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Forest Resources of Arkansas

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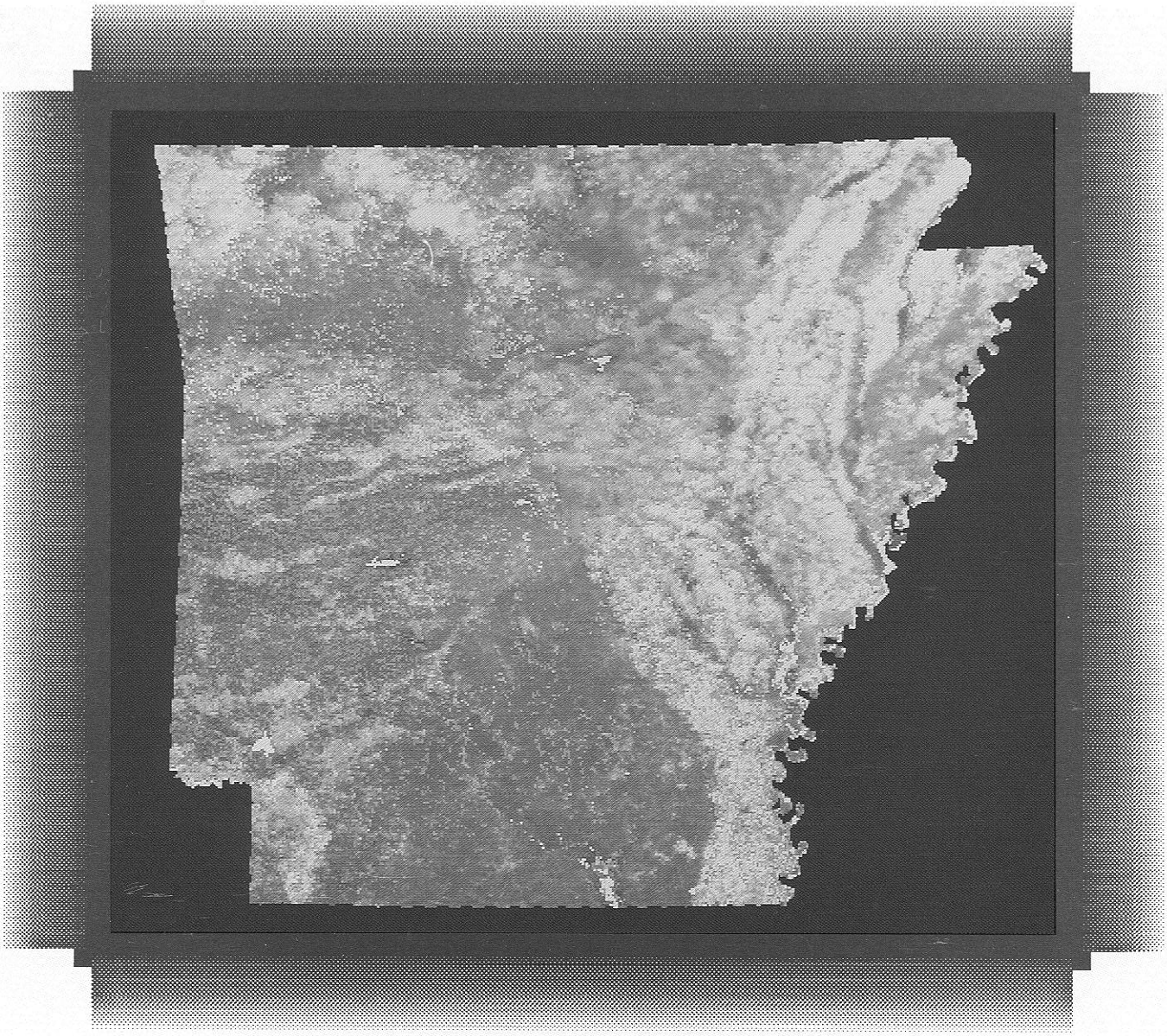

SUMMARY

The 1988 Forest Survey of Arkansas revealed new trends in forest resources. After decades of decline, forest area increased 3 percent. Pine plantation acreage increased substantially while acreage in natural pine stands decreased. Softwood inventory was down 5 percent, with growth also declining. Loblolly pine volume exceeded that of shortleaf pine for the first time in Arkansas history. The outlook for hardwood resources is positive. Inventory and growth have increased, and loss of bottomland hardwood acreage appeared to be at a standstill.

Front cover: Advanced Very High Resolution Radiometer (AVHRR) image of Arkansas produced from data collected by the NOAA-11 satellite of the National Oceanic and Atmospheric Administration on April 11, 1991. In general, forest land is dark red; nonforest land is light red or blue; water is dark blue.

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HIGHLIGHTS

Two considerations are important in interpreting this 1988 survey of Arkansas forest resources and resource changes; these are new in comparison to the 1978 survey. They are: (1) a change in log/tree grading and (2) a reclassification of some forest land from unproductive to productive. The change in grading is detailed in the appendix; the effect is to reclassify certain trees from culls to growing stock. This change affects estimates of inventory, growth, removals, and mortality, especially for hardwoods. The reclassification of forest land based on productivity occurred primarily in the Ozark region and affects area as well as inventory estimates.

This analysis of the 1988 Arkansas survey results has taken these factors into consideration. Comparisons of 1978 and 1988 results reveal the following:

- After declining for about 20 years, area of timberland was up by more than 500,000 acres, or 3 percent. Although the reclassification of woodland to timberland in the Ozark region accounted for part of this gain, the real increase totaled more than 200,000 acres.
- Acreage of timberland occupied by planted pine stands totaled 1.6 million acres and is rapidly increasing. Most of these pine plantations are replacing natural pine stands. Over the past 25 years, area in natural pine decreased by about 1.7 million acres.
- The loss of bottomland hardwood stands has slowed. In the mid-1930's, bottomland hardwood stands occupied almost 6 million acres. Today -they occupy fewer than 3 million acres. Between 1978 and 1988, the net loss was fewer than 100,000 acres. Area occupied by upland hardwood stands was up 10 percent, and now totals 7.3 million acres.
- Pine plantations are reaching merchantable size. More than 600,000 acres of planted pine have now reached poletimber or sawtimber size. In 1978, fewer than 340,000 acres of planted pine were in the merchantable size classes. Beyond the year 2000, recently planted seedling-sapling stands should start reaching merchantable size at about 145,000 acres per year.
- Plantations now account for more than half of all pine sapling-seedling stands. Acreage of natural pine sapling-seedling stands declined by one-third. Almost 60 percent of the remaining natural pine stands are sawtimber size.
- The hardwood resource continues to age. Sawtimber stands accounted for more than 42 percent of all hardwood stands, compared to 40 percent in 1978. The number of hardwood trees 15.0 inches in diameter at breast height (d.b.h.) and larger increased 10 percent, while the number of hardwood saplings decreased in each major ownership class.
- For the first time since 1951, inventory of pine timber declined. Inventory of pine growing stock was down 5 percent. Most of the reduction was on forest industry land, where the inventory of pine sawtimber dropped 23 percent. Most of the remaining loss was on nonindustrial private forest (NIPF) land where pine poletimber inventory decreased 6 percent.
- For the first time, loblolly pine surpassed shortleaf pine in the timber inventory. Inventory of loblolly pine totaled almost 4.0 billion cubic feet-53 percent of all pine. About 94 percent of the loblolly pine volume is in the Southwest region. Inventory of shortleaf pine decreased 14 percent, from 4.2 to 3.6 billion cubic feet.
- After several decades of decline, inventory of hardwood growing stock increased another 16 percent. The largest percentage gain-30 percent-occurred on public timberland. In actual volume, the largest increase occurred on NIPF land, where the inventory was up 20 percent. In contrast to these increases, inventory of hardwood on forest industry land was down almost 4 percent.

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- Average annual net growth declined from 50 to 45 cubic feet per acre. The average annual net growth of pine was down 16 percent, while hardwood growth increased by 5 percent. Most of the reduction in pine growth occurred on NIPF land, where pine growth was down 22 percent. On a percentage basis, an even sharper drop occurred on public land. Most of the increase in hardwood growth was on NIPF land.
- Timber removals continue to increase. Annual removals of all species combined averaged 686 million cubic feet. Pine removals were up by one-third; hardwood removals were down 8 percent. Most of the recent increase in timber removals occurred on forest industry land, which supplied almost one-half of the total harvest.
- Pine removals exceeded growth by 12 percent. Most of the overcut occurred on private timberland in a 16-county area in the west central part of the State. In this area, pine removals exceeded growth by 65 percent, decreasing the pine inventory by 20 percent over the lo-year period.
- Between 1978 and 1988, the annual harvest of timberland averaged 575,000 acres where land use was unchanged. Each year, about 75,000 acres changed from forest to nonforest, and many of these acres were also harvested. The highest rates of harvest occurred on forest industry land, where two-thirds of the timberland had some kind of management over the lo-year period.
- Some 8.0 million acres of timberland supported young, well-stocked stands where no obvious treatment was needed to improve prospective growth. On the remaining 9.3 million acres, the forest survey identified management opportunities that would increase prospective growth.

INTRODUCTION

The principal findings of the sixth survey of Arkansas timber resources are presented in this report. The focus is mainly on changes and trends in timber resources between 1978 and 1988. The extent and condition of timberland, the associated timber inventory, and rates of timber growth and removal are discussed. In accordance with the Forest and Rangeland Renewable Resources Planning Act of 1974, this survey includes information on the nontimber resources. Separate reports will present and evaluate the nontimber data.

Periodic forest surveys in Arkansas are part of a national effort initially authorized by the McSweeney-McNary Act of 1928. New legislation enacted in 1974 and 1978 significantly modified the original authorization. The primary mission of these periodic surveys is to develop and maintain resource information needed to formulate sound forest policies, programs, and practices. Principal users of surveys are public agencies and private forestry interests. In the States of Alabama, Arkansas, Louisiana, Mississippi, Oklahoma, Tennessee, and Texas and the Commonwealth of Puerto Rico, the Forest Inventory and Analysis (FIA) Research Work unit of the Southern Forest Experiment Station conducts the surveys. One of six FIA units in the United States, the Southern FIA Unit is headquartered in Starkville, Mississippi.

Field work on the sixth survey of Arkansas began in April 1987 and was completed in June 1988. Five previous surveys, completed in 1936, 1951, 1959, 1969, and 1978, provide statistics for measuring changes and trends over a 52-year period. In some cases, previously reported statistics have been adjusted to provide better estimates of real change. In other cases, changes in classifications and survey procedures could prevent or cloud comparisons.

To facilitate the survey and analyses, FIA divides Arkansas into four survey regions: (1) Delta, (2) Southwest, (3) Ouachita, and (4) Ozark (fig. 1). Preliminary statistics and highlights of the survey findings have already been published for each region, along with a report of county statistics for the entire State. Copies of these reports can be obtained from the Southern Forest Experiment Station. Custom compilations for the data can also be arranged.

Many people contributed to this latest survey of Arkansas forest resources. The USDA Forest Service gratefully acknowledges the cooperation and assistance provided by the Arkansas Forestry Commission and forest industries in the State who helped collect field data. The survey team enjoyed excellent cooperation from other public agencies and private landowners in the provision of information and access to the sample locations. Finally, the authors express appreciation to all FIA and Southern Station personnel who participated in various phases of the survey.

The FIA obtained the services of Herbert A. Knight, a forestry consultant in Asheville, NC, to assist in this analysis. Knight is an authority on timber resources in the Southern United States.

Questions about the survey and requests for additional information may be directed to:

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HISTORY OF ARKANSAS FORESTS

The early inhabitants of Arkansas lived in an area that was about 95 percent forested (Ashmore 1978). The three main regions of this area, the Ozark-Ouachita, Delta, and Pineywoods, teemed with all kinds of wildlife from buffalo, black bear, deer, and cougar to a wide variety of birds and fish. The area contained vast virgin stands of pine and hardwood (Ashmore 1978). In 1541 the Spanish explorer Hernando de Soto first touched ground in Arkansas near the present Mississippi River town of Helena. More than a century later European explorers reentered the area, when Jacques Marquette and Louis Jolliet voyaged through part of Arkansas in 1673. In 1682, La Salle claimed Louisiana for France. This claim included the region that was to become Arkansas. The first settlement began in 1686 at Arkansas Post, a few miles inland from the Mississippi River. These early settlers used the abundant timber primarily for shelter and fuel for heating and cooking. Occasionally the land was cleared for farming.

The Louisiana purchase in 1803 included the area that became the territory of Arkansas in 1819 and the State of Arkansas in 1836 (Ashmore 1978, Fletcher 1947). Although the initial era of commercial timber cutting began in the 1890's, some pioneers began cutting timber commercially as early as 1826. Arkansas first steam-powered sawmill is believed to have been operating in Helena at about this time (Anon. 1936, Davis 1983). In 1883, Arkansas and Missouri lumber manufacturers organized the first trade association in the South (Davis 1983, USDA FS 1988). In some regions, such as the Ozark-Ouachita mountain regions, white and red oak were cut for barrel staves and wagon stock (Davis 1983).

When timber supplies in the Northern United States began to dwindle, eyes turned toward the South for a new source of timber to meet the demands of the growing country. The initial era of timber cutting in Arkansas began in the 1890's and lasted up to 1920 (Roberts and others 1942, Widner 1968). As local timber supplies declined, land speculators and lumber company "millmen" came to Arkansas from the North looking for cheap timberland (Widner 1968). The 1876 revision of the Southern Homestead Law of 1866 aided "land speculators" in their purchase of millions of timberland acres in Arkansas (Clark 1984). Large tracts of timberland came under single ownership by sawmill operators or timber companies (Davis 1983, Widner 1968), and the push to harvest the great timber resource of Arkansas began. By 1909, there were two dozen big sawmills, such as Dierks, Crossett, Fordyce, Bradley, Southern, and Union mills, in Arkansas (Davis 1983, Widner 1968). During these years of peak production, forested area was reduced from 32 million to 22 million acres (Davis 1983, Roberts and others 1942). The amount of lumber produced ranged from 79 million board feet in 1869 to 2 billion board feet in 1909, when Arkansas ranked fifth in the Nation in lumber production (Arkansas Forest Industries Committee 1962, Davis 1983, Roberts and others 1942, Widner 1968).

Lack of an adequate railroad system to transport timber to the sawmills hindered initial efforts to harvest much of the State's timber. In some areas, thanks to Arkansas large network of navigable streams and rivers, logs were floated downstream to sawmills or railroad depots (Rafferty 1980). As the demand for timber increased, timber companies often built their own railroads. Whole towns sprang up to serve communities of loggers, mill workers, and railroad workers. As timber in an area was depleted, these company towns often relocated, exemplifying the "cut-out and get-out" philosophy of the time. In some cases, buildings were moved on railroad cars down the track to the next logging site, where they were unloaded to house a new community. Many of these towns, such as Rosboro, are no longer visible on a map, but in their heyday, they were home to several thousand families who made their living working for the lumber companies (Smith 1986).

During this era, the first national forest in the South was established in Arkansas. The Arkansas National Forest was established in 1907 in west central Arkansas; it was renamed the Ouachita National Forest in 1926. Areas in southeast Oklahoma were added later, under the administration of President Theodore Roosevelt. In 1908, the Ozark National Forest was created in northwest Arkansas. Federally unappropriated public lands made up a vast portion of these forests, but some tax-delinquent lands were added, as well as forest lands cut over by lumber companies and later purchased by the Federal Government. A third national forest, the St. Francis, was created in 1960 along Crowley's Ridge in east Arkansas. Today these forests cover nearly 2.7 million acres (Bass 1981, Roberts and others 1942, Smith 1986).

This initial period of exploitation severely depleted Arkansas forest resources. Timber was viewed as a never-ending resource. As timber became more scarce in the South, many companies' sights turned to the Pacific Northwest (Clark 1984, Reynolds 1980, Smith 1986). While some lumber companies moved west in search of virgin timber, others stayed and applied forest management concepts to the remaining resources. Following the examples set by Henry Hardtner's experiments in reforestation, selective cutting, and timber management, Arkansas lumbermen began to use new techniques to ensure a continuous yield of timber for their mills (Clark 1984, Davis 1983, USDA FS 1988).

In the 1920's, "peckerwood" sawmills began operation in Arkansas. These small, portable sawmills manufactured the bulk of the lumber in the South during the 1920's and 1930's. In many areas, including the Ozark region of Arkansas, farming supplemented a sawmiller's income, and vice versa (Davis 1983). In the late 1920's, the construction of a kraft-specialty mill introduced the pulp and paper industry to Arkansas (Arkansas Forest Industries Committee 1962). These two new forest industries (peckerwood sawmills and the pulp industry) used smaller trees often left behind after the "high-grading" timber cutting (cutting the best and leaving the rest). They also took advantage of the new growth emerging on the cut-over lands (Bass 1981, Davis 1983, Troutman and others 1981).

