-shortleaf FTG increased by 363,800 acres since the 2010 forest survey. Almost all of the increase occurred in the Southwest unit. Together, the number one and two ranked FTGs (oak-hickory and loblolly-shortleaf) covered 72 percent of Arkansas forest land.

The oak-pine FTG ranked third with 1.9 million acres; but this was a 208,000-acre

decline from the 2010 forest survey. Oak-pine was most dominant in the Southwest unit (726,000 acres), but the Ozark and Ouachita units followed closely with 596,200 and 529,700 acres, respectively.

Following closely behind the oak-pine FTG was the oak-gum-cypress, elm-ash-cottonwood (the bottomland hardwoods), eastern red cedar, and non-typed (nonstocked) lands (table 5). Based on the proportion of forest land, the bottomland hardwoods were most dominant in the North and South Delta units of the Mississippi River Alluvial Plain (table 5). Seventy-nine percent of the eastern red cedar FTG was in the Ozark unit. It was more common on the Salem Plateaus province portion of the Ozark unit and especially common on abandoned agricultural lands and woodlands and glades with thin soils. There was no substantial changes of these types since the 2010 forest survey.

Since 2010, the notable change in FTGs was the increase in the loblolly-shortleaf pine FTG. In contrast to previous surveys, there was not an equivalent loss in the oak-hickory FTG. Instead, the oak-pine FTG had a loss of 208,000

acres. Over half the loss and gain occurred in the Southwest unit (table 5). Again, this was to be expected since this region had the highest forest management activity. It has been an ongoing phenomenon in Arkansas as softwoods were preferred over hardwoods in intensive forest-management activity. It appears that the bottomland hardwood types have stabilized. These types are often more ecologically suited for forest land use than cropland in these situations, which led to many reversions back to forest land. Oak-gum-cypress and elm-ash-cottonwood acreage trends showed only slight changes, with the Southwest unit showing the biggest change. The Southwest unit lost 84,200 acres of oak-gum-cypress (table 5).

As expected, timberland management organizations (TIMO) and real estate investment trusts (REIT) transfer activity from forest industry to nonindustrial private forest (NIPF) land drove changes in FTGs by ownership (table 6) (see the [Ownership](#) section). Among the most significant changes was the loblolly-shortleaf FTG in forest industry management. Since the 2010 survey, forest industry lost 1.0 million acres

**Table 6**—Area of forest land by forest-type group, ownership, and change, Arkansas 2010–2015

Forest-type group	Ownership class							
	National forest		Other public		Forest industry		NIPF	
	2015	Change	2015	Change	2015	Change	2015	Change
~~~~~ thousand acres ~~~~~								
Loblolly-shortleaf	845.3	-26.9	112.0	20.9	1,331.4	-1,018.8	3,569.4	1,388.5
Eastern red cedar	6.9	6.0	12.5	-9.3	5.9	-0.1	276.5	4.9
Oak-pine	384.8	17.5	81.0	-19.1	198.8	-117.1	1,228.2	-89.2
Oak-hickory	1,292.9	58.4	316.9	7.3	414.2	-153.8	5,781.9	183.5
Oak-gum-cypress	4.8	0.4	483.0	2.3	186.5	-205.1	1,347.3	172.9
Elm-ash-cottonwood	0.0	-10.6	131.9	-12.3	87.3	4.9	755.3	100.4
Misc. hardwood	1.5	-10.5	0.0	-6.0	3.6	9.6	20.5	-9.6
Nonstocked	1.4	-4.4	21.3	19.9	19.8	-10.9	116.9	26.0
<b>All groups</b>	<b>2,537.6</b>	<b>29.8</b>	<b>1,158.6</b>	<b>3.6</b>	<b>2,247.6</b>	<b>-1,491.2</b>	<b>13,095.9</b>	<b>1,777.3</b>

Numbers in columns may not sum to totals due to rounding.  
 0.0 = no sample for the cell or a value >0.0 but <0.05.  
 NIPF = nonindustrial private forest.



A planted loblolly pine (*Pinus taeda*) stand acquired from Weyerhaeuser Company in the late 1990s, Ouachita National Forest, Scott County, AR.

while NIPF gained 1.4 million acres. In 2015, most of the FTGs on forest industry land decreased (with the exception of the elm-ash-cottonwood and miscellaneous hardwood FTGs) while most of the FTGs on NIPF increased (exceptions were the oak-pine and miscellaneous hardwood FTGs).

In 2015, several interesting patterns emerged regarding the distribution of the six FTGs by ownership. NIPF owners held the majority of the oak-hickory FTG (table 6). These 5.8 million acres were 30 percent of all forest land in the State and 44 percent of the NIPF forest land, a slight drop in proportion since the 2010 forest survey due to the addition of 1.4 million acres of the loblolly-shortleaf pine FTG. It is also interesting to note that NIPF lands held 2.1 million acres of bottomland hardwoods (oak-gum-cypress and elm-ash-cottonwood), which accounted for 70 percent of all bottomland hardwood stands in the State (table 6).

In 2015, the forest industry ownership category held only 23 percent of the loblolly-shortleaf pine FTG in Arkansas; a substantial decline from the 43 percent held by forest industry in the 2010 forest survey. In 2015, forest industry held 1.3 million acres (a 1.0-million-acre decline) of the loblolly-shortleaf pine FTG; this was 59 percent of all forest industry lands (table 6).

Another unique aspect of ownership patterns was that most of the other public lands were still in the bottomland hardwood FTGs with 53 percent of all of its forest land in this ownership category. In contrast, the national forest ownership had virtually no bottomland hardwoods. Here, the majority of forest land remained in the oak-hickory FTG (51 percent) followed by the loblolly-shortleaf pine (33 percent) FTG (table 6). A slight increase in the oak-hickory FTG accounted for most of the change (58,400 acres) in the national forest ownership category.

In 2015, there were concerns about the decline of two species (white oak and shortleaf pine), both in Arkansas and across the Southern United States. Additionally, it was important to monitor the impact and changes in the areal extent of forest communities in which these two species occurred as well as the absolute decline in each species. These baseline data were important tools for monitoring future changes in the white oak and shortleaf pine forest types.

The white oak forest type was based on dominance typing and was the amount of

forest area in which white oak was either the number 1-, 2-, or 3-ranked species on the FIA plot (using basal area as the importance value). In 2015, there were 4.6 million acres of forest land in the white oak forest type, a 87,646-acre drop since the 2010 forest survey (-1.9 percent). Although the white oak forest type was spread across most of Arkansas, heaviest concentrations were in the Ouachita Mountains and the Boston Mountain regions (fig. 4). The Mississippi Alluvial Plain had the lowest concentrations of the white oak forest type with no FIA records for six counties.

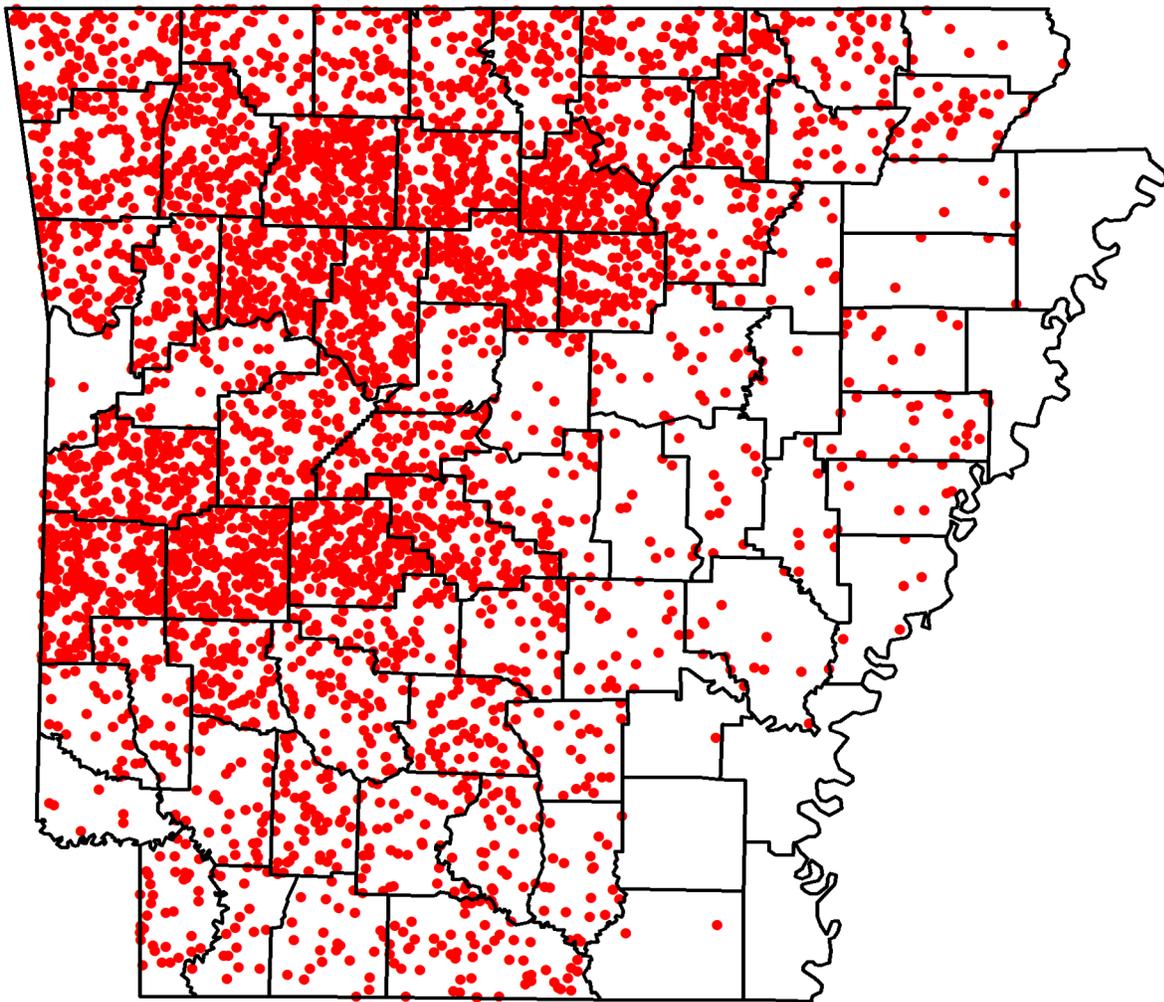


Figure 4—Spatial distribution of white oak forest type, Arkansas, 2015. Each dot represents 1,000 acres of forest land in the white oak type (where white oak is the number 1, 2, or 3 dominant species in the stand). See methods section for map methodology. This map represents 4,629,630 acres of white oak forest type.

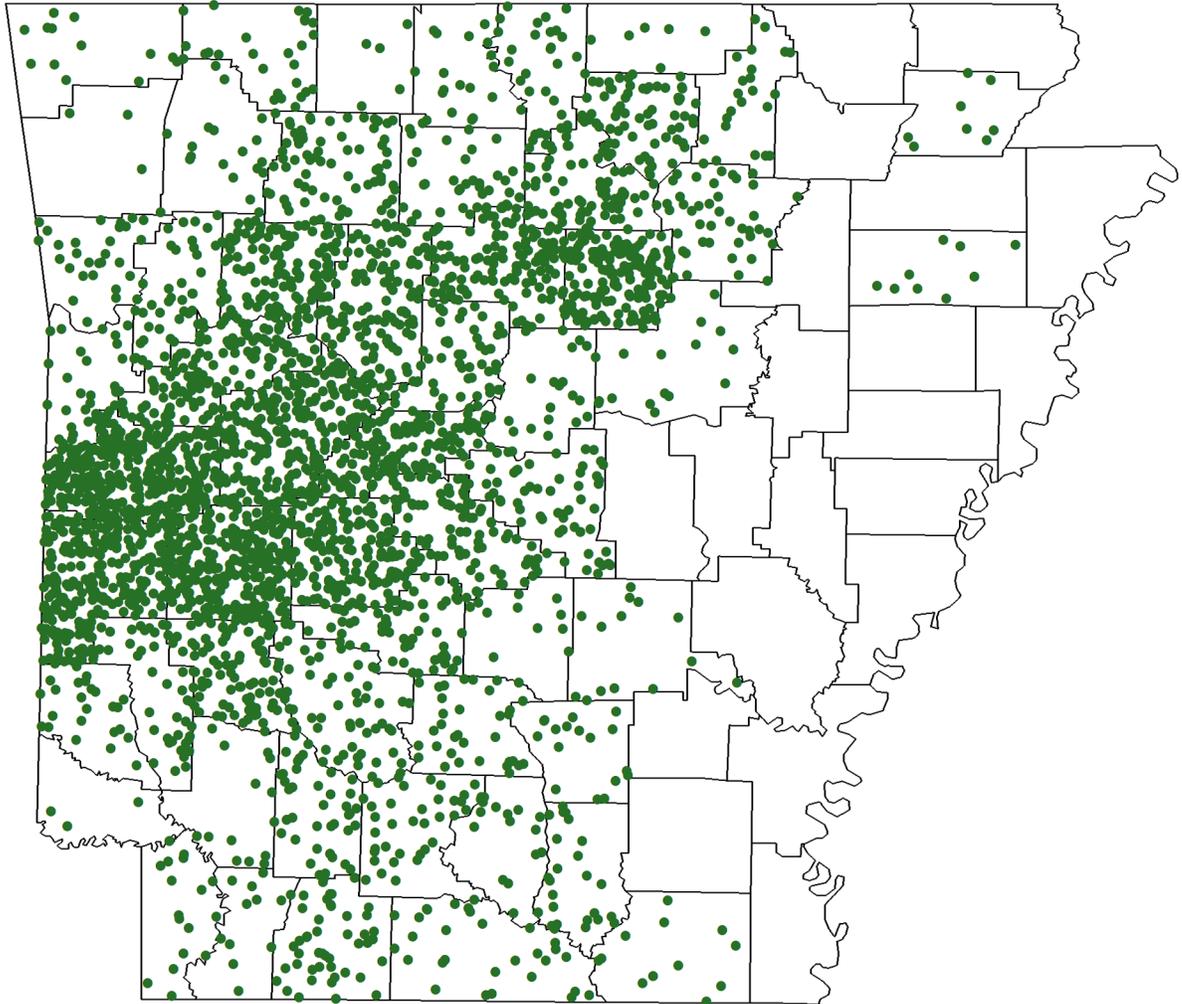


Figure 5—Spatial distribution of shortleaf pine forest type, Arkansas, 2015. Each dot represents 1,000 acres of forest land in the shortleaf pine type (where shortleaf pine is the number 1, 2, or 3 dominant species in the stand). See methods section for map methodology. This map represents 3,401,857 acres of shortleaf pine forest type.

The same dominance parameters, as used for white oak, were used to define the shortleaf pine forest type. In 2015, there were 3.4 million acres of forest land in the shortleaf pine forest type. This amount was 115,484-acres less than what was reported in the 2010 forest survey (-3.3 percent). The shortleaf pine forest type was spread across Arkansas with heaviest concentrations in the Ouachita Mountains and the eastern portion of the Boston Mountains (fig. 5). Lowest concentrations of shortleaf pine were in the Mississippi Alluvial Plain. As expected, no evidence of the shortleaf pine forest type was found in 15 counties.

## OWNERSHIP

Forest land ownership was an important component of forest survey because it carried an implication of the potential type of management or stand treatment on respective forest lands. This activity may range from intense management activity (such as carried out on forest industry lands) or no management activity (as often happens with many NIPF owners). A comprehensive understanding of the forest land ownership breakdown in a respective State helps to guide and refine forest policy formulation and strategies.

The FIA program collects forest land ownership information during the sampling phase of plot remeasurement. There are many different types of owners (most notably in the other public sector owner category) that were grouped into four major classes during data reduction: (1) national forest, (2) other public, (3) forest industry, and (4) NIPF. These four ownership categories have been historically reported in the South over the last 60+ years. Since the 1990s, the forest industry ownership category has been affected by TIMO and REIT structuring. In 2015, there were various difficulties and issues identifying TIMOs or REITs as forest landowners on individual sample plots. Therefore, FIA did not formally assign TIMOs or REITs to individual sample plots. Users should be aware that many transfers of forest industry land into a TIMO or REIT could end up in the NIPF owner category. See Arkansas’ Forests, 2010 (Rosson and Rose 2015) for more details on the TIMO and REIT issue and how it impacts FIA ownership. It is important to understand how these lands are managed because of their impact on future forests in Arkansas. These types of investment portfolios are managed to yield short-term client returns. In some situations, it may not be the best option for

forest management when applied to the respective forest resource in comparison to traditional forest industry ownership applications.

Across the United States, there are an estimated 25 million acres worth 30 billion dollars in the TIMO category and 17 million acres worth 28 billion dollars in the REIT category (Fernholz and others 2007). In 2015, land transfer levels were not available, but acreage was expected to increase into the future (Hickman 2007).

In 2015, the majority of Arkansas forest land (69 percent) was held in the NIPF ownership category. Since the 2010 survey, there was little change in forest land ownership in the national forest and other public categories (table 7). In 2015, there was substantial change in the forest industry and NIPF categories, where forest industry lost 1.5 million acres of forest land and NIPF gained 1.8 million acres. The majority of these changes in the forest industry and NIPF categories were attributed to the TIMO and REIT transfers. The Southwest unit accounted for >90 percent of the forest land shift in the State. This coincides with the large forest industry presence in this unit.

**Table 7**—Area of forest land by survey unit, ownership class, and change, Arkansas 2010–2015

Survey unit	Total 2015	Ownership class							
		National forest		Other public		Forest industry		NIPF	
		2015	Change	2015	Change	2015	Change	2015	Change
~~~~~ thousand acres ~~~~~									
South Delta	1,472.9	27.1	3.2	311.6	30.1	135.5	-27.6	998.7	78.0
North Delta	805.2	0.0	0.0	149.4	3.6	6.1	-6.2	649.7	39.8
Southwest	6,945.2	12.5	-0.3	226.6	-15.1	1,507.2	-1,305.4	5,198.8	1,454.5
Ouachita	3,448.5	1,469.5	22.2	171.6	-12.2	415.4	-124.8	1,392.1	189.5
Ozark	6,368.0	1,028.5	4.7	299.5	-2.7	183.4	-27.2	4,856.6	15.5
<b>All units</b>	<b>19,039.8</b>	<b>2,537.6</b>	<b>29.8</b>	<b>1,158.6</b>	<b>3.6</b>	<b>2,247.6</b>	<b>-1,491.2</b>	<b>13,095.9</b>	<b>1,777.3</b>

Numbers in rows and columns may not sum to totals due to rounding.  
 0.0 = no sample for the cell or a value >0.0 but <0.05.  
 NIPF = nonindustrial private forest.

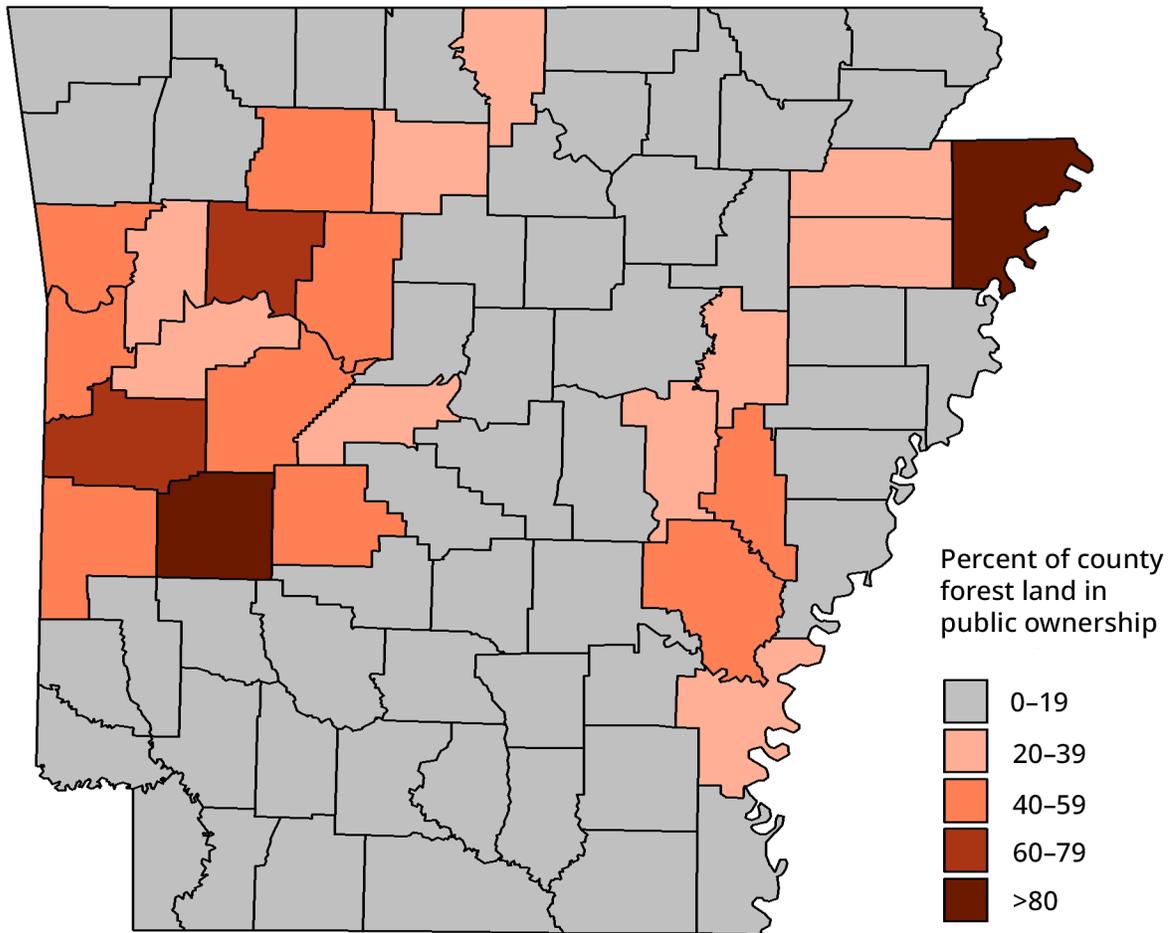


Figure 6—Percent of county forest land in public ownership, Arkansas, 2015. The reciprocal of this would be the amount of forest land in private ownership. For example, if 20 percent of a county’s forest land is in public ownership, then 80 percent would be in private ownership.

Arkansas had 23 counties with  $\geq 20$  percent of forest land in public ownership (fig. 6). There was a large proportion of county forest land in public ownership in Mississippi and Montgomery Counties, 95 and 85 percent, respectively. Note that Mississippi County had very little total forest land (28,000 acres) so the high proportion of forest owners in a specific owner category may be distorted. Figure 6 shows the distribution of public and private ownership by county. The map illustrates public ownership, but private ownership can be derived by taking the reciprocal of the public estimate. For example, Mississippi County in the northeast shows  $\geq 80$  percent of forest land in public ownership. This means the reciprocal would be  $< 20$  percent of the counties forest land was in NIPF. The majority

of Arkansas’s public ownership was in the West Central region and in a portion of the Mississippi River Alluvial Plain.

Regionally, the Southwest unit held the highest amount of forest industry land, 22 percent of all forest land in the unit and 67 percent of all forest industry land across the State. However, this was a substantial change since the 2010 survey with 1.3 million acres lost due to the impact of the TIMO/REIT transfers (table 7).

The highest proportion of forest land in other public ownership was in the South Delta unit, 27 percent (311,600 acres) followed closely by the Ozark unit with 299,500 acres (26 percent). Additionally, there were 226,600 acres of

other public forest land in the Southwest unit. Together, these three units accounted for 72 percent of other public ownership, but across Arkansas this was only 4 percent of all forest land area.

In 2015, the NIPF ownership had more forest land in every survey unit than all of the other three ownership categories combined. An exception was the Ouachita unit in the national forest ownership category. There, the national forest ownership category had 77,400 acres more than the NIPF ownership category.

Finally, the Ouachita unit had the highest concentration and highest amount of national forest land, 43 percent and 1.5 million acres, respectively. The Ozark unit followed with 1.0 million acres. In the South Delta, North Delta, and Southwest survey units, there was very little national forest land.

Most of the ownership change dynamics between 2010 and 2015 occurred in the Southwest unit. The Southwest unit accounted for 82 percent of the 1.8 million-acre increase in NIPF. Similarly, the Southwest unit accounted for 88 percent of the 1.5 million acre decrease in forest industry. This was mainly due to the offsets that came from the TIMO/REIT land transfers.

## STAND INVENTORY

In this report, the cubic-foot volume and board-foot volume descriptors were used to identify the forest resource inventory. Since its establishment in the 1930s, forest survey has used the traditional cubic-foot and board-foot volume descriptors. Users working with weights or carbon can apply their own conversions or use FIA conversions, as needed, to the data. In FIA processing, tree volume was first calculated, then the appropriate conversions were applied to get estimates of biomass weight and carbon.

Since the 2010 inventory, the total live-tree volume increased by 8 percent to 31.6 billion cubic feet in 2015. In 2015, 41 percent of all live tree volume was in softwoods and 59 percent was in hardwoods, which indicated an increase of 3 percent in the softwood proportion and a subsequent decrease of 3 percent in the hardwood proportion since 2010.

The sawtimber inventory was 107.0 billion board feet, an overall increase of 10 percent in the total sawtimber volume since 2010. In 2015, 49 percent of this sawtimber forest resource was softwoods, while 51 percent was hardwoods, reflecting a 2-percent increase in the softwood proportion and a subsequent 2-percent decline in the hardwood proportion. This change in the sawtimber inventory also indicated a continuing shift towards softwoods.

## Softwood Inventory

In 2015, the softwood inventory was 12,920.9 million cubic feet, an increase of 1,703.2 million cubic feet since the 2010 forest survey (table 8). The Southwest survey unit accounted for 62 percent of the inventory increase in 2015. The softwood inventory increased in all of the survey units in 2015.

**Table 8**—Live-tree volume of softwoods on forest land by survey unit, year of survey, and change, Arkansas, 2010 and 2015

Survey unit	Year		Change
	2010	2015	
~~~~~ million cubic feet ~~~~~			
South Delta	451.6	585.2	133.6
North Delta	160.6	175.3	14.7
Southwest	5,953.2	7,003.2	1,050.1
Ouachita	2,856.8	3,230.7	373.9
Ozark	1,795.6	1,926.4	130.8
<b>All units</b>	<b>11,217.8</b>	<b>12,920.9</b>	<b>1,703.2</b>

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

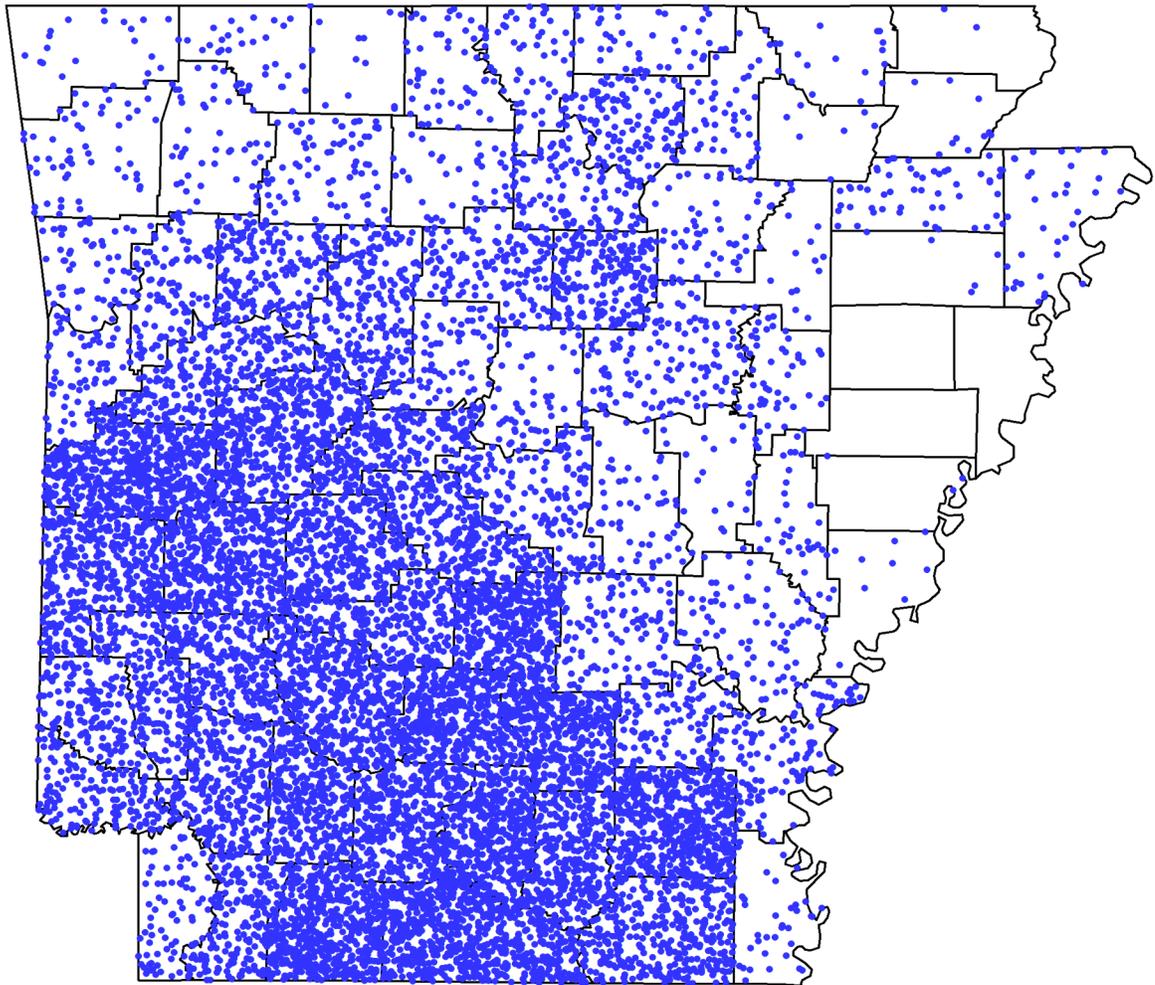


Figure 7—Softwood volume, Arkansas, 2015. Each dot represents 1,000,000 cubic feet of live-tree volume. See methods section for map methodology.

In 2015, the softwood inventory was spread across the State with the exception of no occurrence in four counties in the Mississippi Alluvial Plain (fig. 7). The heaviest concentrations of softwood inventory were in the southern and western regions of Arkansas.

In 2015, the NIPF ownership category held the majority of the softwood volume (7,861.9 million cubic feet). The forest industry ownership category showed a notable change in the softwood inventory; a 1,217.2 million-cubic-foot decline since 2010 (table 9). In turn, much of this volume was transferred to the NIPF ownership category where it increased by 2,645.0 million cubic feet. As discussed previously, TIMO/REIT has impacted forest industry forest lands. For the first time in

several decades, the softwood inventory on forest industry lands was below that of national forest lands.

**Table 9**—Live-tree volume of softwoods on forest land by ownership class, year of survey, and change, Arkansas, 2010 and 2015

Ownership class	Year		Change
	2010	2015	
~~~~~ million cubic feet ~~~~~			
National forest	2,176.9	2,383.3	206.4
Other public	617.0	685.9	69.0
Forest industry	3,207.0	1,989.8	-1,217.2
NIPF	5,216.9	7,861.9	2,645.0
<b>All classes</b>	<b>11,217.8</b>	<b>12,920.9</b>	<b>1,703.2</b>

Numbers in column may not sum to totals due to rounding.  
NIPF = nonindustrial private forest.