In 1928, the Arkansas Forest Protection Association was created. This organization worked to establish a State forestry commission to aid in controlling fires that yearly destroyed millions of acres of Arkansas timberland. After some political opposition and a year of rallying among the citizens, the Arkansas State Legislature authorized the creation of the Arkansas Forestry Commission in 1931. Since no funds were allocated, it was a forestry commission in name only. Under the administration of President Franklin D. Roosevelt, the Federal Government offered to set up Civilian Conservation Corps (CCC) camps in Arkansas if the State would provide the funds for the forestry commission. In 1933, the legislature again denied the funds. It took the efforts of Governor J. M. Futrell and his public appeal for donations before some 8,000 dollars were collected to fund the commission. On May 23, 1933, Charles Gillett was appointed the first State forester (Davis 1983, Roberts and others 1942, Widner 1968).

The commission went to work to prevent or decrease the forest fires that plagued the State. Most of these fires were caused by humans. Burning timberland to clear out snakes and ticks and to clear land for agricultural or homesteading purposes was common practice, and fire could escape from railroad right-of-ways and logging operations. Arsonists also caused many fires. Through the efforts of the CCC, the Arkansas Forestry Commission, the Forest Service, and forest industry, fire towers, roads, and telephone lines were constructed across Arkansas to enable quick action in the event of a fire. Tree nurseries were also established to provide seedlings for planting cut-over, burned-over, and abandoned acreages on private and public land. The commission and the Forest Service worked to educate Arkansans about fire control through forest festivals or special showings of current movies, often preceded by words from a visiting forester (Bass 1981, Davis 1983, Roberts and others 1942, Smith 1986, Widner 1968).

Through the 1930's and 1940's, forest management and conservation efforts continued. The Cole-Crutchfield Forest Fire Law, passed in 1935, illustrated the importance of these efforts to the forests and economy of Arkansas. This law placed restrictions on burning and assessed fines for violations. It prohibited people from setting fires on land not their own and required them to notify fire control personnel in their area before burning. During this time, large forest landowners voluntarily donated 2 cents per acre per year to the Arkansas Forestry Commission for fire control efforts (Troutman and others 1981, Widner 1968). The severance tax law was enacted in Arkansas in 1923. This measure, still in effect, taxes all natural resources removed or severed from their natural state for commercial purposes. These resources include everything from minerals, precious stones, oil, gas, and gravel to timber, turpentine, and all other forest products. In the beginning, the severance tax revenue went to the counties for roads and schools, but in 1937 the State Legislature reassigned the funds to the forestry commission (Roberts and others 1942, Widner 1968).

In 1933 the Crossett Experimental Forest was created in south central Arkansas on land leased from the Crossett Lumber Company. On this holding, the Forest Service, Southern Forest Experiment Station (SFES) set out to study management of second-growth timber stands (Reynolds 1980, USDA FS 1988). Today, research is conducted on multiresource management. The SFES Forest Survey began in Arkansas in 1934. The aim was to provide information on timber inventory, growth, removals, and mortality of the timber resource in Arkansas (USDA FS 1937). The initial survey did not inventory the Ozark region. The first survey to include the entire State was completed between 1947 and 1951 (USDA FS 1953). This research, along with contributions by Federal, State, and private groups, provided insights into the use and availability of the second-growth timber, sustained yield management, and new, improved technologies for cutting, hauling, and processing timber (USDA FS 1988).

During the Depression, lumber production was suppressed, which in turn gave the second-growth forest a chance to grow (Clark 1984). Reversions of abandoned farmland to timberland and tree planting by the CCC bolstered the forest resource (Clark 1984, Widner 1968). With the advent of World War II, lumber production began to increase again, but with new production techniques, new uses for wood, and new forest management ideals, the future of the Arkansas timber was more secure.

In 1945, the Arkansas Forestry Commission was consolidated into the Resources and Development Commission. The resulting combination was called

the Division of Forestry, and the severance tax revenue was moved to the general fund. In the fall of 1952, more than 150,000 acres of timberland in Arkansas burned. This event helped lead to the reestablishment of the Arkansas Forestry Commission in 1953. The severance tax was increased and reassigned to the commission for forest fire control, management, education, insect and disease control, and seedling growth and distribution. This increase in funding allowed the commission to expand its efforts, including establishment of another nursery and the Poison Springs State Forest in 1957. This State forest was established in south Arkansas on land purchased from the Federal Government (Troutman and others 1981, Widner 1968). During the 1940's a 2-year program of study in forestry was established at Arkansas A&M University (now the University of Arkansas at Monticello). In 1950, the program was expanded to 4 years and offered a Bachelor of Science degree in forestry. It remains the only such program in the State of Arkansas (Troutman and others 1981).

During the 1950's, expansion of the pulp and paper industry fueled the forest industry sector and gave the second-growth forest a marketplace. New pulp mills were created, and existing ones were upgraded. With the introduction of debarkers and chippers came a shift in sawmills. Peckerwood sawmills began to disappear, and the few large sawmills grew even larger. Slabs and edgings from the cuttings in these mills were chipped for use in the pulp mills (Arkansas Forest Industries Committee 1962, Sternitzke 1960). The first commercial facilities in the South for converting sawmill waste into chips for pulp mills were in Bradley County in southeast Arkansas (Arkansas Forest Industries Committee 1962). Forest land decreased in the Delta region of Arkansas as farming the fertile soil in that area became more profitable. Small subsistence farms and pastures were abandoned by the population for a more urban existence, thus increasing the forest land in the upland regions. Forested area increased overall during the 1950's (Sternitzke 1960).

The 1960's and 1970's saw a decrease in forest area in Arkansas. Landclearing in the Delta for crops, in other regions for pastureland, and across the State for urban expansion left about 50 percent of the State forested by 1978 (Van Hees 1980, Van Sickle 1970). Even with this decrease in forest area, growing-stock volumes were slightly higher-but most of this volume was in smaller trees. More efficient use and management of the forest resource ensured a constant supply of timber. Sawmills continued to become larger, but fewer in number. Pulpwood production boomed to 179.1 million cubic feet in 1977, partly because of technological changes that provided for the use of hardwood for pulp (Van Hees 1980). Although two-thirds of the timber harvested was softwood (mostly pine), Arkansas remained a major producer of hardwood cooperage and handle stock (Van Sickle 1970).

Federal and State assistance programs have helped to convert millions of acres of idle land into productive timberland. Programs such as the Agricultural Conservation Program (ACP), the Conservation Reserve Program (CRP), and the Forestry Incentives Program (FIP) have paid funds to private landowners to help defray the cost of planting trees and managing the timber on their land (Troutman and others 1981, Troutman and Porterfield 1974, USDA FS 1988). Under new programs, such as the CRP, many acres of land cleared in the 1960's and 1970's in the Arkansas Delta are being reforested.

The forest industry has often been the largest manufacturing industry in the State, thus providing significant employment opportunities and economic benefits to the overall economy of Arkansas (Arkansas Forest Industries Committee 1962, Troutman and others 1981, Tucker 1985). Arkansas forests also provide many recreational and aesthetic benefits to its inhabitants and visitors (Troutman and Porterfield 1974).

FOREST AREA

The total land area of Arkansas is 33.3 million acres, of which 17.7 million acres-or 53 percent-are forested. Today 98 percent of the forest land is classified as timberland (see the definition of terms section in the appendix). The remaining 2 percent is roughly split between reserved timberland and woodland, three-fourths of which is in the Ozark region of the State.

Since 1978, timberland area has increased by 3 percent, reversing the trend of decline between 1959 and 1978. The change is the net result of land entering and departing the timberland base (table I). There were additions to timberland amounting to 1.3 million acres since 1978. These additions were partially offset by diversions to other uses, so the net gain was slightly over 0.5 million acres.

Survey Regions

Arkansas timberland resource varies greatly among the survey regions. In the Delta and Ozark regions (fig. 1), rich mixtures of hardwood species dominate the forests. In the Southwest region, loblolly pine is the leading species. The Ouachita region is noted for its stands of high-quality shortleaf pine.

The Delta Region.-This region is an alluvial plain extending from Missouri south to Louisiana along the Mississippi River. Although this region covers most of

Table *I.-Changes in timberland by survey region, Arkansas, 1978-88*

Survey region	Net change	Additions			Diversions		
		Total	Nonforest	Woodland	Total	Agriculture	Other
	Thousand acres						
Delta	70.2	173.8	173.8	0.0	103.6	66.3	37.3
Ouachita	-66.2	96.1	58.5	37.6	162.3	44.3	118.0
Ozark	511.8	797.6	501.5	296.1*	285.8	171.5	114.3
Southwest	23.5	217.8	195.6	22.2	194.3	135.2	59.1
All regions	539.3	1,285.3	929.4	355.9	746.0	417.3	328.7

*Reflects the reclassification of woodland to timberland.

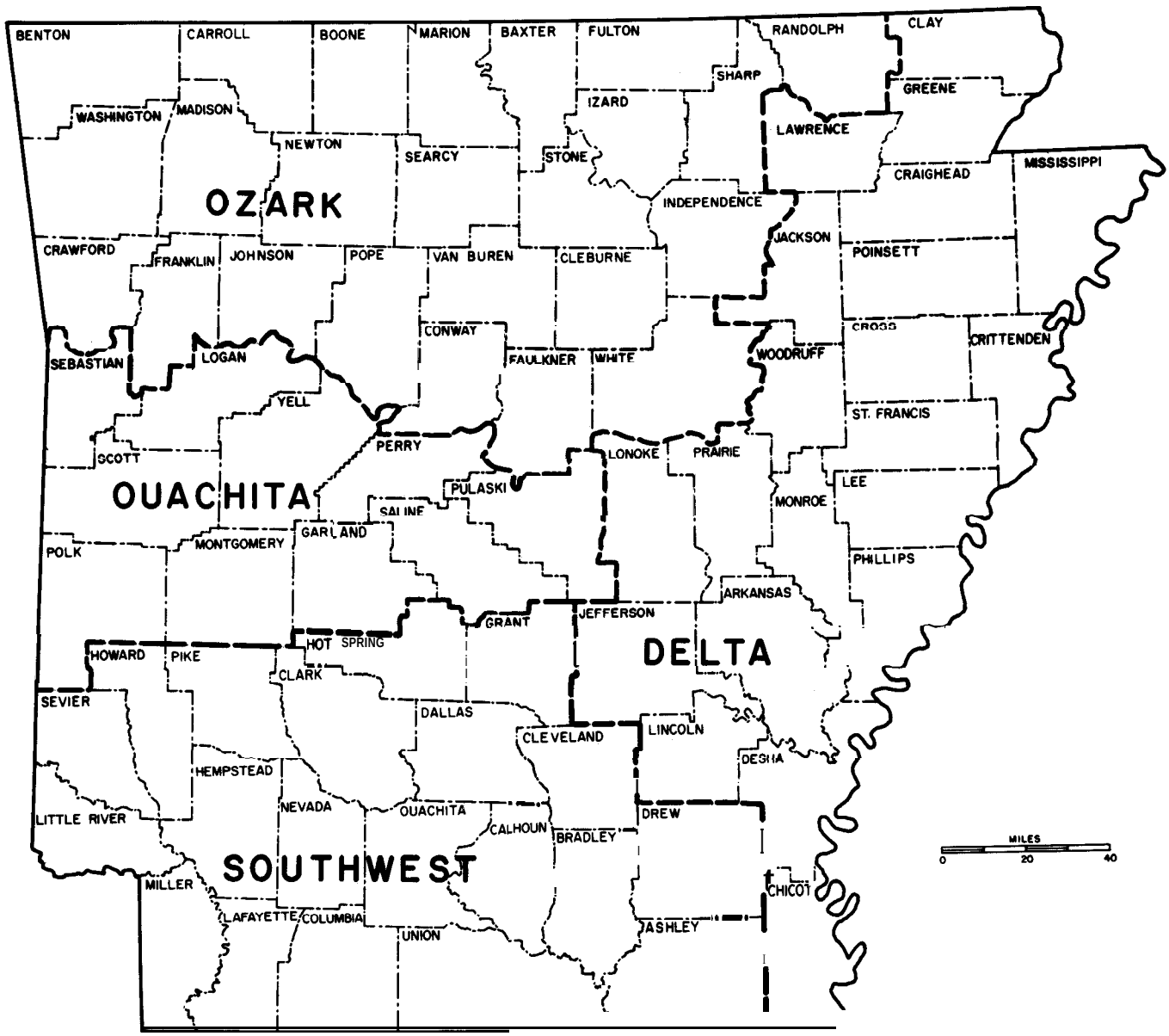

Figure *l.-Forest survey regions* Of *Arkansas.*

the eastern third of the State, it contains only 11 percent of the timberland because most of the Delta has been cleared for agricultural use. Bottomland hardwoods (elm-ash-cottonwood and oak-gum-cypress forest types> occupy more than two-thirds of the remaining timberland. Oak-hickory stands account for another 25 percent. Most of these oak-hickory stands grow along a narrow strip of hills called Crowley's Ridge, which stretches some 200 miles north to south through the central part of the region. The ridge is formed of gravel deposits and wind-blown mineral particles called loess. The St. Francis National Forest is at the south end of Crowley's Ridge, between Helena and Marianna. Further south, the White River National Wildlife Refuge is the largest public holding in the region. In the Delta, 72 percent of the timberland is in NIPF ownerships.

The Ouachita Region.-The Ouachita is the second most important timber-producing area in the State. West of the Delta, the Ouachita region extends northward from the coastal plain to the Arkansas River and contains the eastern part of the Ouachita Mountains, a series of parallel ridges and valleys stretching from eastern Oklahoma to central Arkansas. This region supplies almost 20 percent of the annual timber harvest. Together, loblolly-shortleaf and oak-pine stands occupy almost 60 percent of the 3.2 million acres of timberland. Oak-hickory stands make up most of the remaining forests. Bottomland hardwood stands account for only 6 percent of the total. In sharp contrast to the rest of the State, almost half of the timberland in the Ouachita region is publicly owned. The Ouachita National Forest alone contains 1.3 million acres. Commercial forest industries own or lease 22 percent of the timberland, leaving some 30 percent in NIPF ownerships.

The Ozark Region.-In total land area, the Ozark region is the largest of the four survey regions. It encompasses the northern third of the State west of the Delta and north of the Arkansas River. This region contains one-third of the timberland plus another 375,000 acres of woodland and reserved timberland. Some 300,000 acres of forests in this region have been reclassified from woodland to timberland since the last survey. Rugged hills, deep valleys, and swift streams characterize the Ozark Plateau. In the southern part of the region, north of the Arkansas River Valley, there is a large area of steep, wooded hills called the Boston Mountains. Winding river gorges, 500 to 1,500 feet deep, cut through these mountains. In the northern part of the region, several large lakes form a chain of water impoundments along the upper White River. Oak-hickory stands occupy almost 75 percent of the timberland. About 77 percent of the timberland is in NIPF ownerships-the highest portion in the State. About 20 percent is in public holdings, most of which is in the Ozark National Forest. Only about 3 percent of the timberland in the Ozark region is owned or leased by forest industries.

The Southwest Region.-This region, part of the West Gulf Coastal Plain, covers the southern part of Arkansas west of the Delta. It is by far the most important timber-producing region in Arkansas. Although it contains 37 percent of the timberland, it provides almost two-thirds of the annual timber harvest. Together, loblolly-shortleaf and oak-pine stands cover more than 60 percent of the 6.4 million acres of timberland in the region. Bottomland hardwood stands occupy more than 1 million acres, primarily along the Ouachita, Red, and Saline Rivers. Oak-hickory stands account for the remaining 1.4 million acres. Most of the pine plantations in Arkansas have been established in this region. Forest industries own or lease about half of the timberland in southwest Arkansas. Most of the rest is in NIPF ownerships, and public lands make up less than 3 percent. The Felsenthal National Wildlife Refuge, east of El Dorado, is the largest public holding.

Timberland Trends

Over the years, the greatest loss of timberland in Arkansas occurred in the Delta region where extensive land was cleared for agricultural use. For example, the first forest survey in 1936 measured 5.3 million acres of timberland in the Delta (table II). By

Table *II.-Timberland area by survey region, Arkansas, 1936-88*

Survey region	Survey year					
	1936	1951	1959	1969	1978	1988
	Thousand acres					
Delta	5,345.6	3,497.4	3,249.2	1,975.0	1,828.8	1,899.0
Ouachita	3,376.9	3,391.5	3,552.2	3,319.1	3,238.4	3,172.2
Ozark	*	6,113.7	6,995.9	6,267.5	5,217.8	5,729.6
Southwest	6,097.9	6,339.2	6,959.7	6,645.1	6,422.3	6,445.8
All regions	*	19,341.8	20,757.0	18,206.7	16,707.3	17,246.6

*The Ozark region was not inventoried in the initial survey.

1978, timberland in this region had diminished to 1.8 million acres. These statistics suggest that, over a 40-year period, two-thirds of the timberland in the Arkansas Delta was cleared. Even in the Delta, the decline in timberland seems to have ended, at least for a while.