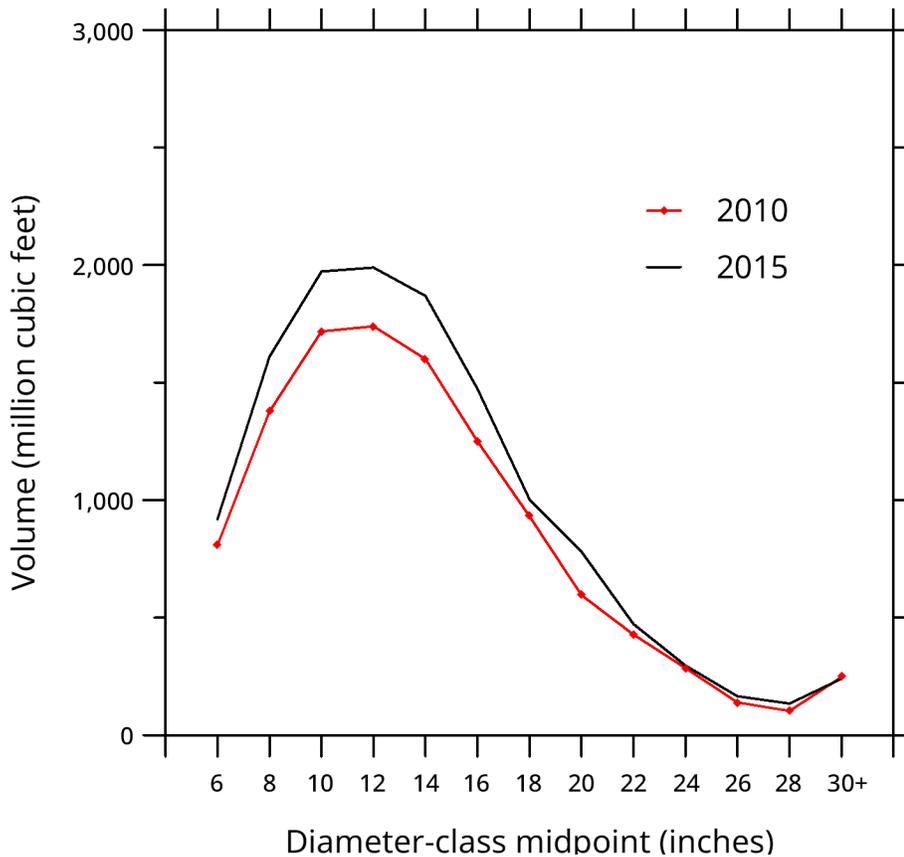


Figure 8—Softwood live-tree volume by diameter class, Arkansas, 2010 and 2015. The labels on the x-axis are the 2-inch d.b.h. midpoints, e.g., the 6-inch d.b.h. midpoint value represents trees ranging from 5.0 to 6.9 inches d.b.h.

In 2015, softwood volume increased by 15 percent across all diameter classes (fig. 8). The most significant volume increases occurred in the 8- to 16-inch diameter classes. Little change was noted in the diameter classes >22 inches. Based on a comparison of the curves from 2010 and 2015 (fig. 8), the softwood resource has continued to mature. Most of the volume increase occurred in the smaller sawlog-size classes.

### Softwood Sawtimber

In 2015, the softwood sawtimber inventory was 52,362.3 million board feet (table 10), an increase of 6,491.3 million board feet (14 percent) since the 2010 inventory. The Southwest and Ouachita survey units held 81 percent of softwood sawtimber volume. The increase of 6,491.3 million board feet was

another sign of Arkansas’s maturing forest. The Delta units accounted for only 6 percent of the softwood sawtimber resource.

**Table 10**—Board-foot volume of sawtimber softwoods on forest land by survey unit, year of survey, and change, Arkansas, 2010 and 2015

Survey unit	Year		Change
	2010	2015	
~~~~~ million board feet' ~~~~~			
South Delta	2,090.3	2,504.3	414.0
North Delta	707.3	728.5	21.3
Southwest	25,540.9	28,877.6	3,336.7
Ouachita	11,520.6	13,618.5	2,097.9
Ozark	6,011.9	6,633.3	621.4
<b>All units</b>	<b>45,871.0</b>	<b>52,362.3</b>	<b>6,491.3</b>

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

<sup>1</sup> International 1/4-inch rule.

**Table 11**—Board-foot volume of sawtimber softwoods on forest land by ownership class, year of survey, and change, Arkansas, 2010 and 2015

Ownership class	Year		Change
	2010	2015	
~~~~~ million board feet <sup>1</sup> ~~~~~			
National forest	9,296.3	10,555.3	1,259.0
Other public	2,989.2	3,391.4	402.2
Forest industry	12,283.7	7,454.4	-4,829.3
NIPF	21,301.8	30,961.2	9,659.3
<b>All classes</b>	<b>45,871.0</b>	<b>52,362.3</b>	<b>6,491.3</b>

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

NIPF = nonindustrial private forest.

<sup>1</sup> International 1/4-inch rule.

In 2015, NIPF forest lands held 59 percent of softwood sawtimber (table 11). A loss of 4,829.3 million board feet was noted on forest industry lands. Again, the TIMO/REIT transfers impacted forest industry lands. The evidence of a maturing softwood sawtimber resource on national forest lands was the increase of 1,259.0 million board feet (14 percent) since the 2010 forest survey (table 11).

## Hardwood Inventory

The hardwood inventory live-tree volume increased by 637.2 million cubic feet (table 12) to 18,643.5 million cubic feet (a 4-percent

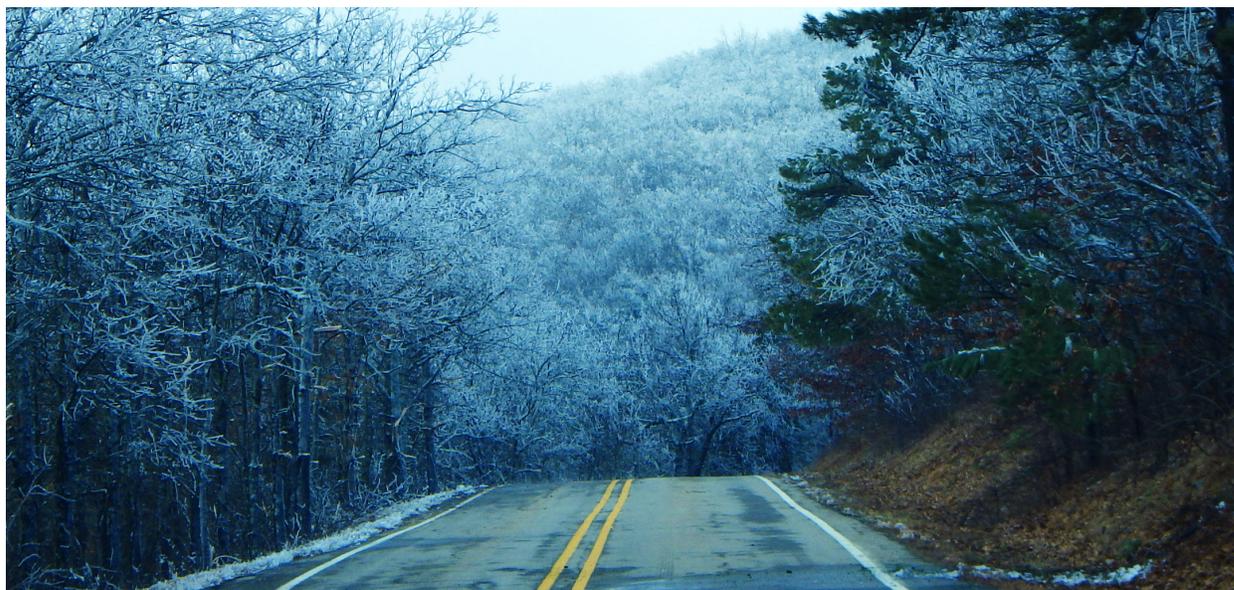
**Table 12**—Live-tree volume of hardwoods on forest land by survey unit, year of survey, and change, Arkansas, 2010 and 2015

Survey unit	Year		Change
	2010	2015	
~~~~~ million cubic feet ~~~~~			
South Delta	2,259.0	2,554.1	295.0
North Delta	1,319.6	1,341.5	21.9
Southwest	4,664.1	4,732.0	68.0
Ouachita	2,295.8	2,496.3	200.5
Ozark	7,467.9	7,519.7	51.9
<b>All units</b>	<b>18,006.3</b>	<b>18,643.5</b>	<b>637.2</b>

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

increase) since the 2010 survey. This increase was slightly down from the 5-percent increase between the 2005 and 2010 forest surveys. In 2015, the majority of volume was in the Ozark and Southwest survey units; however, most of the hardwood volume increases were in the South Delta unit followed by the Ouachita unit.

The spatial distribution of the hardwood inventory was spread across the State. There were no counties without a hardwood presence (fig. 9). Among the heaviest concentrations were in the Boston Mountains region, part of the Ozark survey unit, and a



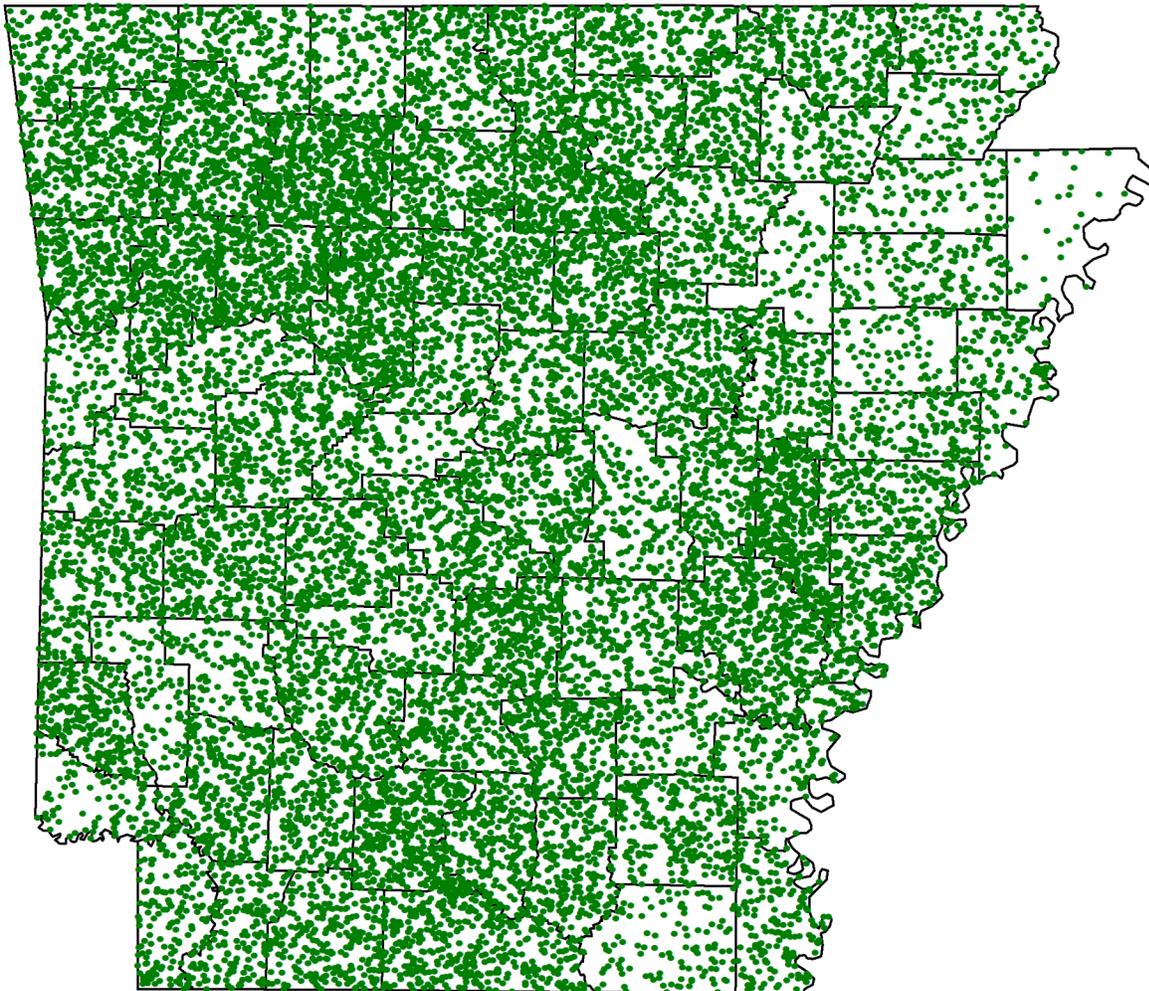


Figure 9—Hardwood volume, Arkansas, 2015. Each dot represents 1,000,000 cubic feet of live-tree volume. See methods section for map methodology.

central portion of the Mississippi Alluvial Plain. In 2015, the Ozark unit contained 40 percent of the Arkansas hardwood resource.

Hardwood was primarily owned by NIPF ownership which held 68 percent of all hardwood resources (table 13). The forest industry ownership lost 640.9 million cubic feet of hardwood volume due to the impact of TIMO and REIT ownership transfers, the same as happened with the softwood inventory.

Similar to softwoods, most of the hardwood volume was in the 8- to 16-inch diameter classes (fig. 10). In contrast to softwoods, most of the increased volume was in the larger

**Table 13**—Live-tree volume of hardwoods on forest land by ownership class, year of survey, and change, Arkansas, 2010 and 2015

Ownership class	Year		Change
	2010	2015	
	~~~~~ million cubic feet ~~~~~		
<b>National forest</b>	2,604.2	2,695.1	90.9
<b>Other public</b>	2,185.6	2,211.6	26.0
<b>Forest industry</b>	1,782.8	1,141.9	-640.9
<b>NIPF</b>	11,433.7	12,594.9	1,161.2
<b>All classes</b>	18,006.3	18,643.5	637.2

Numbers in column may not sum to totals due to rounding.  
NIPF = nonindustrial private forest.

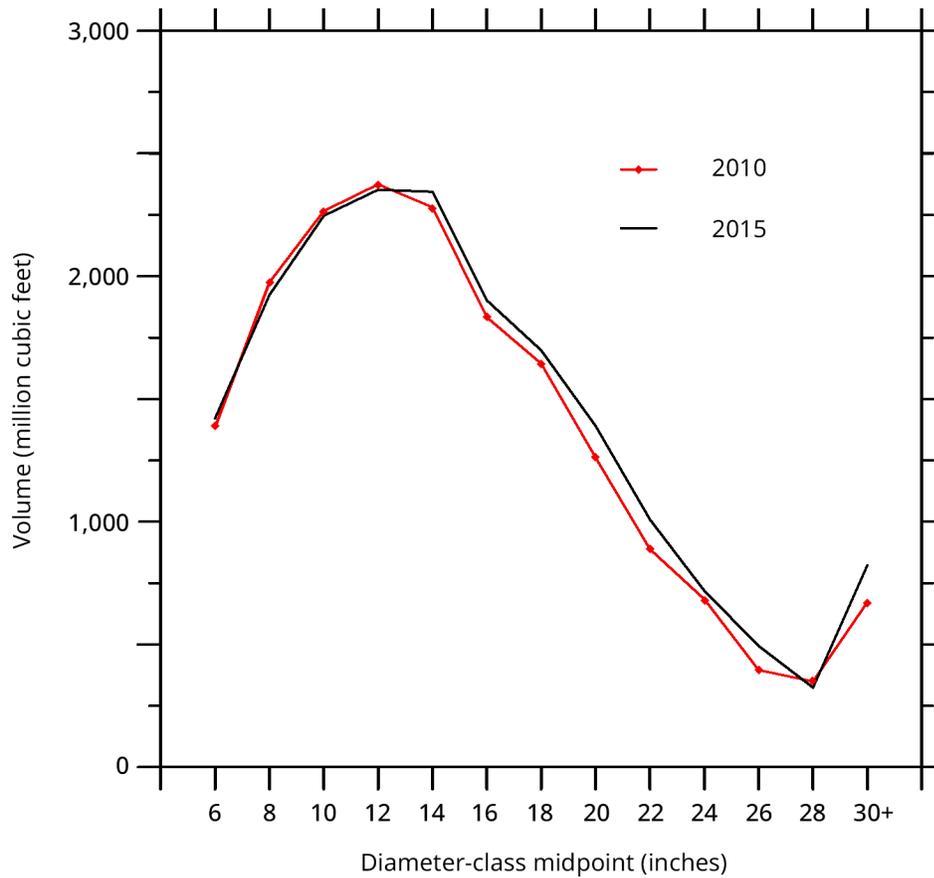


Figure 10—Hardwood live-tree volume by diameter class, Arkansas, 2010 and 2015. The labels on the x-axis are the 2-inch d.b.h. midpoints, e.g., the 6-inch d.b.h. midpoint value represents trees ranging from 5.0 to 6.9 inches d.b.h.

diameter classes (16- to 28-inch diameter classes). The increased volume is a strong indication of the continued maturing of the hardwood resource.

The hardwood sawtimber inventory volume increased from 51,366.7 million board feet in 2010 to 54,606.1 million board feet (a 6-percent increase) in 2015. The South Delta survey unit contained most of the increase (45 percent) (table 14). This was good news for the bottomland hardwood resource.

The NIPF ownership class had most (65 percent) of the hardwood sawtimber volume (table 15). The largest increase was also in the NIPF ownership, but again, this was largely due to the TIMO/REIT ownership transfers that showed up as a large loss in forest industry lands with a subsequent gain in the NIPF hardwood inventory. Since the

2005 inventory, approximately 2,902.6 million board feet have been lost (or transferred) from the forest industry ownerships.

**Table 14**—Board-foot volume of sawtimber hardwoods on forest land by survey unit, year of survey, and change, Arkansas, 2010 and 2015

Survey unit	Year		Change
	2010	2015	
~ ~ ~ ~ ~ million board feet <sup>1</sup> ~ ~ ~ ~ ~			
South Delta	8,314.8	9,771.2	1,456.4
North Delta	4,385.2	4,378.2	-7.0
Southwest	14,132.9	14,758.3	625.4
Ouachita	5,691.0	6,316.4	625.4
Ozark	18,842.9	19,382.0	539.1
<b>All units</b>	<b>51,366.7</b>	<b>54,606.1</b>	<b>3,239.4</b>

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

<sup>1</sup> International 1/4-inch rule.

**Table 15**—Board-foot volume of sawtimber hardwoods on forest land by ownership class, year of survey, and change, Arkansas, 2010 and 2015

Ownership class	Year		Change
	2010	2015	
~~~~~ million board feet' ~~~~~			
National forest	6,814.0	7,264.8	450.9
Other public	8,287.0	8,543.5	256.4
Forest industry	5,156.0	3,562.6	-1,593.4
NIPF	31,109.7	35,235.2	4,125.5
All classes	51,366.7	54,606.1	3,239.4

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

NIPF = nonindustrial private forest.

' International 1/4-inch rule.

### Species Volume

The live-tree volume in species groupings have traditionally been reported by FIA since the inception of the forest survey. Loblolly pine increased from 6.5 billion cubic feet in 2010 to 7.9 billion cubic feet in 2015 (fig. 11). Shortleaf pine remained stable with a slight

increase since the 2010 forest survey. This is good news since the reported declines started in the 1980s. Eastern red cedar and baldcypress increased only slightly in live-tree volume.

Hardwoods are dominated by the other red oak and select white oak species groups (fig. 12). For the first time, both the other red oak and select red oak species groups have declined in the hardwood inventory. The volume increased in the remainder of hardwood groups. Most likely, this reflected the lag time from the red oak borer (*Enaphalodes rufulus*) outbreak and oak decline over the last 20 years. The white oak and red oak groups made up 55 percent of the 2015 hardwood inventory.

In the 2015 forest survey, there were 100 tree species sampled for volume (all trees >5.0 inches in diameter) (table 16). The 75 top-ranked species accounted for over 99 percent of the inventory. Forest inventories,

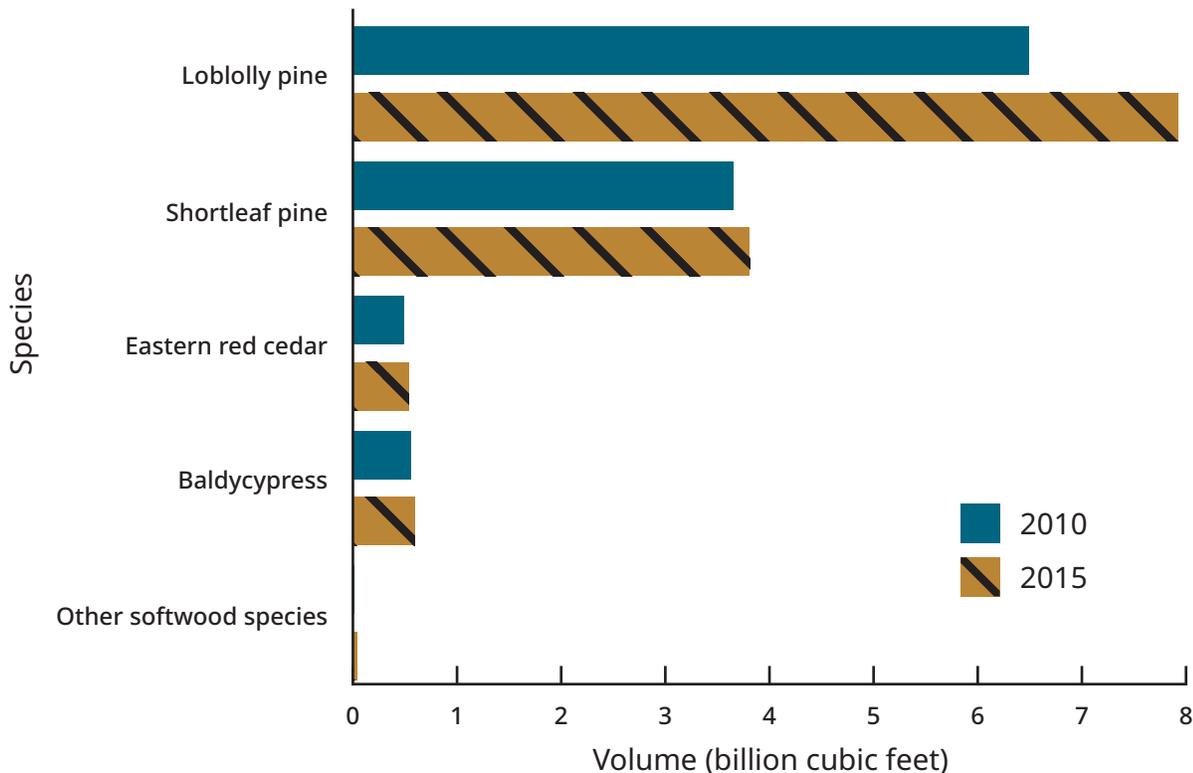


Figure 11—Softwood live-tree volume on forest land by species, Arkansas, 2010 and 2015.

# Stand Inventory

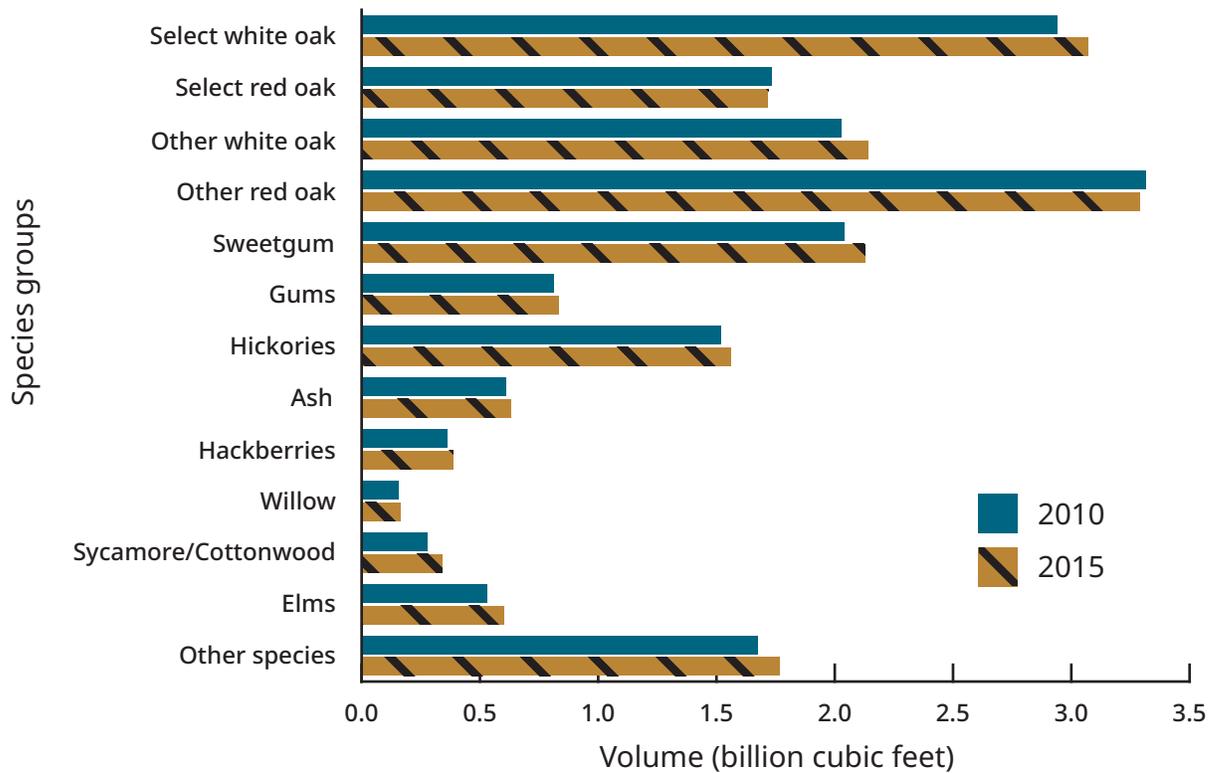


Figure 12—Hardwood live-tree volume on forest land by species group, Arkansas, 2010 and 2015. (See [select white oak](#) and [select red oak](#) definitions in the glossary).

**Table 16**—Ranking and comparison of live-tree volume by species on forest land, Arkansas, 2010 and 2015

Species	FIA species code	Live-tree volume		
		2015	2010	Change
~~ million cubic feet ~~				
Loblolly pine	131	7,913.5	6,491.2	1,422.3
Shortleaf pine	110	3,803.0	3,655.8	147.2
White oak	802	2,876.4	2,759.6	116.8
Sweetgum	611	2,127.8	2,043.5	84.3
Post oak	835	1,557.3	1,512.7	44.6
Northern red oak	833	951.0	1,004.7	-53.7
Southern red oak	812	818.5	850.5	-32.0
Black oak	837	809.0	926.4	-117.4
Water oak	827	696.2	676.0	20.2
Cherrybark oak	813	690.6	653.1	37.5
Black hickory	408	646.4	660.9	-14.5
Willow oak	831	644.6	590.6	54.0

**Table 16**—Ranking and comparison of live-tree volume by species on forest land, Arkansas, 2010 and 2015 (continued)

Species	FIA species code	Live-tree volume		
		2015	2010	Change
~~ million cubic feet ~~				
Baldcypress	221	584.7	560.0	24.7
Overcup oak	822	583.7	510.0	73.7
Eastern red cedar	68	581.7	492.6	89.1
Mockernut hickory	409	541.8	520.3	21.5
Green ash	544	491.7	471.1	20.6
Blackgum	693	481.5	482.4	-0.9
Water tupelo	691	352.5	328.7	23.8
Sugarberry	461	325.1	305.5	19.6
Nuttall oak	828	307.7	269.7	38.0
Red maple	316	302.0	274.0	28.0
Winged elm	971	250.0	224.7	25.3
American sycamore	731	194.8	159.3	35.5

**Table 16**—Ranking and comparison of live-tree volume by species on forest land, Arkansas, 2010 and 2015 (continued)

Species	FIA species code	Live-tree volume		
		2015	2010	Change
~~ million cubic feet ~~				
Shagbark hickory	407	191.9	171.0	20.9
American elm	972	178.5	154.5	24.0
Black willow	922	166.3	150.8	15.5
Water hickory	401	163.0	151.1	11.9
Slippery elm	975	147.8	115.9	31.9
Black cherry	762	147.1	140.5	6.6
Eastern cottonwood	742	145.2	120.3	24.9
White ash	541	136.1	139.5	-3.4
American beech	531	119.4	124.0	-4.6
Florida maple	311	110.4	97.6	12.8
Bitternut hickory	402	108.5	92.3	16.2
Pecan	404	105.7	91.1	14.6
Swamp chestnut oak	825	101.0	100.8	0.2
Chinkapin oak	826	91.9	77.9	14.0
Black walnut	602	89.2	76.6	12.6
Boxelder	313	82.9	70.6	12.3
Shumard oak	834	77.7	74.9	2.8
Pignut hickory	403	73.0	71.9	1.1
Blackjack oak	824	69.5	91.2	-21.7
Silver maple	317	63.7	57.1	6.6
Hackberry	462	62.7	56.1	6.6
Common persimmon	521	62.4	54.8	7.6
Honeylocust	552	52.4	52.0	0.4
American holly	591	46.7	45.1	1.6
American hornbeam	391	37.7	45.5	-7.8
Ashe juniper	61	37.0	18.2	18.8
Water-elm planertree	722	36.9	31.3	5.6
River birch	373	30.0	25.6	4.4

**Table 16**—Ranking and comparison of live-tree volume by species on forest land, Arkansas, 2010 and 2015 (continued)

Species	FIA species code	Live-tree volume		
		2015	2010	Change
~~ million cubic feet ~~				
Sassafras	931	28.1	31.1	-3.0
Cedar elm	973	26.3	34.5	-8.2
Waterlocust	551	26.1	25.0	1.1
Sweetbay	653	25.9	26.6	-0.7
Black locust	901	24.5	24.4	0.1
Eastern hophornbeam	701	22.9	25.2	-2.3
American basswood	951	22.4	19.4	3.0
Yellow-poplar	621	22.1	14.0	8.1
Eastern redbud	471	10.2	9.6	0.6
Red mulberry	682	9.9	9.1	0.8
Flowering dogwood	491	9.6	12.0	-2.4
Osage-orange	641	9.1	10.6	-1.5
Cucumbertree	651	7.0	3.8	3.2
Laurel oak	820	6.2	2.8	3.4
Sugar maple	318	5.5	14.2	-8.7
Pin oak	830	5.1	0.0	5.1
Serviceberry spp.	356	4.1	4.5	-0.4
Butternut	601	2.8	2.8	0.0
Ailanthus	341	2.8	2.6	0.2
Shingle oak	817	2.5	0.6	1.9
Chinaberry	993	2.4	1.1	1.3
Bur oak	823	2.1	3.6	-1.5
Umbrella magnolia	658	2.1	3.4	-1.3
<b>Total top 75 species</b>		31,545.8	29,202.4	2,343.4
<b>Remaining 25 species</b>		18.8	21.5	-2.7
<b>Total</b>		31,564.6	29,223.9	2,340.7

Species are ranked by the 2015 inventory.  
Numbers in columns may not sum to totals due to rounding.  
FIA = Forest Inventory and Analysis

such as this one for Arkansas, typically show an oligarchic distribution, e.g., most of the volume is concentrated in a very few dominant species. The top five species accounted for 58 percent of the volume (a 2-percent increase since the 2010 forest survey). The top 10 species accounted for 70 percent of the volume (no change since the 2010 forest survey). The top 20 species made up 87 percent of the total volume in the State. The top 30 species made up 93 percent of total volume and the top 40 species made up 97 percent of total volume. The remaining 60 species contributed only 3 percent to Arkansas's timber inventory.

Loblolly pine is clearly the dominant tree in the State (table 16). The loblolly pine volume was 7,913.5 million cubic feet in 2015. The loblolly pine volume increased by 1,422.3 million cubic feet since the 2010 forest survey. Table 16 lists the 75 most dominant tree species, which accounted for slightly more than 99 percent of the Arkansas live-tree volume in 2015.

Of the top 75 species, 19 had losses in volume. In 2015, black oak had the largest volume loss at 117.4 million cubic feet. Northern red oak and southern red oak followed with 53.7 and 32.0 million cubic foot losses, respectively. Readers that wish to compare changes in species ranking and change in species volumes since the 2010 survey are referred to table 16 in Rosson and Rose (2015).

Similar to the 2005 and 2010 surveys, oaks made up 7 of the top 10 species in 2015, conifers made up 2 of the top 10 species, and sweetgum was the remaining species (table 16). In 2015, black hickory dropped out of the

top 10 species in Arkansas while loblolly pine continued to be the predominant tree species in Arkansas. The proportion of loblolly pine in the total Arkansas inventory increased from 22 percent in 2010 to 25 percent in 2015. The proportion of it in the total softwood inventory increased from 58 percent in the 2010 to 61 percent in 2015. Loblolly pine was definitely the preferred tree species of forest management in Arkansas. The dominance of loblolly pine will likely continue or increase over time due to the combination of its superb natural regeneration capabilities and it being the preferred species in forest industry and NIPF pine plantation management (Schultz 1997). This is especially true on the Coastal Plain of southern Arkansas. The loblolly pine volume of 7,913.5 million cubic feet was striking when compared to shortleaf pine the second dominant tree species in the State. In 2015, the volume of loblolly pine was more than double that of shortleaf pine. Even though shortleaf pine was ranked second, it still made up a respectable 3,803.0 million cubic feet of volume, much more than even the highest ranked hardwood. In 2015, white oak was ranked third overall, and first of the hardwoods with 2,876.4 million cubic feet of volume. White oak continued to make up 9 percent of the total volume in the State (no change since 2010) and 15 percent of the total hardwood volume, again no change since 2010.

Of all the tree species, loblolly pine increased the most in volume (1,422.3 million cubic feet) since the 2010 forest survey. Most of the species increased since the 2010 forest survey. Of the top 20 tree species, northern red oak, southern red oak, black oak, black hickory, and blackgum decreased in volume in 2015 (table 16).

### Effective Density, Softwood

Effective density analysis is an important tool that describes how the forest resource is distributed across the landscape. In this application, analysis was based upon the arbitrary classification of forest stands by respective amounts of stand volume. The amount of forest land and total volume was then determined for each identified stand category. Ideally, a fairly even distribution of volume and forest land area was spread among the stand volume classes. Large departures from this may indicate future resource issues, especially in procurement. For further discussion about effective density analysis, see Rosson and Rose (2015).

An obvious repeating pattern was seen in the effective density graphs. A large portion of Arkansas’s forest land contained a small

amount of volume and a small portion of forest land contained a large portion of the total State volume. In both live and sawtimber volumes, this held true for the softwood and hardwood group.

This general distribution pattern was evident in Arkansas’s softwood live-tree volume. In 2015, approximately, 65 percent of the State’s forest land had only 6 percent of its 12.9 billion cubic feet of volume (fig. 13). These were forest stands with <500 cubic feet of softwood live-tree volume per acre. The stands were most likely immature softwood stands or stands that typically had few or no softwood species present, such as upland hardwood stands or bottomland hardwood sites. In contrast, 12 percent of forest land held 53 percent of all the Arkansas softwood live-tree volume. This was a substantial amount

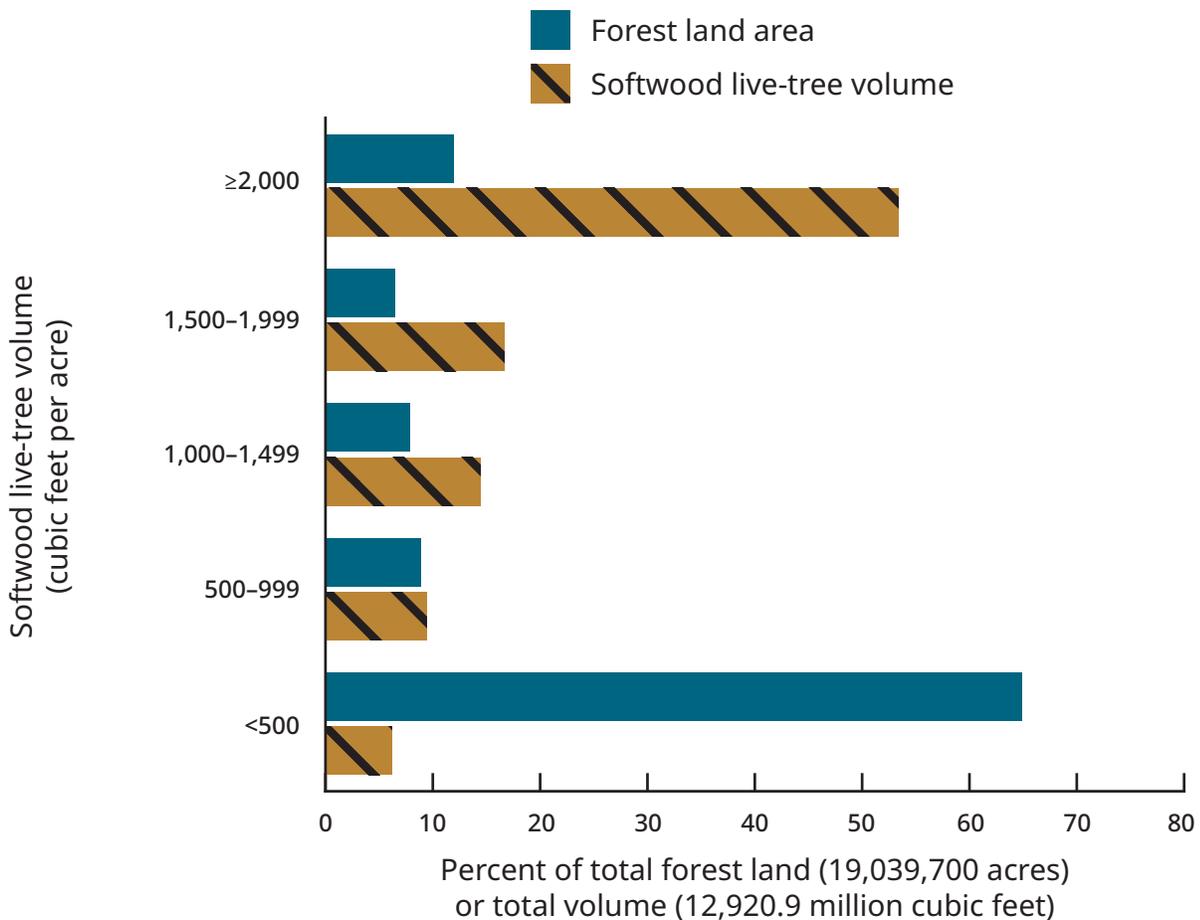


Figure 13—Effective density for softwood live-tree volume by cubic feet per acre class, Arkansas, 2015.

of volume confined to few acres (fig. 13). If forest resource competition increases, this may often mean procurement problems in maintaining resource supplies for mills.

The softwood sawtimber volume effective density graph shows a pattern similar to that of the softwood live-tree volume. The pattern shows large areas with little softwood

sawtimber (fig. 14). In 2015, 61 percent of softwood sawtimber occurred on only 11 percent of the State's forest lands. Stands with >1,000 but <9,000 softwood board feet per acre were more evenly distributed across the State. Moving upward in the stand classes, the pattern of decreased amounts of forest land and increased softwood volume was evident.

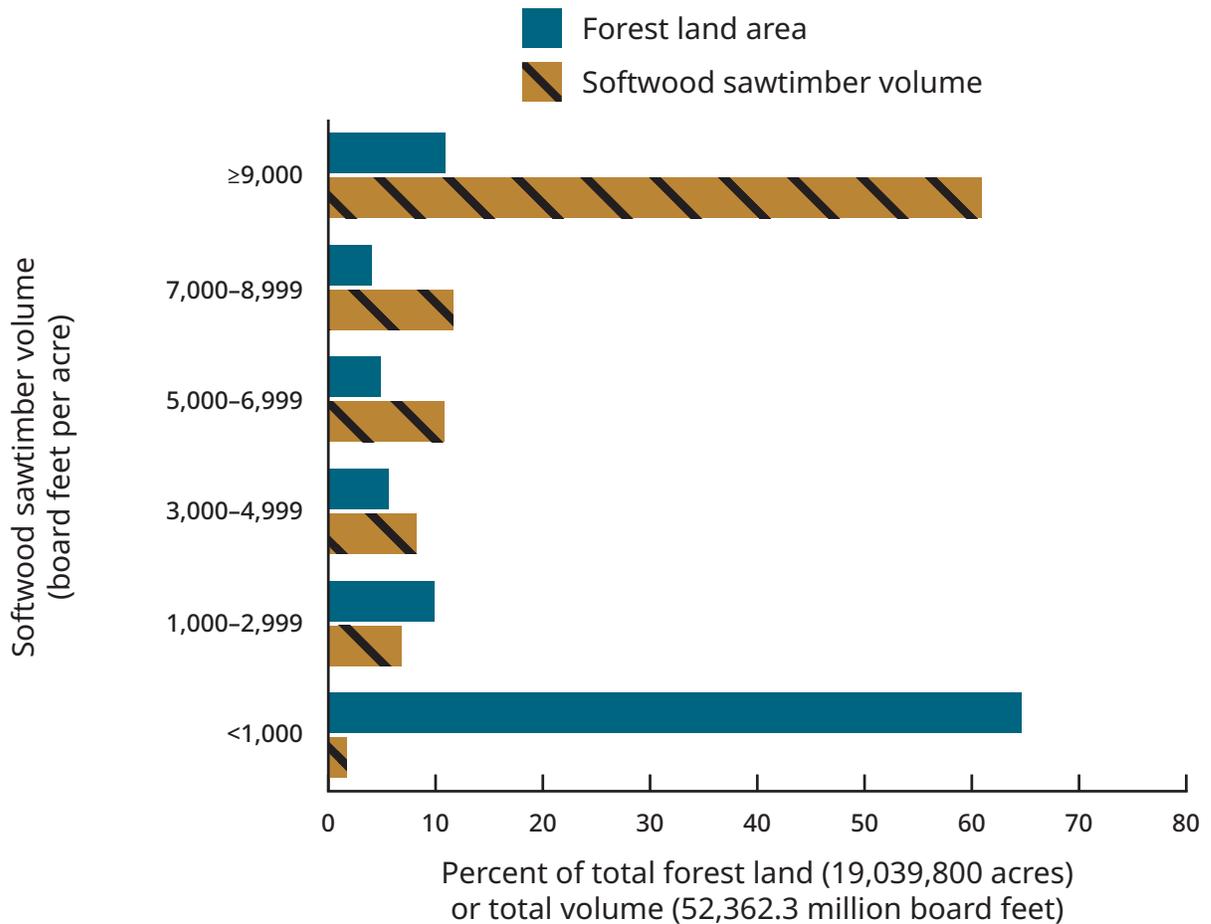


Figure 14—Effective density for softwood sawtimber volume by board feet per acre class, Arkansas, 2015.

### Effective Density, Hardwood

The hardwood live-tree volume effective density graph showed a similar pattern as that of the softwoods. However, the low- and high-volume categories were slightly lower in forest land amounts and volume. In stands with <500 cubic feet per acre of hardwood live-tree volume, 46 percent of Arkansas’s forest land contained only 6 percent of the State’s hardwood volume (fig. 15). The higher volume stands (>2,000 cubic feet per acre of hardwood volume) occurred on 16 percent of the forest land. The hardwood trees on these

lands made up 49 percent of the hardwood live-tree volume in the State.

The hardwood sawtimber volume effective density situation was slightly different than the hardwood live-tree volume. There were more stands in the lowest per acre category, 54 percent of the State’s forest lands (fig. 16). Additionally, there was less forest land (9 percent) in the highest stand sawtimber category ( $\geq 9,000$  board feet per acre) but the amount (49 percent) of sawtimber volume proportion was about the same.

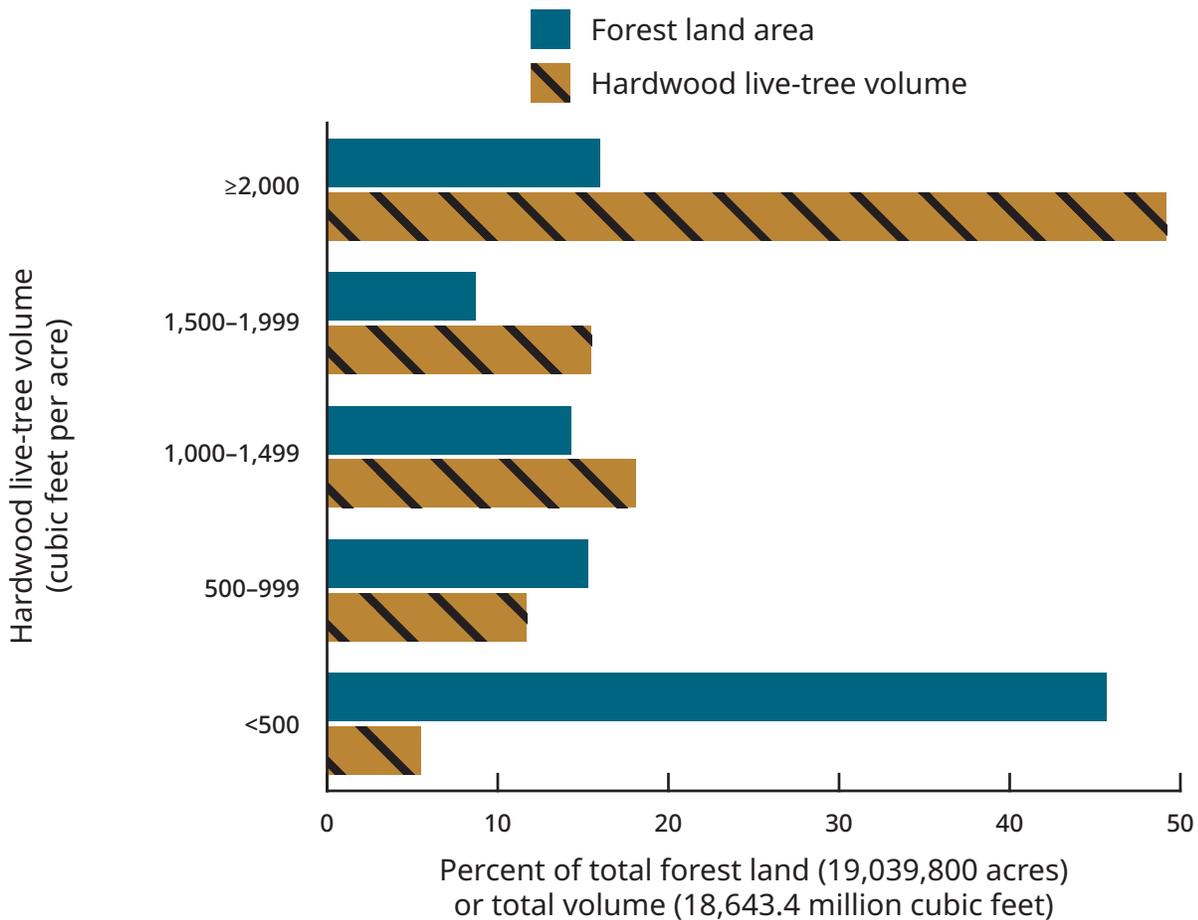


Figure 15—Effective density for hardwood live-tree volume by cubic feet per acre class, Arkansas, 2015.

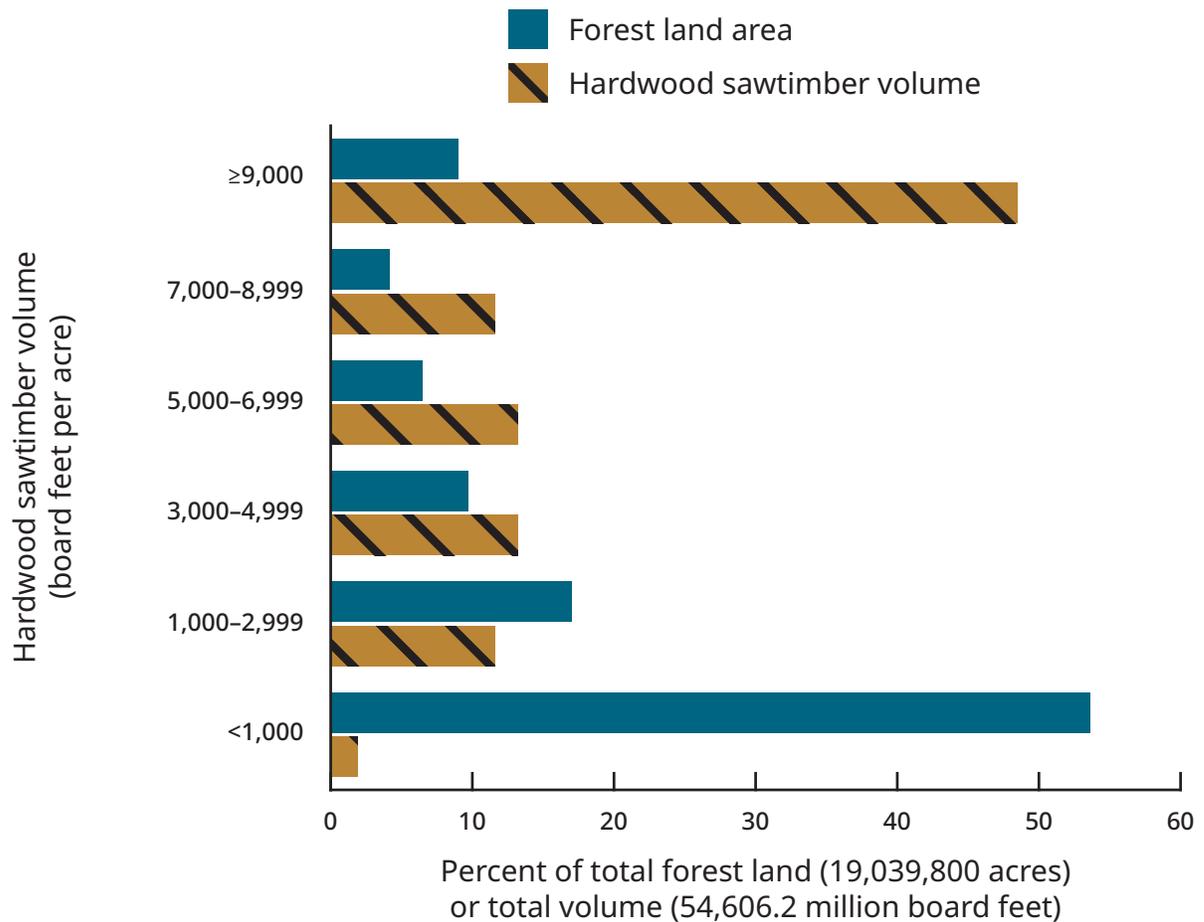


Figure 16—Effective density for hardwood sawtimber volume by board feet per acre class, Arkansas, 2015.

## GROWTH, REMOVALS, AND MORTALITY

Following Husch and others (1982), there are three major components of change in the forest inventory: (1) growth of volume in the inventory, (2) removal of volume from the inventory by means of cutting/harvesting or land-use change, and (3) tree mortality (and subsequent loss of volume) from the inventory. The most reliable estimates of growth, removals, and mortality (GRM) come from the remeasurement of plots and trees, i.e., plots (and trees) that were measured at time 1 and then remeasured at time 2. In such a continuous forest inventory scenario, all trees tallied at time 1 are accounted for at the second measurement and they either grew, were removed, or died. In addition, new

trees may grow into the plot (ingrowth). An accounting of all these components results in a net change of the inventory; this results in an increase, a decrease, or no change in the inventory.

In 2000, a change in the sample design was implemented in Arkansas. The first cycle of the new design measured plots that spanned 2000 through 2005. The first GRM estimates coming from the new sample design were the trees measured in the 2005 survey and then remeasured in the 2010 survey. The second set of GRM estimates were derived in the 2015 survey, so GRM trends can now be analyzed and compared between the two surveys. Readers wishing to compare GRM estimates between the 2010 survey and the 2015 survey are referred to the matching tables 17 through 24 in Rosson and Rose (2015). See the inventory

methods section (appendix A) for more details regarding GRM.

### Growth

Between 2010 and 2015, Arkansas’s live-tree forest land inventory grew at the rate of 1,150.2 million cubic feet per year (table 17). This was slightly lower (92.1 million cubic feet per year) than growth for the 2010 survey. Softwood live-tree growth continues to exceed hardwood live-tree growth, 786.6 versus 363.6 million cubic feet per year. Even though total growth declined, softwood growth increased and hardwood growth decreased since the 2010 survey (table 17). Most of the growth in softwoods and hardwoods continued to be in the Southwest unit. There was a noted decline

in hardwood live-tree growth in the Ozark unit, from 166.1 million cubic feet per year in 2010 to 88.0 million cubic feet per year in 2015.

Even though there was a substantial land transfer from forest industry lands to a TIMO or REIT status, forest industry forest lands continued to show a high growth rate for softwoods, 344.4 million cubic feet per year (table 18). This is slightly higher than the (330.9 million cubic feet) reported for the 2010 survey. Currently, the NIPF ownership group clearly showed the highest growth (372.6 million cubic feet per year) for softwoods.

In 2015, the loblolly-shortleaf pine FTG accounted for the majority of softwood

**Table 17**—Average net annual growth, removals, and mortality of live trees on forest land by survey unit and by softwoods and hardwoods, Arkansas 2010–2015

Survey unit	Net growth		Removals		Mortality	
	Softwood	Hardwood	Softwood	Hardwood	Softwood	Hardwood
~~~~~ million cubic feet ~~~~~						
South Delta	43.8	74.7	13.6	25.7	2.4	25.1
North Delta	5.4	28.9	0.9	10.7	1.7	19.7
Southwest	548.8	121.9	362.5	116.8	34.9	72.3
Ouachita	124.9	50.0	52.5	15.1	23.1	32.6
Ozark	63.8	88.0	37.9	58.5	27.6	131.0
All units	786.6	363.6	467.2	226.7	89.7	280.7

Numbers in columns may not sum to totals due to rounding.  
0.0 = no sample for the cell or a value >0.0 but <0.05.

**Table 18**—Average net annual growth, removals, and mortality of live trees on forest land by ownership class and by softwoods and hardwoods, Arkansas 2010–2015

Ownership class <sup>1</sup>	Net growth		Removals		Mortality	
	Softwood	Hardwood	Softwood	Hardwood	Softwood	Hardwood
~~~~~ million cubic feet ~~~~~						
National forest	50.9	18.8	10.9	9.1	21.8	40.4
Other public	18.7	22.9	8.4	9.2	4.3	39.4
Forest industry	344.4	43.4	265.6	44.9	19.9	30.9
NIPF	372.6	278.5	182.3	163.5	43.6	170.0
All classes	786.6	363.6	467.2	226.7	89.7	280.7

Numbers in columns may not sum to totals due to rounding.  
NIPF = nonindustrial private forest.  
<sup>1</sup> Ownership at the end of the 2010 survey.

**Table 19**—Average net annual growth, removals, and mortality of live trees on forest land by forest-type group and by softwoods and hardwoods, Arkansas 2010–2015

Forest-type group <sup>1</sup>	Net growth		Removals		Mortality	
	Softwood	Hardwood	Softwood	Hardwood	Softwood	Hardwood
~~~~~ million cubic feet ~~~~~						
Loblolly-shortleaf	647.7	42.0	421.2	28.9	59.8	10.8
Eastern red cedar	8.8	1.9	1.8	0.4	2.3	1.0
Oak-pine	72.6	38.8	35.2	27.8	15.1	18.0
Oak-hickory	33.3	130.1	8.1	95.8	11.0	164.0
Oak-gum-cypress	23.0	97.1	1.0	50.6	1.2	64.5
Elm-ash-cottonwood	1.1	52.3	0.0	23.0	0.1	22.2
Other types	0.1	0.4	0.0	0.1	0.0	0.1
Nonstocked	0.1	0.9	0.0	0.0	0.0	0.2
<b>All groups</b>	<b>786.6</b>	<b>363.6</b>	<b>467.2</b>	<b>226.7</b>	<b>89.7</b>	<b>280.7</b>

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

0.0 = no sample for the cell or a value >0.0 but <0.05.

<sup>1</sup> Ownership at the end of the 2010 survey.

live-tree growth (table 19). This FTG accounted for 82 percent of the net annual growth, a slight increase over the 81 percent reported in 2010. In the loblolly-shortleaf pine FTG, growth increased from 604.8 million cubic feet per year in 2010 to 647.7 million cubic feet per year in 2015. Very little softwood growth occurred in stands with a pine mixture (oak-pine and oak-hickory) mostly because pine is such a minor component of these types. The oak-pine and oak-hickory FTGs accounted

for only 13 percent of total softwood live-tree growth.

The softwood sawtimber growth showed patterns similar to live-tree growth (table 20). As of 2015, the inventory had grown by 3,251.8 million board feet per year, only a 1-percent increase in growth since 2010. The Southwest unit accounted for most of the growth (2,168.9 million board feet), while the North Delta, Ouachita, and Ozark survey units had noted decreases in softwood growth (table 20).

**Table 20**—Average net annual growth, removals, and mortality of sawtimber on forest land by survey unit and by softwoods and hardwoods, Arkansas 2010–2015

Survey unit	Net growth		Removals		Mortality	
	Softwood	Hardwood	Softwood	Hardwood	Softwood	Hardwood
~~~~~ million board feet <sup>1</sup> ~~~~~						
South Delta	184.0	351.9	58.7	86.5	7.6	63.4
North Delta	16.5	113.4	2.4	37.5	7.1	67.9
Southwest	2,168.9	435.4	1,583.4	300.2	134.2	198.9
Ouachita	601.4	178.3	183.5	30.6	80.0	76.3
Ozark	280.9	403.0	141.5	177.2	79.3	313.3
<b>All units</b>	<b>3,251.8</b>	<b>1,482.2</b>	<b>1,969.5</b>	<b>632.0</b>	<b>308.2</b>	<b>719.8</b>

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

0.0 = no sample for the cell or a value >0.0 but <0.05.

<sup>1</sup> International ¼-inch rule.

**Table 21**—Average net annual growth, removals, and mortality of sawtimber on forest land by ownership class and by softwoods and hardwoods, Arkansas 2010–2015

Ownership class <sup>1</sup>	Net growth		Removals		Mortality	
	Softwood	Hardwood	Softwood	Hardwood	Softwood	Hardwood
~~~~~ million board feet <sup>2</sup> ~~~~~						
National forest	286.9	109.8	39.5	20.7	85.8	99.5
Other public	110.4	139.1	30.4	36.6	16.5	145.1
Forest industry	1,254.2	140.5	1,111.8	100.4	68.8	94.4
NIPF	1,600.3	1,092.7	787.8	474.2	137.0	380.7
<b>All classes</b>	<b>3,251.8</b>	<b>1,482.2</b>	<b>1,969.5</b>	<b>632.0</b>	<b>308.2</b>	<b>719.8</b>

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

NIPF = nonindustrial private forest.

<sup>1</sup> Ownership at the end of the 2010 survey.

<sup>2</sup> International ¼-inch rule.

The NIPF ownership group had the most softwood sawtimber growth followed by forest industry; each accounted for 1,600.3 and 1,254.2 million board feet per year, respectively (table 21). The amount of softwood sawtimber growth on forest industry lands was a very respectable amount, given that forest industry forest land holdings are only 17 percent of that in the NIPF ownership group, 2.2 million versus 13.1 million acres, respectively. The TIMO/REIT land transfers were mostly responsible for the decrease (5 percent) in softwood sawtimber growth on forest industry forest lands and the increase (11 percent) in softwood sawtimber growth on NIPF forest lands (table 21).

In 2015, the hardwood live-tree growth was 363.6 million cubic feet per year (table 17). This amount was down from the 492.1 million cubic feet per year reported in the 2010 survey. Most of the hardwood growth occurred in the Southwest unit followed closely by the Ozark and South Delta units. The NIPF ownership group had most (77 percent) of the hardwood live-tree growth (table 18). Note that all of the ownership categories showed declines in growth since the 2010 survey. The oak-hickory and oak-gum-cypress FTGs accounted for 36 and 27 percent, respectively, of the hardwood

live-tree growth (table 19). This was a change from the 49- and 24-percent proportions reported in the 2010 survey.

The growth in hardwood sawtimber was 1,482.2 million board feet per year (table 20), a substantial drop from the 1,849.4 million board feet reported in 2010 (20 percent). In 2015, most of the hardwood live-tree growth was in the Southwest unit while in 2010 most of the hardwood live-tree growth was in the Ozark unit. The NIPF ownership group accounted for the majority of hardwood sawtimber growth, 1,092.7 million board feet per year, an increase to 74 percent compared with 68 percent reported in 2010 (table 21). All of the ownership categories showed declines in hardwood sawtimber growth since the 2010 survey.

### Removals

Softwood live-tree removals were 467.2 million cubic feet per year, a decrease from the 548.1 million cubic feet per year reported in the 2010 survey (table 17). The Southwest unit accounted for 78 percent of softwood removals. In 2015, removals decreased in every survey unit except for a small increase in the Ozark unit. The softwood removals were well below the softwood growth, meaning that more volume was added to

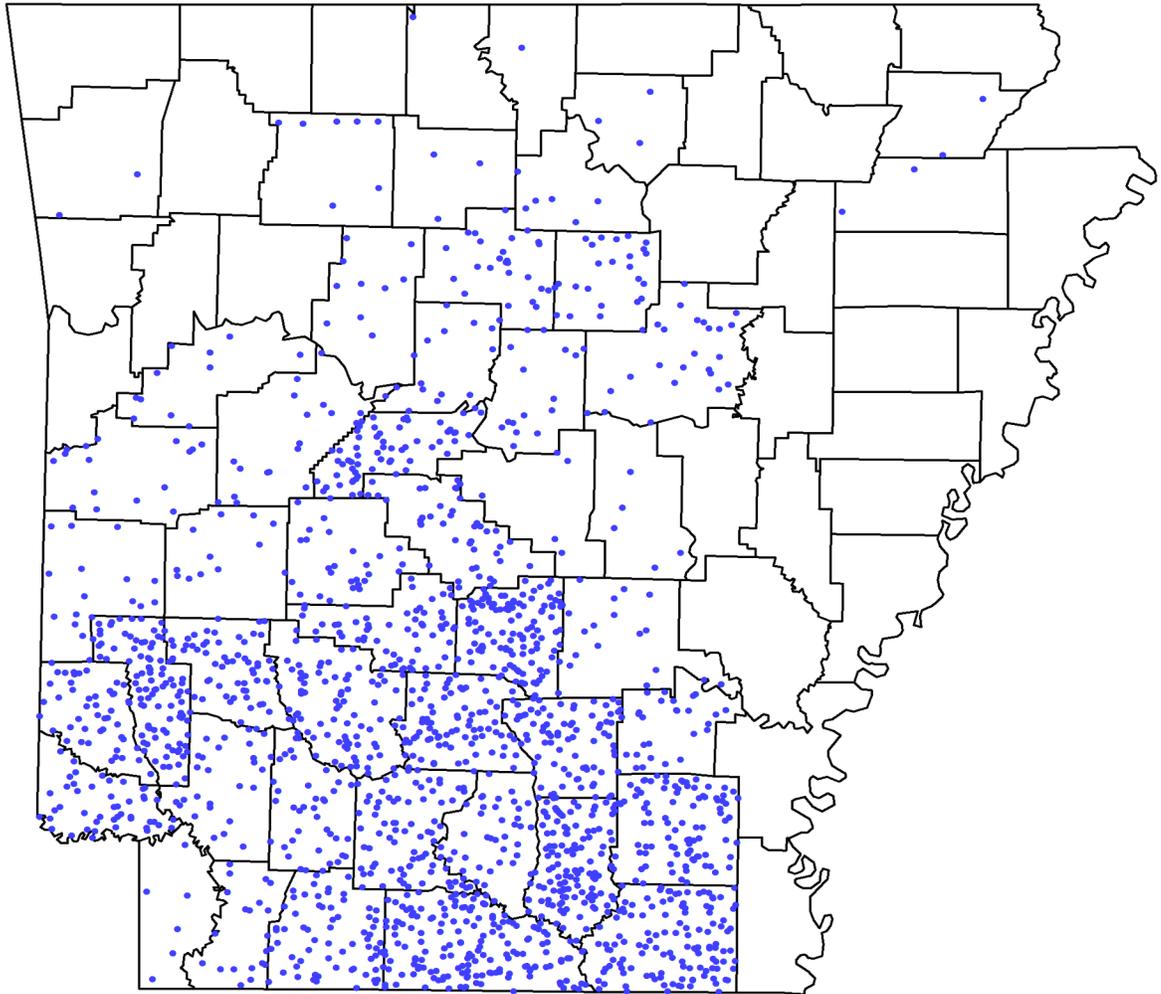


Figure 17—Softwood removals volume, Arkansas, 2015. Each dot represents 250,000 cubic feet of live-tree softwood volume removed per year. See methods section for map methodology.

the inventory than was removed. The high level of removals in the Southwest unit can be attributed to the impact and emphasis of timber harvest activity from forest industry and NIPF forest lands.

In 2015, 57 percent of removals were on forest industry lands, 265.6 million cubic feet per year (table 18). NIPF lands accounted for an additional 39 percent of softwood removals. Together, these two ownership groups accounted for 96 percent of softwood live-tree removals. As expected, the majority of softwood removals (90 percent) were in the loblolly-shortleaf pine FTG (table 19). Softwood removals from the loblolly-shortleaf pine FTG increased since the 2010 forest

survey and removals in the oak-pine and oak-hickory FTG decreased substantially in 2015.

Softwood removals were most concentrated in southern Arkansas (fig. 17). Again, this area in Arkansas supported the highest amounts of forest industry activity. Few softwood live-tree removals were reported in the Mississippi Alluvial Plain and the north-northwest regions of the State.

Softwood sawtimber removals were 1,969.5 million board feet per year (table 20), a decline of 300.1 million board feet per year and a 13-percent drop since the 2010 survey. The Southwest unit had the highest levels of live-tree removals, similar to softwood

live-tree removals (table 20). The Southwest unit accounted for 80 percent of softwood sawtimber removals. By ownership, forest industry lands accounted for 56 percent of removals and NIPF lands accounted for 40 percent of removals (table 21). Since the 2010 survey, these proportions between ownerships were expected to move into NIPF as forest industry land transfers continue. However, forest industry still accounted for the majority of softwood sawtimber removals in 2015.