Outside the Delta, there was a significant increase in timberland between 1936 and the early 1960's. In fact, many of the older pine stands in Arkansas today were established during that period, on idle and abandoned agricultural land. During the late 1950's and early 1960's, under the Conservation Reserve Soil-bank Program, some 100,000 acres of idle agricultural land were planted with trees. Trends in forest planting rates reflect the impact of this program in Arkansas (table III). For every acre planted under the Soil-bank Program, several additional acres of idle agricultural land seeded back to trees through natural regeneration.

This increase in Arkansas timberland between 1936 and the early 1960's was part of a Southwide trend. During this period, millions of acres of agricultural land across the South reverted back to pine trees. In many areas of the South, these land-use changes were much more extensive than those in Arkansas. A large share of the pine forests some people call "the South's third forest" was established during the era described. Today these pine stands are supplying timber for the mills. By the year 2000, most of this third pine forest will have been harvested.

Just as the decline in agriculture outside the Delta and the establishment of the Soil-bank Program were

Table III-Area *of forest planting, by ownership, Arkansas, 1957–89**

Fiscal year	Ownership class			All owners	Cumulative total
	Public	Forest industry	Other private		
	Thousand acres				
					154†
1957	...	11	9	20	174
1958	1	10	26	37	211
1959	3	16	63	82	293
1960	7	13	52	72	365
1961	6	9	13	28	393
1962	11	10	11	32	425
1963	10	9	8	27	452
1964	7	7	5	19	471
1965	4	11	8	23	494
1966	4	8	10	22	516
1967	8	7	5	20	536
1968	9	9	6	24	560
1969	10	8	1	19	579
1970	10	23	7	40	619
1971	13	21	4	38	657
1972	15	24	4	43	700
1973	15	43	6	64	764
1974	16	57	5	78	842
1975	19	86	8	113	955
1976	20	90	9	119	1,074
1977	15	80	13	108	1,182
1978	14	56	9	79	1,261
1979	16	82	11	109	1,370
1980	15	106	27	148	1,518
1981	24	109	19	152	1,670
1982	23	110	22	155	1,825
1983	19	109	20	148	1,973
1984	19	92	16	127	2,100
1985	18	91	23	132	2,232
1986	18	71	24	113	2,345
1987	16	113	45	174	2,519
1988	15	83	64	162	2,681
1989	15	68	62	145	2,826

***Source: 1957-89. U.S. Department of Agriculture, Forest Service, [Annual issues.] 1980 (etc.) U.S. forest planting report. Washington, DC: U.S. Department of Agriculture, Forest Service.**

†Cumulative total before fiscal year 1957.

factors in the earlier increase in timberland in Arkansas, the more recent CRP has been a factor in ending the decline in timberland. Authorized by the 1985 Farm Bill, the CRP motivated farmers to plant marginal crop land back to trees. Again, trends in forest planting rates provide some measure of the CRP response in Arkansas (table III). Tree planting under the CRP contributes to the establishment of the South's fourth forest.

Little Change in Timberland Ownership

Generally, forest ownership patterns in Arkansas remained about the same between 1978 and 1988. All together, NIPF owners control 9.8 million acres of timberland, or 57 percent of the total. The NIPF owners controlled about the same share in 1978. By survey region, the NIPF share of total timberland ranges from 31 percent in the Ouachita to 77 percent in the Ozark.

Forest industry controls 4.4 million acres, or 25 percent of all timberland in Arkansas. Again, this is about the same share as in 1978. By survey region, the industry share ranges from 3 percent in the Ozark to 51 percent in the Southwest.

Public agencies control the remaining 3.1 million acres, or 18 percent of the timberland. About three-fourths of the public timberland in Arkansas is made up of the Ouachita, Ozark, and St. Francis National Forests. In 1959, only 14 percent of the timberland was publicly owned. The public share ranges from less than 3 percent in the Southwest region to 47 percent in the Ouachita region.

People expect a wide range of benefits from their public forests, and because of this, the management of these forests attempts to accommodate a myriad of objectives. Even on public timberland, timber production often is not the primary management objective. For this reason, many companies prefer not to rely on public timber to run their mills. Nevertheless, public timberland is a major source of timber supply in some parts of the State.

Plantations Replace Natural Stands

In the past, timberland owners in Arkansas appear to have relied on natural regeneration more than owners in any other Southern State. Based on forest planting records, fewer than 1 million acres had been planted-with trees in Arkansas as recently as 1975 (table III).

Although natural stands still occupy most of Arkansas timberland, acreage in plantations is now increasing at a rapid rate. The 1978 survey showed that planted pine stands occupied only 720,000 acres (table IV). This estimate included all stands where yellow pines accounted for 25 percent or more of the live-tree stocking and there was evidence of artificial regeneration. By 1988, the acreage occupied by planted pine stands had increased to almost 1.6 million acres (table V). There was also evidence of artificial regeneration on an additional 300,000 acres classed as hardwood forest type.

Based on independent estimates of forest planting compiled by the Forest Service (table III), these latest survey estimates of plantations appear to be conservative. For example, the planting records show 1.4 million acres were planted in Arkansas between 1978 and 1988. Regardless of which statistics are more precise, most of Arkansas plantations have been established since 1975.

In 1988, more than two-thirds of the pine plantations in Arkansas were on forest industry lands. On this ownership, plantations made up 70 percent of all pine sapling-seedling stands and 37 percent of the pine poletimber stands (table V). More than half of all pine plantations are in the Southwest region.

Between 1962 and 1988, the natural pine stands in Arkansas decreased by about 1.7 million acres. Between 1978 and 1988, the net loss in natural pine stands was almost 900,000 acres.

Loss of Bottomland Hardwood Stands Slows

The rapid rate of loss of elm-ash-cottonwood and oak-gum-cypress forest types in Arkansas between 1935 and 1970 has slowed over the past 20 years. When the initial forest survey was conducted in the mid-1930's, these hardwood types occupied almost 6 million acres of the State's timberland. By 1969, bottomland hardwood covered just over 3 million acres. Practically all of this net loss occurred in the Delta region. Between 1969 and 1978, the net loss was just over 200,000 acres. Between 1978 and 1988, the net loss was just under 100,000 acres. In recent years, the largest loss in Arkansas occurred in the Southwest region.

In contrast to the decrease in bottomland hardwood stands, area of timberland occupied by upland hardwood stands increased from 6.6 million to 7.3 million acres, or about 10 percent between 1978 and 1988. The reclassifications of forest land in the Ozark region accounted for about one-half of this net gain. Most of the real gain in upland hardwood stands was seen in the Southwest region.

THE SOFTWOOD RESOURCE

Pine Plantations Reach Merchantable Size

As mentioned earlier in this report, most of the plantations in Arkansas have been established since 1975. Nevertheless, the oldest pine plantations have now reached merchantable size.

Table IV.-Area *of timberland, by ownership, forest type, and stand size, Arkansas, 1978*

Ownership	Forest type*	All stands	Stand size			
			Nonstocked	Sapling-seedling	Poletimber	Sawtimber
			Thousand acres			
Public	Planted pine	*49.2*	*0.0*	5.5	25.7	18.0
	Natural pine	1,276.4	0.0	203.6	396.0	676.8
	Upland hardwood	1,291.7	0.0	183.3	583.3	525.1~
	Bottomland hardwood	394.2	0.0	55.7	39.9	298.6
	All types	3,011.5	0.0	448.1	1,044.9	1,518.5
Forest industry	Planted pine	382.2	0.0	303.5	22.8	55.9
	Natural pine	2,421.6	4.2	533.1	471.7	1,412.6
	Upland hardwood	671.4	0.0	319.8	179.1	172.5
	Bottomland hardwood	782.4	0.0	65.9	165.7	550.8
	All types	4,257.6	4.2	1,222.3	839.3	2,191.8
Other private	Planted pine	288.6	0.0	72.9	120.7	95.0
	Natural pine	2,890.6	5.9	626.1	914.0	1,344.6
	Upland hardwood	4,610.4	5.8	1,400.4	2,013.6	1,190.6
	Bottomland hardwood	1,648.6	0.0	199.4	430.8	1,018.4
	All types	9,438.2	11.7	2,298.8	3,479.1	3,648.6
All owners	Planted pine	720.0	0.0	382.0	169.2	168.9
	Natural pine	6,588.6	10.1	1,362.8	1,781.7	3,434.0
	Upland hardwood	6,573.5	5.8	1,903.5	2,776.0	1,888.2
	Bottomland hardwood	2,825.2	0.0	321.0	636.4	1,867.8
	All types	16,707.3	15.9	3,969.3	5,363.3	7,358.9

*Oak-pine and nontyped stands included with natural and planted pine; elm-ash-cottonwood and oak-gum-cypress stands included with bottomland hardwood.

Tables IV and V provide measures of stand establishment and development in the State between 1978 and 1988 by ownership class, forest type, and stand size. Based on these statistics, more than 600,000 acres of planted pine have now reached merchantable size-poletimber and sawtimber (see appendix for definitions). In 1978, fewer than 340,000 acres of planted pine were in the merchantable size classes. More than one-half of the merchantable size pine plantations are on forest industry holdings. Over the next two decades, thinning and harvesting these older plantations will supply a significant share of the pine requirements in Arkansas.

Beyond the year 2000, planted sapling-seedling stands are expected to start reaching merchantable size at a rate of about 145,000 acres per year, based on recent planting records. Plantations now account for more than one-half of all pine sapling-seedling stands in the State. In the State's fourth forest, plantations will likely dominate.

A rapid decline in young, natural pine stands accompanies the establishment and development of the pine plantation resource. For example, between 1978 and 1988, acreage of natural pine sapling-seedling stands declined by one-third. Almost 60 percent of the remaining natural pine stands in Arkansas are sawtimber size.

Changes in number of trees by diameter class provide additional evidence that Arkansas pine resource is maturing (table VI). Except for increases in the 4-, 6-, and 8-inch diameter classes on industry land, the number of small-diameter pines was down. The developing pine plantations accounted for the differences on industry land. In contrast to the decrease in small pines, the number of pines 14.0 inches in d.b.h. and larger was up on both NIPF and public lands. Again, differences appear on industry land, where the number of pines 10.0 inches and larger in d.b.h. is declining rapidly as forest industry harvests and converts its natural stands to plantations.

Inventory of Pine Declines

For the first time since 1951, the forest survey indicates a decline in the inventory of pine timber in Arkansas. Between 1978 and 1988, inventory of pine growing stock declined from 8.0 to 7.6 billion cubic feet-or by 5 percent. This decrease in pine inventory is attributed to a 16-percent reduction in pine growth and a sharp increase in pine removals-up by one-third.

Table V.-Area *of timberland, by ownership, forest type, and stand size, Arkansas, 1988*

Ownership	Forest type*	All stands	Stand size			
			Nonstocked	Sapling-seedling	Poletimber	Sawtimber
		Thousand acres				
Public	Planted pine	138.0	0.0	62.4	24.1	51.5
	Natural pine	1,144.8	0.0	102.6	312.9	729.3
	Upland hardwood	1,344.3	0.0	160.8	682.1	501.4
	Bottomland hardwood	448.4	0.0	22.5	61.9	364.0
	All types	3,075.5	0.0	348.3	1,081.0	1,646.2
Forest industry	Planted pine	1,064.8	0.0	741.0	246.6	77.2
	Natural pine	1,849.0	5.3	325.0	425.2	1,093.5
	Upland hardwood	794.6	5.6	307.3	206.7	275.0
	Bottomland hardwood	655.8	21.4	65.0	73.0	496.4
	All types	4,364.2	32.3	1,438.3	951.5	1,942.1
Other private	Planted pine	348.7	0.0	146.3	106.6	95.8
	Natural pine	2,695.3	5.7	485.6	748.1	1,455.9
	Upland hardwood	5,125.7	74.1	1,132.9	2,351.7	1,567.0
	Bottomland hardwood	1,637.2	43.5	149.7	422.1	1,021.3
	All types	9,806.9	123.3	1,914.5	3,629.1	4,140.0
All owners	Planted pine	1,551.5	0.0	949.7	377.3	224.5
	Natural pine	5,689.1	11.0	913.2	1,486.2	3,278.7
	Upland hardwood	7,264.6	79.7	1,601.0	3,240.5	2,343.4
	Bottomland hardwood	2,741.4	64.9	237.2	557.6	1,881.7
	All types	17,246.6	155.6	3,701.1	5,661.6	7,728.3

*Oak-pine and nontyped stands included with pine types; elm-ash-cottonwood and oak-gum-cypress types are included with bottomland hardwood.

By ownership class, most of the reduction in pine inventory occurred on forest industry land, where the inventory of pine sawtimber was down 23 percent (table VII). Most of the remaining loss was on NIPF land, where the inventory of pine pulpwood1 was down 6 percent. On industry land, the decrease in pine sawtimber reflects a rapid harvest and conversion of natural pine stands to plantations in the Southwest and Ouachita regions. On NIPF land, the decrease in pine pulpwood reflects deficiencies in pine regeneration in earlier years, particularly in the Ouachita region.

By survey region, the largest reduction in pine inventory-13 percent-occurred in the Ouachita region (table VIII). Here, sawtimber and pulpwood inventories were down. In the Southwest region, the pine inventory was down 5 percent. An increase in pine poletimber on forest industry land partially offset a lo-percent reduction in pine sawtimber. In the Delta and Ozark regions, the relatively small inventories of pine were up sharply.

'Pulpwood in this instance refers to volume in poletimber trees and upper stems of sawtimber trees.

Most of the reduction in pine inventory occurred on privately owned timberland in a 16-county area in west central Arkansas (fig. 2). Between 1978 and 1988, the cutting of pine in the area exceeded growth by 65 percent. Figure 2 also depicts another southern three-county area where pine removals significantly exceeded pine growth. All together, these 19 counties supplied almost 65 percent of the pine harvest in Arkansas over the lo-year period.

Loblolly Pine Surpasses Shortleaf

In 1988, for the first time, loblolly pine surpassed shortleaf pine in Arkansas timber inventory (fig. 3). When the first Statewide forest survey was completed in 1951, loblolly pine accounted for less than 40 percent of the pine inventory; this share has gradually increased. By 1988, the inventory of loblolly had increased to almost 4.0 billion cubic feet, or 53 percent of all pine. About 94 percent of the State's loblolly pine grows in the Southwest region, where it is the primary species featured in timber management.

Through 1978, shortleaf pine dominated all other species in Arkansas forests. In the 1951 survey,

Table *W.--Number of live trees on Arkansas timberland, by diameter class and ownership, 1988, and change between 1978 and 1988**

Diameter class	All owners		Public		Forest industry		Other private	
	Inventory 1988	Change 1978-88	Inventory 1988	Change 1978-88	Inventory 1988	Change 1978-88	Inventory 1988	Change 1978-88
	Million trees							
Yellow pines								
2	865.2	-169.0	122.6	*-79.2*	453.6	-11.2	*289.0*	-78.6
4	469.5	-26.0	69.7	-20.1	230.0	50.7	169.8	-56.6
6	243.5	-9.6	40.4	-9.3	118.3	32.5	85.0	-32.8
8	164.7	-16.3	34.7	-6.0	65.4	6.2	64.6	-16.5
10	98.0	-23.0	24.8	-3.7	33.4	-8.3	39.8	-11.0
12	68.2	-8.2	18.1	-0.2	22.3	-5.1	27.8	-2.9
14	42.8	0.3	11.6	2.0	12.7	-4.6	18.5	2.9
16+	42.1	-0.6	8.0	1.2	16.1	-3.2	18.0	1.4
Hardwoods								
2	5,709.6	-512.7	*890.0*	-205.8	1,468.8	-82.1	3,350.8	-224.8
4	1,544.4	-184.2	303.1	-53.3	294.1	49.4	947.2	-81.5
6	636.3	-28.0	133.5	-5.2	105.6	-19.6	397.2	-3.2
8	358.8	1.0	74.2	6.5	55.8	-12.1	228.8	6.6
10	207.3	6.7	41.5	5.1	31.5	-4.8	134.3	6.4
12	117.7	2.1	23.6	2.7	16.7	-3.9	77.4	3.3
14	76.0	2.1	16.0	1.8	12.1	-1.8	47.9	2.1
16+	109.6	11.0	25.4	3.9	19.2	-1.2	65.0	8.3

*Other softwoods are excluded in this table.