Hardwood live-tree removals were much lower than that of softwood removals, almost half (49 percent). Across the State, removals averaged 226.7 million cubic feet per year (table 17). This amount was a 83.8 million cubic feet per year decrease since the 2010

survey. In 2015, there were no situations where hardwood removals exceeded growth. The highest removals (116.8 million cubic feet per year) were in the Southwest unit. The NIPF ownership group had the highest removals (163.5 million cubic feet per year), 72 percent of total hardwood removals (table 18). This proportion was an increase from 66 percent reported in the 2010 survey.

Although hardwood removals were much more widely and evenly dispersed across the State than softwood removals, two areas of higher concentrations were evident, (1) the southern region of Arkansas, and (2) counties along the northern tier of the State (fig. 18). Surprisingly, little harvesting activity was evident in the bottomlands of the Mississippi River Alluvial Plain. An exception was Greene



A plantation-grown loblolly pine (*Pinus taeda*) harvested for dimension lumber, Scott County, Arkansas.

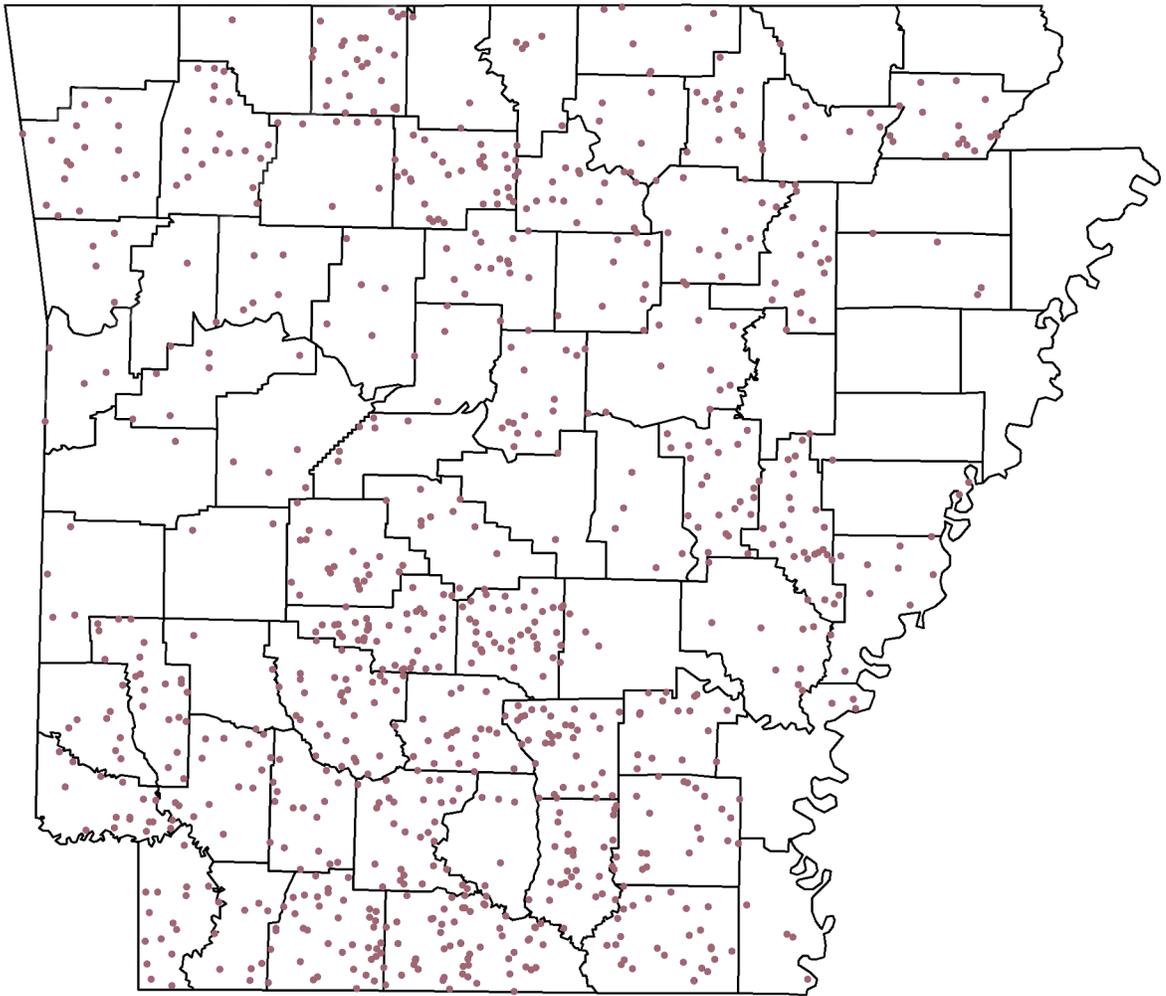


Figure 18—Hardwood removals volume, Arkansas, 2015. Each dot represents 250,000 cubic feet of live-tree hardwood volume removed per year. See methods section for map methodology.

County in the north and Prairie, Monroe, Phillips, and Arkansas counties in the central region of the Mississippi River Alluvial Plain.

In 2015, hardwood sawtimber removals were only 632.0 million board feet per year. Since 2010, hardwood sawtimber removals have decreased by 289.0 million board feet (31 percent). In 2015, there were no instances where hardwood removals exceeded growth. The Southwest unit accounted for 48 percent of removals and the Ozark unit accounted for 28 percent of removals (table 20). Both of these proportions were increases since the 2010 survey. The majority of hardwood sawtimber removals were on NIPF lands (75 percent) followed by forest industry with 16 percent (table 21). Since the 2010 survey, the

sawtimber removal proportion increased for NIPF forest lands and decreased for forest industry forest lands.

### Mortality

Total live-tree mortality was 370.4 million cubic feet per year, a 63-percent increase over the reported 227.3 million cubic feet per year in the 2010 forest survey. In 2015, softwoods accounted for 24 percent (89.7 million cubic feet per year) of total live-tree mortality (table 17). Softwood mortality was spread fairly evenly among the Southwest, Ouachita, and Ozark survey units. The majority (39 percent) of softwood mortality occurred in the Southwest unit. Overall, softwood mortality was relatively low, but increased by 58

percent since the 2010 survey. Spatially, it was confined mostly to the southern and western regions of the State plus the north-central region. Users can detect changes in specific counties by comparing the 2015 map (fig. 19) with the map (fig. 18) in the 2010 report (Rosson and Rose 2015).

In 2015, the NIPF ownership group accounted for the majority (49 percent) of the softwood live-tree mortality. National forest and forest industry ownerships had comparable levels of softwood mortality, 21.8 and 19.9 million cubic feet per year, respectively (table 18). As expected, the loblolly-shortleaf pine FTG accounted for a large proportion (67 percent) of softwood live-tree mortality (table 19).

Since the 2010 survey, softwood sawtimber mortality increased substantially (73 percent) from 178.5 million board feet per acre per year to 308.2 million board feet per acre per year (table 20). The increases in the Ouachita and Ozark survey units were nearly double that of the 2010 survey. Softwood sawtimber mortality increased substantially in all of the ownership categories. The NIPF ownership group accounted for 44 percent of softwood sawtimber mortality (table 21).

Hardwood mortality was 280.7 million cubic feet per year, a 65-percent increase over the 170.5 million cubic reported in the 2010 survey. The Ozark unit accounted for 47 percent of hardwood mortality (table 17),

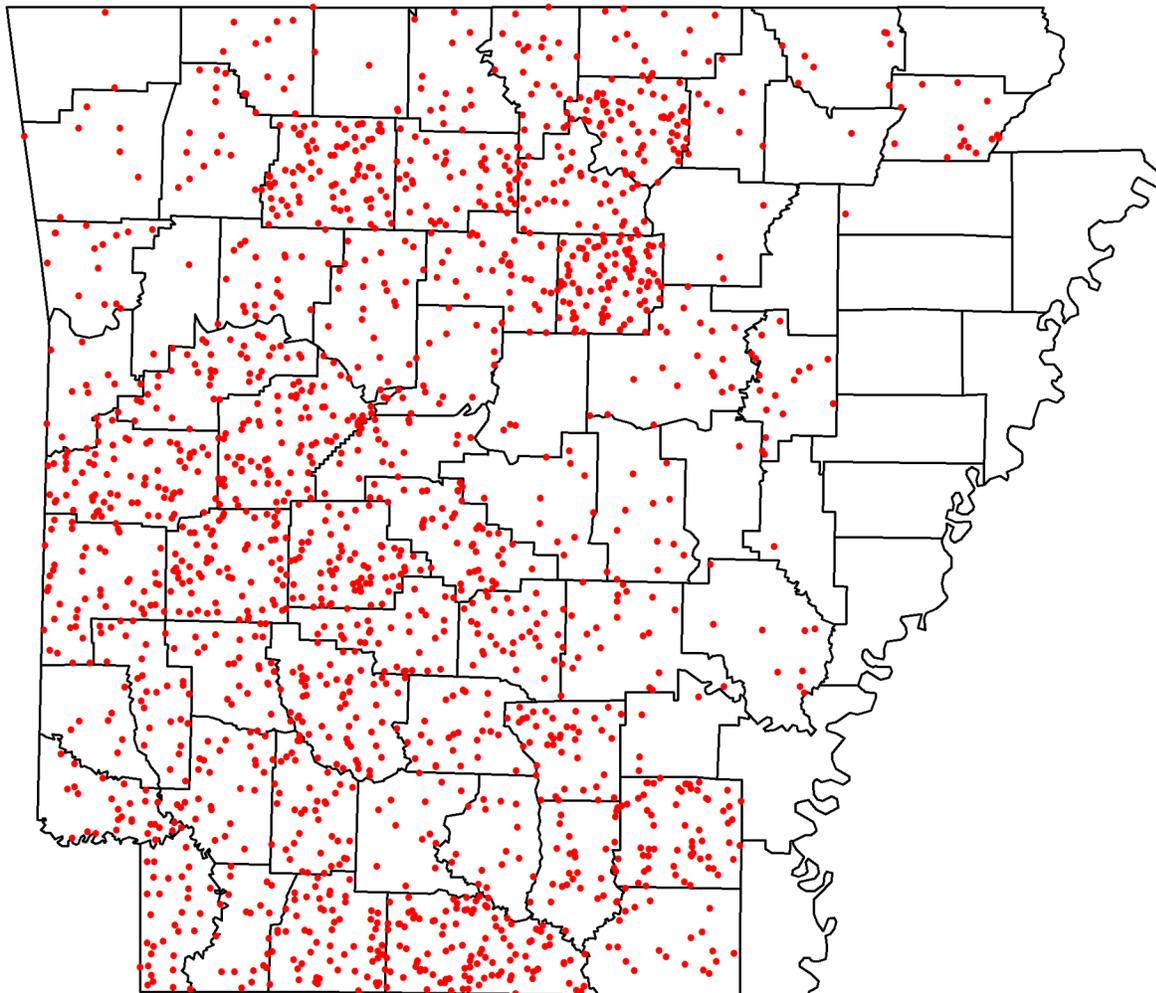


Figure 19—Softwood mortality volume, Arkansas, 2015. Each dot represents 50,000 cubic feet of live-tree softwood volume lost to mortality per year. See methods section for map methodology.

similar to the proportion in the 2010 forest survey. However, the actual mortality in the unit more than doubled, from 62.5 million cubic feet per year in 2010 to 131.0 million cubic feet per year in 2015. Many oak species occupied a considerable amount of the forest land resulting in the oak-hickory FTG being dominant in these regions. The Southwest unit ranked second with 26 percent of the mortality volume. Together, the Ozark and Southwest units accounted for 72 percent of hardwood mortality in Arkansas.

The NIPF ownership group had a hardwood live-tree mortality rate of 170.0 million cubic feet per year, a substantial increase over the 98.5 million cubic feet per year reported in the 2010 survey (table 18). This was 61 percent

of all hardwood mortality. The national forest ownership group ranked second with 40.4 million cubic feet per year, followed closely by the other public category with 39.4 million cubic feet per year. These two ownership groups accounted for 28 percent of all hardwood mortality. All of the ownership categories increased since the 2010 survey. Hardwood mortality was more widely spread across Arkansas than softwood mortality (fig. 20). Highest concentrations were in the northwest regions of the State. A comparison of the 2015 map (fig. 20) with the 2010 map (fig. 19) in Rosson and Rose (2015) shows that a hardwood mortality increase was evident in northwest Arkansas.

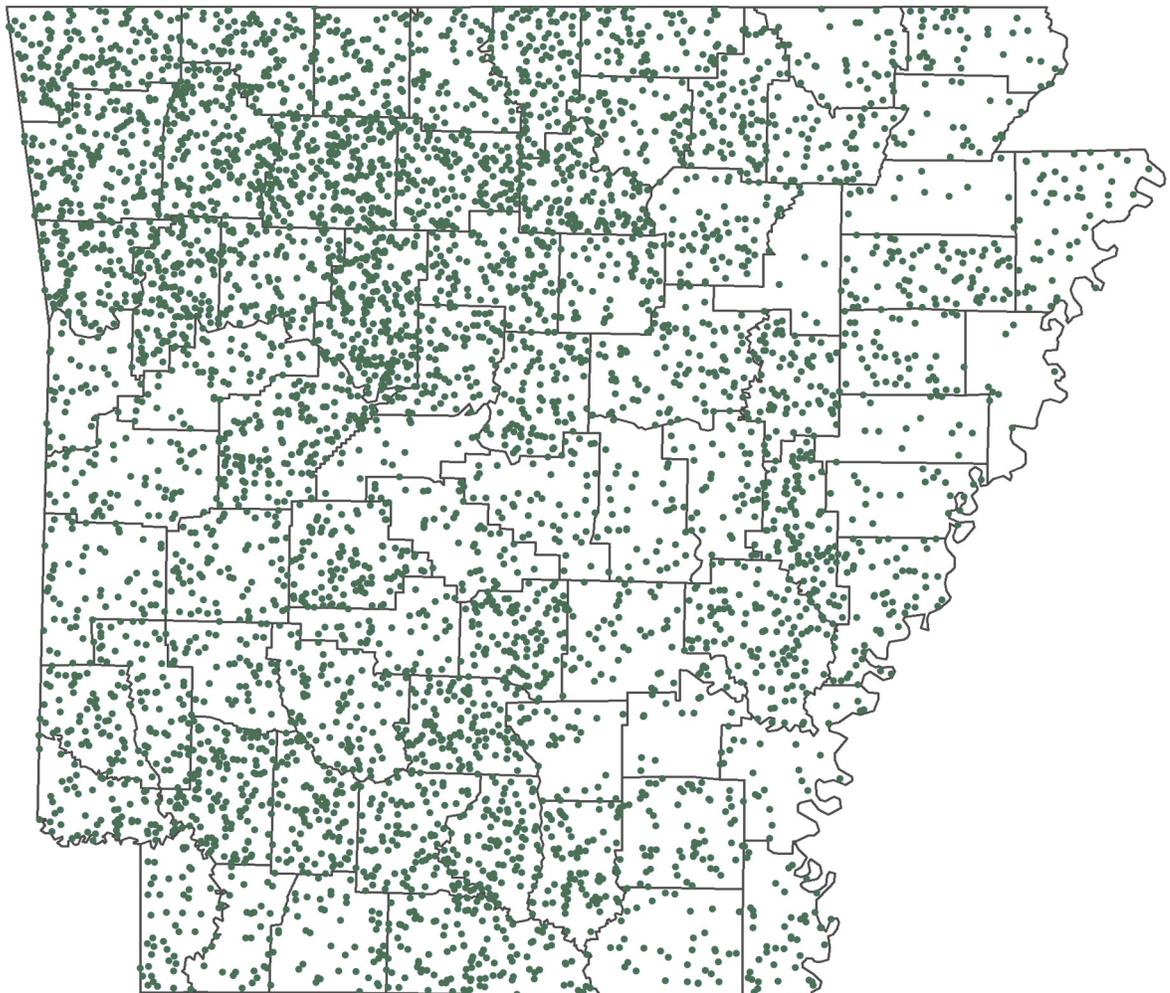


Figure 20—Hardwood mortality volume, Arkansas, 2015. Each dot represents 50,000 cubic feet of live-tree hardwood volume lost to mortality per year. See methods section for map methodology.

Hardwood sawtimber mortality was 719.8 million board feet per year, a substantial increase (85 percent) over the 388.3 million board feet reported in the 2010 survey (table 20). The Southwest and Ozark survey units had the largest increases in hardwood sawtimber mortality. Together, these two units accounted for 71 percent of all hardwood sawtimber mortality.

NIPF forest land held a little over half (53 percent) of hardwood sawtimber mortality. The remaining hardwood sawtimber mortality was distributed evenly between the national forest, other public, and forest industry ownership groups, 14, 20, and 13 percent, respectively (table 21).

### Species Growth, Removal, and Mortality

In 2015, 20 species accounted for 93 percent of all live-tree growth in Arkansas (table 22). Of the top 20 species, this is a 2-percent increase in live-tree growth over live-tree growth reported for the 2010 survey. As expected, the rankings were similar to the live-tree volume rankings. Loblolly pine continued to be the number one species in growth and made up 58 percent of all growth in the State, an increase from 47 percent reported in the 2010 survey. Shortleaf pine was the second ranked species, sweetgum was third, and white oak was fourth. Together, these four species accounted for 74 percent of live-tree growth in Arkansas. Note that the shortleaf pine and white oak tree species had growth declines. Shortleaf pine dropped from 121.1 million cubic feet per year in 2010 to 81.2 million cubic feet per year in 2015. White oak dropped from 69.1 million cubic feet per year in 2010 to 49.6 million cubic feet per year in 2015. For more detailed comparisons of the top 20 species in Arkansas, users are referred to table 22 in Rosson and Rose (2015).

Table 23 lists the top 20 species with removals in Arkansas. These top 20 species accounted for 95 percent of all removals, the same as in the 2010 survey. As with growth, loblolly and

**Table 22**—Average net annual growth of live trees on forest land by species, Arkansas, 2010–2015

Species	FIA species code	Growth
		<i>million cubic feet</i>
Loblolly pine	131	663.4
Shortleaf pine	110	81.2
Sweetgum	611	54.6
White oak	802	49.6
Post oak	835	26.6
Eastern red cedar	68	22.3
Cherrybark oak	813	20.2
Willow oak	831	19.4
Baldcypress	221	16.7
Water oak	827	16.4
Southern red oak	812	14.8
Overcup oak	822	14.0
Water tupelo	691	12.4
Red maple	316	11.0
Green ash	544	10.3
Winged elm	971	10.1
Black hickory	408	8.3
Blackgum	693	7.8
American sycamore	731	7.8
Mockernut hickory	409	7.6
<b>Total top 20 species</b>		<b>1,074.6</b>
<b>Remaining species</b>		<b>75.6</b>
<b>Total</b>		<b>1,150.2</b>

Numbers in columns may not sum to totals due to rounding.  
FIA = Forest Inventory and Analysis.

shortleaf pine were the number one and two species. Sweetgum and white oak also ranked third and fourth, respectively. Together, these four species made up 74 percent of all live-tree removals in Arkansas, the same as in the 2010 survey. However, it should be noted these four species had declines in removals since the 2010 forest survey. For more detailed comparisons of removal trends of the top 20 species in Arkansas, users are referred to table 23 (Rosson and Rose 2015).

## Growth, Removals, and Mortality

**Table 23**—Average net annual removals of live trees on forest land by species, Arkansas, 2010–2015

Species	FIA species code	Removals
		<i>million cubic feet</i>
Loblolly pine	131	402.6
Shortleaf pine	110	59.4
Sweetgum	611	41.2
White oak	802	26.0
Southern red oak	812	18.9
Post oak	835	15.3
Black oak	837	14.9
Water oak	827	13.2
Cherrybark oak	813	10.9
Willow oak	831	8.6
Blackgum	693	7.0
Black hickory	408	5.9
Northern red oak	833	5.8
Green ash	544	5.5
Mockernut hickory	409	5.5
Eastern red cedar	68	5.1
Overcup oak	822	4.4
Red maple	316	4.3
Winged elm	971	4.1
Sugarberry	461	3.9
<b>Total top 20 species</b>		<b>662.4</b>
<b>Remaining species</b>		<b>31.5</b>
<b>Total</b>		<b>693.9</b>

Numbers in columns may not sum to totals due to rounding.  
FIA = Forest Inventory and Analysis.

In Arkansas, the top 20 species in mortality made up 86 percent of all mortality (table 24). The distribution of mortality among the top species was more uniform than the distribution for growth or removals. However, instead of loblolly pine in its usual number one ranked position, it was number two in mortality. Shortleaf pine ranked number one in mortality. It increased from 23.9 million cubic feet per year in 2010 to 43.6 million

**Table 24**—Average net annual mortality of live trees on forest land by species, Arkansas, 2010–2015

Species	FIA species code	Mortality
		<i>million cubic feet</i>
Shortleaf pine	110	43.6
Loblolly pine	131	38.7
White oak	802	32.1
Black oak	837	29.9
Sweetgum	611	25.9
Northern red oak	833	23.1
Water oak	827	18.8
Southern red oak	812	17.2
Post oak	835	15.1
Green ash	544	9.4
Black hickory	408	8.3
Cherrybark oak	813	8.1
Willow oak	831	7.4
Mockernut hickory	409	6.8
Black willow	922	6.5
Eastern red cedar	68	6.4
Blackjack oak	824	5.6
Sugarberry	461	5.0
Red maple	316	4.8
Black cherry	762	4.0
<b>Total top 20 species</b>		<b>316.6</b>
<b>Remaining species</b>		<b>53.7</b>
<b>Total</b>		<b>370.3</b>

Numbers in columns may not sum to totals due to rounding.  
FIA = Forest Inventory and Analysis.

cubic feet per year in 2015. Shortleaf pine accounted for 12 percent of total live-tree mortality in the State. The top four mortality species in Arkansas—shortleaf pine, loblolly pine, white oak, black oak—accounted for 39 percent of all live-tree mortality. For more detailed comparisons of mortality trends of the top 20 species in Arkansas, users are referred to table 24 in Rosson and Rose (2015).

Loblolly pine continued to rank high in the GRM categories because it was the most dominant species, by volume, in the State. This is because it has been the most favored species in plantation establishment and also due to its natural ability to regenerate prolifically in both nonintensive (natural) and intensive forestry applications. Therefore, because of its high amount of volume, it will naturally have correspondingly higher growth, removal, and mortality estimates. Even though the respective overall estimates of removals and mortality for loblolly pine may be higher than those for other species, the ratio of removals (or mortality) to growth are much lower in loblolly pine than other species.

Shortleaf pine was once the dominant conifer in Arkansas. However, because of historical harvesting activity and regeneration of harvested lands through plantation preferences for loblolly pine, it was a distant second in 2015. Additionally, shortleaf pine removals exceeded growth for a period of

time, which indicated continued population declines in this species in Arkansas. Population levels seemed to have stabilized at the beginning of the 2010 forest survey. The 2015 survey shows a continuing period of growth exceeding removals. In the 2010 survey, shortleaf pine growth was 121.1 million cubic feet per year and removals 95.5 million cubic feet per year. In 2015, shortleaf pine growth was 81.2 million cubic feet per year and removals 59.4 million cubic feet per year. This was a substantial decline in both growth and removals, but growth still exceeded removals. However, troubling is the 43.6 million cubic feet per year in mortality, an 82-percent increase since the 2010 survey. This is especially noteworthy because in 2015, shortleaf pine led all other species in mortality across Arkansas. Future surveys to monitor the shortleaf pine situation in Arkansas will be very important to determine if the species returns to a downward population trend.



A shortleaf pine-oak forest stand, Ozark-St. Francis National Forest, Pope County, AR.

### Effective Density, Growth

In Arkansas, the net growth of softwoods and hardwoods was not evenly dispersed across all forest land, the same as with tree volumes. Stands grew at different rates depending on site conditions, stocking levels, past disturbance, site conditions, etc. The effective growth density analysis was applied to natural stands. Plantation stands are analyzed in the next section of this report. It is important to keep in mind that the total natural forest land area is included in the analysis that follows, for both softwoods and hardwoods. No attempt was made to define a stand as softwood or hardwood, therefore stands that were composed of 100 percent hardwoods would show no growth in softwoods, and vice versa.

In 2015, 83 percent of Arkansas’s natural forest land stands had grown at a rate of <50 cubic feet of softwood volume per acre per year (fig. 21), no change from that reported in the 2010 forest survey. Another 9 percent of stands had grown at a rate of 50 to 99 cubic feet per acre per year. In total, 92 percent of forest land had grown softwood volume at a rate of <100 cubic feet per acre per year. These two growth classes accounted for 44 percent of softwood growth. In contrast, very small amounts of forest land had grown at high rates. Approximately, 2 percent of forest land had grown at a rate of  $\geq 200$  cubic feet per acre per year, no change since the 2010 forest survey. More importantly, about 23 percent of Arkansas’s softwood growth was in these high yielding stands. This means that

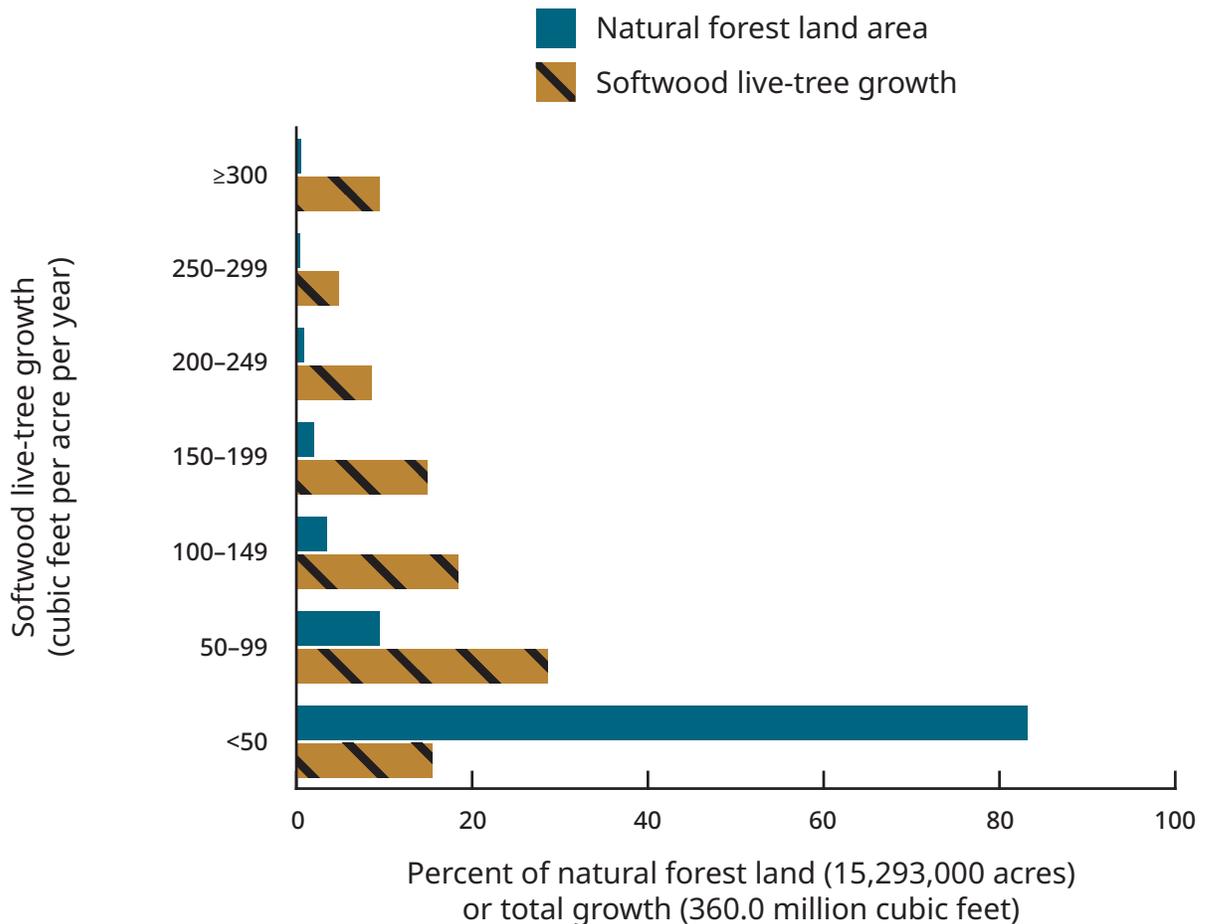


Figure 21—Effective density for live-tree net annual growth for softwoods on forest land by cubic feet per acre class, Arkansas, 2010–2015. This figure is based upon land that was in natural stands, i.e., plantations are excluded.

23 percent of softwood growth occurred on approximately 278,000 acres of forest land. The largest proportion of Arkansas growth (29 percent) continued to be in stands growing at the rate of 50 to 99 cubic feet per acre per year. This is an improvement since the 2010 forest survey. For more detailed comparisons on the effective density softwood growth trends, users are referred to figure 20 in Rosson and Rose (2015). Small improvements in stand productivity through silvicultural practices (e.g., stand thinning) would help increase Arkansas’s softwood timber inventory and also boost the State’s carbon sequestration level. An inventory improvement goal would be to see more forest land in the 50–99 and 100–149 growth per acre classes (fig. 21). The 2015 graphs show only a very small

improvement since the 2010 forest survey. The reduction of the amount of forest land area in the <50 cubic feet per year growth class would be a preferred improvement in Arkansas’s forest resource situation.

The effective density analysis for hardwood growth on natural stands was similar to the softwood situation. There were high amounts of forest land with low amounts of growth and few acres with high growth rates (fig. 22). In 2015, 81 percent of natural forest land stands had hardwood growth rates of <50 cubic feet per year, an increase since the 2010 forest survey. Hardwoods growing at high rates ( $\geq 200$  cubic feet per acre per year), were on very few acres (<2 percent of forest land).

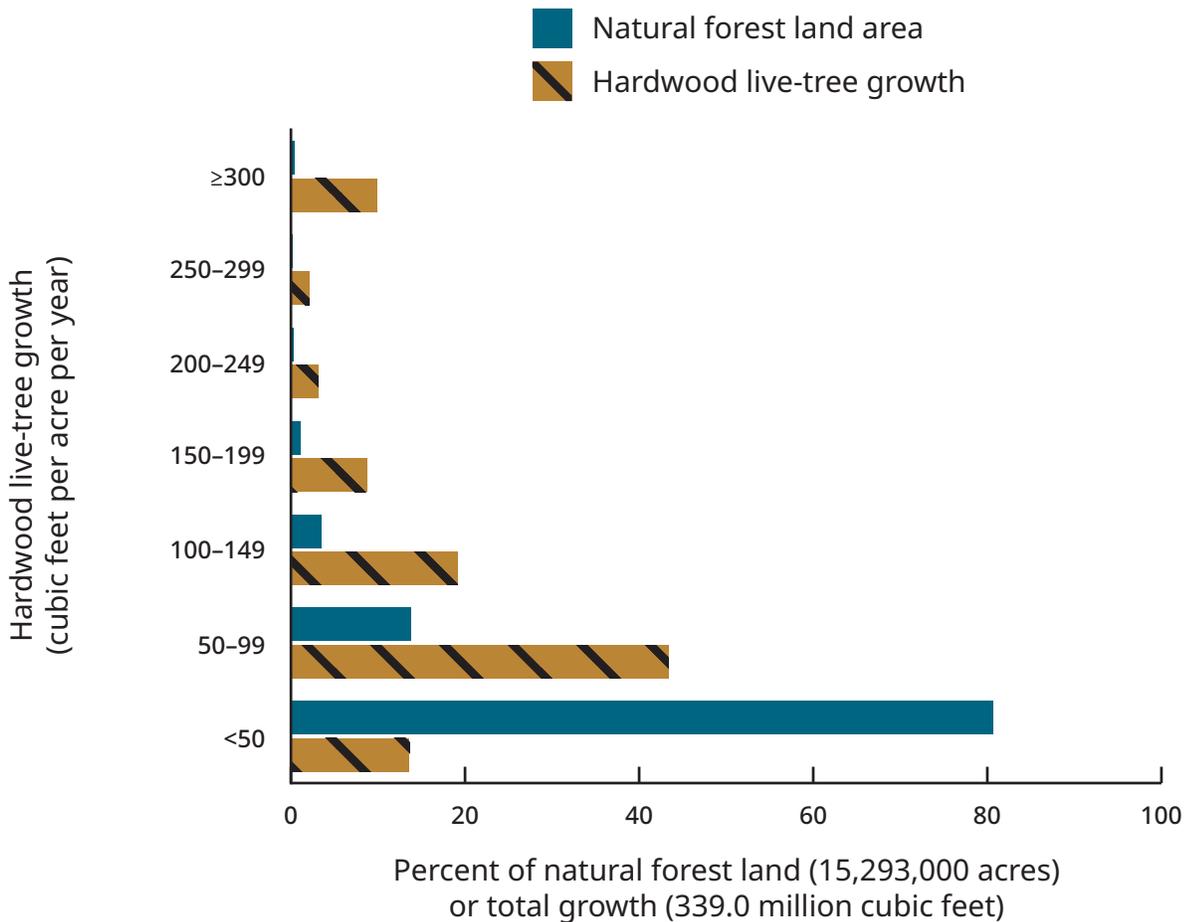


Figure 22—Effective density for live-tree net annual growth for hardwoods on forest land by cubic feet per acre class, Arkansas, 2010–2015. This figure is based upon land that was in natural stands, i.e., plantations are excluded.