Table VII.—*Changes in inventory ofgrowing stock, by ownership and timber class, Arkansas, 1978-88*

Broad ownership	Timber class*	Inventory		Change 1978-88	
		1978	1988	Volume	Percent
		Milliocubifeet			
Public	Pine sawtimber	1,178.2	1,264.4	86.2	7.3
	Pine pulpwood	511.7	504.4	-7.3	-1.4
	Other softwood	62.7	73.2	10.5	16.7
	Hardwood sawtimber	875.0	1,249.1	374.1	42.8
	Hardwood pulpwood	998.7	1,183.4	184.7	18.5
Forest industry	Pine sawtimber	2,413.9	1,851.4	-562.5	-23.3
	Pine pulpwood	768.9	888.3	119.4	15.5
	Other softwood	59.1	59.9	0.8	1.4
	Hardwood sawtimber	1,108.6	1,134.4	25.8	2.3
	Hardwood pulpwood	1,035.0	931.6	-103.4	-10.0
Other private	Pine sawtimber	2,130.0	2,148.6	18.6	0.9
	Pine pulpwood	979.5	917.9	-61.6	-6.3
	Other softwood	183.9	214.9	31.0	16.9
	Hardwood sawtimber	2,479.3	3,215.2	735.9	29.7
	Hardwood pulpwood	3,011.1	3,353.0	341.9	11.4
All owners	Pine sawtimber	5,722.1	5,264.4	-457.7	-8.0
	Pine pulpwood	2,260.1	2,310.6	50.5	2.2
	Other softwood	305.7	348.0	42.3	13.8
	Hardwood sawtimber	4,462.9	5,598.7	1,135.8	25.4
	Hardwood pulpwood	5,044.8	5,468.0	423.2	8.4

*Sawtimber includes the merchantable volume in the sawlog portion of sawtimber trees. Pulpwood includes the merchantable volume in poletimber trees and in the upperstem portion of sawtimber trees.

Table VIII.—*Changes in inventory ofgrowing stock, by survey region and timber class, Arkansas, 1978-88*

Survey region	Timber class*	Inventory		Change 1978-88	
		1978	1988	Volume	Percent
		Million cubic feet			
Delta	Pine sawtimber	85.9	103.0	17.1	19.9
	Pine pulpwood	40.0	65.9	25.9	64.8
	Other softwood	114.4	121.3	6.9	6.0
	Hardwood sawtimber	1,110.7	1,435.5	324.8	29.2
	Hardwood pulpwood	741.7	807.9	66.2	8.9
Ouachita	Pine sawtimber	1,575.0	1,376.9	-198.1	-12.6
	Pine pulpwood	754.8	641.0	-113.8	-15.1
	Other softwood	32.1	32.6	0.5	1.6
	Hardwood sawtimber	397.2	512.4	115.2	29.0
	Hardwood pulpwood	745.6	806.6	61.0	8.2
Ozark	Pine sawtimber	398.4	483.4	85.0	21.3
	Pine pulpwood	230.6	276.2	45.6	19.8
	Other softwood	82.0	127.6	45.6	55.6
	Hardwood sawtimber	1,247.4	1,786.7	539.3	43.2
	Hardwood pulpwood	1,654.0	2,090.9	436.9	26.4
Southwest	Pine sawtimber	3,662.8	3,301.1	-361.7	-9.9
	Pine pulpwood	1,234.7	1,327.5	92.8	7.5
	Other softwood	77.2	66.5	-10.7	-13.9
	Hardwood sawtimber	1,707.6	1,864.1	156.5	9.2
	Hardwood pulpwood	1,903.5	1,762.6	-140.9	-7.4

*Sawtimber includes the merchantable volume in the sawlog portion of sawtimber trees. Pulpwood includes the merchantable volume in poletimber trees and in the upperstem portion of sawtimber trees.

shortleaf pine accounted for more than 60 percent of the pine; this share has gradually decreased to 47 percent. Between 1978 and 1988, inventory of shortleaf pine decreased from 4.2 billion to 3.6 billion cubic feet-or by 14 percent. In the Ouachita and Ozark regions, which are mostly north of the natural loblolly range, shortleaf pine still dominates. There is relatively little pine in the Arkansas Delta.

The inventory of other softwood growing stock totaled 348 million cubic feet, up 14 percent. In the Delta and Southwest regions, cypress accounts for most of the other softwood volume. In the Ouachita and Ozark regions, redcedar makes up most of the other softwoods.

THE HARDWOOD RESOURCE

Hardwood Inventory Gains Substantially

After several decades of decline, the inventory of hardwood growing stock increased 16 percent between 1978 and 1988. Some of this increase, about 3 percent, is caused by the change in log/tree grade. We now accept trees as growing stock if they contain two 8-foot logs anywhere in the tree. Formerly, they had to contain a 12-foot log in the first 16 feet. Although the reclassification of woodland to timberland in the Ozark region accounts for part of the recent increase, most of the gain is real.

By ownership class, the largest percentage gain in hardwood volume occurred on public timberland, where the inventory was up 30 percent. Because of this rapid buildup, the hardwood inventory on public land surpassed the hardwood inventory on industry land. Hardwood volume increased even more on NIPF land, where the inventory was up 20 percent. In contrast to these increases, hardwood inventory on forest industry land was down almost 4 percent.

By survey region, the largest increase in hardwood volume occurred in the Ozark region, where the inventory was up by one-third. In the Delta and Ouachita regions, the increases were 21 and 15 percent, respectively. In the Southwest region, there was almost no overall change in hardwood inventory.

By timber class, most of the hardwood gain was in sawtimber. Between 1978 and 1988, hardwood sawtimber in Arkansas increased from 4.5 billion to 5.6 billion cubic feet, or by one-fourth. Inventory of hardwood pulpwood increased from 5.0 billion to 5.5 billion cubic feet, or by less than 10 percent. On forest

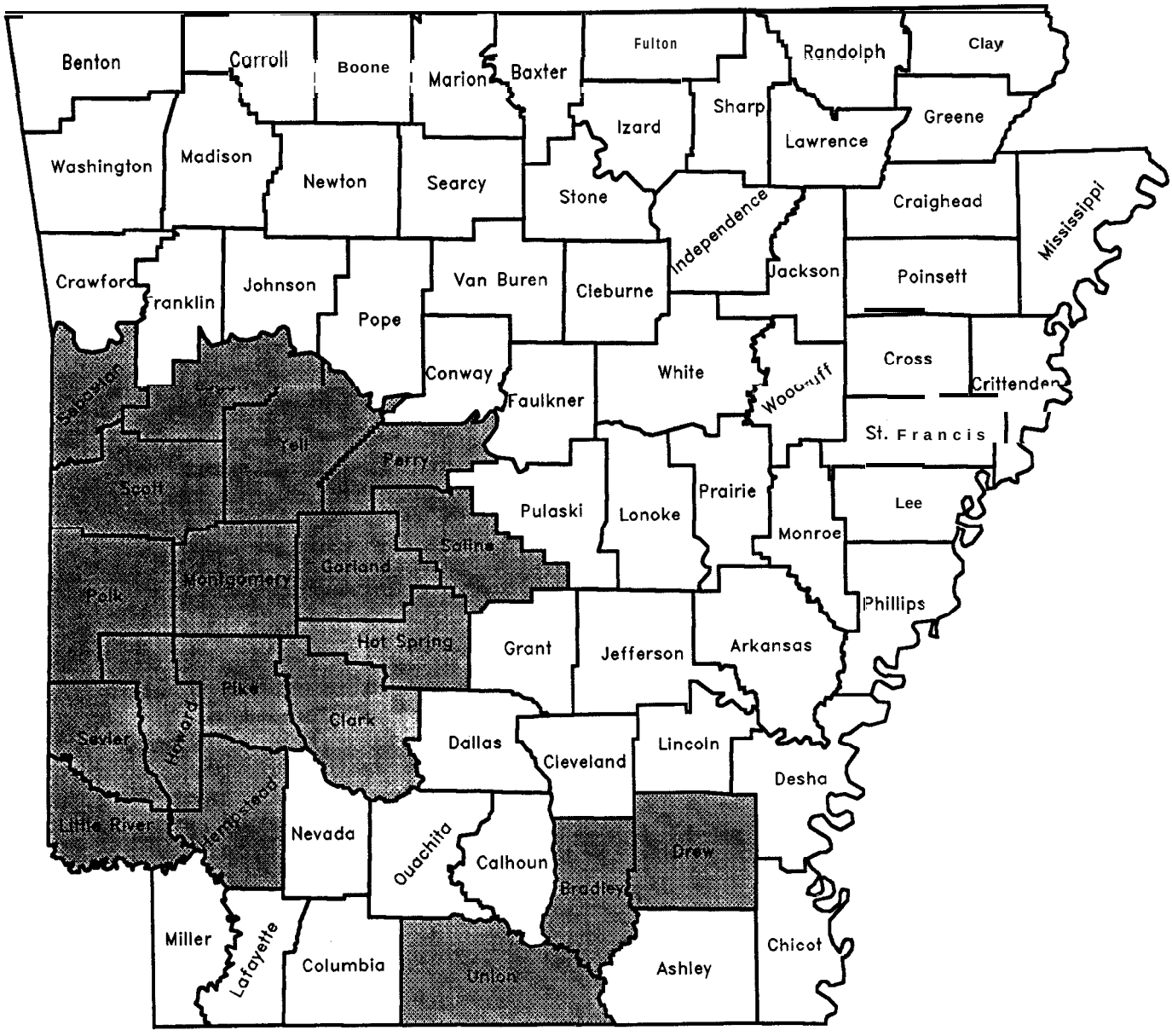

Figure 2.—*Counties where pine removals significantly exceeded pine growth between 1978 and 1988.*

industry land, inventory of hardwood pulpwood actually dropped by 10 percent.

Together, oak, hickory, ash, and other hard-textured species comprise more than 70 percent of Arkansas hardwood timber. Sweetgum, blackgum, and tupelo account for another 17 percent. In the years analyzed, almost all of the major hardwood species increased in volume. Much of the hardwood, however, is of low quality; less than one-fourth of the hardwood sawtimber is in tree grades 1 and 2.

Hardwood Resource Matures

Arkansas hardwood resource is also maturing. Between 1978 and 1988, acreage of hardwood sawtimber stands increased by more than 12 percent, while acreage of hardwood sapling-seedling stands declined by 17 percent. Compared to 40 percent in 1978, more than 42 percent of the hardwood stands were sawtimber size in 1988. Over this same period, the number of hardwood trees 15.0 inches in d.b.h. and larger increased 10 percent.

The area of timberland supporting hardwood poletimber stands increased from 3.4 million to 3.8 million acres, or by 11 percent. While the number of 6-inch hardwoods was down across all ownerships, numbers of 8- and lo-inch hardwoods were up on NIPF and public holdings. On forest industry holdings, the number of hardwood trees declined across the range of diameter classes.

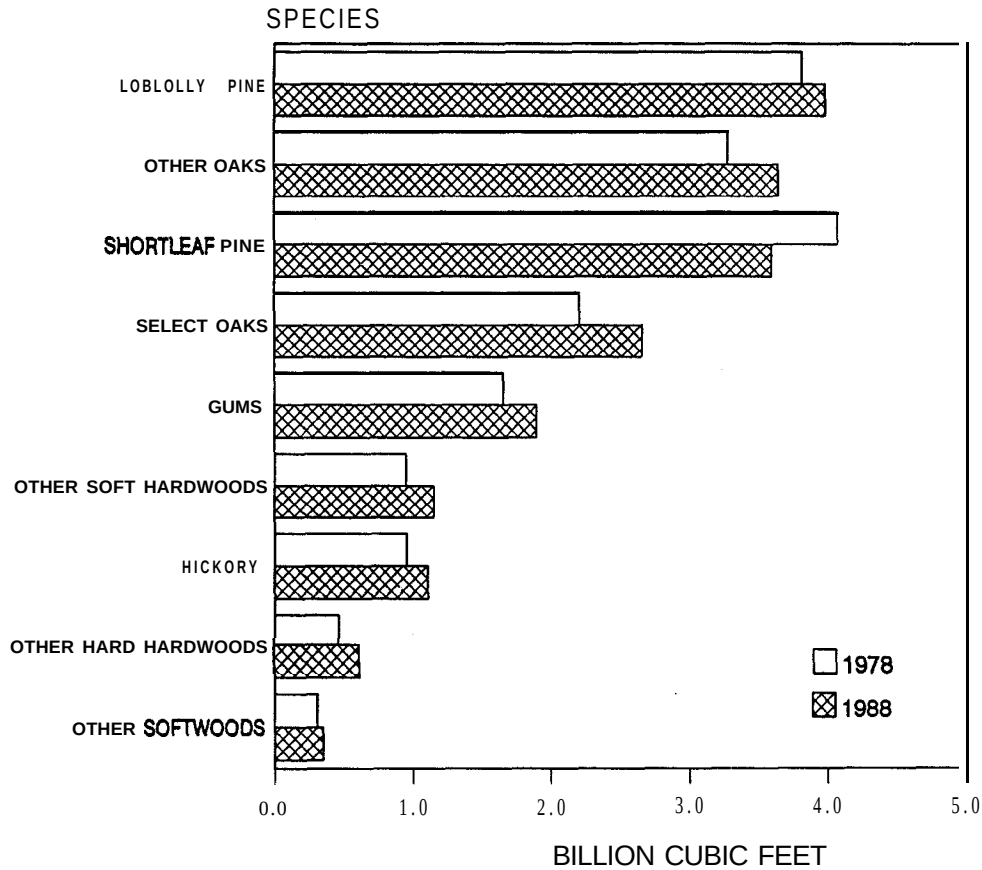

Figure 3.—*Volume of* growing ***stock in 1988, and change between 1978 and 1988, by species.***

GROWTH, REMOVALS, AND MORTALITY

Timber Growth Drops Off

Between 1950 and 1978, average net annual growth of growing stock in Arkansas gradually increased from about 615 million to 840 million cubic feet, or by more than 35 percent. Between 1978 and 1988, annual growth averaged 785 million cubic feet-a decrease of about 7 percent.

Between 1950 and 1978, yellow pines accounted for most of the increase in growth, hardwood growth remained relatively flat over the period. Between 1978 and 1988, pine growth was down 16 percent. Most of this reduction occurred on NIPF land, where pine growth was down 22 percent. An even sharper drop in pine growth occurred on public timberland, where the decrease was 32 percent. Even on forest industry land, pine growth was down 5 percent.

A large increase in timber mortality seemingly contributed to the overall decrease in pine growth. Between 1978 and 1988, annual pine mortality averaged 41 million cubic feet, up more than 45 percent from the 1978 estimate. Survey field crews attributed most of the increase in pine mortality to disease.

A more significant factor affecting pine growth statistics is fewer young pine stands on NIPF and public land. Between the early 1960's and early 1980's, there was a low rate of pine establishment on these lands.

A small increase in hardwood growth compensated for part of the reduction in pine growth. Over the period this survey addresses, annual hardwood growth averaged 398 million cubic feet-up 5 percent from the 1978 estimate. Except for a 50-percent increase in mortality, the increase in hardwood growth would have been much greater. All together, mortality reduced the gross growth of hardwood by 20 percent (table IX). Again, survey field crews attributed most of the increase in hardwood mortality to disease. Most of the increase in hardwood growth occurred on NIPF land.

Net annual growth of other softwoods was up about 15 percent.

Across the State's 17.2 million acres of timberland, net annual growth averaged 45 cubic feet per acre between 1978 and 1988, when all species were combined. In 1978, annual growth was averaging 50 cubic feet per acre. Although pines make up less than

Table *M.-Average annual components of change in volume ofgrowing stock, by survey region and species group, Arkansas, 197848*

Survey region	Species group	Gross growth	Mortality	Net growth	Removals	Net change
		Million cubic feet				
Delta	Pine	11.4	1.3	10.1	7.3	2.8
	Other softwood	1.8	0.3	1.5	0.9	0.6
	Hardwood	97.0	29.9	67.1	37.9	29.2
	Total	110.2	31.5	78.7	46.1	32.6
Ouachita	Pine	71.3	9.4	61.9	95.4	-33.5
	Other softwood	1.7	0.2	1.5	0.6	0.9
	Hardwood	55.1	12.5	42.6	27.4	15.2
	Total	128.1	22.1	106.0	123.4	-17.4
Ozark	Pine	33.0	2.4	30.6	18.3	12.3
	Other softwood	5.6	0.4	5.2	0.9	4.3
	Hardwood	175.5	29.6	145.9	47.5	98.4
	Total	214.1	32.4	181.7	66.7	115.0
Southwest	Pine	303.0	28.1	274.9	302.9	-28.0
	Other softwood	1.8	0.6	1.2	0.8	0.4
	Hardwood	169.5	27.4	142.1	145.8	-3.7
	Total	474.3	56.1	418.2	449.5	-31.3
State	Pine	418.7	41.2	377.5	423.9	-46.4
	Other softwood	10.9	1.5	9.4	3.2	6.2
	Hardwood	497.1	99.4	397.7	258.6	139.1
	Total	926.7	142.1	784.6	685.7	98.9

40 percent of the inventory, they accounted for almost one-half of the growth over this most recent remeasurement period.

Timber Removals Continue to Rise

Although the rate of timber growth in Arkansas has dropped in recent years, timber removals continue to rise. Between 1950 and 1970, annual removals increased by more than 50 percent. Between 1970 and 1978, annual removals leveled off at just over 600 million cubic feet. Between 1978 and 1988, annual removals averaged 686 million cubic feet. Annual removals of softwood were up by one-third, making up most of this recent increase. The average annual rate of removals of hardwood was down 8 percent.