Efforts could be concentrated toward increased growth on those forest lands that are growing at the rate of <50 cubic feet per acre per year. If stands are understocked, stocking could be improved; if establishing new stands, stocking (and survival stocking) can be assessed for adequacy. Additionally, regeneration lag times could be kept to a minimum. While these may be lofty goals to increase productivity, these aggressive practices may also interfere with natural forms of the regeneration/succession cycle. This could impact certain wildlife species and plants that are dependent on the early stages of the succession cycle. Striking a proper balance to achieve resource goals remains to be a challenge for land managers who are also charged with protecting forest ecosystems in

their entirety (Rosson and Rose 2015). Noted were the stands growing hardwoods at the rate of >300 cubic feet per year. In 2015, 10 percent of all hardwood growth was in these types of stands but only on a very limited amount of forest land (<1 percent).

## PLANTATIONS

### Plantation Area

Plantation forest area continued to increase in Arkansas. There were 3.6 million acres of plantation and artificially regenerated stands in Arkansas, an increase of 328,300 acres since 2010 (table 25). In 2015, this increase represented approximately 19 percent of all forest land in the State, up from 17 percent reported in 2010. The Southwest unit had most

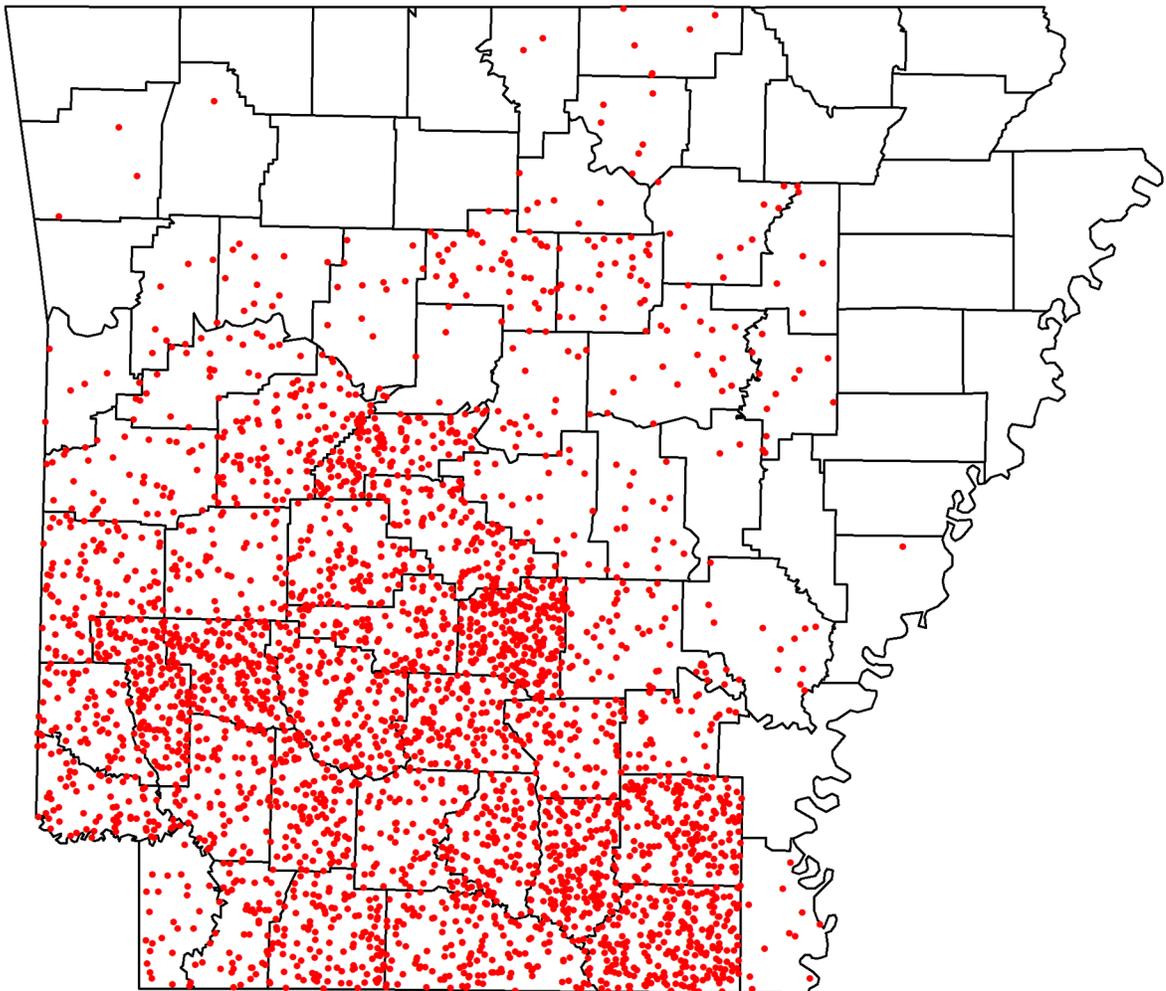


Figure 23—Pine plantation distribution, Arkansas, 2015. Each dot represents 1,000 acres; there were 3,393,400 acres of planted pine across Arkansas. See methods section for map methodology.

**Table 25**—Forest land area in plantations on forest land by survey unit and change, Arkansas, 2010 and 2015

Survey unit	Year		Change
	2010	2015	
~~~~~ thousand acres ~~~~~			
South Delta	217.5	208.0	-9.5
North Delta	40.9	58.9	17.9
Southwest	2,163.8	2,460.1	296.3
Ouachita	595.5	643.3	47.8
Ozark	244.2	220.0	-24.2
<b>All units</b>	<b>3,262.0</b>	<b>3,590.3</b>	<b>328.3</b>

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

(2.5 million acres) of these plantations or 69 percent of all plantations in the State. In 2015, the majority of pine plantations occurred in the central and southwestern regions, with very few in the northern and eastern regions of the State (fig. 23). For detailed map comparisons to detect trends, users are referred to figure 22 in Rosson and Rose (2015). The expansion into the northern tier of counties was especially evident. Analysis by forest survey units showed the percentage of total forest land in planted stands ranged from a low of 7 percent in the North Delta unit to a high of 35 percent in the Southwest unit. This was an increase from 32 percent reported for the Southwest unit in the 2010 survey.

Most of the plantations continue to be planted in loblolly pine, approximately 92 percent of all artificial stands (table 26). Some plantations were planted in shortleaf pine but as stated previously in the report, loblolly pine has been the favored species for plantation forestry in Arkansas. Only 80,500 acres were planted in shortleaf pine (table 26). This is troubling because it is a decrease from the 128,900 acres in artificial stands in 2010. Another minor component of artificial stands was in hardwood plantations, only 203,300 acres distributed among 11 species (including baldcypress). It was likely that much of the planting was done for wildlife

management and restoration of abandoned agricultural land. Hardwood plantations were very infrequent across the landscape and usually established on bottomland sites. In many cases, hardwood plantations are difficult for field crews to recognize because they are seldom in nice, straight, and easily recognizable rows (as is the case with softwood plantations). Because it becomes increasingly difficult to recognize hardwood plantations, especially 3+ years after their establishment, the estimate of hardwood plantations should be considered very conservative (Rosson and Rose 2015). There were only 47 sample plot conditions in the survey with a hardwood species as the primary planted species. One sample plot condition had Virginia pine as the primary planted species, a very minor part of the sample.

**Table 26**—Forest land area in plantations by primary planted species and number of forest conditions, Arkansas, 2015

Primary planted species	FIA species code	Plantation area	Forest conditions
		thousand acres	number
Loblolly pine	131	3,302.0	754
Shortleaf pine	110	80.5	20
Nuttall oak	828	76.3	15
Willow oak	831	39.1	10
Green ash	544	24.4	6
Water oak	827	15.2	4
Eastern cottonwood	742	13.6	3
Overcup oak	822	11.8	2
Baldcypress	221	6.4	2
Other spp.	999	5.7	1
Cherrybark oak	813	4.7	2
Sweetgum	611	4.6	1
Virginia pine	132	4.5	1
Shumard oak	834	1.5	1
<b>Total plantations</b>		<b>3,590.3</b>	<b>822</b>

Numbers in plantation area may not sum to total due to rounding.  
FIA = Forest Inventory and Analysis.

**Table 27**—Live-tree volume of softwoods in plantations by survey unit, and change, Arkansas, 2010 and 2015

Survey unit	Year		Change
	2010	2015	
~~~~~ million cubic feet ~~~~~			
South Delta	121.8	216.4	94.6
North Delta	17.4	30.8	13.4
Southwest	1,872.1	2,711.7	839.6
Ouachita	599.6	800.7	201.1
Ozark	265.0	239.7	-25.3
<b>All units</b>	<b>2,875.9</b>	<b>3,999.3</b>	<b>1,123.4</b>

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

One of the noted findings of the 2015 survey was the tremendous increase in plantation softwood live-tree volume. In 2015, Arkansas had 4.0 billion cubic feet of softwood live-tree volume in plantations (table 27), a 1,123.4 million cubic foot increase (39 percent) since the 2010 forest survey. Most of the plantation volume continued to be in softwoods, only 279.8 million cubic feet was in hardwoods (7 percent). With the exception of the hardwood plantings, the hardwood volume was made up of trees that were coincident with softwood plantations. These trees most likely survived stand improvements, thinning operations, or were allowed to grow freely after establishing themselves following plantation establishment.

The Southwest unit had 68 percent of the softwood volume, an increase of 3 percent since 2010. The southwest unit accounted for 75 percent of the softwood increase in 2015. Southwest Arkansas has some of the most productive sites in the South for loblolly pine. Forest management practices may continue to capitalize on this region whether on forest industry- or NIPF-owned lands. The Ozark unit had an actual decrease in softwood plantation volume; a likely consequence of phasing out softwood plantation practices on national forest lands (table 27).

The majority (88 percent) of softwood volume in plantations continued to be in trees <15.0 inches d.b.h., while <2 percent was in trees ≥20.0 inches d.b.h. (table 28). The volume was evenly divided between the 5.0–9.9 and 10.0–14.9-inch d.b.h. class. However, the volumes increased appreciably since 2010, 29 percent for the former and 47 percent for the latter. Only the Southwest unit had an appreciable amount of volume in trees ≥15.0 inches d.b.h. This reflects the possible approach to managing loblolly pine plantations for sawtimber products rather than managing for pulp products. Rotation lengths are targeted at 25 years or less, and trees are produced to target d.b.h. classes in the 15- to 18-inch diameter range. The production of fast-growth sawtimber has long-term implications for lumber quality as trees that are grown rapidly

**Table 28**—Live-tree volume of softwoods in plantations on forest land by survey unit and diameter class, Arkansas, 2015

Survey unit	Total volume	Diameter class (inches at breast height)					
		5.0–9.9	10.0–14.9	15.0–19.9	20.0–24.9	25.0–29.9	30.0 +
~~~~~ million cubic feet ~~~~~							
South Delta	216.4	88.5	107.3	20.6	0.0	0.0	0.0
North Delta	30.8	22.1	1.5	5.1	2.2	0.0	0.0
Southwest	2,711.7	1,256.4	1,101.6	313.9	34.4	5.4	0.0
Ouachita	800.7	299.5	423.4	72.9	4.8	0.0	0.0
Ozark	239.7	77.7	134.9	24.4	2.7	0.0	0.0
<b>All units</b>	<b>3,999.3</b>	<b>1,744.3</b>	<b>1,768.7</b>	<b>436.8</b>	<b>44.1</b>	<b>5.4</b>	<b>0.0</b>

Numbers in rows and columns may not sum to totals due to rounding.  
0.0 = no sample for the cell or a value >0.0 but <0.05.

tend to have a larger core of juvenile wood, lower wood density, and less dimensional stability than wood from larger trees grown in naturally regenerated (and perhaps slower growing) stands (Rosson and Rose 2015).

Effective density analysis shows the spatial distribution of softwood volume in plantations was not balanced evenly across forest land in Arkansas. There were large areas with little amounts of softwood volume and smaller amounts of forest land with large amounts of volume (fig. 24). For example, a large proportion of plantation acreage was composed of stands that had <500 cubic feet per acre in softwood live-tree volume. Approximately 40 percent of plantations were in this stand class. These types of plantations accounted for about 3 percent of all plantation softwood volume. In contrast, 23 percent of

plantations were composed of high-volume stands, those with  $\geq 2,000$  cubic feet per acre. Even though these types of stands were not common in extent, approximately 57 percent of plantation softwood volume was located in these stands. Combining the two largest volume classes showed that about 77 percent of softwood plantation volume was on 37 percent of plantation forest land. This was an increase over that reported in the 2010 forest survey, 65 and 25 percent, respectively. This indicates a probable maturing of plantation stands. To detect changes in the resource, users can compare to figure 23 in Rosson and Rose (2015). Overall, with respect to plantation forestry, there was a large amount of plantation forest land with little volume and a small amount of plantation forest land with a large amount of volume.

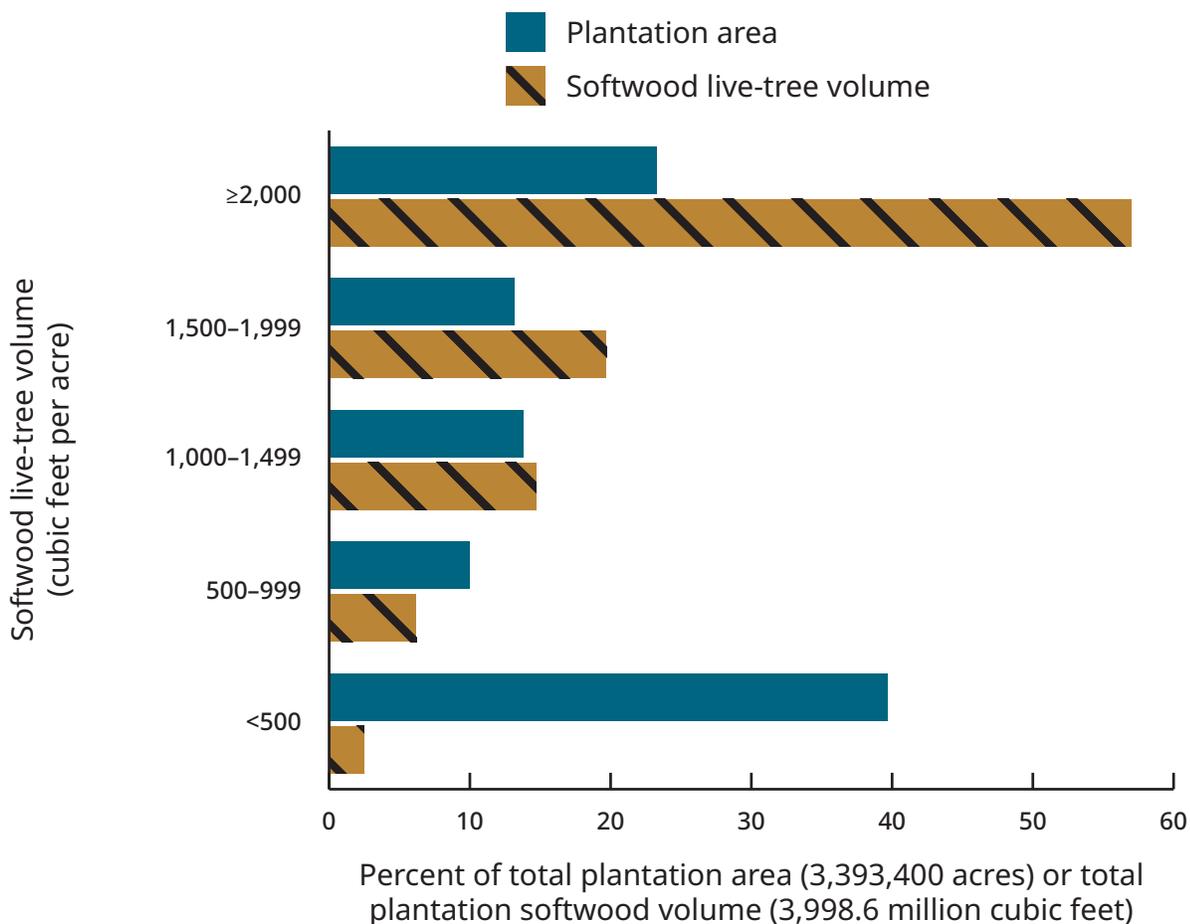


Figure 24—Effective density for softwood live-tree volume in plantations by cubic feet per acre class, Arkansas 2015. Plantation area, in this instance, is that where softwoods are planted.

### Plantation Growth, Removals, and Mortality

Softwood growth in Arkansas plantations continues to increase over time. Live-tree growth for plantation softwoods was 425.4 million cubic feet per year (table 29), an increase over the 346.2 million cubic feet (23 percent) reported in 2010. This was 54 percent of the total softwood growth in the State. Plantation growth now accounts for the majority of total softwood growth in Arkansas, up from the 46 percent in 2010. In sharp contrast, hardwoods (on plantations) were growing at the rate of 23.2 million cubic feet per year, only 6 percent of Arkansas's hardwood growth. This was a very small increase since 2010 where hardwoods were clearly a very minor component of plantations in the State. Softwood removals on plantations were well below growth, averaging 262.1 million cubic feet per year,

a slight decline since the 2010 survey. In 2015, 56 percent of Arkansas's softwood removals came from plantations (table 29), up from 50 percent in 2010. This means an even larger proportional share of softwood removals came from plantations because only 19 percent of Arkansas's forest land was in plantations. Even though down slightly from 2010, softwood plantations carried a major share of the softwood harvest between the 2010 and 2015 surveys. A higher proportion of softwood mortality was on plantations than in natural stands. In 2015, 21 percent of all softwood mortality in Arkansas occurred in plantations, but the expected amount of mortality was not substantially out of balance compared to 17 percent of forest land in plantations. Comparisons between total softwood growth and removals and softwood plantation growth are illustrated in table 30. The table clearly shows the positive impact on



**Table 29**—Average net annual growth, removals, and mortality of live trees in plantations on forest land by survey unit and by softwoods and hardwoods, Arkansas, 2010–2015

Survey unit	Net growth		Removals		Mortality	
	Softwood	Hardwood	Softwood	Hardwood	Softwood	Hardwood
~~~~~ million cubic feet ~~~~~						
South Delta	24.1	3.1	6.5	0.8	1.2	0.0
North Delta	3.3	1.1	0.0	1.3	0.1	0.1
Southwest	311.1	12.5	210.9	35.4	13.5	1.5
Ouachita	66.0	4.0	28.4	3.0	3.9	0.3
Ozark	21.0	2.6	16.2	0.8	1.3	0.1
All units	425.4	23.2	262.1	41.3	20.1	2.0

Numbers in columns may not sum to totals due to rounding.  
0.0 = no sample for the cell or a value >0.0 but <0.05.

growth in softwood plantation forestry in the Southwest unit. Users can compare this table to table 30 in Rosson and Rose (2015).

The effective density of softwood live-tree net growth shows a pattern slightly different than that of total softwood volume. There was a more even distribution of plantation area by the growth classes with the exception of the lowest class (fig. 21). Here, 36 percent of Arkansas’s plantations were growing softwoods at the rate of <50 cubic feet per acre per year (fig. 25). Four percent of total plantation softwood growth occurred in stands of this type, so 36 percent of plantation area contributed little toward the total

softwood plantation growth. However, this is an improvement from the 42 percent reported in 2010. Approximately 13 percent of Arkansas’s plantations were growing softwoods at the annual rate of 50 to 99 cubic feet per acre per year. The highest growth class, plantations growing at the rate of ≥300 cubic feet per acre per year, was present on only 7 percent of plantation forest land, but 20 percent of softwood plantation growth was in these stands. Note that some extremely high growth rates may be present because of small plot proportions caused by the FIA mapped plot design. These small plot sizes have a direct impact on per-acre estimates. See definition of [condition class](#) in the glossary.

**Table 30**—Comparison of softwood plantation growth and removals to total softwood growth and removals, Arkansas, 2010–2015

Survey unit	Net growth		Removals	
	Total softwood net growth <sup>†</sup>	Total softwood plantation net growth	Total softwood removals <sup>†</sup>	Total softwood plantation removals
~~~~~ million cubic feet ~~~~~				
South Delta	43.8	24.1	13.6	6.5
North Delta	5.4	3.3	0.9	0.0
Southwest	548.8	311.1	362.5	210.9
Ouachita	124.9	66.0	52.5	28.4
Ozark	63.8	21.0	37.9	16.2
All units	786.6	425.4	467.2	262.1

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

<sup>†</sup> Includes natural stands and plantations.

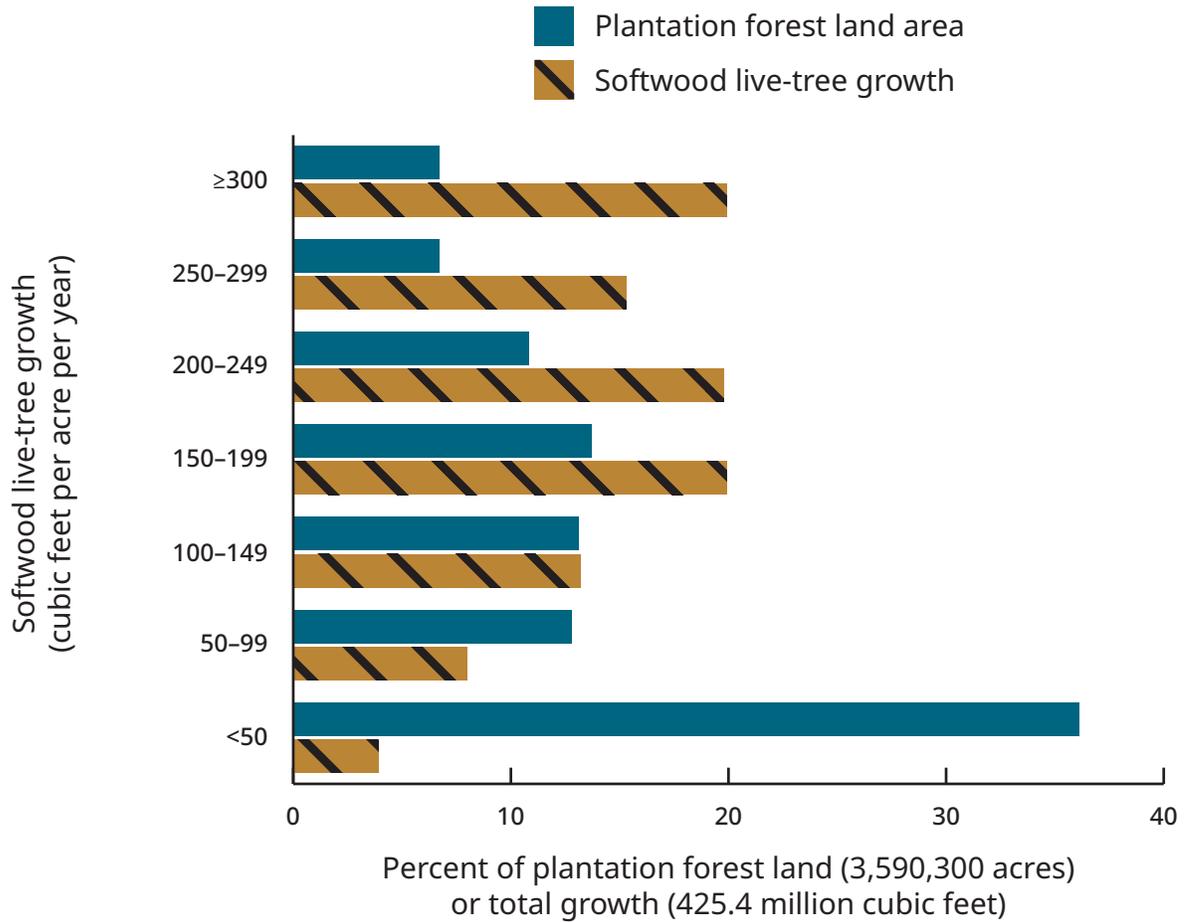


Figure 25—Effective density for softwood live-tree net annual growth by cubic feet per acre class in plantations, Arkansas, 2010–2015.

Growth could be improved across Arkansas plantations through better stocking control and a reduction in the lag time between harvest and plantation establishment. However, most of the low acreage situations in the higher growth per acre classes can be attributed to site conditions and the overall young age of plantations in Arkansas, and by different rates of annual growth as plantations go through different stages from planting to harvest.

**STAND STRUCTURE**

Studying changes in stand structural components can aid in understanding and defining the overall health and sustainability levels of Arkansas’s forests. Sustainability is a concept that is often very difficult to define. In its most simplistic definition, it implies that the portion of the resource

considered most important (usually from an economic viewpoint) will last forever. In a more complex form, it means that every biological and abiotic component of a system is considered sustainable for the long term. Somewhere between these two extremes is a working definition that addresses as many important factors as possible. One of the challenges in defining sustainability is identifying resource levels or system thresholds that indicate resource declines or stresses, and at what levels intervention and action should be taken. In all likelihood, the definition of sustainability regarding forest resources will be debated for quite some time. Monitoring resource attributes (such as the components of stand structure) over time is a first step in addressing many sustainability concerns and issues. Many attributes were previously addressed in the 2005 and 2010 reports (Rosson and Rose 2010, 2015) and

could be studied to assess some degree of sustainability: basal area, stocking, quadratic mean diameter, species diversity, proportions of forest land in old-growth or regeneration stages, and more. In this report, we focus primarily on the basal area component of forest structure and changes in basal area components since the 2010 survey as it relates to stand size, stand density, stand volume, species dominance, and stand composition.

### Stand Size

The FIA program defines stand size as the size of a stand of trees according to three defined categories: (1) [small-sized trees](#), (2) [medium-sized trees](#), and (3) [large-sized trees](#) (see definitions in glossary). Most of Arkansas’s forest land was in the large-diameter size class, 10.7 million acres (table 31). This was a 4-percent increase since the 2010 survey. The area in this size class was mostly in the Ozark and Southwest units, along with a

sizeable portion in the Ouachita unit. All of the survey units had increases in this size class. There were 4.8 million acres in the medium-diameter size stands, little change since the 2010 survey. Again, most of this forest land was in the Ozark unit followed by the Southwest unit. All of the survey units showed declines but were offset by a 120,901-acre increase in the Southwest unit. The least amount of area was in the small-diameter class. There were 3.3 million acres in this size class where 51 percent of this was in the Southwest unit. There were three survey units that showed decreases and two survey units showed increases since 2010. The high proportion of small-sized stands in the Southwest unit can be attributed to high levels of forest management, mostly in the form of regenerating harvested stands into plantation establishment. Small-diameter stands accounted for 18 percent of the total forest land area in Arkansas.

**Table 31**—Area of forest land by survey unit, stand-size class, and change, Arkansas 2010–2015

Survey unit	Stand-size class							
	Small diameter		Medium diameter		Large diameter		Nonstocked	
	2015	Change	2015	Change	2015	Change	2015	Change
	~~~~~ thousand acres ~~~~~							
South Delta	269.4	-6.4	192.8	-14.9	959.1	85.1	51.6	20.0
North Delta	149.6	30.3	157.0	-6.2	486.3	8.7	12.3	4.4
Southwest	1,690.7	-53.5	1,615.7	120.9	3,576.9	55.4	61.9	10.9
Ouachita	519.6	8.5	850.1	-17.6	2,062.2	70.1	16.5	13.6
Ozark	714.3	-26.1	1,986.2	-116.1	3,650.5	150.9	17.1	-18.3
All units	3,343.6	-47.2	4,801.9	-33.8	10,734.9	370.0	159.3	30.5
Average all-live basal area per acre (in square feet)	30.8	3.4	90.1	2.2	114.8	7.1	3.6	0.6
Average number of all-live trees per acre	706.0	114.3	747.8	1.7	557.6	15.8	34.1	5.2

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

### Stand Basal Area

The basal area of all live trees ( $\geq 1.0$ -inch d.b.h.) averaged 90.4 square feet per acre across Arkansas’s forest land. This was an increase from 87.4 reported in 2010. The basal area was divided between an average of 33.4 (30.1 in 2010) square feet per acre for softwoods and 57.0 (57.3 in 2010) square feet per acre for hardwoods. This indicates that all of the basal area increase for Arkansas’s forests was in softwoods. A breakdown by tree size showed 15.0 (15.0 in 2010) square feet per acre for trees  $< 5.0$  inches in d.b.h. and 75.4 (72.4 in 2010) square feet per acre for trees  $\geq 5.0$  inches in d.b.h. Again, all of the increase was in softwoods and overstory trees.

In 2015, basal area increased in all of the stand size classes (table 31). The largest increase was 7.1 square feet per acre in the large-diameter class, almost a 7-percent increase, rising to 114.8 square feet per acre.

Again, this points to a continued maturing of stands in Arkansas’s forests. In 2015, the average number of trees per acre also increased across all the stand size classes. Since 2010, the substantial amount of increase (19 percent) to 706 trees per acre was in the small-diameter stand-size class. In the 2010 forest survey, this class had a density decline of 13 percent.

Basal area was also evaluated by individual trees in 2-inch diameter classes. These particular estimates were not applied to stand-level evaluations but instead all live trees were lumped into one aggregated pool and then placed into their respective d.b.h. class. This approach treated the entire State of Arkansas as one, unsegregated stand of trees. Figure 26 illustrates how much each diameter class contributed to the total State average basal area of 90.4 square feet per acre. As in previous surveys, most of the basal area in Arkansas came from trees in the 4-, 6-, 8-, 10-,

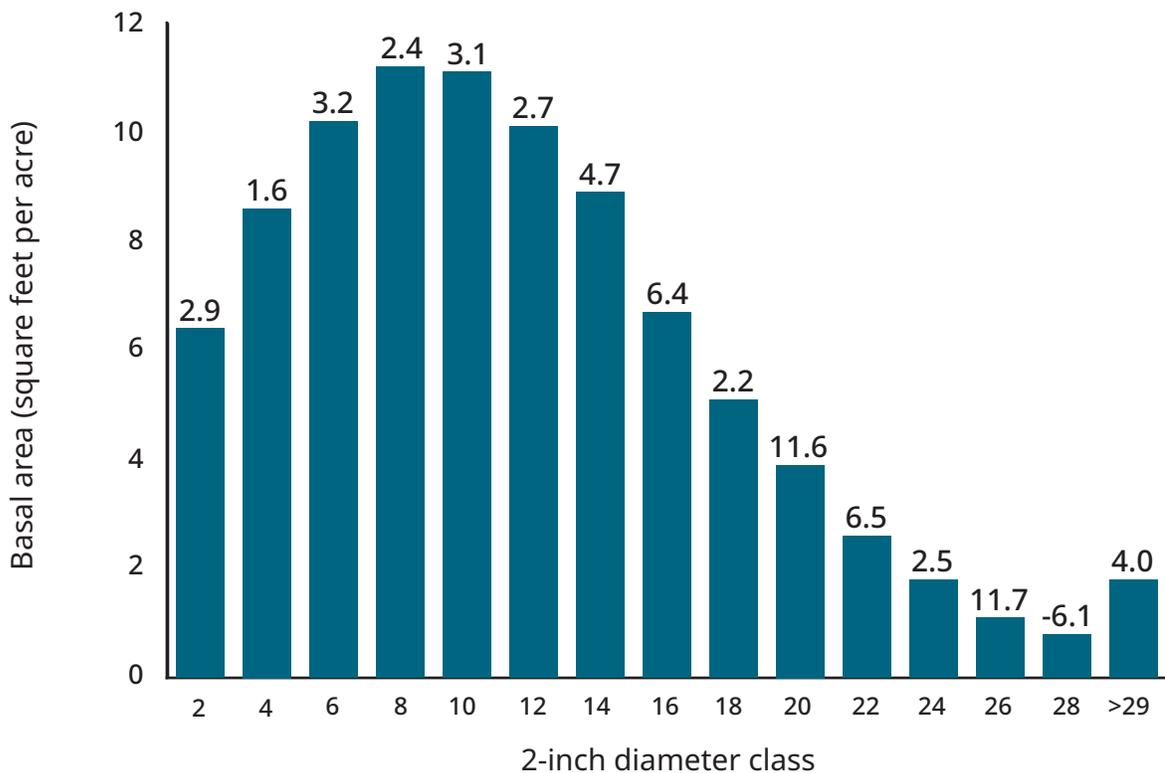


Figure 26—Average per acre basal area of all-live trees on forest land by diameter class, Arkansas, 2015. The numbers above the bars represent the percent change since the 2010 survey. The diameter classes shown represent the midpoints, e.g., the 2-inch class ranges from 1.0 to 2.9 inches d.b.h., the 4-inch class ranges from 3.0 to 4.9 inches d.b.h. and so on. The sum of all the basal-area classes equals the average per acre basal area for the 2015 survey, 90.3 square feet.

and 12-inch diameter classes. Compared to the 2010 survey, all of the diameter classes had increases in basal area with the exception of the 28-inch diameter class. The 20- and 26-inch diameter classes increased substantially (12 percent). Users are referred to figure 25 in Rosson and Rose (2015) to make trend comparisons.

Stand basal area is often used to describe the structure and complexity of forests. In addition, it is commonly used as an easily measured surrogate indicator of stand age, volume, biomass, density, and structural complexity. Typically, a basal area >120 square feet per acre markedly decreases ground cover and slows timber growth. The thinning of stands is commonly done back to

a 60 to 80 square feet per acre level in order to satisfy most owners' objectives of balancing adequate timber growth with wildlife management objectives (Walker 1991).

Eight arbitrarily defined basal-area classes were established to describe stand structure by respective amounts of forest land area for the survey units, ownership groups, FTGs, and stand-size classes (tables 32, 33, 34, 35). These basal area classes represent the stand-level basal area, i.e., the total per acre basal area was compiled for each FIA sample plot. All live trees (≥1.0-inch d.b.h.) were used to derive this basal area. Most of Arkansas's forest land was in three basal area classes ranging from 61 to 120 square feet per acre (table 32). There were 9.6 million acres in

**Table 32**—Forest land area by survey unit and basal area class, Arkansas, 2010 and 2015

Survey unit	Basal area class (square feet per acre)															
	>140		121–140		101–120		81–100		61–80		41–60		21–40		0–20	
	2010	2015	2010	2015	2010	2015	2010	2015	2010	2015	2010	2015	2010	2015	2010	2015
~~~~~ thousand acres ~~~~~																
South Delta	265.3	310.6	154.8	196.6	219.5	189.7	145.0	173.0	148.7	146.0	139.3	145.3	78.1	91.9	238.4	220.0
North Delta	175.2	143.2	53.9	89.8	115.2	113.5	113.4	166.2	145.2	81.3	51.5	64.5	48.4	59.2	65.2	87.4
Southwest	885.3	1,116.0	740.2	838.0	1,018.4	1,047.0	1,068.7	1,053.7	907.8	856.9	683.9	688.7	437.2	371.4	1,070.0	973.6
Ouachita	393.1	474.1	332.8	394.4	543.6	546.9	679.6	603.3	562.2	598.2	364.7	326.3	217.5	197.6	280.3	307.7
Ozark	479.6	500.8	677.4	542.8	1,207.8	1,301.2	1,451.6	1,521.4	1,293.7	1,248.5	563.8	590.8	298.0	375.5	405.7	286.9
All units	2,198.5	2,544.6	1,959.0	2,061.6	3,104.6	3,198.3	3,458.3	3,517.5	3,057.7	2,931.0	1,803.2	1,815.6	1,079.2	1,095.7	2,059.7	1,875.6

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

**Table 33**—Forest land area by ownership and basal area class, Arkansas, 2010 and 2015

Ownership class	Basal area class (square feet per acre)															
	>140		121–140		101–120		81–100		61–80		41–60		21–40		0–20	
	2010	2015	2010	2015	2010	2015	2010	2015	2010	2015	2010	2015	2010	2015	2010	2015
~~~~~ thousand acres ~~~~~																
Public	618.7	637.3	452.4	463.7	716.8	667.7	739.1	749.0	639.7	646.5	256.4	276.5	108.2	123.1	125.5	132.6
Forest industry	400.4	281.3	400.4	260.7	487.9	309.9	559.1	300.9	533.5	251.5	375.1	216.4	243.2	134.4	745.3	492.4
NIPF	1,179.4	1,626.0	1,106.3	1,337.2	1,899.8	2,220.7	2,160.1	2,467.7	1,884.5	2,033.0	1,171.6	1,322.6	727.9	838.2	1,188.9	1,250.6
All classes	2,198.5	2,544.6	1,959.0	2,061.6	3,104.6	3,198.3	3,458.3	3,517.5	3,057.7	2,931.0	1,803.2	1,815.6	1,079.2	1,095.7	2,059.7	1,875.6

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

0.0 = no sample for the cell or a value >0.0 but <0.05.

NIPF = nonindustrial private forest.

# Stand Structure

**Table 34**—Forest land area by forest-type group and basal area class, Arkansas, 2010 and 2015

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	
	2010	2015	2010	2015	2010	2015	2010	2015	2010	2015	2010	2015	2010	2015	2010	2015
----- thousand acres -----																
Loblolly-shortleaf	890.7	1,271.4	693.3	703.1	814.8	963.2	913.5	902.0	786.0	725.0	533.8	455.5	231.6	227.7	630.7	610.3
Eastern red cedar	22.1	19.5	24.1	36.5	36.6	47.1	44.2	36.6	52.7	61.9	39.7	49.1	55.8	36.8	25.1	14.4
Oak-pine	197.5	217.8	213.0	213.5	364.6	298.4	343.7	399.6	310.7	308.4	213.4	171.1	145.0	140.3	312.7	143.7
Oak-hickory	380.5	391.4	719.4	726.6	1,480.8	1,561.3	1,782.8	1,737.0	1,529.7	1,497.1	742.4	782.4	411.1	481.2	663.9	628.8
Oak-gum-cypress	579.4	519.2	243.8	290.1	309.3	221.1	257.1	361.5	253.1	210.3	129.7	157.3	122.8	91.3	155.8	170.9
Elm-ash-cottonwood	128.4	125.4	65.4	91.8	98.3	107.2	112.5	79.2	118.9	126.7	137.5	189.8	95.9	107.5	135.1	146.9
Misc. hardwood	0.0	0.0	0.0	0.0	0.0	0.0	4.5	1.5	4.9	1.5	6.8	8.9	15.4	6.4	10.6	7.3
Nonstocked	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.5	0.0	0.0	1.5	1.6	4.6	125.7	153.3
<b>All groups</b>	<b>2,198.5</b>	<b>2,544.6</b>	<b>1,959.0</b>	<b>2,061.6</b>	<b>3,104.6</b>	<b>3,198.3</b>	<b>3,458.3</b>	<b>3,517.5</b>	<b>3,057.7</b>	<b>2,931.0</b>	<b>1,803.2</b>	<b>1,815.6</b>	<b>1,079.2</b>	<b>1,095.7</b>	<b>2,059.7</b>	<b>1,875.6</b>

Numbers in columns may not sum to totals due to rounding.  
0.0 = no sample for the cell or a value >0.0 but <0.05.

**Table 35**—Forest land area by stand-size class and basal area class, Arkansas, 2010 and 2015

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	
	2010	2015	2010	2015	2010	2015	2010	2015	2010	2015	2010	2015	2010	2015	2010	2015
----- thousand acres -----																
Small diameter	25.8	27.9	32.5	35.4	68.9	72.5	149.9	122.8	222.9	245.1	412.5	456.7	605.6	729.4	1,872.7	1,653.7
Medium diameter	367.2	519.8	416.6	445.7	736.0	675.5	1,152.5	1,147.7	1,140.3	1,123.8	731.8	619.8	258.3	227.7	33.1	41.9
Large diameter	1,805.5	1,996.9	1,510.0	1,580.4	2,299.6	2,450.2	2,155.9	2,247.0	1,692.9	1,562.1	658.9	737.5	213.8	134.0	28.2	26.7
Nonstocked	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.5	0.0	0.0	1.5	1.6	4.6	125.7	153.3
<b>All classes</b>	<b>2,198.5</b>	<b>2,544.6</b>	<b>1,959.0</b>	<b>2,061.6</b>	<b>3,104.6</b>	<b>3,198.3</b>	<b>3,458.3</b>	<b>3,517.5</b>	<b>3,057.6</b>	<b>2,931.0</b>	<b>1,803.2</b>	<b>1,815.5</b>	<b>1,079.3</b>	<b>1,095.7</b>	<b>2,059.7</b>	<b>1,875.6</b>

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

these three basal area classes; no change since 2010. This was still within the optimum basal area range for normally stocked stands in the Southern United States (Walker 1991). It should be noted, however, that pine stands that rise above 100 square feet per acre are more likely to experience southern pine beetle (*Dendroctonus frontalis*) outbreaks (Guldin 2011).

As Arkansas forest stands mature, more forest land moved into the higher basal area classes. The biggest increase was in forest stands with

>140 square feet per acre: 346,100 acres. The Southwest unit had 67 percent of the increase in the >140 square feet per acre class. Only one unit, the North Delta, lost forest land in this high basal area class. The other notable change was a 184,100-acre decline in the 0 to 20 square feet per acre class. Most of the losses in the 0 to 20 square feet per acre class were in the Southwest and Ozark survey units.

The three basal area classes (combined) in the optimum stocking ranges, 61–120 square feet per acre, had a slight increase since the 2010

survey. Increases in the 101–120 and 81–100 square feet per acre classes offset the 126,700-acre loss in the 61–80 square feet per acre class (table 32).

The forest land area by basal area classes was applied to the ownership categories (table 33). There was a large increase (446,600 acres) in the NIPF ownership in the ≥140 square feet per acre class. This was offset by a 119,100-acre decrease in the forest industry ownership. The forest industry forest lands also impacted shifts in the 0–20 square feet per acre class. Here, a 252,900-acre loss was offset by a 61,700-acre increase in NIPF forest land area (table 33).

Reflecting forest industries emphasis on softwood management, the loblolly-shortleaf FTG had a 380,700-acre increase in the >140 square feet per acre class (table 34). Forest industry was probably not carrying many of their forest stands into higher basal areas (see table 33); therefore, it's likely most of the high basal area loblolly-shortleaf FTG stands are on NIPF lands.

It was interesting to note that there were large increases in both the medium-diameter and large-diameter stand size classes in the >140 square feet per acre class (table 35). Depending on management objectives it may or may not be desirable to have large trees in the optimum basal area classes (61–120 square feet per acre). In contrast, it may not be desirable to have medium-diameter trees in the large class (>140 square feet per acre). This may mean an overstocking of smaller-sized trees (table 35).

Tables 36 and 37 illustrate the correlations between volume and basal area. Three classes (0–20, 21–40, 61–80) showed losses in volume since the 2010 survey. The largest increase in volume was in the >140 square feet per acre class (1,624.4 million cubic feet). Most of the increase (896.6 million cubic feet) was in the Southwest unit. This was expected given the large increase in forest land area in this basal area class. Most of Arkansas's volume increase was in stands in the higher basal area classes or in stands growing into these classes (tables 36 and 37).

**Table 36**—Live-tree volume on forest land by survey unit and basal area class, Arkansas, 2010 and 2015

Survey unit	Basal area class (square feet per acre)															
	>140		121–140		101–120		81–100		61–80		41–60		21–40		0–20	
	2010	2015	2010	2015	2010	2015	2010	2015	2010	2015	2010	2015	2010	2015	2010	2015
	~~~~~ million cubic feet ~~~~~															
<b>South Delta</b>	1,204.4	1,452.2	435.5	587.2	498.3	455.4	241.4	329.7	180.9	164.9	104.0	114.6	34.6	29.4	11.5	5.9
<b>North Delta</b>	710.7	659.4	150.2	254.1	254.5	209.0	169.2	239.9	150.1	95.7	33.3	41.8	9.8	14.3	2.4	2.5
<b>Southwest</b>	3,232.5	4,129.1	1,896.5	2,122.5	2,123.7	2,253.5	1,618.9	1,655.7	1,104.3	1,002.7	449.6	467.7	168.3	79.3	23.5	24.8
<b>Ouachita</b>	1,265.8	1,669.4	821.0	996.6	1,107.1	1,186.0	988.7	907.3	609.4	640.1	270.6	251.1	81.3	68.6	8.8	8.0
<b>Ozark</b>	1,625.1	1,752.7	1,466.5	1,215.5	2,278.0	2,438.3	2,050.6	2,234.8	1,343.3	1,287.9	378.0	377.4	99.5	128.3	22.4	11.3
<b>All units</b>	8,038.4	9,662.8	4,769.7	5,175.8	6,261.5	6,542.3	5,068.8	5,367.4	3,387.9	3,191.3	1,235.4	1,252.6	393.6	320.0	68.7	52.4

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

**Table 37**—Sawtimber volume on forest land by survey unit and basal area class, Arkansas, 2010 and 2015

Survey unit	Basal area class (square feet per acre)															
	>140		121–140		101–120		81–100		61–80		41–60		21–40		0–20	
	2010	2015	2010	2015	2010	2015	2010	2015	2010	2015	2010	2015	2010	2015	2010	2015
~~~~~ million board feet <sup>1</sup> ~~~~~																
South Delta	5,325.1	6,223.0	1,620.1	2,245.6	1,799.4	1,721.4	740.5	1,271.0	549.1	462.2	277.5	291.0	76.8	57.9	16.6	3.5
North Delta	2,827.7	2,607.8	571.2	1,029.4	893.5	528.8	424.1	652.8	321.6	205.2	42.9	72.8	9.6	7.2	1.7	2.7
Southwest	13,200.9	16,423.0	7,013.4	7,650.6	7,997.0	8,632.7	5,425.3	5,651.0	4,128.1	3,533.0	1,377.8	1,578.3	481.2	130.2	50.1	37.1
Ouachita	4,593.9	6,361.7	2,984.5	3,646.3	3,770.0	4,318.6	3,105.8	2,822.6	1,792.5	1,947.1	769.2	634.2	179.4	191.9	16.3	12.5
Ozark	5,785.4	6,091.7	4,202.3	3,521.9	6,317.7	6,830.2	4,811.3	5,845.3	2,836.1	2,793.3	744.7	674.1	124.0	251.0	33.3	7.8
All units	31,733.1	37,707.1	16,391.5	18,093.8	20,777.6	22,031.7	14,507.1	16,242.8	9,627.4	8,940.7	3,212.0	3,250.4	871.0	638.2	117.9	63.6

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

0.0 = no sample for the cell or a value >0.0 but <0.05.

<sup>1</sup> International 1/4-inch rule.

## Species Dominance

One way to broadly assess some aspect of evenness in the complex of species diversity measures at the State level is through some type of dominance measure. One simple approach used earlier was to list the ranks of individual species according to their respective volumes (table 16). A further refinement of this approach is to rank, by species (where it is the dominant species in the stand), the amount of forest land a respective species occupies. The metric used was basal area and the arbitrary threshold of dominance applied here was a basal area of  $\geq 50$  percent of a plot condition. Thresholds other than an arbitrary 50 percent could have been used for this type of evaluation. Theoretically, no matter what dominance threshold was used, the more diverse stands will have species importance (in this case, basal area) distributed among several species and would not have any one species accounting for  $\geq 50$  percent of stand basal area. Less diverse forests will have the basal area of the stand confined to a fewer number of species and in this application stands with one species with  $\geq 50$  percent of stand basal area would appear less diverse. Trend analysis is important in this type of approach and monitoring changes in dominance over time

will provide some insights into a particular State’s overall tree species diversity situation. Table 38 of this report can be compared to table 38 in Rosson and Rose (2015) for trend assessments.

**Table 38**—Ranked forest land area, by species, where stand basal area<sup>1</sup> is  $\geq 50$  percent for a respective species, Arkansas, 2015

Species name	FIA species code	Forest land area thousand acres
Loblolly pine	131	4,236.9
Shortleaf pine	110	1,225.2
White oak	802	641.9
Post oak	835	580.9
Sweetgum	611	448.8
Eastern red cedar	68	429.0
Willow oak	831	157.1
Northern red oak	833	121.2
Overcup oak	822	119.8
Southern red oak	812	119.5
Sugarberry	461	109.1
Winged elm	971	108.7
Black willow	922	108.2
Black oak	837	103.8

**Table 38**—Ranked forest land area, by species, where stand basal area<sup>1</sup> is ≥50 percent for a respective species, Arkansas, 2015 (continued)

Species name	FIA species code	Forest land area
		<i>thousand acres</i>
Black hickory	408	101.2
Green ash	544	96.0
Baldcypress	221	91.4
Water oak	827	82.4
Nuttall oak	828	77.1
Red maple	316	65.8
Cherrybark oak	813	55.9
Water tupelo	691	53.9
Mockernut hickory	409	41.0
American sycamore	731	35.3
Boxelder	313	34.2
Blackgum	693	32.9
Hackberry	462	27.5
Eastern cottonwood	742	27.3
Pecan	404	24.4
Common persimmon	521	22.6
Blackjack oak	824	21.9
Water-elm planertree	722	21.6
Black cherry	762	19.5
American beech	531	18.4
Ashe juniper	61	17.4
Silver maple	317	17.0
Slippery elm	975	15.2
Honeylocust	552	13.9
American elm	972	11.6
Eastern hophornbeam	701	11.3
Shagbark hickory	407	10.6
Water hickory	401	10.1
River birch	373	10.1
Pignut hickory	403	9.3
American hornbeam	391	9.1
Other unknown	999	8.5

**Table 38**—Ranked forest land area, by species, where stand basal area<sup>1</sup> is ≥50 percent for a respective species, Arkansas, 2015 (continued)

Species name	FIA species code	Forest land area
		<i>thousand acres</i>
Florida maple	311	8.3
Black walnut	602	7.5
White ash	541	7.4
Osage-orange	641	6.1
Virginia pine	132	6.1
Paulownia empress-tree	712	6.0
Swamp chestnut oak	825	4.6
Laurel oak	820	4.5
Shumard oak	834	4.2
Bitternut hickory	402	4.2
Sweetbay	653	3.0
Yellow-poplar	621	1.7
Cedar elm	973	1.6
Blue ash	546	1.5
Red mulberry	682	1.5
Flowering dogwood	491	0.5
Silver poplar	752	0.3
<b>All species</b>		<b>9,673.1</b>

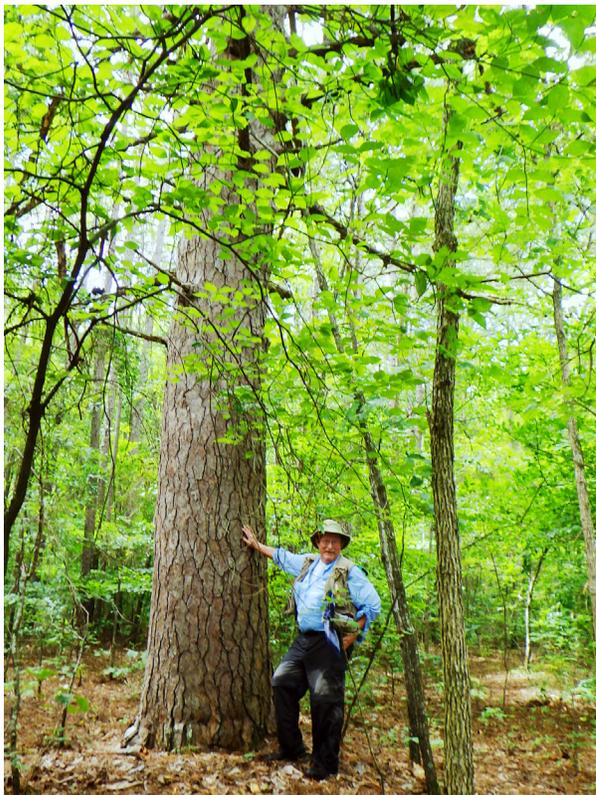
FIA = Forest Inventory and Analysis.

<sup>1</sup> All-live trees ≥1.0 inch d.b.h. were included in deriving stand basal area per acre.

Ideally, where species diversity was optimum, there should be very few plots where one species has more than one-half of the importance value. There were 62 tree species occupying at least one plot condition where ≥50 percent of basal area was in that respective species (table 38), no change since the 2010 survey. Other unknown species were all grouped into their own separate category. The 62 dominant species were spread across 9.7 million acres of forest land in Arkansas, an increase of 310,700 acres since the 2010 forest survey. By a wide margin, loblolly pine covered 4.2 million acres and continued to be the most dominant species. Further, loblolly pine covered 44 percent of all forest land

where one species had  $\geq 50$  percent of stand basal area. This was a 251,800-acre increase since the 2010 forest survey. Shortleaf pine was second with 1.2 million acres, a decrease of 110,500 acres. Again, much of the loblolly pine dominance can be attributed to being favored heavily in forest management.

In 2015, 73 percent (7.5 million acres) of this class of species–dominant forest land—was dominated and occupied by six species: loblolly pine, shortleaf pine, white oak, post oak, sweetgum, and eastern red cedar. Note that white oak was ranked third in 2015 versus fourth in the 2010 survey (Rosson and Rose 2015). While some species become dominant through forest management practices (plantations), others become dominant because of their ecological characteristics and habitat adaptations. Examples in Arkansas are post oak, which capitalized on harsh growing conditions, and eastern red cedar, which was rapidly



James M. Guldin next to a large shortleaf pine (*Pinus echinata*) near the Buffalo River, Newton County, AR.

and widely distributed by birds. Clearly, plantation establishment and management were responsible for much of the pine-dominant stands in Arkansas. But it should also be noted that early and mid-successional natural stands are often dominated by one or two species. The large amount of forest land in one dominant species was also an indicator of past disturbance as stands proceed through the recovery and succession processes. Ideally, however, it would be an improvement in species diversity and evenness for the dominant type stands, discussed earlier, to show decreases in forest land occupancy area further into the future.

### Softwood/Hardwood Composition

Much of the inventory information is presented by softwood or hardwood attributes. It was also important to consider the amounts of forest land area where these two major species groups coexist in a stand. Recent concerns have been raised about declines in mixed oak-pine stands. As hardwoods are eliminated, mixed stands might decrease because pine is possibly favored. Figure 27 shows the relative breakdown of forest land stands based upon the relative contribution of softwoods or hardwoods to total stand basal area on each FIA plot condition. Only upland stands were included in figure 27 because bottomland hardwoods are usually 100 percent stocked with hardwoods. For example, there were 2.6 million acres of upland forest land composed of 5 percent stand basal area in hardwoods and 95 percent basal area in softwoods (fig. 27). See the caption in figure 27 for information regarding the pine versus softwood classes. In contrast, there were 5.4 million acres of forest land with 95 percent of stand basal area in hardwoods and 5 percent in softwoods. The remaining 7.3 million acres were spread between these two extremes. Overall, there were 9.1 million acres of stands with  $>50$  percent of basal area in hardwoods (88,600-acre increase) and 6.2 million acres with  $>50$  percent of basal area in softwoods (198,800-acre increase) since the 2010 forest

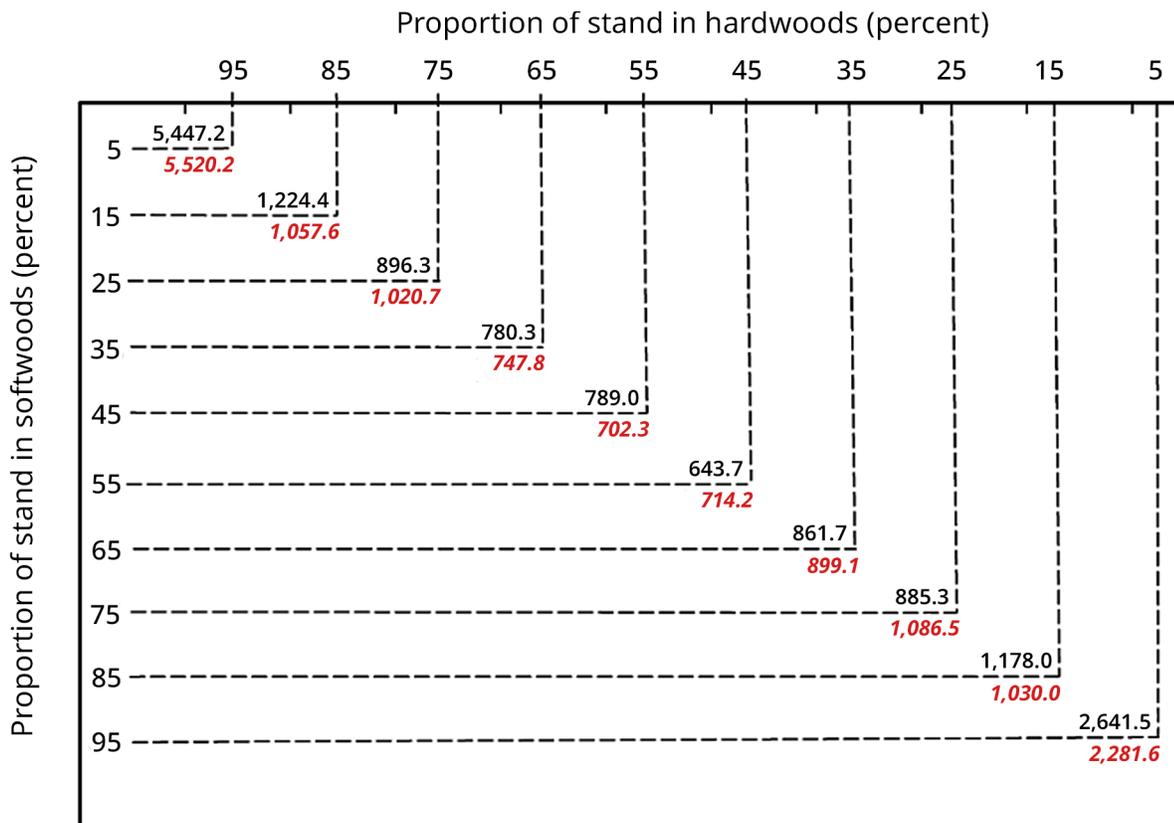


Figure 27—Area of upland forest land by proportion of stand in softwoods and hardwoods, Arkansas, 2010 and 2015. The percentage values are the midpoints of the deciles. Thus, 85 percent includes values >80 percent but <90 percent. Area is in thousand acres; the acreage in red italics is for the 2010 survey. Proportions were based on basal area, and only stands with trees >1.0 inch in d.b.h. are included. There were 15,060.0 and 15,347.4 thousand acres included in this graph for the 2010 and 2015 surveys, respectively.

survey. Monitoring these stand metrics over time provides valuable information regarding stand dynamics and in particular the mixed pine stand situation.

Since the 2010 survey, there has been an increase in pine-dominated stands. The 95-percent softwood class alone increased from 2.3 to 2.6 million acres (359,900-acre increase). This represents a continued interest in pine, particularly pine plantations. Another large increase was in the 85-percent softwood class (148,000 acres). The largest decrease was in the 75-percent class (201,200 acres). Overall, five softwood classes decreased and five increased. Again, one of the strong driving forces in the class shifts was the forest management practices that favored loblolly pine in plantation forestry. This influenced the loblolly pine share of the available habitat space (see table 38).

Overall, there was no change in Arkansas's upland forest structure balance between the softwood and hardwood components. In 2010, the balance of hardwood to softwood-dominated stands was 60 to 40 percent, respectively. Hardwood-dominated stands are defined as stands with  $\geq 50$  percent of basal area in hardwoods; softwood-dominated stands are defined as stands with  $\geq 50$  percent of basal area in softwoods, the same as in the 2010 forest survey. Although there was no change overall, there were declines in some of the important mixed-component classes (75-, 65-, and 55-percent pine classes). The declines were offset by large increases in the 85- and 95-percent classes (fig. 27). Interesting is that even though there has been a strong interest favoring pine in Arkansas over the last 40+ years, Arkansas's forest land is still predominately dominated by hardwood stands.

## DISTURBANCE

The focus on disturbance in this report primarily originated from forest management activity. However, the mortality assessment does include all causes, both natural and non-natural. The FIA program identified six types of cutting: (1) clearcut, (2) partial cut, (3) seed tree/shelterwood cut, (4) commercial thinning, (5) timber stand improvement (TSI), and (6) salvage cutting (table 39). Between the 2010 and 2015 surveys, 2.5 million acres underwent some form of cutting (table 39). This was a 693,100-acre decrease since the 2010 survey, a number also reflected in the softwood and hardwood removals discussed previously (table 17). The cutting was almost evenly divided between forest industry and NIPF ownerships, 1.1 and 1.3 million acres, respectively. There was a difference in the type of cutting done on forest industry lands versus NIPF lands. As in the 2010 forest survey, the majority of forest industry lands were clearcut, whereas most of the NIPF lands had a partial-cut harvest (table 39).

There were 1.0 million acres that had a commercial thinning operation since the 2010 survey, a decline of 122,300 acres. A TSI operation was also conducted on 147,100 acres which was a decrease of 85,700 acres compared to the previous survey.

Continuing from 2010, and as expected, the majority of cutting and thinning was done in the loblolly-shortleaf pine FTG: 66 percent of the clearcuts and 78 percent of the commercial thinning (table 39).

The report assessed five types of stand treatments: (1) cutting (sum of the six cutting categories), (2) site preparation, (3) artificial regeneration, (4) natural regeneration, and (5) other silviculture treatments (table 40). Besides cutting, most of the stand treatment activity was centered on site preparation activity and artificial regeneration, 582,800 and 563,200 acres respectively. This involved various activities in preparation for planting after removing the managed stand, then

planting the selected target plantation species. In the 2010 forest survey much more harvested forest land was planted into plantations than allowed to regenerate naturally. Forest land was allowed to regenerate naturally on 450,500 acres in 2015, an increase of 71 percent. Since the 2010 forest survey, the amount of artificially regenerated stands declined 117,300 acres.

As expected, the majority of site preparation activity took place on forest industry lands in the loblolly-shortleaf pine FTG: 302,100 acres, 52 percent. As a result, 276,400 acres established on forest industry lands in the loblolly-shortleaf pine FTG were artificially planted (table 40). A total of 49 percent of all artificial plantings were made in this way.

The amounts of other types of silviculture treatment on public lands was particularly interesting. Here, 143,000 acres underwent some other form of treatment (table 40). This was a decrease from the 324,300 acres reported in the 2010 survey. This appeared to be treatments to enhance (or restore) forest stands and communities or manage for wildlife habitat in unique settings. These other treatments may include such activities as the use of fertilizers, herbicides, girdling, pruning, invasive species removal or similar activities designed to improve the commercial value of the residual stand, or chaining (a practice used on woodlands to encourage wildlife forage). Prescribed fires are not considered to be a treatment. Note that FIA does not list fire as a treatment because of difficulties differentiating between prescribed and unintended fires. Fire is listed as a disturbance when evidence is encountered.