Forest industry land was the site of most of the recent increase in timber removals. There pine removals were up 38 percent and hardwood removals rose 23 percent. Forest industry controls only 25 percent of the timberland in Arkansas; nevertheless, this land provided one-third of the timber growth and supplied almost one-half of the total removals between 1978 and 1988.

On NIPF land, total timber removals remained at about the same level as in the previous survey. A 17-percent decrease in hardwood removals just about offset a 25-percent increase in pine removals. The NIPF owners in Arkansas now control 57 percent of the timberland. These NIPF lands provided about one-half of the timber growth and supplied more than 40 percent of the removals between 1978 and 1988.

On public timberland, total timber removals also remained at about the same level as in the previous survey. A 35-percent decrease in hardwood removals just about offset a 34-percent increase in pine removals. While less than 20 percent of Arkansas timberland is publicly owned, these holdings support almost one-third of the inventory. Between 1978 and 1988, public timberland provided 15 percent of the timber growth, but it supplied less than 10 percent of the harvest.

Pine Removals Exceed Growth

Between 1978 and 1988, pine removals exceeded growth by 12 percent. This overcut reduced the inventory of pine in Arkansas by 5 percent. As mentioned earlier, the most serious overcut occurred in a 16-county area in the west central part of the State in the

Ouachita and Southwest survey regions. There pine removals exceeded growth by 65 percent, an overcut that reduced the inventory of pine 20 percent over a lo-year period. Several factors are influencing the forest growth/cut balance in this area. Four of our sample points were on national forest land that was set aside as wilderness. Although the trees remain, the area is no longer timberland, so the inventory is reduced by several million cubic feet. Since the entire volume is withdrawn (removed) from the inventory, average annual removals were increased by about a million cubic feet during the period. Forest industry lands are being cut heavily and converted to plantations. Certainly there are additional factors at work, but it is also certain that the present level of removals cannot continue without depleting the pine inventory on private timberland in this 16-county area.

For the State as a whole, most of the overcut occurred on forest industry land, where pine removals exceeded growth by about one-third. On NIPF land, pine growth still exceeded removals at the State level, but by only 6 percent. On public holdings, pine growth and removals were just about in balance.

In contrast to the pine overcut, hardwood growth exceeded removals by more than 50 percent. Again, there were significant differences by survey region and ownership class. In the Southwest region, hardwood growth and removals were just about in balance. The largest surplus of hardwood growth was measured in the Ozark region (table IX).

By ownership, all of the hardwood surplus was on NIPF and public holdings. On NIPF land, hardwood growth exceeded removals by more than 70 percent. On public holdings, hardwood growth was 3.5 times the removals. These large surpluses were in sharp contrast to the situation on forest industry lands, where hardwood removals exceeded growth by almost 20 percent. This supports the aforementioned notion of stand conversion on forest industry lands.

Annual Harvest Averages 575,000 Acres

Of the 17.2 million acres classed as timberland in this latest survey, 2 of every 5 acres underwent some kind of harvest or significant treatment between 1978 and 1988 (table X). The most common treatment was partial cutting, which includes all selection cuts, diameter-limit cuts, salvage cuts, and any other sawtimber cutting practices leaving a residual stand of crop trees and cull trees. In table X, seed tree and shelterwood cuts are also included in the partial cut. With this definition, partial cutting occurred on 4.3 million acres over the lo-year period.

Clearcuts occurred on an additional 1.4 million acres over the period. With the partial cuts and clearcuts combined, the average annual harvest of timberland in Arkansas between 1978 and 1988 is estimated at 575,000 acres. More harvesting occurred on an additional 75,000 acres of timberland diverted to other land uses each year.

Over the lo-year remeasurement period, the rate of commercial thinning averaged just under 23,500 acres per year. Other treatments, including precommercial thinnings and stand improvement practices, averaged 96,000 acres annually.

The rates of harvest and related treatments differed significantly by ownership. The highest rates of harvest and treatment occurred on forest industry land. By 1988, two-thirds of the timberland in this ownership class had undergone some kind of treatment over the lo-year remeasurement period. On public land, less than one-fourth of the timberland had been treated. On NIPF land, one-third of the timberland had been treated.

Clearcutting was particularly far more prevalent on industry ownerships than elsewhere. Although forest industry controls only 25 percent of the timberland, it implemented 60 percent of the clearcuts. Forest industry had clearcut one-fifth of its timberland over the lo-year remeasurement period.

TIMBER PRODUCTS OUTPUT

Emerging technology, a changing resource, and new product markets have combined to change considerably Arkansas primary forest products industry. These changes are generally described in the following overview, which derives mainly from a separate and more detailed report (May 1990).

Today Arkansas primary forest products industry is smaller, more efficient, and less diverse than in the past. Larger roundwood harvests supply fewer mills. Three main sectors dominate the industry: (1) lumber, (2) pulp, and (3) veneer. Roundwood harvests for these three products constitute more than 90 percent of the State's timber output. These three sectors developed along with an expanding pine resource. Softwoods (primarily yellow pines) supply about 2 out of every 3 cubic feet of roundwood harvested in Arkansas. The current situation contrasts conditions 40 years ago. In 1948, sawlogs, domestic fuelwood, and pulpwood were the three leading products, and hardwoods supplied almost 45 percent of the annual timber harvest.

The Lumber Industry

Today's forest products industry is described as smaller than in the past because of a large reduction in the number of sawmills (fig. 4). In 1948, small sawmills (annual output of less than 3 million board feet) dominated the State's lumber industry in both number and output. Many of these small sawmills were peckerwood mills that were moved from one tract of

Table ***X.-Area of timberland in 1988 by ownership, forest type, and type of harvest or other treatment, Arkansas, 1978-88***

Ownership	Forest type*	All stands	No treatment	Clearcut	Partial cut	Commercial thinning	Other† treatment
		Thousand acres					
Public	Planted pine	138.0	55.8	34.4	24.2	0.0	23.6
	Natural pine	1,144.8	829.5	22.6	173.0	22.6	97.1
	Upland hardwood	1,344.3	1,054.7	68.6	101.0	0.0	120.0
	Bottomland hardwood	448.4	414.6	0.0	33.8	0.0	0.0
	All types	3,075.5	2,354.6	125.6	322.0	22.6	240.7
Forest industry	Planted pine	1,064.8	286.4	428.4	67.5	22.5	260.0
	Natural pine	1,849.0	568.6	99.1	952.4	59.8	169.1
	Upland hardwood	794.6	266.0	261.8	250.5	5.9	10.4
	Bottomland hardwood	655.8	346.7	59.7	249.4	0.0	0.0
	All types	4,364.2	1,467.7	849.0	1,519.8	88.2	439.5
Other private	Planted pine	348.7	146.7	55.1	66.1	33.3	47.5
	Natural pine	2,695.3	1,452.3	89.4	1,002.4	63.9	87.3
	Upland hardwood	5,125.7	3,682.8	250.3	1,047.7	21.2	123.7
	Bottomland hardwood	1,637.2	1,198.7	39.9	370.8	5.6	22.2
	All types	9,806.9	6,480.5	434.7	2,487.0	124.0	280.7
All owners	Planted pine	1,551.5	488.9	517.9	157.8	55.8	331.1
	Natural pine	5,689.1	2,850.4	211.1	2,127.8	146.3	353.5
	Upland hardwood	7,264.6	5,003.5	580.7	1,399.2	27.1	254.1
	Bottomland hardwood	2,741.4	1,960.0	99.6	654.0	5.6	22.2
	All types	17,246.6	10,302.8	1,409.3	4,338.8	234.8	960.9

*Oak-pine and nontyped stands included with pine types; bottomland hardwoods include elm-ash-cottonwood and oak-gum-cypress types.
†Includes precommercial thinnings and stand improvement practices.

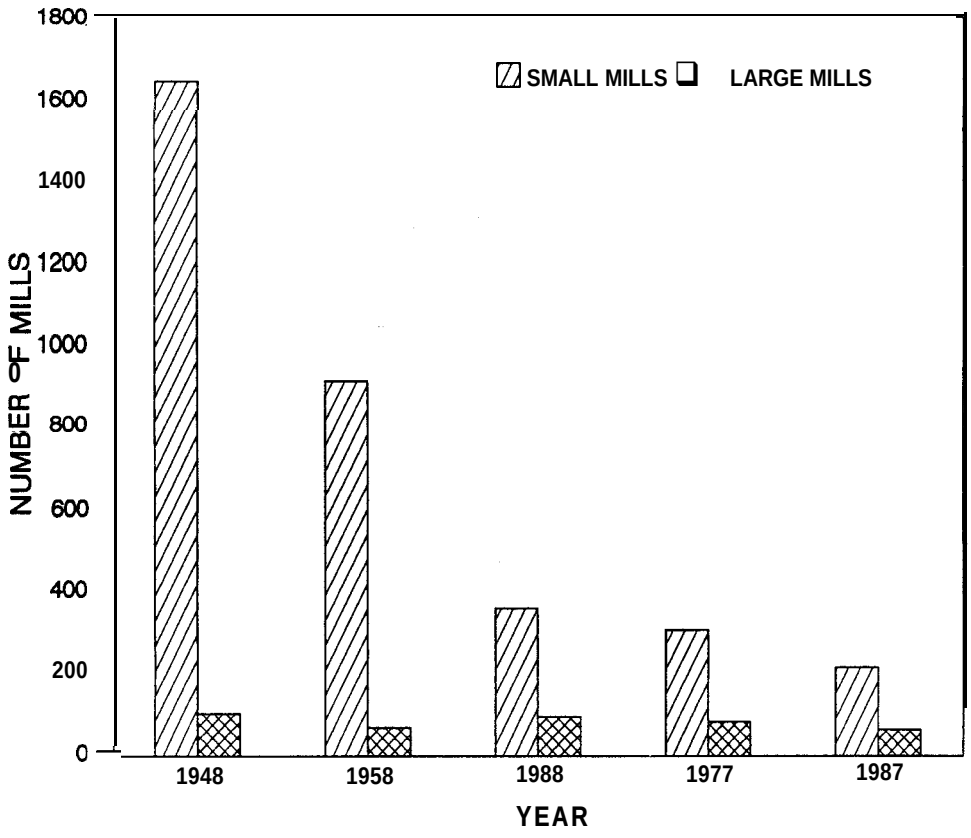

Figure ***4.-Number of sawmills in Arkansas, by size class and survey year.***

timberland to another. At their peak, there were more than 1,600 small sawmills in Arkansas, processing about 60 percent of the State's annual sawlog harvest.

Over time, larger, stationary sawmills improved their efficiency through new technology. The small mills could not compete, and, by 1968, most of them had to close. By 1987, only about 200 small sawmills remained in operation, and they processed less than 5 percent of the sawlog harvest.

Even with the drastic reduction in number of sawmills, lumber production continued to increase through the late 1970's (fig. 5). Between 1952 and 1978, annual lumber production in the State increased from just under 1.0 billion to almost 1.6 billion board feet-or by 65 percent. Since hardwood lumber production decreased over this period, Arkansas softwood resources shouldered all of the increase. In 1952, softwoods made up 55 percent of all lumber produced. By 1978, softwoods accounted for more than 80 percent of total production.

After a sharp decrease in lumber production in the early 1980's, annual production has averaged about 1.4 billion board feet in recent years. Softwoods have supplied 84 percent of recent production.

The Pulp Industry

An increasing supply of pine timber in Arkansas also provided the impetus for expansion of the State's pulp industry. As the State's pulping capacity increased, so did its pulpwood production (fig. 6). Initially, pine roundwood was the source of almost all of the pulpwood; however, advances in pulping technology have steadily increased the use of hardwoods in the manufacture of pulp and paper products.

When debarking and chipping equipment came into use at the State's sawmills in the 1950's, chipped wood residues emerged as a major new source of pulping fiber. The high quality and favorable prices of these chips encouraged their acceptance. Recent surveys of timber product output suggest wood residues are supplying more than half of the State's pulpwood; however, this estimate might be inflated. Since the introduction of merchandising and satellite chipping mills, it is increasingly difficult to distinguish between wood residues and chipped roundwood.

Roundwood and wood residues combined gave Arkansas an eightfold increase in annual pulpwood production between 1952 and 1987. Over this 35-year

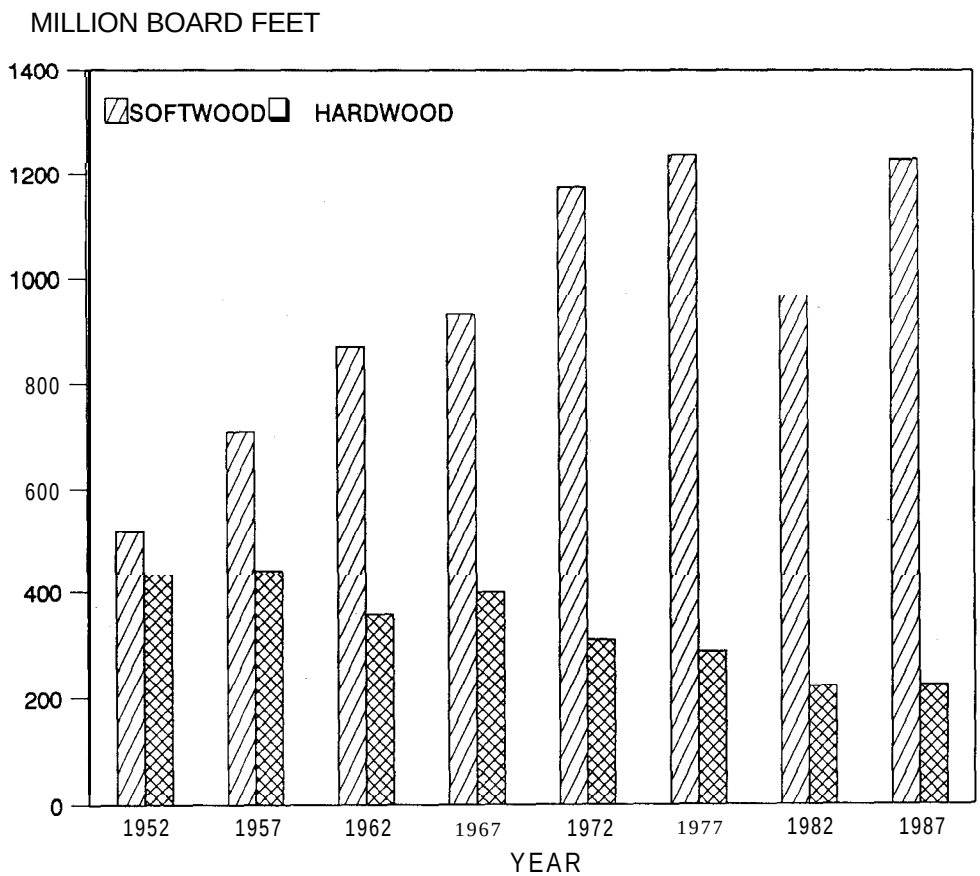

Figure 5.—*Lumber production in Arkansas for selected years, 1952 to 1987.*

period, annual production increased from 620,000 to 5.0 million cords. These pulpwood production statistics also reflect the increased use of hardwood. In 1952, hardwood accounted for only 15 percent of total production. In 1987, hardwood supplied 35 percent of the total, and this share continues to rise.

The Veneer Industry

Arkansas veneer industry has also undergone substantial change over the past 40 years. In 1948, this sector of timber products centered around the production of container veneers used in the shipping and packing industries. The container-veneer industry depended primarily on the State's hardwood timber resource, with a strong preference for large trees of soft-textured species, especially gums. Competition from plastics and paperboard used in the shipping and packing industries, combined with scarcities in preferred hardwood raw materials, led to a continued decline in the container-veneer industry; only two container mills were operating in 1987.

In the early 1960's, new technology revitalized the State's declining veneer industry. The timber products industry began to manufacture plywood from southern yellow pines. Blessed with a relatively abundant supply of large pine sawtimber, Arkansas actually pioneered the southern pine plywood industry in 1963. Over a 20-year period from 1964 to 1984, annual production of softwood plywood in Arkansas rose from 65 million square feet to 1.3 billion square feet (%-inch basis). The veneer industry, almost exclusively centered on hardwood in 1948, has shifted to a predominantly pine industry.

Miscellaneous Products

Relative to the top three product sectors, the remaining forest industries in Arkansas account for a rather small share of timber products output. The cooperage industry, down to one mill and negligible timber product output in 1987, has become virtually nonexistent. In contrast, the post, pole, and piling industries have remained fairly strong and have taken advantage of the expanding pine resource and its ability to take wood-preserving treatments. Timber production to meet the demands of these industries has shifted to softwoods as markets accepted preservative-treated pines and local use of hardwood declined.