The information in tables 39 and 40 came from field crew observations on the plot. The report also quantified cutting and mortality information using sample data and tracking trees over time. This provided the means to put cutting and mortality into classes based upon the amount of stand basal area removed between the 2010 and 2015 surveys. Over 1.7 million acres of Arkansas's forest land had >10

**Table 39**—Area of harvesting on forest land by forest-type group and ownership class, Arkansas, 2010–2015

Forest-type group and ownership class <sup>1</sup>		Type of cutting							
		Total <sup>2</sup>	No cutting	Clearcut	Partial cut	Seed tree/ shelterwood	Commercial thinning	TSI (cutting)	Salvage cut
~~~~~ thousand acres ~~~~~									
Eastern red cedar	Public	30.7	30.7	0.0	0.0	0.0	0.0	0.0	0.0
	Forest industry	5.9	5.9	0.0	0.0	0.0	0.0	0.0	0.0
	NIPF	284.4	281.4	1.5	0.0	0.0	1.4	0.0	0.0
	All classes	321.0	318.0	1.5	0.0	0.0	1.4	0.0	0.0
Loblolly-shortleaf	Public	962.8	849.2	0.0	7.0	0.0	63.0	36.8	6.9
	Forest industry	2,351.2	1,523.1	406.6	41.1	0.0	365.2	22.9	0.0
	NIPF	2,193.7	1,601.5	160.2	105.5	6.1	329.7	1.4	0.0
	All classes	5,507.7	3,973.7	566.8	153.6	6.1	757.9	61.0	6.9
Oak-pine	Public	473.2	428.0	1.8	1.7	0.0	16.5	15.6	9.6
	Forest industry	310.9	233.7	39.4	8.2	0.0	23.7	5.9	0.0
	NIPF	1,274.5	1,132.0	79.3	29.9	5.8	17.9	3.5	6.1
	All classes	2,058.5	1,793.7	120.6	39.8	5.8	58.1	25.0	15.6
Oak-hickory	Public	1,558.3	1,491.3	0.0	3.0	0.0	31.8	19.6	12.6
	Forest industry	563.0	525.6	27.1	4.1	1.5	0.0	4.6	0.0
	NIPF	5,341.6	4,971.9	100.8	161.8	0.0	66.3	20.8	20.0
	All classes	7,462.8	6,988.7	128.0	168.9	1.5	98.2	44.9	32.6
Bottomland hardwoods <sup>3</sup>	Public	625.0	614.5	0.0	10.5	0.0	0.0	0.0	0.0
	Forest industry	472.5	416.8	18.7	11.3	0.0	19.6	6.1	0.0
	NIPF	1,761.4	1,618.6	19.3	57.4	6.6	34.4	10.0	15.1
	All classes	2,858.9	2,649.9	38.0	79.1	6.6	54.0	16.1	15.1
Nontyped	Public	2.1	2.1	0.0	0.0	0.0	0.0	0.0	0.0
	Forest industry	32.5	32.5	0.0	0.0	0.0	0.0	0.0	0.0
	NIPF	40.3	40.3	0.0	0.0	0.0	0.0	0.0	0.0
	All classes	74.9	74.9	0.0	0.0	0.0	0.0	0.0	0.0
All forest-type groups	Public	3,652.0	3,415.8	1.8	22.2	0.0	111.4	71.9	29.0
	Forest industry	3,735.9	2,737.6	491.9	64.6	1.5	408.4	39.5	0.0
	NIPF	10,895.8	9,645.6	361.2	354.5	18.5	449.7	35.7	41.2
	All classes	18,283.8	15,799.0	854.9	441.3	20.0	969.6	147.1	70.2

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

Numbers in rows are not additive because the cutting categories are not mutually exclusive.

0.0 = no sample for the cell or a value >0.0 but <0.05.

TSI = timber stand improvement; NIPF = nonindustrial private forest.

<sup>1</sup> Forest-type groups and ownership classes were those from the previous measurement (2010).

<sup>2</sup> Only plots that were forest land at time 1 (2010) and time 2 (2015) and remeasured were included in this table.

<sup>3</sup> Includes the oak-gum-cypress and elm-ash-cottonwood forest-type groups.

# Disturbance

**Table 40**—Area of treatment on forest land by forest-type group and ownership class, Arkansas, 2010–2015

Forest-type group and ownership class <sup>1</sup>		Type of treatment						
		Total <sup>2</sup>	No treatment	Cutting	Site preparation	Artificial regeneration	Natural regeneration	Other silvicultural treatment
~~~~~ thousand acres ~~~~~								
Eastern red cedar	Public	30.7	30.7	0.0	0.0	0.0	0.0	0.0
	Forest industry	5.9	5.9	0.0	0.0	0.0	0.0	0.0
	NIPF	284.4	275.5	2.9	0.0	5.9	0.0	0.0
	<b>All classes</b>	<b>321.0</b>	<b>312.1</b>	<b>2.9</b>	<b>0.0</b>	<b>5.9</b>	<b>0.0</b>	<b>0.0</b>
Loblolly-shortleaf	Public	962.8	786.1	113.7	5.5	0.0	33.4	87.2
	Forest industry	2,351.2	1,459.0	835.7	302.1	276.4	67.7	70.6
	NIPF	2,193.7	1,561.5	602.8	72.5	59.4	79.0	27.9
	<b>All classes</b>	<b>5,507.7</b>	<b>3,806.5</b>	<b>1,552.2</b>	<b>380.1</b>	<b>335.8</b>	<b>180.1</b>	<b>185.6</b>
Oak-pine	Public	473.2	406.5	45.1	1.8	15.0	8.8	18.3
	Forest industry	310.9	221.9	77.2	49.2	36.7	0.0	5.2
	NIPF	1,274.5	1,106.2	142.5	23.6	16.7	85.1	7.3
	<b>All classes</b>	<b>2,058.5</b>	<b>1,734.7</b>	<b>264.8</b>	<b>74.6</b>	<b>68.5</b>	<b>93.9</b>	<b>30.8</b>
Oak-hickory	Public	1,558.3	1,447.7	67.0	0.0	0.0	35.3	37.5
	Forest industry	563.0	450.8	37.4	64.8	86.4	6.0	14.6
	NIPF	5,341.6	4,931.4	369.7	27.7	30.9	81.2	18.1
	<b>All classes</b>	<b>7,462.8</b>	<b>6,829.9</b>	<b>474.1</b>	<b>92.6</b>	<b>117.4</b>	<b>122.5</b>	<b>70.2</b>
Bottomland hardwoods <sup>3</sup>	Public	625.0	614.5	10.5	0.0	0.0	0.0	0.0
	Forest industry	472.5	411.2	55.6	18.2	18.2	6.1	0.0
	NIPF	1,761.4	1,607.5	142.9	12.3	4.0	48.0	4.8
	<b>All classes</b>	<b>2,858.9</b>	<b>2,633.3</b>	<b>208.9</b>	<b>30.6</b>	<b>22.2</b>	<b>54.1</b>	<b>4.8</b>
Nontyped	Public	2.1	2.1	0.0	0.0	0.0	0.0	0.0
	Forest industry	32.5	19.0	0.0	5.0	13.5	0.0	0.0
	NIPF	40.3	40.3	0.0	0.0	0.0	0.0	0.0
	<b>All classes</b>	<b>74.9</b>	<b>61.4</b>	<b>0.0</b>	<b>5.0</b>	<b>13.5</b>	<b>0.0</b>	<b>0.0</b>
All forest-type groups	Public	3,652.0	3,287.6	236.3	7.3	15.0	77.6	143.0
	Forest industry	3,735.9	2,567.9	1,005.9	439.3	431.2	79.7	90.4
	NIPF	10,895.8	9,522.4	1,260.9	136.2	116.9	293.3	58.1
	<b>All classes</b>	<b>18,283.8</b>	<b>15,377.9</b>	<b>2,503.0</b>	<b>582.8</b>	<b>563.2</b>	<b>450.5</b>	<b>291.5</b>

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

Numbers in rows are not additive because the treatment categories are not mutually exclusive.

0.0 = no sample for the cell or a value >0.0 but <0.05.

NIPF = nonindustrial private forest.

<sup>1</sup> Forest-type groups and ownership classes were those from the previous measurement (2010).

<sup>2</sup> Only plots that were forest land at time 1 (2010) and time 2 (2015) and remeasured were included in this table.

<sup>3</sup> Includes the oak-gum-cypress and elm-ash-cottonwood forest-type groups.

percent of stand basal area removed between 2010 and 2015 (table 41). Most of the cutting (1.1 million acres) was in the Southwest unit. This was a decline from the 1.8 million acres reported in the 2010 forest survey.

The heaviest cutting, in terms of basal area removed, was also in the Southwest unit. There were 548,100 forest land acres in Arkansas that had more than 70 percent of stand basal area removed. In 2015, 74 percent of this forest land was in the Southwest unit. There was no change in the proportion (74 percent) but the total acres that had  $\geq 70$  percent of basal area removed was down from the 789,200 acres reported in the 2010 forest survey. To make further trend comparisons, users are referred to table 41 in Rosson and Rose (2015). Note: because the cutting

assessments were done differently, the cutting estimates in tables 39 and 40 (based on visual field estimate) may not exactly match those in table 41 (based on sample plot tally).



A Forest Service second generation shortleaf pine (*Pinus echinata*) seed orchard, Mount Ida, Montgomery County, AR.

**Table 41**—Area of forest land by harvest class and survey unit, Arkansas, 2015

Harvest class <sup>1</sup>	Survey unit					
	All units	South Delta	North Delta	Southwest	Ouachita	Ozark
<i>percent</i>	<i>thousand acres</i>					
<1.0	17,092.4	1,357.3	784.2	5,727.2	3,236.4	5,987.3
1.0–9.9	222.8	15.0	4.6	89.3	15.1	98.9
10.0–19.9	314.1	30.3	6.1	145.5	31.8	100.5
20.0–29.9	228.4	12.1	6.2	151.0	18.3	40.8
30.0–39.9	210.9	16.7	0.0	129.7	24.7	39.9
40.0–49.9	258.7	7.4	0.0	180.5	25.6	45.2
50.0–59.9	118.8	0.0	0.0	83.9	28.9	6.0
60.0–69.9	45.6	0.0	0.0	30.8	8.6	6.2
70.0–79.9	139.6	0.0	1.3	92.7	33.2	12.3
80.0–89.9	169.8	5.3	0.0	138.1	4.5	21.9
$\geq 90.0$	238.7	29.0	2.7	176.6	21.6	8.8
<b>All classes</b>	<b>19,039.8</b>	<b>1,472.9</b>	<b>805.2</b>	<b>6,945.2</b>	<b>3,448.5</b>	<b>6,368.0</b>

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

0.0 = no sample for the cell or a value  $>0.0$  but  $<0.05$ .

<sup>1</sup> Percent of total stand basal area removed by cutting.

Mortality assessments were also made by the amounts lost in stand basal area (table 42). Table 42 shows the amount of stand basal area that was lost to mortality between 2010 and 2015. Some stands lost more than 50 percent of basal area to mortality (256,600 acres), an increase over the 188,500 acres reported in the 2010 forest survey. However, most of the losses were in the 0.1–9, 10–19 and 20–29 percent classes, 7.6, 3.8, and 1.7

million acres, respectively. Most of this level of mortality occurred in the Ozark, Southwest, and Ouachita units. The Ozark unit led in this area distribution of mortality with 2.2 million acres impacted in the 10–19 and 20–29 percent classes, an increase since 2010. This was mostly from the mortality impacts in the oaks and shortleaf pine (see table 24). To make further trend comparisons, users are referred to tables 24 and 42 in Rosson and Rose (2015).

**Table 42**—Area of forest land by mortality class and survey unit, Arkansas, 2015

Mortality class <sup>1</sup>	Survey unit					Ozark
	All units	South Delta	North Delta	Southwest	Ouachita	
<i>percent</i>	<i>thousand acres</i>					
<0.1	4,955.6	461.4	238.4	2,233.9	900.7	1,121.2
0.1–9.9	7,559.4	609.9	309.1	2,676.3	1,393.1	2,571.1
10.0–19.9	3,790.7	235.2	158.0	1,231.0	696.9	1,469.6
20.0–29.9	1,655.7	78.6	44.5	505.4	265.0	762.2
30.0–39.9	538.9	38.5	16.8	141.2	67.9	274.6
40.0–49.9	282.9	19.7	16.6	72.1	72.1	102.5
50.0–59.9	87.0	3.0	10.7	32.6	17.7	23.0
60.0–69.9	26.7	2.5	0.0	12.0	3.0	9.1
70.0–79.9	55.0	7.2	0.0	15.8	13.8	18.3
80.0–89.9	25.1	2.1	0.0	11.8	7.2	4.0
≥90.0	62.8	15.0	11.0	13.2	11.1	12.5
<b>All classes</b>	<b>19,039.8</b>	<b>1,472.9</b>	<b>805.2</b>	<b>6,945.2</b>	<b>3,448.5</b>	<b>6,368.0</b>

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

0.0 = no sample for the cell or a value >0.0 but <0.05.

<sup>1</sup> Percent of total stand basal area lost to mortality.

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## GLOSSARY

**Additions**—See definition for reversions.

**All-live biomass**—Weight of trees which includes all trees  $\geq 1.0$  inches d.b.h. See biomass.

**All-live trees**—All living trees  $\geq 1.0$  inches in d.b.h. All tree sizes, tree classes, and both commercial and noncommercial species are included. Note: live trees include all living trees  $\geq 5.0$  inches in d.b.h. Also, see definitions for live trees, live-tree volume, and all-live biomass.

**All live-tree volume**—Cubic-foot volume of all living trees  $\geq 1.0$  inches in d.b.h. All tree classes, and both commercial and noncommercial species are included. Also, see definitions for live trees, live-tree volume, and all-live biomass.

**Average annual mortality**—Average annual volume of trees  $\geq 5.0$  inches d.b.h. that died during the inter-survey period.

**Average annual removals**—Average annual volume of trees  $\geq 5.0$  inches d.b.h. removed from the inventory by harvesting, cultural operations (such as timber-stand improvement), land clearing, or changes in land use during the inter-survey period.

**Average net annual growth**—Average annual net change in volume of trees  $\geq 5.0$  inches d.b.h. (gross growth minus mortality) 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.

**Biomass**—The above-ground oven-dry weight of solid wood and bark in live trees  $\geq 1.0$ -inch d.b.h., from ground level to the tip of the tree. All foliage is excluded.

**Blind check**—A reinstallation of a field measurement plot done by a qualified

inspection crew without production crew data on hand for the purpose of obtaining a measure of data quality. All plot-level information, and at least two subplots are fully remeasured.

**Bole**—The portion of a tree between a 1-foot stump and a 4-inch top d.o.b. in trees  $\geq 5.0$  inches d.b.h. Also called the merchantable bole or merchantable stem.

**Bottomland hardwoods**—Stands that have at least 10 percent stocking with oak-gum-cypress or elm-ash-cottonwood forest-type group.

**Census water**—Streams, sloughs, estuaries, canals, and other moving bodies of water  $>200$  feet wide and lakes, reservoirs, ponds, and other permanent bodies of water  $>4.5$  acres in size.

**Cold check**—An inspection done either as part of the training process, or as part of the ongoing Quality Control (QC) program. Normally the installation crew is not present at the time of inspection and the inspector has the completed data in-hand at the time of inspection. This type of quality control measurement is a “blind” measurement in that the crews do not know when or which of their plots will be remeasured by the inspection crew and cannot therefore alter their performance because of knowledge that the plot is a QA plot.

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

**Condition class**—The attributes used to subdivide (called mapping) sample plots that straddle more than one homogeneous condition. This mapping into homogeneous conditions is done in two phases: (1) the first map delineation identifies if forest or nonforest, and (2) if forest, the plot is mapped according to the following condition classes when present: forest type, stand origin, stand

size, owner group, reserve status, and stand density.

**D.b.h. (diameter at breast height)**—Tree diameter in inches (outside bark) at breast height (4.5 feet aboveground).

**Diversions**—Land that was forest at the time 1 measurement and changed to nonforest before the time 2 measurement.

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

**Forest industry land**—See Ownership.

**Forest land**—Land at least 10 percent stocked by forest trees of any size, or formerly having had such tree cover, and not currently developed for nonforest use. The minimum area considered for classification is 1 acre. Forested strips must be at least 120 feet wide.

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

*Eastern red cedar*—Forests in which eastern red cedar constitutes a plurality of the stocking. (Common associates, in Arkansas, include shortleaf pine, loblolly pine, and oaks.) Note: in national FIA reporting, the eastern red cedar type is included in the Pinyon\Juniper FTG.

*Elm-ash-cottonwood*—Forests in which elm, ash, or cottonwood, singly or in combination, constitute a plurality of the stocking. (Common associates include willow, sycamore, beech, and maple.)

*Loblolly-shortleaf pine*—Forests in which loblolly pine, shortleaf pine, or other southern yellow pines, except longleaf or slash pine, singly or in combination, constitute a plurality of the stocking. (Common associates include oak, hickory, and gum.)

*Oak-gum-cypress*—Bottomland forests in which tupelo, blackgum, sweetgum, oaks, or southern cypress, singly or in combination, constitute a plurality of the stocking, except where pines account for 25–50 percent of stocking, in which case the stand would be classified as oak-pine. (Common associates include cottonwood, willow, ash, elm, hackberry, and maple.)

*Oak-hickory*—Forests in which upland oaks or hickory, singly or in combination, constitute a plurality of the stocking, except where pines account for 25–50 percent, in which case the stand would be classified oak-pine. (Common associates include yellow-poplar, elm, maple, and black walnut.)

*Oak-pine*—Forests in which hardwoods (usually upland oaks) constitute a plurality of the stocking but in which pines account for 25–50 percent of the stocking. (Common associates include gum, hickory, and yellow-poplar.)

**Gross annual growth**—Annual increase in volume of trees  $\geq 5.0$  inches d.b.h. (Gross growth includes survivor growth, ingrowth, growth on ingrowth, growth on removals before removal, and growth on mortality before death.)

**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.

**Growing-stock volume**—The cubic-foot volume of sound wood in growing-stock trees at least 5.0 inches d.b.h. from a 1-foot stump to a minimum 4.0-inch top d.o.b. of the central stem.

**Hardwoods**—Dicotyledonous trees, usually broadleaf and deciduous.

*Soft hardwoods*—Hardwood species with an average specific gravity of  $\leq 0.50$  or less, such as gums, yellow-poplar, cottonwoods, red maple, basswoods, and willows.

*Hard hardwoods*—Hardwood species with an average specific gravity  $> 0.50$  such as oaks, hard maples, hickories, and beech.

**Hexagonal grid (Hex)**—A hexagonal grid formed from equilateral triangles for the purpose of tessellating the FIA inventory sample. Each hexagon in the base grid has an area of 5,937 acres (2,402.6 ha) and contains one (phase 2) inventory plot. The base grid can be subdivided into smaller hexagons to intensify the sample.

**Hot check**—An inspection done as part of the training process. Normally the inspector is present to document/monitor crew performance as a plot is measured.

**Land area**—The area of dry land and land temporarily or partly covered by water, such as marshes, swamps, and river floodplains (omitting tidal flats below mean high tide), streams, sloughs, estuaries, and canals  $< 200$  feet wide, and lakes, reservoirs, and ponds  $< 4.5$  acres in size.

**Large-diameter tree**—Softwoods  $\geq 9.0$  inches d.b.h. and hardwoods  $\geq 11.0$  inches d.b.h. These trees were called sawtimber trees in prior surveys. See Stand-size class.

**Live trees**—All living trees  $\geq 5.0$  inches in d.b.h. All tree classes, and both commercial and noncommercial species are included. Note: all-live trees include all living trees  $\geq 1.0$  inches in d.b.h. Also, see all-live trees, live-tree volume, and all-live biomass.

**Live-tree volume**—Cubic-foot volume of all living trees  $\geq 5.0$  inches in d.b.h. All tree classes, and both commercial and noncommercial species are included.

**Measurement quality objective**

**(MQO)**—An estimate of the precision, bias, and completeness of data necessary to satisfy a prescribed application (e.g., Resource Planning Act). Describes the established tolerance for each data element. MQOs consist of two parts: a statement of the tolerance and a percentage of time when the collected data are required to be within tolerance. Measurement quality objectives can only be assigned where standard methods of sampling or field measurements exist, or where experience has established upper or lower bounds on precision or bias.

**Medium-diameter tree**—Softwoods 5.0 to 8.9 inches d.b.h. and hardwoods 5.0 to 10.9 inches d.b.h. These trees were called poletimber trees in prior surveys. See Stand-size class.

**National forest land**—See Ownership.

**Net annual change**—Increase or decrease in stand volume of growing-stock or live trees at least 5.0 inches d.b.h. or larger. Net annual change is equal to net annual growth minus average annual removals.

**Net annual growth**—Increase in stand volume of growing-stock or live trees 5.0 inches in d.b.h. or larger. Net annual growth is equal to gross growth minus mortality.

**Noncensus water**—A nonforest classification used by FIA to identify water bodies that are 1 to 4.5 acres, or water courses 30 to 200 feet in width, sizes that are below the thresholds used by the U.S. Census.

**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.

**Nonforest land**—Land that has never supported forests and land formerly forested where establishment of trees is precluded by development for other uses.

**Nonindustrial private forest (NIPF)**—See Ownership.

**Nonstocked stands**—Stands <10 percent stocked with live trees.

**Other forest land**—Forest land other than timberland and productive reserved forest land. It includes available and reserved forest land which is incapable of producing 20 cubic feet per acre per year of industrial wood under natural conditions, because of adverse site conditions such as sterile soils, dry climate, poor drainage, high elevation, steepness, or rockiness. Called woodland in previous reports.

**Other public land**—See Ownership.

**Ownership**—Four classes of ownership were used in this report.

*National forest land*—Federal land that has been legally designated as national forests or purchase units, and other land under the administration of the Forest Service, including experimental areas and Bankhead-Jones Title III land. Note that the forest land area for national forest in this report is a statistical estimate and may not reflect the exact known acreage (where available) of national forests in Arkansas.

*Forest industry land*—Land owned by companies or individuals operating primary wood-using plants.

*Nonindustrial private forest land*—Privately owned land excluding forest industry land.

*Other public land*—An ownership class that includes all public lands except national forests.

**Plantation**—Stands that currently show evidence of being planted or artificially seeded. See Stand origin.

**Plot condition**—See Condition class.

**Poletimber-size trees**—Softwoods 5.0 to 8.9 inches d.b.h. and hardwoods 5.0 to 10.9 inches d.b.h. Now referred to as medium-sized trees.

**Productive-reserved forest land**—Forest land sufficiently productive to qualify as timberland but withdrawn from timber utilization through statute or administrative regulation.

**Quality assurance (QA)**—The total integrated program for ensuring that the uncertainties inherent in Forest Inventory and Analysis data are known and do not exceed acceptable magnitudes within a stated level of confidence. Quality assurance encompasses the plans, specifications, and policies affecting the collection, processing, and reporting of data. It is the system of activities designed to provide program managers and project leaders with independent assurance that total system quality control is being effectively implemented.

**Quality control (QC)**—The routine application of prescribed field and laboratory procedures (e.g., random check cruising, periodic calibration, instrument maintenance, use of certified standards, etc.) in order to reduce random and systematic errors and ensure that data are generated within known and acceptable performance limits. Quality control also ensures the use of qualified personnel; reliable equipment and supplies; training of personnel; good field and laboratory practices; and strict adherence to standard operating procedures.

**Reversions**—Land that was nonforest at the time 1 measurement and changed to forest before the time 2 measurement. Sometimes called additions.

**Rotten trees**—Live trees of commercial species not containing at least one 12-foot saw log, or two noncontiguous saw logs, each 8 feet or longer, now or prospectively, primarily because of rot or missing sections, and with

less than one-third of the gross board-foot tree volume in sound material.

**Rough trees**—Live trees of commercial species not containing at least one 12-foot saw log, or two noncontiguous saw logs, each 8 feet or longer, now or prospectively, primarily because of roughness, poor form, splits, and cracks, and with less than one-third of the gross board-foot tree volume in sound material; and live trees of noncommercial species.

**Sampling error**—The standard error of the mean (SEM) expressed as a percentage. This percentage format allows the application of confidence intervals to the population values (the most common values presented in FIA reports). Most FIA sampling errors are presented at the 0.6827 level but the 0.95 level can easily be obtained by multiplying the sampling error by 1.96, or higher appropriate t-value if n is less than 120 (Rohlf and Sokal 1969). The sampling errors in tables B.3 and B.4 are presented at the 0.6827 confidence level.

**Sapling**—Live trees 1.0 to 4.9 inches in diameter. Now referred to as small-sized trees. See Stand-size class.

**Saw log**—A log meeting minimum standards of diameter, length, and defect, including logs at least 8 feet long, sound and straight, with a minimum diameter inside bark for softwoods of 6 inches (8 inches for hardwoods).

**Saw-log portion**—The part of the bole of sawtimber trees between a 1-foot stump and the saw-log top.

**Sawtimber-size trees**—Softwoods  $\geq 9.0$  inches d.b.h. and hardwoods  $\geq 11.0$  inches d.b.h. Now referred to as large-sized trees.

**Sawtimber volume**—Growing-stock volume in the saw-log portion of sawtimber-size trees in board feet (International 1/4inch

rule). Includes qualifying softwood trees  $\geq 9.0$  inches in d.b.h. and qualifying hardwood trees  $\geq 11.0$  inches in d.b.h. See Volume of sawtimber trees (in saw-log portion).

**Seedlings**—Trees  $< 1.0$ -inch d.b.h. and  $> 1$  foot tall for hardwoods,  $> 6$  inches tall for softwoods, and  $> 0.5$  inch in diameter at ground level for longleaf pine. Now referred to as small-sized trees. See Stand-size class.

**Select red oaks**—A group of several red oak species composed of 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 composed of 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 based on fully stocked natural stands.

**Small-diameter tree**—Trees  $< 5.0$  inches in d.b.h. These trees were called saplings (trees 1.0 to 4.9 inches in d.b.h.) or seedlings (trees  $< 1.0$ -inch d.b.h. and  $> 1$ -foot tall for hardwoods;  $> 6$  inches tall for softwoods, and  $> 0.5$  inch in d.b.h. at ground level for longleaf pine) in prior surveys. See Stand-size class.

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

*Yellow pines*—Loblolly, longleaf, slash, pond, shortleaf, pitch, Virginia, sand, spruce, and Table Mountain pines.

*Other softwoods*—Cypress, eastern redcedar, white-cedar, eastern white pine, eastern hemlock, spruce, and fir.

**Stand**—A forest stand is a contiguous community of trees sufficiently uniform in composition, structure, age, size, class, distribution, spatial arrangement, condition, or location on a site of uniform quality to distinguish it from adjacent communities.

**Stand age**—The average age of dominant and co-dominant trees in the stand.

**Stand origin**—A classification of forest stands describing their means of origin.

*Planted*—Planted or artificially seeded.

*Natural*—No evidence of artificial regeneration.

**Stand-size class**—A classification of forest land based on the diameter-class distribution of live trees in the stand. See definitions of large tree, medium tree, and small trees.

*Large-diameter stands*—Stands at least 10 percent stocked with live trees, with one-half or more of total stocking in large- and medium-diameter trees, and with large-diameter tree stocking at least equal to medium-diameter tree stocking. Referred to as sawtimber in previous reports.

*Medium-diameter stands*—Stands at least 10 percent stocked with live trees, with one-half or more of total stocking in medium- and large-diameter trees, and with medium-diameter tree stocking exceeding large-diameter tree stocking. Referred to as poletimber in previous reports.

*Small-diameter stands*—Stands at least 10 percent stocked with live trees, in which small trees and seedlings account for more than one-half of total stocking. Called sapling-seedling in previous reports.

*Nonstocked stands*—Stands <10 percent stocked with live trees.

**Stocking**—The degree of occupancy of land by trees. The stocking value is based on the basal area or the number of trees in a stand as compared to a minimum specified stocking standard.

Stocking standard used by FIA; density of trees and basal area per acre required for full stocking

D.b.h. class	Trees per acre for full stocking	Basal area
inches		(square feet per acre)
Seedlings	600	–
2	560	–
4	460	–
6	340	67
8	240	84
10	155	85
12	115	90
14	90	96
16	72	101
18	60	106
20	51	111

– = not applicable.

**Stocking class**—All-live tree stocking classes, including seedlings.

*Overstocked*—Stands with  $\geq 100$  percent stocking.

*Fully stocked*—Stands with 60–99 percent stocking.

*Medium stocked*—Stands with 35–59 percent stocking.

*Poorly stocked*—Stands with 10–34 percent stocking.

*Nonstocked*—Stands with 0–9 percent stocking.

**Timberland**—Forest land capable of producing 20 cubic feet, or more, of industrial wood per acre per year and not withdrawn

from timber utilization. Timberland is synonymous with “commercial forest land” in earlier reports.

**Tree**—Woody plant having one erect perennial stem or trunk at least 3 inches d.b.h., a more or less definitely formed crown of foliage, and a height of at least 13 feet (at maturity).

**Tree class**—An assessment of the general quality of a tree. Three classes are recognized: growing stock, rough, and rotten. See definitions for these types of trees.

**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. Tree grade is an indicator of quality; grade 1 is the best quality.

**Volume of live trees**—The cubic-foot volume of sound wood in live trees at least

5.0 inches d.b.h. from a 1-foot stump to a minimum 4.0-inch bole top d.o.b. of the central stem.

**Volume of sawtimber trees (in saw-log portion)**—The cubic-foot volume (International ¼-inch rule) of sound wood in the saw-log portion of sawtimber trees (from a 1-foot stump to a log top minimum of 7.0-inches d.o.b. for softwoods; from a 1-foot stump to a log top minimum of 9.0-inches d.o.b. for hardwoods). Volume is the net result after deductions for rot, sweep, and other defects that affect use for lumber. Sawtimber trees are growing-stock trees that meet the minimum size requirements. See definition for growing-stock trees.

## APPENDIX A—INVENTORY METHODS

The current inventory sample used in Arkansas 2015 is a fixed-plot design conducted on an annualized basis. Annualized means that a portion of the entire sample population (a cycle) is collected each year (a subcycle) until all the plots have been measured. For the 2015 survey, measurements were done over a 5-year period, i.e., 20 percent of the total plot population (a subcycle) is measured each year (table A.1). After that, a new cycle begins. Area estimates are derived from a combination of ground location attributes combined with remote sensing National Land Cover Data (NLCD). Ground measurements by field personnel of forest land and forest tree attributes were completed on sample plots. The following information is a very brief overview of the FIA sample design and some of its features. Further in-depth details about the sample design may be found in Bechtold and Patterson (2005) and Westfall and others (2022).

**Table A.1**—Change in forest land area by inventory year throughout the 2015 inventory cycle (cycle 10)

Inventory year	Forest land	Change from previous year
	~ ~ ~ ~ thousand acres ~ ~ ~ ~	
2010	18,720.1	— <sup>1</sup>
2011	18,754.9	34.8
2012	18,943.7	188.8
2013	18,965.8	22.0
2014	19,024.4	58.7
2015	19,039.8	15.4
<b>Total change<sup>2</sup></b>		319.7

Years 2011, 2012, 2013, 2014, and 2015 each carry an additional 20 percent of sampling to the current inventory cycle (cycle 10). Forest land in inventory year 2015 represents the full sample complement of this newest cycle (cycle 10).

<sup>1</sup> No change noted; baseline forest land area for inventory year 2010 (cycle 9).

<sup>2</sup> Changes may not sum to total due to rounding. Total change is equal to 2015 inventory year (cycle 10) minus the 2010 inventory year (cycle 9) or the addition of changes in the 2011 through 2015 inventory years (subcycles 1,2,3,4,5).

### Area

The current approach in the determination of forest area applies a stratification technique to improve the precision of the estimate, i.e., it reduces the variance of the estimate. With this method, the placement (on the ground) and subsequent classification (by land use) of the sample plot carries much of the weight in determining forest area. The area of control was the forest survey unit. FIA used NLCD for the stratification platform. The NLCD has a land classification produced by the U.S. Geological Survey, derived from Landsat Thematic Mapper data. Using these data, FIA identifies various strata to improve the variance estimate. The estimation of forest area is then summed across all strata from respective pixel counts (based on placement within the above strata) and the mean area from the ground sample plots. See Westfall and others (2022) for more details.

### Sample Design and Plot Placement

The current sampling method is based upon a hexagonal grid laid across the landscape, used for sample placement on the ground. In general, this involves placement of a single FIA sample plot inside each hexagon grid cell where measurements of sample variables were made by field crews. The grid ensures a systematic coverage with sample plots across the sample domain (a State). The hexagons in the grid represent approximately 6,000 acres.

To ensure systematic coverage across the sample domain (a State), the procedure is to place one sample plot in each hexagonal grid cell boundary.

## Plot Design

The design of the ground sample plots is described in Bechtold and Patterson (2005) and Westfall and others (2022). These plots are clusters of four subplots arranged so that one point is central and the other three lie 120 feet from it at azimuths of 0, 120, and 240 degrees (fig. A.1). Each point is the center of a circular subplot with a fixed 24-foot radius. Trees  $\geq 5.0$  inches in d.b.h. are measured in these subplots. Each subplot in turn contains a circular microplot with a fixed 6.8-foot radius. Trees  $\geq 1.0$  to 4.9 inches in d.b.h. and seedlings ( $< 1.0$  inch in d.b.h.) are measured on these microplots (fig. A.2).

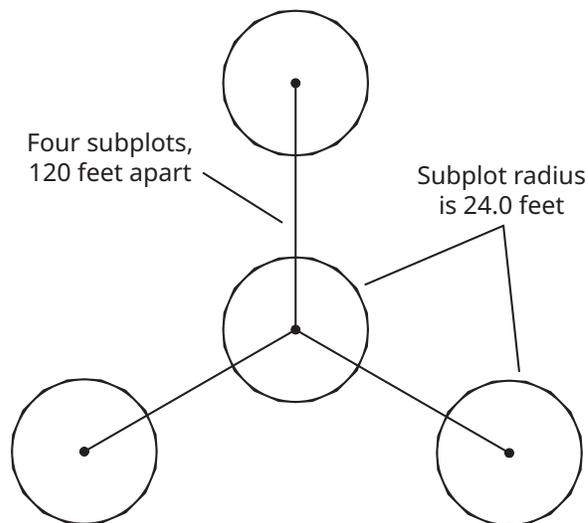


Figure A.1—Annual inventory fixed-plot design.

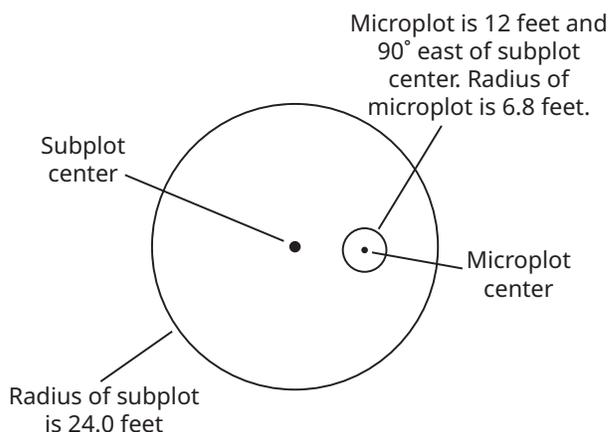


Figure A.2—Subplot and microplot layout.

Sometimes a plot cluster straddles two or more land-use or forest condition classes (Bechtold and Patterson 2005). There are seven condition-class variables that require mapping of a unique condition on a plot: land use, forest type, stand size, ownership, stand density, regeneration status, and reserved status. A new condition is defined and mapped each time the aerial extent of one of these variables is encountered during plot measurement. The process of mapping any of these conditions on a plot changes the plot size for a respective condition, i.e., the condition size will be smaller than a full plot complement and this may increase the variance of this respective estimate.

## Volume Estimation

Tree volumes for each individual tally tree were derived by a linear regression model. The general form of the model involves two tree measurements from sample trees: d.b.h. and total height. This equation estimated gross cubic foot volume from a 1-foot stump to a 4-inch upper diameter for each sample tree. Separate equation coefficients for 77 species or species groupings were utilized. The volume in forks in the central bole and the volume in limbs outside of the main bole were excluded. Net cubic foot volume was derived by subtracting the estimate of rotten or missing wood for each sample tree. Volume of the saw-log portion (expressed in International 1/4-inch board feet) of sample trees was derived by using board foot-to-cubic foot ratio equations. All equations and coefficients were developed from standing and felled tree volume studies conducted by FIA across several Southern States. See SRS in the following document: [http://www.fia.fs.usda.gov/library/sampling/docs/supplement3\\_121704.pdf](http://www.fia.fs.usda.gov/library/sampling/docs/supplement3_121704.pdf). For more detailed and specific information regarding volume models and coefficients, contact the Southern Research Station, Forest Inventory and Analysis work unit.

## Growth, Removals, and Mortality Estimation

Growth, removal, and mortality (GRM) estimates were determined from the remeasurement of 5,656 sample plots measured in the 2010 inventory. The estimates are presented in an annual format, e.g., cubic feet per acre per year, and were based on the latest survey period. In most cases this will be the most recent 5-year survey period.

## Trends/Remeasurement Between 2010 and 2015 Surveys

When determining the strength of trend (change between time 1 and time 2 estimates), it is important to consider, not only changes in sample design, but also the number of plots that were remeasured between the survey periods. The sample design for this remeasurement period was essentially the same. However, a 100-percent plot remeasurement was not possible because of strategic issues. Table A.2 shows the plot distribution between the 2010 and 2015 surveys. There were 5,686 and 5,679 plots visited and measured in the 2010 and 2015 surveys, respectively. It appears there was only a difference of seven plots between the time 1 and time 2 measurements; however, closer examination reveals that only 5,656 plots were actually measured in both surveys. Reasons for fluctuations in the remeasured plot numbers were because some plots could not be found (lost plots), access was denied by

**Table A.2**—Plot counts by survey year, 2010 and 2015

Attribute	Plots
	<i>number</i>
P2 plots measured in 2010	5,686
P2 plots measured in 2015	5,679
P2 plots measured only in 2010	30
P2 plots measured only in 2015	23
P2 plots measured in both 2010 and 2015 (true remeasure)	5,656

owners, or hazardous conditions were present (conditions resulting in an unsafe work environment). It is difficult to quantitatively assess how much trend information is impacted from lack of a complete remeasurement, but users should be aware of this issue when evaluating trend information. Estimates highly impacted by lack of plot total remeasurement were growth, removals, and mortality; land-use trends; and variables that reflect change because of an activity or disturbance since the previous measurement, e.g., harvesting. The strength of trend analysis is difficult to quantify but trend strength increases as plot remeasurement approaches 100 percent between time 1 and time 2.

## Dot Map Methodology

Dot maps are a valuable tool to portray the areal distribution of volumetric data. In forestry, these data may be tree volume, tree growth, forest area, and more. They are especially useful in displaying relative densities of resource attributes across State regions. There are three factors that affect the usefulness and accuracy of dot maps: (1) the size of the dots, (2) the value assigned to each dot, and (3) the placement of the dots on a map (Robinson and others 1984). The choices of values for factors (1) and (2) are mostly arbitrary but the important function of the maps was to show relative densities of resource attributes across the State of Arkansas.

Regarding factor (3), placement of the dots, the area of control was the county. A minimum volumetric value (cubic-foot volume or area) for a species (or other attribute) was needed in a given county for it to be represented on a map. For example, in order for one dot to be placed in a county representing loblolly pine volume, there had to be a minimum of 1.0 million cubic feet of loblolly pine in that respective county. For two dots, 2.0 million cubic feet were needed and so on. The dots

were placed randomly in each county by GIS software so that means there was no location accuracy inside any specific county. However, there was adequate accuracy at the regional (survey unit) and State level of scale to portray specific species distributions and relative densities.

It is often difficult or impossible to detect forest resource changes when comparing and analyzing maps between time 1 and time 2 measurements. Usually, the change needs to be quite large before a real difference in a respective resource attribute can be detected visually. The maps in this report can be compared directly to the maps in Rosson and Rose (2015) because the same mapping techniques and software were used in both instances.

## APPENDIX B—DATA 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.

### Measurement Error

Measurement error is also called nonsampling or data acquisition error. These are errors that arise in the acquisition, recording, or editing of statistical data (Burt and Barber 1996). 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, recording, and compiling. All of these are held to a minimum by a system, the Forest Inventory and Analysis (FIA) quality assurance (QA) program that incorporates training, check plots, and editing and checking for consistency. The goal of the QA program is to provide a framework to assure the production of complete, accurate, and unbiased forest assessments for given standards.

One of the objectives of the FIA program is to include data quality documentation in all nationally available reports including State reports and national summary reports. The following is a summary of some of the P2 variables and measurement quality objective (MQO) analyses from FIA blind check measurements.

It is not possible to determine field measurement error, statistically, but it is held to a minimum level through a number of quality control (QC) procedures. These methods include use of nationally standardized field manuals, use of portable data recorders (PDRs), thorough entry-level training, periodic review training, supervision, use of check plots, editing checks, and an emphasis on careful work.

Additionally, data quality is assessed and documented using performance measurements and post survey assessments. These assessments are then used to identify areas of the data collection process that need improvement, or refinement, in order to meet quality objectives of the program.

Editing checks in the PDR and office screen out logical and data entry inconsistencies and errors for all plots. Use of PDRs also helps ensure that specified procedures are followed. The minimum national standards for annual training of field crews are: (1) a minimum of 40 hours for new employees, and (2) a minimum of 8 hours for returning employees. Field crew members are certified on a test plot. All crews are required to have at least one certified person present on the plot at all times.

Field audits consist of hot checks, cold checks, and blind checks. A hot check is an inspection normally done as part of the training process. The inspector is present with the crew to document crew performance as plots are measured. The recommended intensity for hot checks is 2 percent of the plots installed.

Cold checks are done at regular intervals throughout the field season. The crew that installed the plot is not present at the time of inspection and does not know when or which plots will be remeasured. The inspector visits the completed plot, evaluates the crew's data collection, and notes corrections where necessary. The recommended intensity for cold checks is 5 percent of the plots installed.

A blind check is a complete reinstallation measurement of a previously completed plot. However, the QA crew performs the remeasurement without the previously recorded data. This type of blind measurement provides a direct, unbiased observation of measurement precision from two independent crews. Plots selected for blind checks are chosen to be a representative subsample of all plots measured and are randomly selected. Blind checks are planned

to take place within 2 weeks of the date of the field measurement. The recommended intensity for blind checks is 3 percent of the plots installed.

Each variable collected by FIA is assigned an MQO and a measurement tolerance level. The MQOs are documented in the FIA National Field Manuals for plot data collection (USDA Forest Service 2012). In some instances the MQOs are a “best guess” of what experienced field crews should be able to consistently achieve. Tolerances are somewhat arbitrary and are based on the ability of crews to make repeatable measurements or observations within the assigned MQO. Based on review and analysis, these tolerances improved over time.

Evaluation of field crew performance is accomplished by calculating the differences between data collected by the field crew and that collected by the QA crew on blind check plots. Results of these calculations are compared to the established MQOs. In the analysis of blind-check data, an observation is within tolerance when the difference between the field crew observation and the QA crew observation does not exceed the assigned tolerance for that variable. For many categorical variables, the tolerance is “no error” allowed, so only observations that are identical with the standard are within the tolerance level. Tables B.1 and B.2 show the percentage of observations that were within the program tolerances for plot-level

**Table B.1**—Blind-check results for some select plot-level variables for Arkansas and the Southern Region, 2015

Variable	Tolerance	Number of observations	Number within tolerance	Percent within tolerance
Distance to road	No tolerance	372	302	81.18
Water on plot	No tolerance	372	334	89.78
Latitude-longitude	±140 feet	239	239	100.00
Condition status	No tolerance	659	655	99.39
Reserved status	No tolerance	434	430	99.08
Owner group	No tolerance	434	434	100.00
Regeneration status	No tolerance	434	423	97.47
Artificial regeneration species	No tolerance	83	81	97.59
Owner class	No tolerance	434	427	98.39
Private owner industrial status	No tolerance	249	243	97.59
Stand age	±10 percent	433	290	66.97
Disturbance	No tolerance	488	446	91.40
Treatment	No tolerance	512	495	96.70
Physiographic class	No tolerance	434	388	89.40
Present land use	No tolerance	434	432	99.54
Percent forest	±10 percent	324	277	85.49
Site class	±1 class	293	235	80.20
Harvest type	No tolerance	161	156	96.90
Subplot slope (subplots)	±10 percent	809	799	98.76
Subplot aspect (subplots)	±10 degrees	809	671	82.94

Source: David Gartner, Mathematical Statistician, Southern Research Station, USDA Forest Service.

**Table B.2**—Blind-check results for some select tree-level variables for Arkansas and the Southern Region, 2015

Variable	Tolerance	Number of observations	Number within tolerance	Percent within tolerance
Condition number	No tolerance	5,760	5,650	98.09
Azimuth	±10 degrees	5,339	4,953	92.77
Horizontal distance	±1.0 foot	5,157	5,066	98.24
Present tree status	No tolerance	5,750	5,667	98.56
Reconcile	No tolerance	1,086	1,075	98.99
Standing dead	No tolerance	703	697	99.15
Species	No tolerance	5,760	5,575	96.79
Genus	No tolerance	5,716	5,674	99.27
Live d.b.h.	±0.1 inch	4,340	3,377	77.81
Total length	±10 percent	4,569	3,843	84.11
Live tree actual length	±10 percent	63	51	80.95
Crown class	No tolerance	4,569	3,904	85.45
Compacted crown ratio	±10 percent	4,566	3,837	84.03
Tree class	No tolerance	3,656	3,356	91.79
Tree grade	No tolerance	858	661	77.04
Damage agent	No tolerance	1,788	1,520	85.01

Source: David Gartner, Mathematical Statistician, Southern Research Station, USDA Forest Service.

and tree-level conditions, respectively. At this time, only the blind-check results for plot-level and tree-level variables are presented.

### Sampling Error

Sampling error is associated with the natural and expected deviation of the sample from the true population mean (see the Glossary for definition of [sampling error](#)). This deviation is susceptible to a mathematical evaluation of the probability of error. Sampling errors for State totals are based on one standard deviation unless otherwise noted; that is, there is a 68.27 percent probability that the confidence interval given for each sample estimate will cover the true population mean (table B.3).

The sampling error for area is derived by a variance reduction method using NLCD (Westfall and others 2022). The sampling error for tree-measured assessments (volume, biomass, growth, removals, mortality, and

more) is derived by the random sampling formula. The sampling errors for the tree-measured assessments in this report did not include the area error. In addition, these volume and biomass estimates were derived by models and the model error was not included in the sampling error.

The size of the sampling error generally increases as the size of the area examined decreases. Also, as area or volume totals are stratified by forest type, species, diameter class, ownership, or other subunits, the sampling error may increase and be greatest for the smallest divisions. However, there may be instances where a smaller component does not have a proportionately larger sampling error. This can happen when the post-defined strata are more homogeneous than the larger strata, thereby resulting in a smaller variance. The magnitude of the increase (where homogeneity is not changed over that of the normal State-level sample) is depicted in

**Table B.3**—Sampling errors, at one standard error, for estimates of total forest land area<sup>1</sup> (2015), volume<sup>2</sup>, average net annual growth<sup>2</sup> (2010–2015), average annual removals<sup>2</sup> (2010–2015), and average annual mortality<sup>2</sup> (2010–2015), Arkansas

Component		Component total	Percent sampling error
Forest land area (thousand cubic feet)		19,039.8	0.53
Total live trees (million cubic feet)	Volume	31,564.4	1.48
	Average net annual growth	1,150.2	2.60
	Average annual removals	694.0	5.46
	Average annual mortality	370.3	3.77
Total sawtimber (million board feet)	Volume	106,968.4	2.06
	Average net annual growth	4,733.9	2.79
	Average annual removals	2,601.5	6.61
	Average annual mortality	1,028.0	6.25
Softwood live trees (million cubic feet)	Volume	12,920.9	2.60
	Average net annual growth	786.6	2.99
	Average annual removals	467.2	6.47
	Average annual mortality	89.7	6.50
Softwood sawtimber (million board feet <sup>3</sup> )	Volume	52,362.3	3.15
	Average net annual growth	3,251.8	3.18
	Average annual removals	1,969.5	7.73
	Average annual mortality	308.2	9.28
Hardwood live trees (million cubic feet)	Volume	18,643.5	2.01
	Average net annual growth	363.6	4.82
	Average annual removals	226.7	8.22
	Average annual mortality	280.7	4.53
Hardwood sawtimber (million board feet <sup>3</sup> )	Volume	54,606.1	2.90
	Average net annual growth	1,482.2	5.46
	Average annual removals	632.0	11.02
	Average annual mortality	719.8	8.03

Note that the component totals are for plots that were in a forest land status at the end of the 2010 remeasurement period and re-measured in the 2015 remeasurement period.

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

<sup>1</sup> By binomial formula.

<sup>2</sup> By random sampling formula.

<sup>3</sup> International ¼-inch rule.

**Table B.4**—Sampling error approximations to which estimates are liable at one standard error, Arkansas, 2015<sup>1</sup>

Sampling error	Forest land area	Volume	Average net annual growth	Average annual removals	Average annual mortality	Volume	Average net annual growth	Average annual removals	Average annual mortality
<i>percent</i>	<i>thousand acres</i>	<i>million cubic feet</i>				<i>million board feet<sup>2</sup></i>			
1.0	5,348.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2.0	1,337.1	17,284.7	0.0	0.0	0.0	106,968.4	0.0	0.0	0.0
3.0	594.3	7,682.1	863.9	0.0	0.0	50,436.8	4,094.4	0.0	0.0
4.0	334.3	4,321.2	486.0	0.0	0.0	28,370.7	2,303.1	0.0	0.0
5.0	213.9	2,765.6	311.0	0.0	210.5	18,157.2	1,474.0	0.0	0.0
10.0	53.5	691.4	77.8	206.9	52.6	4,539.3	368.5	1,136.7	401.6
15.0	23.8	307.3	34.6	92.0	23.4	2,017.5	163.8	505.2	178.5
20.0	13.4	172.9	19.4	51.7	13.2	1,134.8	92.1	284.2	100.4
25.0	8.6	110.6	12.4	33.1	8.4	726.3	59.0	181.9	64.3

0.0 = no value for that particular sampling error.

<sup>1</sup> Component estimates for a given sampling error are derived by ratio approximation.

<sup>2</sup> International ¼-inch rule.

table B.4. For specific post-defined strata the sampling error can be calculated using the following formula.

$$SE_s = SE_t \frac{\sqrt{X_t}}{\sqrt{X_s}}$$

where

$SE_s$  = sampling error for subdivision of survey unit or State total

$SE_t$  = sampling error for survey unit or State total (table B.4)

$X_s$  = sum of values for the variable of interest (area or volume) for subdivision of survey unit or State

$X_t$  = total area or volume for survey unit or State.

For example, the estimate of the sampling error for softwood live-tree growth on forest industry timberland (table 18) is computed as:

$$SE_s = 2.99\% \left[ \frac{\sqrt{786.6}}{\sqrt{344.4}} \right] = 4.52\%$$

Thus, the sampling error is 4.52 percent, and the resulting 68.27 percent confidence interval for softwood live-tree growth on forest industry timberland is 344.4 ± 15.6 million cubic feet.

Sampling errors obtained by this method are only approximations of reliability because this process assumes constant variance across all subdivisions of totals. Therefore, resulting errors derived by this approximation method should be considered very liberal, i.e., it usually produces sampling errors much better than those derived by the actual random sampling formula.

## APPENDIX C—SPECIES LIST

**Table C.1**—Common name, scientific name, and FIA species codes of live tree species  $\geq 1.0$  but  $< 5.0$  inches in d.b.h. occurring on forest land in the FIA sample, Arkansas, 2015

Common name	Scientific name	FIA species code	Trees tallied in the sample <i>number</i>
Ashe juniper	<i>Juniperus ashei</i>	61	33
Eastern red cedar	<i>Juniperus virginiana</i>	68	1,116
Shortleaf pine	<i>Pinus echinata</i>	110	615
Loblolly pine	<i>Pinus taeda</i>	131	2,604
Virginia pine	<i>Pinus virginia</i>	132	5
Baldcypress	<i>Taxodium distichum</i>	221	18
Florida maple	<i>Acer barbatum</i>	311	132
Boxelder	<i>Acer negundo</i>	313	74
Red maple	<i>Acer rubrum</i>	316	1,067
Silver maple	<i>Acer saccharinum</i>	317	23
Sugar maple	<i>Acer saccharum</i>	318	3
Ailanthus	<i>Ailanthus altissima</i>	341	1
Mimosa, silktree	<i>Albizia julibrissin</i>	345	5
Serviceberry spp.	<i>Amelanchier</i> spp.	356	99
Pawpaw	<i>Asimina triloba</i>	367	54
River birch	<i>Betula nigra</i>	373	1
Gum bumelia	<i>Bumelia</i> spp.	381	8
American hornbeam	<i>Carpinus caroliniana</i>	391	597
Water hickory	<i>Carya aquatica</i>	401	44
Bitternut hickory	<i>Carya cordiformis</i>	402	58
Pignut hickory	<i>Carya glabra</i>	403	10
Pecan	<i>Carya illinoensis</i>	404	19
Shagbark hickory	<i>Carya ovata</i>	407	98
Black hickory	<i>Carya texana</i>	408	704
Mockernut hickory	<i>Carya tomentosa</i>	409	606
Ozark chinkapin	<i>Castanea ozarkensis</i>	423	2
Sugarberry	<i>Celtis laevigata</i>	461	182
Hackberry	<i>Celtis occidentalis</i>	462	102
Eastern redbud	<i>Cercis canadensis</i>	471	172
Flowering dogwood	<i>Cornus florida</i>	491	623

**Table C.1**—Common name, scientific name, and FIA species codes of live tree species  $\geq 1.0$  but  $< 5.0$  inches in d.b.h. occurring on forest land in the FIA sample, Arkansas, 2015 (continued)

Common name	Scientific name	FIA species code	Trees tallied in the sample number
Hawthorn spp.	<i>Crataegus</i> spp.	500	30
Cockspur hawthorn	<i>Crataegus crus-galli</i>	501	1
Common persimmon	<i>Diospyros virginiana</i>	521	320
American beech	<i>Fagus grandifolia</i>	531	45
White ash	<i>Fraxinus americana</i>	541	143
Green ash	<i>Fraxinus pennsylvanica</i>	544	428
Blue ash	<i>Fraxinus quadrangulata</i>	546	8
Water locust	<i>Gleditsia aquatica</i>	551	3
Honeylocust	<i>Gleditsia triacanthos</i>	552	47
American holly	<i>Ilex opaca</i>	591	437
Black walnut	<i>Juglans nigra</i>	602	12
Sweetgum	<i>Liquidambar styraciflua</i>	611	2,007
Yellow-poplar	<i>Liriodendron tulipifera</i>	621	11
Osage-orange	<i>Maclura pomifera</i>	641	11
Sweetbay	<i>Magnolia virginiana</i>	653	24
Umbrella magnolia	<i>Magnolia tripetala</i>	658	10
Southern crab apple	<i>Malus augustifolia</i>	662	1
Red mulberry	<i>Morus rubra</i>	682	21
Water tupelo	<i>Nyssa aquatica</i>	691	23
Blackgum	<i>Nyssa sylvatica</i>	693	816
Eastern hophornbeam	<i>Ostrya virginiana</i>	701	961
Sourwood	<i>Oxydendrum arboreum</i>	711	4
Paulownia	<i>Paulownia tomentosa</i>	712	4
Water-elm, planertree	<i>Planera aquatica</i>	722	80
American sycamore	<i>Platanus occidentalis</i>	731	42
Eastern cottonwood	<i>Populus deltoides</i>	742	9
Cherry and plum spp.	<i>Prunus</i> spp.	760	2
Black cherry	<i>Prunus serotina</i>	762	344
Common chokecherry	<i>Prunus virginia</i>	763	2
American plum	<i>Prunus americana</i>	766	43
White oak	<i>Quercus alba</i>	802	698
Southern red oak	<i>Quercus falcata</i>	812	435
Cherrybark oak	<i>Quercus falcata</i> var. <i>pagodifolia</i>	813	144

## Appendix C—Species List

**Table C.1**—Common name, scientific name, and FIA species codes of live tree species  $\geq 1.0$  but  $< 5.0$  inches in d.b.h. occurring on forest land in the FIA sample, Arkansas, 2015 (continued)

Common name	Scientific name	FIA species code	Trees tallied in the sample number
Shingle oak	<i>Quercus imbricaria</i>	817	1
Laurel oak	<i>Quercus laurifolia</i>	820	7
Overcup oak	<i>Quercus lyrata</i>	822	37
Blackjack oak	<i>Quercus marilandica</i>	824	146
Swamp chestnut oak	<i>Quercus michauxii</i>	825	21
Chinkapin oak	<i>Quercus muehlenbergii</i>	826	47
Water oak	<i>Quercus nigra</i>	827	400
Nuttall oak	<i>Quercus nuttallii</i>	828	37
Willow oak	<i>Quercus phellos</i>	831	221
Northern red oak	<i>Quercus rubra</i>	833	117
Shumard oak	<i>Quercus shumardii</i>	834	8
Post oak	<i>Quercus stellata</i>	835	456
Black oak	<i>Quercus velutina</i>	837	262
Black locust	<i>Robinia pseudoacacia</i>	901	45
Black willow	<i>Salix nigra</i>	922	93
Sassafras	<i>Sassafras albidum</i>	931	212
American basswood	<i>Tilia americana</i>	951	11
Winged elm	<i>Ulmus alata</i>	971	1,628
American elm	<i>Ulmus americana</i>	972	88
Cedar elm	<i>Ulmus crassifolia</i>	973	10
Slippery elm	<i>Ulmus rubra</i>	975	166
Chinese tallowtree	<i>Sapium sebiferum</i>	994	1
American smoketree	<i>Cotinus obovatus</i>	996	5
Unknown hardwood		999	5

There were 20,265 trees tallied in this size class. Nomenclature follows Little (1979).  
d.b.h. = diameter at breast height; FIA = Forest Inventory and Analysis.

**Table C.2**—Common name, scientific name, and FIA species codes of live tree species  $\geq 5.0$  inches in d.b.h. occurring on forest land in the FIA sample, Arkansas, 2015

Common name	Scientific name	FIA species code	Trees tallied in the sample <i>number</i>
Ashe juniper	<i>Juniperus ashei</i>	61	135
Eastern red cedar	<i>Juniperus virginiana</i>	68	3,239
Shortleaf pine	<i>Pinus echinata</i>	110	6,618
Loblolly pine	<i>Pinus taeda</i>	131	20,334
Virginia pine	<i>Pinus virginiana</i>	132	7
Baldcypress	<i>Taxodium distichum</i>	221	360
Florida maple	<i>Acer barbatum</i>	311	433
Boxelder	<i>Acer negundo</i>	313	301
Red maple	<i>Acer rubrum</i>	316	1,377
Silver maple	<i>Acer saccharinum</i>	317	105
Sugar maple	<i>Acer saccharum</i>	318	24
Ohio buckeye	<i>Aesculus glabra</i>	331	1
Ailanthus	<i>Ailanthus altissima</i>	341	7
Mimosa, silktree	<i>Albizia julibrissin</i>	345	10
Serviceberry spp.	<i>Amelanchier</i> spp.	356	45
Pawpaw	<i>Asimina triloba</i>	367	4
River birch	<i>Betula nigra</i>	373	49
Gum bumelia	<i>Bumelia</i> spp.	381	13
American hornbeam	<i>Carpinus caroliniana</i>	391	398
Water hickory	<i>Carya aquatica</i>	401	235
Bitternut hickory	<i>Carya cordiformis</i>	402	341
Pignut hickory	<i>Carya glabra</i>	403	124
Pecan	<i>Carya illinoensis</i>	404	123
Shellbark hickory	<i>Carya laciniata</i>	405	1
Nutmeg hickory	<i>Carya myristiciformis</i>	406	2
Shagbark hickory	<i>Carya ovata</i>	407	446
Black hickory	<i>Carya texana</i>	408	2,892
Mockernut hickory	<i>Carya tomentosa</i>	409	1,944
Ozark chinkapin	<i>Castanea ozarkensis</i>	423	4
Southern catalpa	<i>Catalpa bignonioides</i>	451	1

## Appendix C—Species List

**Table C.2**—Common name, scientific name, and FIA species codes of live tree species  $\geq 5.0$  inches in d.b.h. occurring on forest land in the FIA sample, Arkansas, 2015 (continued)

Common name	Scientific name	FIA species code	Trees tallied in the sample <i>number</i>
Northern catalpa	<i>Catalpa speciosa</i>	452	4
Sugarberry	<i>Celtis laevigata</i>	461	817
Hackberry	<i>Celtis occidentalis</i>	462	186
Eastern redbud	<i>Cercis canadensis</i>	471	91
Flowering dogwood	<i>Cornus florida</i>	491	164
Hawthorn spp.	<i>Crataegus</i> spp.	500	7
Common persimmon	<i>Diospyros virginiana</i>	521	272
American beech	<i>Fagus grandifolia</i>	531	162
White ash	<i>Fraxinus americana</i>	541	390
Green ash	<i>Fraxinus pennsylvanica</i>	544	1,032
Blue ash	<i>Fraxinus quadrangulata</i>	546	11
Carolina ash	<i>Fraxinus caroliniana</i>	548	1
Waterlocust	<i>Gleditsia aquatica</i>	551	45
Honeylocust	<i>Gleditsia triacanthos</i>	552	140
Carolina silverbell	<i>Halesia carolina</i>	581	2
American holly	<i>Ilex opaca</i>	591	298
Butternut	<i>Juglans cinerea</i>	601	8
Black walnut	<i>Juglans nigra</i>	602	207
Sweetgum	<i>Liquidambar styraciflua</i>	611	4,866
Yellow-poplar	<i>Liriodendron tulipifera</i>	621	36
Osage-orange	<i>Maclura pomifera</i>	641	53
Cucumbertree	<i>Magnolia acuminata</i>	651	12
Southern magnolia	<i>Magnolia grandiflora</i>	652	1
Sweetbay	<i>Magnolia virginiana</i>	653	60
Umbrella magnolia	<i>Magnolia tripetala</i>	658	16
Apple spp.	<i>Malus</i> spp.	660	3
Southern crab apple	<i>Malus angustifolia</i>	662	1
White mulberry	<i>Morus alba</i>	681	1
Red mulberry	<i>Morus rubra</i>	682	77
Water tupelo	<i>Nyssa aquatica</i>	691	393

**Table C.2**—Common name, scientific name, and FIA species codes of live tree species  $\geq 5.0$  inches in d.b.h. occurring on forest land in the FIA sample, Arkansas, 2015 (continued)

Common name	Scientific name	FIA species code	Trees tallied in the sample <i>number</i>
Blackgum	<i>Nyssa sylvatica</i>	693	1,563
Swamp tupelo	<i>Nyssa biflora</i>	694	2
Eastern hophornbeam	<i>Ostrya virginiana</i>	701	248
Paulownia, empress-tree	<i>Paulownia tomentosa</i>	712	11
Water-elm, planertree	<i>Planera aquatica</i>	722	322
American sycamore	<i>Platanus occidentalis</i>	731	241
Eastern cottonwood	<i>Populus deltoides</i>	742	46
Silver poplar	<i>Populus alba</i>	752	1
Cherry, plum spp.	<i>Prunus</i> spp.	760	1
Black cherry	<i>Prunus serotina</i>	762	624
American plum	<i>Prunus americana</i>	766	8
White oak	<i>Quercus alba</i>	802	5,639
Southern red oak	<i>Quercus falcata</i>	812	1,315
Cherrybark oak	<i>Quercus falcata</i> var. <i>pagodifolia</i>	813	624
Shingle oak	<i>Quercus imbricaria</i>	817	9
Laurel oak	<i>Quercus laurifolia</i>	820	17
Overcup oak	<i>Quercus lyrata</i>	822	534
Bur oak	<i>Quercus macrocarpa</i>	823	3
Blackjack oak	<i>Quercus marilandica</i>	824	406
Swamp chestnut oak	<i>Quercus michauxii</i>	825	109
Chinkapin oak	<i>Quercus muehlenbergii</i>	826	314
Water oak	<i>Quercus nigra</i>	827	1,053
Nuttall oak	<i>Quercus nuttallii</i>	828	265
Pin oak	<i>Quercus palustris</i>	830	8
Willow oak	<i>Quercus phellos</i>	831	793
Northern red oak	<i>Quercus rubra</i>	833	1,605
Shumard oak	<i>Quercus shumardii</i>	834	77
Post oak	<i>Quercus stellata</i>	835	4,304
Delta post oak	<i>Quercus stellata</i> var. <i>mississippiensis</i>	836	2
Black oak	<i>Quercus velutina</i>	837	1,620

## Appendix C—Species List

**Table C.2**—Common name, scientific name, and FIA species codes of live tree species  $\geq 5.0$  inches in d.b.h. occurring on forest land in the FIA sample, Arkansas, 2015 (continued)

Common name	Scientific name	FIA species code	Trees tallied in the sample <i>number</i>
<b>Black locust</b>	<i>Robinia pseudoacacia</i>	901	106
<b>Black willow</b>	<i>Salix nigra</i>	922	251
<b>Sassafras</b>	<i>Sassafras albidum</i>	931	172
<b>American basswood</b>	<i>Tilia americana</i>	951	56
<b>Winged elm</b>	<i>Ulmus alata</i>	971	1,585
<b>American elm</b>	<i>Ulmus americana</i>	972	491
<b>Cedar elm</b>	<i>Ulmus crassifolia</i>	973	47
<b>Slippery elm</b>	<i>Ulmus rubra</i>	975	529
<b>Chinaberry</b>	<i>Melia azedarach</i>	993	16
<b>Chinese tallowtree</b>	<i>Sapium sebiferum</i>	994	4
<b>Unknown hardwood</b>		999	8

There were 73,958 trees tallied in this size class. Nomenclature follows Little (1979).  
d.b.h. = diameter at breast height; FIA = Forest Inventory and Analysis.

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The principal findings of the 10th forest survey of Arkansas are presented. The survey examines trends between the 2010 and 2015 surveys. Topics examined include forest area, ownership, forest-type groups, stand structure, basal area, timber volume, growth, removals, mortality, and forest plantations.

**Keywords:** FIA, forest disturbance, forest harvest, forest inventory, forest plantations, forest productivity, forest survey, species distribution, species dominance, trend analysis.



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