Because of competition from substitute products, miscellaneous specialty mills have been on a downward trend in both number and production volume. With only half as many mills operating today as in

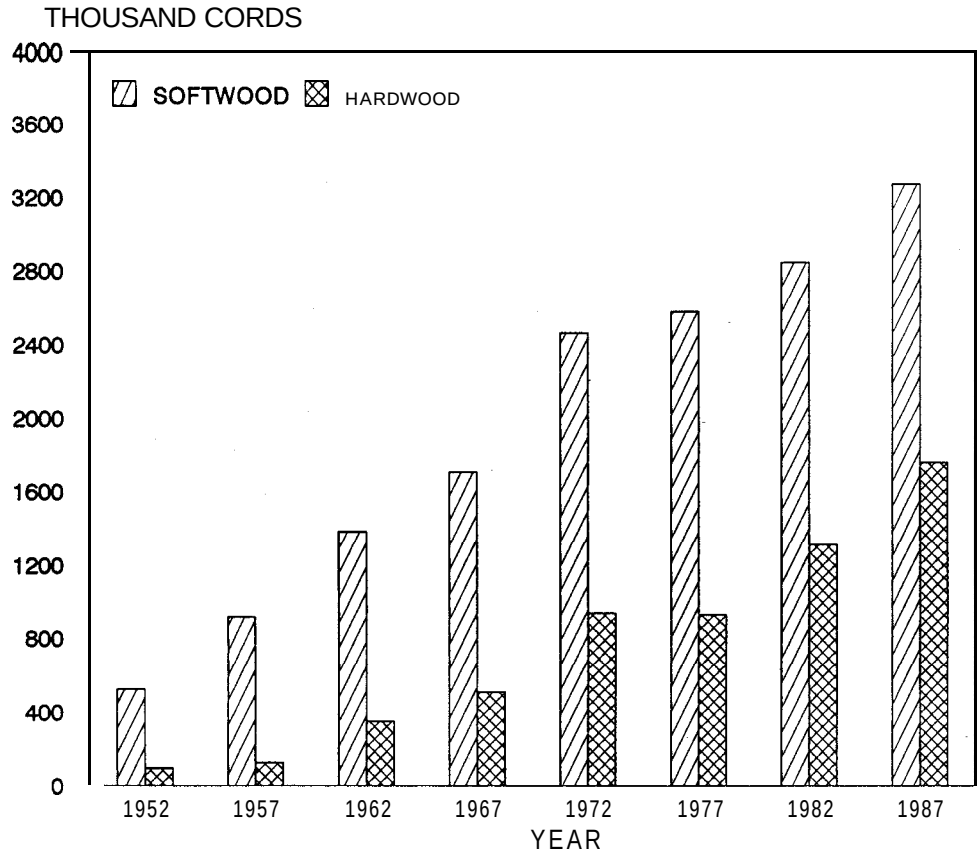

Figure *6.-Pulpwood production, roundwood, and residues in Arkansas for selected years, 1952 to 1987.*

1977, the remaining sector of this industry comprises mostly handle and charcoal mills. Both of these continue to face stiff competition: plastics are replacing wood handles and mesquite charcoal is gaining popularity.

Fuelwood use in Arkansas declined until the onset of the oil crisis in the 1970's. In response to escalating energy costs, use of fuelwood made a resurgence during the 1970's and early 1980's. There is some evidence that fuelwood consumption has been declining again since the mid-1980's, when glutted oil markets reduced prices of conventional heating fuels.

1989 Timber Production

Table XI shows the county distribution of Arkansas 1989 timber production based on severance tax information compiled by the Arkansas Forestry Commission. The county production estimates are divided into pine and other. The initial compilations were expressed in tons and were converted to thousands of cubic feet using two average conversion factors: (1) pine, 61.1 pounds per cubic foot, and (2) other, 71.9 pounds per cubic foot.

As converted, these severance tax statistics suggest that pine production totaled about 472 million cubic feet in 1989. Based on the forest survey measurement, annual removals of pine growing stock between 1978 and 1988 averaged 424 million cubic feet.

The severance tax statistics suggest that the production of other species in 1989 totaled 200 million cubic feet. Based on the forest survey, annual removals of growing stock, excluding pine, averaged 262 million cubic feet between 1978 and 1988.

In 1989, Union, Drew, and Ashley were the three leading counties in timber production.

TIMBER OUTLOOK

After examining recent trends in Arkansas timber resources, this analysis briefly assesses the prospective outlook for timber supplies in the State. Actions taken or forgone have already established the amount of merchantable timber that will likely be in the inventory over the next decade.

Beyond the next decade, estimates of prospective supplies are subjective because people still have time to significantly alter future inventories through forest management practices. Estimates of the long-term outlook are always contingent on assumptions about future conditions and events. Predictions and perceptions of future supplies may trigger actions that alter the outcome. Perhaps this very fact helps to explain why resource analysts do not have an outstanding record in projecting future timber supplies, particularly in a region as dynamic as the Southern United States.

Table XI.—*Timber production by* county and *by pine and other species, Arkansas, 1989**

County	Pine	Other	Total
	Thousand cubic feet†		
Arkansas	7,780	2,751	10,531
Ashley	28,357	8,618	36,975
Baxter	101	142	243
Benton	1	799	800
Boone	2	273	275
Bradley	17,888	6,798	24,686
Calhoun	17,763	6,450	24,213
Carroll	192	342	534
Chicot	7	873	880
Clark	18,579	10,140	28,719
Clay	122	619	741
Cleburne	2,840	1,501	4,341
Cleveland	13,492	9,022	22,514
Columbia	25,383	4,783	30,166
Conway	3,023	352	3,375
Craighead	. .	81	81
Crawford	64	311	375
Crittenden	. . .	1	1
Cross	12	489	501
Dallas	26,796	8,159	34,955
Desha	11	2,408	2,419
Drew	20,809	17,605	38,414
Faulkner	186	145	331
Franklin	942	14	956
Fulton	659	739	1,398
Garland	8,521	1,164	9,685
Grant	13,238	11,270	24,508
Greene	157	1,697	1,854
Hempstead	18,082	3,785	21,867
Hot Spring	11,642	3,084	14,726
Howard	19,613	3,250	22,863
Independence	91	603	694
Izard	858	709	1,567
Jackson	. .	443	443
Jefferson	3,325	3,164	6,489
Johnson	4,125	684	4,809
Lafayette	9,184	2,341	11,525
Lawrence	. .	718	718
Lee	. . .	1,631	1,631
Lincoln	3,077	2,059	5,136
Little River	9,910	2,567	12,477
Logan	5,590	54	5,644
Lonoke	36	503	539
Madison	54	2,525	2,579
Marion	145	433	578
Miller	8,639	3,509	12,148
Mississippi	. . .	65	65
Monroe	180	2,492	2,672
Montgomery	11,196	1,932	13,128
Nevada	16,709	9,577	26,286
Newton	633	3,289	3,922
Ouachita	17,218	8,104	25,322
Perry	5,893	697	6,590
Phillips		1,889	1,889
Pike	15,413	2,954	18,367
Poinsett	40	168	208
Polk	10,745	1,658	12,403
Pope	2,611	449	3,060
Prairie	105	1,055	1,160
Pulaski	3,543	1,634	5,177
Randolph	. . .	569	569

Table XI.—*Timber production by county and by pine and other species, Arkansas, 1989*—Continued*

County	Pine	Other	Total
	Thousancubfeet†		
Saline	8,386	2,421	10,807
Scott	11,797	442	12,239
Searcy	672	1,750	2,422
Sebastian	430	6	436
Sevier	11,403	4,607	16,010
Sharp	1	762	763
St. Francis	. . .	918	918
Stone	1,304	2,045	3,349
Union	37,420	11,469	48,889
Van Buren	3,270	742	4,012
Washington	. . .	719	719
White	518	2,260	2,778
Woodruff		993	993
Yell	9,935	931	10,866
Non-89-timber	1,535	4,015	5,550
Total	472,252	200,219	672,471

*Source: Arkansas Forestry Commission, Severance Tax.

†Converted from tons using the following factors: pine, 61.1 pounds per cubic foot; other, 71.9 pounds per cubic foot.

A few statements of fact preface this brief assessment of prospective timber supplies:

1. Between 1950 and 1988, Arkansas timber resources accommodated a 75-percent increase in the average harvest of timber, and a 3-million-acre loss in timberland, without any major decline in the overall timber inventory. In 1988, inventory of growing stock was about one-third greater than in 1950.
2. When all ownerships are grouped, the 1988 inventory of growing stock includes an 18-year supply of pine at recent levels of harvest, without any additional net growth.
3. The 1988 inventory of growing stock includes a 43-year supply of hardwood at recent levels of harvest, again without any additional net growth.
4. Average annual removals of Arkansas pine exceeded growth by 12 percent between 1978 and 1988, the first serious overcut of pine since 1950.
5. In contrast to pine statistics, average annual growth of hardwoods exceeded removals by more than 50 percent over this same period.

The new overall survey statistics suggest that during the 1990's Arkansas will experience a major decline in pine inventory on private timberland in the west central part of the State, unless the recent rate of harvest is reduced or there is a flush of ingrowth from plantations. The new statistics suggest there should be relatively abundant supplies of hardwood in Arkansas for another decade, except in the Southwest survey region. In that region, forest industry has been harvesting hardwood from its own timberland at a very rapid rate.

Projections

Rather than develop new projections of prospective timber supplies for Arkansas, attention is called to the projections developed in a major study titled "The South's Fourth Forest" (SFF) (USDA FS 1988). In general, the new survey statistics for Arkansas depict trends that are fairly consistent with those projected in the SFF study. For example, the SFF study projected declines in softwood growth and inventory in Arkansas in the 1990's; the decline in softwood inventory first appears on forest industry land. Beyond the year 2000, softwood inventory is projected to increase on industry land. The SFF study projects an almost 30-percent decline in softwood inventory on NIPF land between 1990 and 2010.

As the projected decline in softwood inventory in Arkansas bottoms out and the inventory starts to recover, in about 2010, annual softwood supplies are projected to range from 415 million to 465 million cubic feet. Bear in mind that softwood removals have annually averaged 427 million cubic feet in recent years. When all ownerships are combined, the projected decline in softwood inventory in Arkansas between 1990 and 2010 is about 15 percent (fig. 7).

The recent buildup in hardwood inventory measured in the new survey is also consistent with the SFF projections. The SFF study projects hardwood inventory in Arkansas will continue to increase until around 2000 and then decrease by more than 20 percent by 2030. Hardwood growth is projected to drop by more than 20 percent in the 1990's. Beyond 2000, annual hardwood supplies are projected to range from 340 million to 365 million cubic feet. These statistics point to a major increase in the use of hardwood in Arkansas. In recent years, hardwood removals have averaged just under 260 million cubic feet per year.

The SFF study did not project the recent increase in timberland in Arkansas. Instead, it projected a continued decline in timberland down to about 14.5 million acres, with all the loss in the NIPF ownerships. Again, the recent increase measured includes the reclassification of some 300,000 acres from woodland to timberland in the Ozark region. The recent real increase in Arkansas timberland may be a temporary departure-boosted by the CRP-from a long downward trend.

The SFF projections of prospective timber supplies in Arkansas reflect State allocations of regional projections made using the Timber Resource Inventory Model (TRIM) (Tedder and others 1987). In the regional projections, a somewhat more intensive level

of timber management was assumed than has been practiced in the past. The results reflect what will likely happen if there continues to be major progress in forestry in the South. Still, the projections do not reflect the full potential for timber production in the region. Even with a continuation of past progress, Arkansas can increase prospective timber supplies through more intensive forest management.

Management Opportunities

The latest survey indicated that some 8.0 million acres-less than half the State's timberland-supported young, well-stocked stands where no obvious treatment was needed to enhance prospective growth (table XII). On the other end of the spectrum, some 2.9 million acres were so poorly stocked that establishment of new stands was needed. Since the State's annual rate of harvest averaged 575,000 acres between 1978 and 1988, there seems to be a considerable need for regeneration.

Mature and over-mature stands occupied another 4.1 million acres and were assigned a treatment opportunity of final harvest. Hardwoods accounted for almost 80 percent of these mature stands. Many of these mature hardwood stands may grow on adverse sites or on public timberland.

Almost 600,000 acres were assigned a treatment opportunity of commercial thinning. Pines accounted for almost 80 percent of these stands. Between 1978 and 1988, commercial thinning averaged 23,500 acres annually. Commercial thinning is expected to increase, especially on forest industry holdings, as more pine plantations reach merchantable size.

On an additional 1.8 million acres, the treatment opportunity assigned called for some other kind of stocking control, such as cleaning and release.

Arkansas forest resources have been dynamic and were apparently undergoing restructure at the occasion of the sixth survey. Forests were maturing, being harvested, and regenerating naturally or by planting. Imbalances due to stand conversions—reduced growth in maturing forests and set-aside for forest and wildland reserves-are major determinants of Arkansas future forests. A solid base of state-of-the-art forestry already in place in Arkansas and the cooperative efforts of forest owners, managers, and users will ensure that Arkansas forests will continue to thrive.

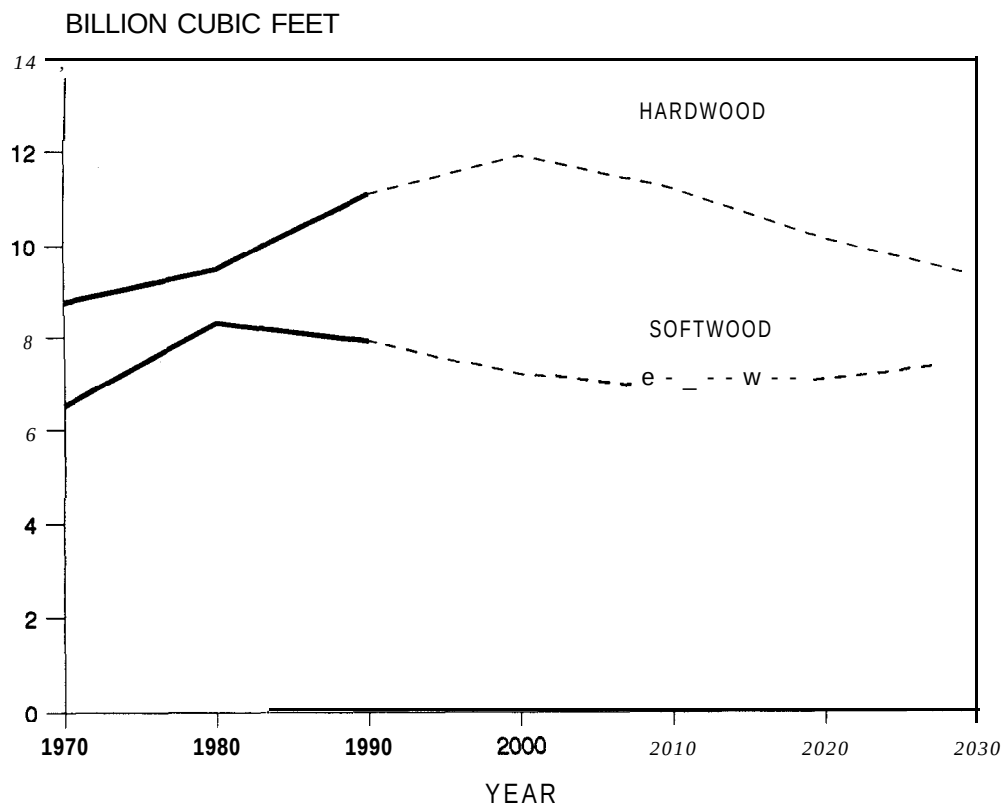

Figure *T.-Recent trends-in Arkansas growing stock inventory, with projections to 2030.*

Table XII.—*Area of timberland, by ownership, forest type, and treatment opportunity class, Arkansas, 1988*

Ownership	Forest type*	All stands	No treatment	Stand establishment	Commercial thinning	Other stocking control	Final harvest
		Thousand acres					
Public	Planted pine	138.0	75.7	22.6	5.9	11.3	22.5
	Natural pine	1,144.8	735.4	59.1	60.8	78.8	210.7
	Upland hardwood	1,344.3	570.0	230.4	16.6	132.4	394.9
	Bottomland hardwood	448.4	142.8	45.7	10.1	11.0	238.8
	All types	3,075.5	1523.9	357.8	93.4	233.5	866.9
Forest industry	Planted pine	1,064.8	616.4	105.5	114.4	189.9	38.6
	Natural pine	1,849.0	1,239.2	162.6	119.7	149.0	178.5
	Upland hardwood	794.6	330.1	220.0	10.8	118.9	114.8
	Bottomland hardwood	655.8	195.1	108.5	7.1	16.0	329.1
	All types	4,364.2	2,380.8	596.6	252.0	473.8	661.0
Other private	Planted pine	348.7	163.9	48.3	33.0	53.7	49.8
	Natural pine	2,695.3	1,734.1	262.5	112.4	248.3	338.0
	Upland hardwood	5,125.7	1,667.1	1,343.4	67.5	683.7	1,364.0
	Bottomland hardwood	1,637.2	498.8	275.0	12.8	74.3	776.3
	All types	9,806.9	4,063.9	1,929.2	225.7	1,060.0	2,528.1
All owners	Planted pine	1,551.5	856.0	176.4	153.3	254.9	110.9
	Natural pine	5,689.1	3,708.7	484.2	292.9	476.1	727.2
	Upland hardwood	7,264.6	2,567.2	1,793.8	94.9	935.0	1,873.7
	Bottomland hardwood	2,741.4	836.7	429.2	30.0	101.3	1,344.2
	All types	17,246.6	7,968.6	2,883.6	571.1	1,767.3	4,056.0

*Oak-pine and nontyped stands included with pine types; bottomland hardwoods include elm-ash-cottonwood and oak-gum-cypress types.

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APPENDIX

Survey Methods

Forest resource statistics were obtained by a systematic sampling method involving forest-nonforest classification on aerial photographs, ground checks of land use, and on-the-ground measurements of trees at selected locations. Inventory volume and area statistics are required to give precise answers at the State level to one standard deviation of the total, equal to 1 percent per million acres of forest land and to 5 percent per billion cubic feet.

The estimate of timberland area is based on the forest-nonforest interpretation of recent aerial photography for points representing approximately 230 acres. The photo interpretation of these points was checked in the field at sample locations representing approximately 3,840 acres. These field checks are used to correct photo interpretation errors and adjust the proportion of forest-to-nonforest area for each county. The proportion of forest area is combined with United States census land area data to develop forest area statistics at county levels.

Descriptive forest resource statistics come from permanent sample plots located at the intersection of a 3-by 3-mile grid representing, on the average, 5,760 acres. The sample plots are remeasured each survey to allow assessments of changes and trends as well as current status of the forest resources. In Arkansas, 5,939 sample plots were visited, of which 3,033 are currently forested. Each sample plot consists of a cluster of 10 sample points. This satellite point system is combined with a large-factor prism to get a representative sample of stand conditions at each sample- plot location. This method eliminates the effect that vegetation clumping and open gaps would induce if only one point or fixed plot were used at each location.

At each forested sample plot, trees 5.0 inches in d.b.h. and larger were selected with a 37.5-factor prism from each of the 10 sample points; thus each tree selected with the prism represented 3.75 square feet of basal area per acre. Trees smaller than 5.0 inches in d.b.h. were tallied on a 1/275-acre circular plot fixed around the first 3 points of the lo-point cluster. Pine seedlings were tallied on a l/1000-acre circular plot established at each of the 10 points.

Volumes in Arkansas were derived from deterministic measurements of trees on all sample locations. These deterministic measurements included d.b.h., bark thickness, total height, bole length, log length, and four upper stem diameters. Volumes for these trees were computed by means of Smalian's formula. Volume equations were developed for seven species groups. These equations were used to estimate volumes of trees (at time of removal or death) that did not survive the remeasurement period and to estimate the past volume for new sample trees.

Each tally tree is assigned a classification of growing stock or cull based on its ability to produce sawlogs. Since the 1978 survey, a new tree-classification and tree-grading system has been initiated. The result is greater compatibility in the definition of growing stock among Forest Inventory and Analysis projects (May 1990). Under this new system, tree grade 5 is used to designate trees currently or prospectively capable of producing at least one 12-foot log or two 8-foot logs in the sawlog portion, but not able to produce a 12-foot log in the butt 16 feet. These trees, formerly classified as rough or rotten culls, are now included in growing stock. For comparison, the 1978 survey data were reprocessed to agree with current definitions and procedures.

Components of inventory volume change (growth, removals, and mortality) are estimated from tally tree data on remeasured sample plots. The remeasurement of sample plots allows the history and volume change of each tally tree to be tracked. This information can then be used to assign tally trees into one of eight components of growth (survivor growth, ingrowth, mortality growth, cut growth, cull increment, mortality, cut, and landclearings), and, in turn, these components can be combined to estimate gross growth, net growth, and net change using a Beers and Miller (1964) approach, as modified by Van Deusen and others (1986) and demonstrated by May (1988).

Measurements at each forested location also included collection of data on site productivity, stand origin, stand age, size of forest tract, distance from road, slope, aspect, disturbance, management, evidence of use, and nontimber resources. Ownership information was obtained for each plot from county tax assessors' records and contact with owners in the field. Personnel from public agencies and other contacts were consulted when classifying absentee owners as farmers, individuals, corporations, or lessors.

Field work was started in April 1987 and completed in June 1988.

Reliability of the Data

Reliability of the Forest Inventory and Analysis (FIA) estimates may be affected by two sources of error. The first source, "estimating error," arises from mistakes in measurement, judgment, recording, or compiling and from limitations of the equipment used. Estimating error is minimized by FIA through comprehensive training, supervision, quality-control programs, and emphasis on careful work.

The second type of error, "sampling error," is the error associated with natural and expected deviation of the sample mean from the true population mean. Thus, the deviation is susceptible to a mathematical evaluation of the probability of error. Sampling errors

for State totals are based on one standard deviation (table XIII). That is, the chances are two out of three that if the results of a loo-percent census were known, the sample results would be within the limits indicated.

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

Definition of Terms

Land Classes

Deferred timberland-National forest land that meets productivity standards for timberland but is under study for possible inclusion in the wilderness system.

Forest land-Land at least 16.7 percent stocked by forest, trees of any size, or formerly having such tree cover, and not, currently developed for nonforest uses. Minimum area considered for classification is 1 acre. Forest land is divided into commercial categories (timberland and deferred timberland) and noncom-

Table *XIII.Sampling errors for estimates of total timberland area, volume, net annual growth (1978–88), and annual removals (1978–88), Arkansas, 1988*

Item	Total	Units	Sampling error
			Percent
Timberland	17,246.6	Thousand acres	0.2
Growing stock			
Volume	18,989.7	Million cubic feet	1.4
Periodic net annual growth	784.6	Million cubic feet	1.7
Periodic annual removals	685.7	Million cubic feet	3.4
Sawtimber			
Volume	66,776.3	Million board feet*	2.0
Periodic net annual growth	3,313.0	Million board feet*	2.0
Periodic annual removals	2,688.1	Million board feet*	3.8

*International ¼-inch Rule.

Table XIV.—*Sampling error to which estimates are liable, two chances out of three, Arkansas, 1988**

Sampling error	Timberland area	Volume	Periodic net annual growth	Periodic annual removals	Volume	Periodic net annual growth	Periodic annual removals
Percent	*Thousand acres*	*Million cubic feet*			*Million board feet†*		
1.0	689.9	...	...	...	...		.
2.0	172.5	9,305.8	566.9	...	66,776.3	3,313:;	.
3.0	76.7	4,135.5	251.9	.	29,678.4	1,472.4	...
4.0	43.1	2,326.2	141.7	495.4	16,694.1	828.3	2,426.0
5.0	27.6	1,488.8	90.7	317.1	10,684.2	530.1	1,552.6
10.0	6.9	372.2	22.7	79.3	2,671.1	132.5	388.2
15.0	3.1	165.4	10.1	35.2	1,187.1	58.9	172.5
20.0	1.7	93.0	5.7	19.8	667.8	33.1	97.0
25.0	1.1	59.6	3.6	12.7	427.4	21.2	62.1

*By random sampling formula.
†International ¼-inch Rule.

mercial categories (productive-reserved forest land and unproductive forest land).

Lund area-The area of dry land and land temporarily or partly covered by water such as marshes, swamps, and river floodplains (omitting tidal plots below mean high tide), streams, sloughs, estuaries, and canals less than one-eighth of a statute mile in width, and lakes, reservoirs, and ponds less than 40 acres in area.

Nonforest land-Land that has never supported forests and land formerly forested where timber production is precluded by development for other uses.

Productive-reserved forest land-Productive public forest land withdrawn from timber utilization through statute or administrative regulations.

Reserved timberland-Forest land sufficiently productive to qualify as timberland, but withdrawn from timber use through statute or administrative regulation.

Timberland-Forest land that is producing, or is capable of producing, crops of industrial wood and that is not withdrawn from timber utilization. Timberland is synonymous with "commercial forest land" in prior reports.

Unproductive forest land-Forest land incapable of yielding crops of industrial wood because of adverse site conditions and that produces less than 20 cubic feet per acre per year.

Tree Classes

Commercial species-Tree species currently or prospectively suitable for industrial wood products. Excluded are noncommercial species. See Species List.

Cull trees-Rough or rotten trees.

Growing-stock trees-Live trees of commercial species classified as sawtimber, poletimber, saplings, and seedlings. Trees must contain at least one 12-foot log or two 8-foot logs in the sawlog portion now or prospectively to be classed as growing stock.

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

Live trees-All trees that are alive. Included are all size classes and all tree classes.

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

Rotten trees-Live trees of commercial species that are unmerchantable for sawlogs currently or potentially because of rot deduction in the sawlog portion.

Rough trees-Live trees of commercial species that are unmerchantable for sawlogs currently or potentially because of roughness or poor form in the sawlog portion. Also included are all live trees of noncommercial species.

Salvable dead trees-Standing or down dead trees that were formerly growing stock and are considered merchantable.

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

Forest Types

Elm-ash-cottonwood-Forests in which elm, ash, or cottonwood, singly or in combination, make up a plurality of the stocking. Common associates include willow, sycamore, beech, and maple.

Loblolly–shortleaf pine-Forests in which yellow pines (except longleaf or slash pine), singly or in combination, make up a plurality of the stocking. Common associates include oak, hickory, and gum.

Nontyped-Timberland currently unoccupied with any live trees; for example, very recent clearcut areas.

Oak--gum-cypress-Bottomland forests in which tupelo, blackgum, sweetgum, oaks, or cypress, singly or in combination, make up a plurality of the stocking, except where pines number 25 to 49 percent, in which case the stand would be classified 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, make up a plurality of the stocking, except where pines comprise 25 to 49 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) are a plurality of the stocking but in which pines comprise 25 to 49 percent of the stocking. Common associates include gum, hickory, and yellow-poplar.

Dimension Classes of Trees

Poletimber trees-Trees 5.0 to 8.9 inches in d.b.h. for softwoods and 5.0 to 10.9 inches for hardwoods.

Rough, rotten, and salvable dead trees-See Tree Classes.

Saplings-Trees 1.0 inch to 4.9 inches in d.b.h.

Sawtimber trees-Trees 9.0 inches and larger in d.b.h. for softwoods and 11.0 inches and larger for hardwoods.

Seedlings-Trees less than 1.0 inch in d.b.h.

Stand Size Classes

Nonstocked stands-stands less than 16.7 percent stocked with live trees.

Poletimber stands-Stands at least 16.7 percent stocked with live trees, half or more of this stocking in

sawtimber or poletimber trees, and with poletimber stocking exceeding that of sawtimber stocking.

Sapling-seedling stands-Stands at least 16.7 percent stocked with live trees, more than half of this stocking in saplings or seedlings.

Sawtimber stands-Stands at least 16.7 percent stocked with live trees, half or more of this stocking in sawtimber or poletimber trees, and with sawtimber stocking at least equal to poletimber stocking.

Stocking

Stocking is a measure of the extent to which the growth potential of the site is used by live trees or preempted by vegetative cover. Stocking is determined by comparing the stand density in terms of number of trees or basal area with a specified standard (May 1990); therefore, full stocking is 100 percent of the stocking standard.

Arbitrarily defined stocking categories are defined as follows:

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

Overstocked-Stands greater than 100 percent stocked with growing-stock trees. These stands will become stagnant, with mortality of individual trees increasing as stocking increases over 100 percent.

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

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

D.b.h. (inches)	Number of trees	D.b.h. (inches)	Number of trees
Seedlings	600	16	72
2	560	18	60
4	460	20	51
6	340	22	42
8	240	24	36
10	155	26	31
12	115	28	27
14	90	30	24

Volume

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

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

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

Volume of sawtimber-The board-foot volume (International ¼-inch Rule) of sound wood in the sawlog portion of growing-stock sawtimber trees.

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

Biomass

Merchantable dry weight-Dry weight of woody biomass of all growing-stock trees greater than 5.0 inches in d.b.h. from a l-foot stump to a 4.0-inch top d.o.b. or to a point prior to 4.0-inch d.o.b. because of branching, forking, or other factors.

Residual dry weight-Dry weight of woody biomass of the nonmerchantable portion of all growing-stock trees greater than or equal to 5.0 inches in d.b.h.; included are all saplings, all noncommercial trees, all rough trees, and all rotten trees.

Total dry weight-Dry weight of woody biomass for all live woody vegetation greater than 1.0 inch in d.b.h.; included are growing-stock, commercial, noncommercial, rough, and rotten (sound portion) trees.

Woody biomass-The amount of live organic material in woody vegetation; included are bark and wood; excluded are fruits, leaves, stump, and roots.

Growth Classes

Gross growth-Total increase in stand volume computed on growing-stock trees. Gross growth equals survivor growth, plus ingrowth, plus growth on removals, plus growth on mortality, plus cull increment.

Net growth-Increase in stand volume, computed on growing-stock trees. Net growth is equal to gross growth minus mortality.

Net change-Increase or decrease in stand volume, computed on growing-stock trees. Net change is equal to net growth minus removals.

Classes of Trees Used in Growth Computations

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

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

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

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

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

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

Ownership Classes

Farmer-owned land-Lands operated as a unit of 10 acres or more from which the sale of agricultural products totals $1,000 or more annually.

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

National forest land-Federal lands that have been legally designated as national forests or purchase units and other lands under the administration of the USDA Forest Service, including experimental areas.

Nonindustrial private land (individual)—Lands privately owned by individuals other than forest industry, farmers, or miscellaneous private corporations.

Nonindustrial private land (corporate&Lands privately owned by private corporations other than forest industry and incorporated farms.

Other federal land-Federal lands other than national forests; lands administered by the Bureau of Land Management and Indian Lands.

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

Miscellaneous Definitions

Average annual mortality-Average annual soundwood volume of growing-stock trees dying from natural causes.

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

Average net annual growth-Average net annual volume increase of growing-stock trees for 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.

Cull increment-The change in growing-stock volume due to growing-stock, rough, or rotten trees changing tree class between time 1 and time 2.

D. b.h. (diameter at breast height&Tree diameter in inches, outside bark, 'usually measured at 4.5 feet above ground.

Diameter classes—The 2-inch diameter classes extend from 1.0 inch below to 0.9 inch above the stated midpoint. Thus, the 12-inch class includes trees 11.0 inches through 12.9 inches in d.b.h.

D.o.b.-Diameter outside bark.

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

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

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

Plantations—Stands evidenced by regeneration from planting or seeding. The FIA categorizes plantations by forest type based on plot tally.

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

Sawlog portion—The point on the bole of a sawtimber tree between a l-foot stump and the sawlog top.

Sawlog top-The portion of the bole of a sawtimber tree above which a sawlog cannot be produced. The minimum sawlog top is 7.0 inches in diameter outside bark (d.o.b.) for softwoods and 9.0 inches in d.o.b. for hardwoods.

Select red oaks-A group of select species in the red oak *(Erythrobalanus)* subgenus; may include one or more of the following species: cherrybark oak *(Quercus falcata* var. *pagodifolia),* northern red oak *(Q. rubra),* or Shumard oak *(Q. shumardii).* Other red oak species are included in the "other red oaks" group.

Select white oaks-A group of select species in the white oak *(Leucobalanus)* subgenus; may include one or more of the following species: white oak *(Quercus alba),* swamp white oak *(Q. bicolor),* Durand oak *(Q. durandii),* bur oak *(Q. macrocarpa),* swamp chestnut oak *(Q. michauxii),* or chinkapin oak *(Q. muehlenbergii).* 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.

Tree grade-A classification of the volume of the sawlog portion of sawtimber trees based on: (1) the log 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 sawlog portion. In past surveys, a log grade was assigned to each upper log based on log grade standards.

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

Species List

Scientific and common names of tree species sampled in Arkansas2

Commercial Species

Scientific Name	Common Name
Softwoods	
Juniperus silicicola	Southern redcedar
J. virginiana	Eastern redcedar
Pinus echinata	Shortleaf pine
P. taeda	Loblolly pine
Taxodium distichum var. *distichum*	Baldcypress
Hardwoods	
Acer barbatum	Florida maple
A. negundo	Boxelder
A. rubrum var. *rubrum*	Red maple
A. saccharinum	Silver maple
A. saccharum	Sugar maple
Aesculus glabra	Ohio buckeye
A. octandra	Yellow buckeye
Betula nigra	River birch
Carya spp.	Hickory
C. aquatica	Water hickory
C. illinoensis	Pecan
Castanea dentata	American chestnut
Catalpa spp.	Catalpa
Celtis laevigata	Sugarberry
C. occidentalis	Hackberry
Cornus florida	Flowering dogwood
C. virginiana	Common persimmon
Fagus grandifolia	American beech
Fraxinus americana	White ash
F. pennsylvanica	Green ash
F. profunda	Pumpkin ash
F. quadrangulata	Blue ash
Gleditsia aquatica	Water locust
G. triacanthos	Honey locust
Halesia Carolina	Mountain silverbell
Ilex opaca	American holly
Juglans cinerea	Butternut
J. nigra	Black walnut
Liquidambar styraciflua	Sweetgum
Liriodendron tulipifera	Yellow-poplar
Maclura pomifera	Osage-orange
Magnolia acuminata	Cucumber-tree
M. grandiflora	Southern magnolia
M. virginiana	Sweetbay
Morus rubra	Red mulberry
Nyssa aquatica	Water tupelo
N. sylvatica var. *biflora*	Swamp tupelo
N. sylvatica var. *sylvatica*	Black tupelo, blackgum
Persea borbonia	Redbay
Platanus occidentalis	American sycamore
Populus spp.	Cottonwood
Prunus serotina	Black cherry
Quercus alba	White oak
Q. bicolor	Swamp white oak
Q. coccinea	Scarlet oak
Q. falcata	Southern red oak
Q. falcata var. *pagodaefolia*	Cherrybark oak
Q. imbricaria	Shingle oak
Q. laurifolia	Laurel oak
Q. lyrata	Overcup oak
Q. macrocarpa	Bur oak
Q. michauxii	Swamp chestnut oak
Q. muehlenbergii	Chinkapin oak
Q. nigra	Water oak
Q. nuttallii	Nuttall oak
Q. palustris	Pin oak
Q. phellos	Willow oak
Q. prinus	Chestnut oak
Q. rubra	Northern red oak
Q. shumardii	Shumard oak
Q. stellata var. *stellata*	Post oak
Q. stellata var. *paludosa*	Delta post oak
Q. velutina	Black oak
Robinia pseudoacacia	Black locust
Salix spp.	Willow
Sassafras albidum	Sassafras
Tilia americana	American basswood
T. heterophylla	White basswood
Ulmus alata	Winged elm
U. americana	American elm
U. crassifolia	Cedar elm
U. pumila	Siberian elm
U. rubra	Slippery elm
U. serotina	September elm

Noncommercial Species

Aesculus spp.	Buckeye
Ailanthus altissima	Ailanthus
Amelanchier spp.	Serviceberry
Bumelia spp.	Chittamwood
Carpinus caroliniana	American hornbeam
Castanopsis spp.	Chinkapin
Cercis canadensis	Eastern redbud
Crataegus spp.	Hawthorn
Magnolia macrophylla	Bigleaf magnolia
Malus spp.	Apple
Morus alba	White mulberry
Ostrya virginiana	Eastern hophornbeam
Oxydendrum arboreum	Sourwood
Prunus spp.	Plums
Quercus laevis	Turkey oak
Q. marilandica	Blackjack oak
Q. incana	Bluejack oak
Vaccinium arboreum	Sparkleberry
Melia azedarach	Chinaberry
Planera aquatica	Water-elm

"Names according to: Little, Elbert L., Jr. 1979. Checklist of United States trees (native and naturalized). Agric. Handb. 541. Washington, DC: U.S. Department of Agriculture. 375p.

Standard Tables

Table l.-Area *by land class, Arkansas, 1988*

Land class	Area
	Thousand acres
Forest	
Timberland	17,246.6
Reserved timberland	204.2
Woodland	236.5
Total	17,687.3
Nonforest	
Cropland*	9,950.4
Other	5,692.4
Total	15,642.8
All land+	33,330.1

*U.S. Department of Commerce, Bureau of the Census, Census of Agriculture: State and County data, issued 1989. 15 p. Volume 1.
†U.S. Bureau of the Census, 1980.

Table 2.—*Area of timberland by ownership class, Arkansas, 1988"*

Ownership class	Area
	Thousand acres
Public	
National forest	2,296.8
Other Federal	381.3
State	341.3
County	56.2
Total public	3,075.5
Private	
Forest industry+	4,376.3
Farmer	2,926.0
Miscellaneous private	
Individual	5,927.7
Corporate	941.0
Total private	14,171.1
All ownerships	17,246.6

*Columns may not sum to totals due to rounding.
†Includes 12,100 acres under lease.

Table *3.-Area of timberland by stand size and ownership class, Arkansas, 1988**

Stand size class	All ownerships	National forest	Other public	Forest industry	Farmer	Miscellaneous private
			Thousand acres			
Sawtimber	7,728.3	1,157.1	489.1	1,954.2	1,105.5	3,022.3
Poletimber stands	5,661.6	889.0	191.9	951.5	1,149.4	2,479.8
Sapling and seedling	3,701.1	250.7	97.7	1,438.4	626.1	1,288.3
Nonstocked areas	155.6	. . .	. . .	32.3	45.0	78.3
All classes	17,246.6	2,296.8	778.7	4,376.3	2,926.0	6,868.7

*Rows and columns may not sum to totals due to rounding.

Table 4.—*Area of timberland by stand volume and ownership class, Arkansas, 1988**

Stand volume per acre	All ownerships	National forest	Other public	Forest industry	Farmer	Miscellaneous private
Board feet†	*Thousand acres*					
Less than 1,500	6,480.7	510.6	208.4	1,732.8	1,408.8	2,620.1
1,500 to 5,000	5,597.0	887.2	185.0	1,157.7	991.6	2,375.6
More than 5,000	5,169.0	899.1	385.3	1,485.9	525.7	1,873.1
All classes	17,246.6	2,296.8	778.7	4,376.3	2,926.0	6,868.7

*Rows and columns may not sum to totals due to rounding.
†International ?&inch Rule.

Table *B.-Area of timberland bypercentgrowing-stock trees and cull trees, Arkansas, 1988**

Growing-stock trees	Total	Cull trees (Percent stocking)						
		O-10	10-20	2030	30-40	40-50	50-60	60+
Percent stocking		*Thousand acres*						
O-10	44.5	5.3	6.1	9.9	5.4	.	...	17.8
10-20	174.5	5.5	11.4	10.7	22.5	12.0	28.6	83.9
20-30	341.9	10.6	23.0	11.6	48.6	41.0	33.1	174.1
30-40	612.8	14.5	18.8	62.7	45.6	122.9	162.0	186.3
40–50	1,051.5	52.0	52.5	98.5	176.7	265.1	208.4	198.2
50-60	1,615.0	69.2	140.5	282.2	384.8	311.5	220.2	206.7
60-70	2,188.3	100.4	292.0	595.7	542.9	429.1	131.4	96.8
70-80	2,364.4	198.2	537.1	606.9	678.6	255.3	66.4	21.9
80-90	2,743.9	422.3	738.2	899.1	506.5	106.5	49.1	22.1
90-100	2,220.5	510.4	837.1	598.9	195.1	67.8	5.4	5.8
100-110	1,764.3	602.1	722.4	322.7	82.5	29.4	5.2	. .
110-120	1,005.2	422.9	393.3	160.1	28.9	...	...	...
120-130	671.2	381.3	234.5	50.3	5.2	...	...	...
130-140	305.3	217.0	77.1	11.2	.	. .	. .	.
140-150	92.1	70.1	22.0	...	...	...	...	...
150-160	45.5	45.5	...	. .	. .	.	. .	. .
160+	5.6	5.6	. . .	...				.
Total	17,246.6	3,133.0	4,106.0	3,720.4	2,723.2	1,640.5	909.8	1,013.7

*Rows and columns may not sum to totals due to rounding.

Table *6.-Average basal area of live trees on timberland by ownership and tree class, Arkansas, 1988**

Ownership and tree class	All species	Softwood			Hardwood		
		Sapling & seedling	Poletimber	Sawtimber	Sapling & seedling	Poletimber	Sawtimber
	Square feet per acre						
National forest							
Growing stock	72.6	2.4	7.9	20.5	5.2	19.1	17.4
Rough and rotten	19.6	1.3	0.7	0.2	8.1	4.1	5.2
Total	92.3	3.7	8.6	20.7	13.3	23.3	22.7
Other public							
Growing stock	73.9	1.4	2.2	9.3	5.4	20.1	35.5
Rough and rotten	19.5	0.6	0.1	0.4	6.9	4.6	6.7
Total	93.4	2.0	2.3	9.7	12.4	24.8	42.2
Forest industry							
Growing stock	59.7	5.6	9.8	17.9	4.3	9.8	12.3
Rough and rotten	14.0	1.1	0.6	0.3	6.7	3.0	2.3
Total	73.7	6.8	10.4	18.1	11.0	12.7	14.6
Farmer							
Growing stock	54.9	1.6	3.0	6.4	5.7	18.6	19.6
Rough and rotten	19.6	0.6	0.5	0.4	7.5	4.5	6.2
Total	74.6	2.3	3.5	6.8	13.1	23.1	25.8
Miscellaneous private							
Growing stock	62.4	2.5	5.0	11.8	6.1	18.4	18.6
Rough and rotten	18.5	0.7	0.3	0.3	8.0	4.4	4.8
Total	80.9	3.1	5.3	12.1	14.1	22.8	23.4
All owners							
Growing stock	62.3	3.1	6.2	13.5	5.4	16.4	17.8
Rough and rotten	17.8	0.9	0.4	0.3	7.5	4.0	4.6
Total	80.1	3.9	6.6	13.8	12.9	20.5	22.4

*Rows and columns may not sum to totals due to rounding.

Table 7.—*Area of timberland by site and ownership class, Arkansas, 1988**

Site class	All ownerships	National forest	Other public	Forest industry	Farmer	Miscellaneous private
	Thousand acres					
165 ft^3 or more	526.3	11.3	40.3	154.8	73.1	246.8
120 to 165 ft^3	2,056.7	42.3	150.9	821.7	238.7	803.0
85 to 120 ft^3	4,947.9	287.4	209.1	1,930.7	586.7	1,934.0
50 to 85 ft^3	6,864.1	1,438.9	286.1	1,282.2	1,251.1	2,605.9
Less than 50 ft^3	2,851.6	516.8	92.3	186.9	776.5	1,279.0
All classes	17,246.6	2,296.8	778.7	4,376.3	2,926.0	6,868.7

*Rows and columns may not sum to totals due to rounding.

Table 8.—*Area of timberland by forest type and ownership class, Arkansas, 1988**

Type	All ownerships	National forest	Other public	Forest industry	Forest Industry-leased	Other private
	Thousand acres					
Loblolly-shortleafpine	4,185.4	702.6	72.2	1,953.1	6.1	1,451.3
Oak-pine	3,049.9	439.4	68.5	955.4	. . .	1,586.6
Oak-hickory	7,264.6	1,138.0	206.3	794.6	. . .	5,125.7
Oak-gum-cypress	2,582.5	16.7	403.5	640.4	6.1	1,515.8
Elm-ash-cottowood	158.9	. . .	28.2	15.4	. .	115.4
Nontyped	5.3	. . .	. . .	5.3	. . .	. . .
All types	17,246.6	2,296.8	778.7	4,364.2	12.1	9,794.7

*Rows and columns may not sum to totals due to rounding.

Table 9.—*Area of reserved timberland and woodland by forest type, Arkansas, 1988**

Type	All areas	Reserved timberland	Woodland
		Thousand acres	
Loblolly-shortleaf	55.0	23.9	31.1
Oak-pine	99.9	46.6	53.3
Oak-hickory	285.8	133.8	152.0
All types	440.7	204.3	236.4

*Rows and columns may not sum to totals due to rounding.

Table *lO.-Number ofgrowing-stock trees on timberland by species and diameter class, Arkansas, 1988*"

Species	All classes	Diameter class *(Inches at breast height)* 5.0-6.9	7.0-8.9	9.0–10.9	11.0–12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0–28.9	29.0 & larger
	Thousand trees										
Shortleaf pine	292,123	86,236	76,639	53,935	37,526	22,426	9,581	3,809	1,339	630	. . .
Loblolly pine	335,450	135,420	81,508	42,038	30,009	20,130	11,563	7,170	4,059	3,460	95
Redcedar	40,389	22,939	12,160	2,938	1,471	613	180	69	12	7	. . .
Cypress	7,291	1,321	1,336	736	968	898	585	490	243	495	220
Total softwoods	675,254	245,916	171,642	99,647	69,974	44,068	21,909	11,538	5,653	4,592	315
Select white oaks†	198,012	76,177	53,790	31,375	15,245	10,267	5,164	2,850	1,659	1,456	76
Select red oaks‡	71,808	21,314	17,138	11,869	8,010	5,055	3,180	2,031	1,368	1,695	147
Other white oaks	156,560	61,802	39,912	24,550	11,606	7,736	4,675	2,603	1,460	1,988	232
Other red oaks	197,283	58,292	47,888	32,640	20,701	14,195	10,033	5,801	3,540	3,803	389
Sweet pecan	2,823	1,132	604	351	171	151	68	51	95	167	34
Water hickory	8,687	2,361	2,519	1,069	956	498	452	356	185	243	49
Other hickories	162,353	80,764	41,145	20,312	10,112	5,599	2,459	1,067	439	425	30
Persimmon	5,732	2,980	1,437	805	387	60	37	26	. . .	. . .	. .
Hard maple	7,450	2,400	2,802	1,326	389	283	126	72	24	28	. .
Soft maple	18,720	10,964	4,124	1,987	677	410	235	112	136	58	18
Boxelder	4,186	1,608	1,332	453	342	168	177	48	45	14	.
Beech	2,951	644	406	461	303	226	177	277	154	276	28
Sweetgum	150,381	64,343	35,851	21,723	11,953	7,880	4,207	2,333	1,078	908	105
Blackgum	35,017	14,624	8,020	4,896	2,908	1,782	1,434	597	333	384	40
Other gums/tupelos	7,108	1,760	2,079	1,406	397	244	229	227	146	433	188
White ash	10,590	4,261	2,607	1,463	1,038	645	255	126	55	120	21
Other ashes	21,262	7,715	5,683	3,156	1,340	1,164	842	550	334	439	39
Sycamore	4,319	976	718	746	540	371	298	241	120	291	16
Cottonwood	2,938	325	190	425	350	397	391	261	184	349	66
Basswood	1,243	366	163	265	262	121	28	12	9	17	. .
Yellow-poplar	243	. . .	. .	26	27	52	55	29	27	20	8
Magnolia	203	. . .	66	36	55	. . .	15	23	9	. . .	. .
Sweetbay	1,562	626	230	313	208	81	49	13	19	23	
Willow	8,074	1,774	2,421	857	495	551	482	604	389	459	40
Black walnut	2,936	940	959	607	197	60	97	61	9	5	. . .
Black cherry	5,795	2,685	1,618	794	229	265	98	37	48	20	. . .
American elm	14,531	5,746	3,710	2,535	942	803	249	206	189	138	13
Other elms	34,914	19,037	9,057	4,047	1,482	609	291	165	122	94	8
River birch	1,849	726	303	289	237	91	49	38	52	54	10
Hackberry	22,255	7,365	5,352	3,678	1,573	1,463	1,105	786	503	405	23
Black locust	1,443	716	383	211	56	39	12	25		. . .	. . .
Other locusts	3,655	713	1,110	898	452	278	97	21	'34	46	7
Sassafras	1,455	1,012	339	45	25	22	.	12	. . .	. . .	. . .
Dogwood	1,660	1,552	61	47	. . .	. . .	. . .	. . .	. . .	. . .	. . .
Holly	4,716	2,524	1,052	585	362	122	72	. . .	. .	. .	. .
Other commercial	1,336	582	513	178	29	22	,	13	, . .	. . .	. . .
Total hardwoods	1,176,053	460,806	295,580	176,426	94,054	61,713	37,136	21,629	12,764	14,358	1,587
All species	1,851,307	706,722	467,223	276,073	164,027	105,781	59,045	33,167	18,417	18,950	1,902

*Rows and columns may not sum to totals due to rounding.

†Includes white, swamp chestnut, and bur oaks.

‡Includes cherrybark and Shumard oaks.

Table 11.—*Volume of timber on timberland by class of timber and by softwoods and hardwoods, Arkansas, 1988**

Class of timber	All species	Softwood	Hardwood
	Millioncubicfeet		
Sawtimber trees			
Sawlog portion	11,075.6	5,476.8	5,598.8
Upper-stem portion	1,913.3	803.6	1,109.8
Total	12,988.9	6,280.4	6,708.6
Poletimber trees	6.000.9	1.642.7	4.358.2
All growing stock	18,989.7	7,923.1	11,066.8
Rough trees	1,474.5	155.9	1,318.5
Rotten trees	286.2	12.7	273.6
Salvable dead trees	108.9	34.5	74.4
All timber	20,859.4	8,126.2	12,733.3

*Rows and columns may not sum to totals due to rounding.

Table 12.—*Volume of growing stock and sawtimber on timberland by ownership class and by softwoods and hardwoods, Arkansas, 1988**

	Growing-stock			Sawtimber		
Ownership class	All species	Softwood	Hardwood	All species	Softwood	Hardwood
	Millioncubicfeet			*Millioboarfeet*†		
National forest	3,205.0	1,629.8	1,575.2	11,488.4	7,082.8	4,405.6
Other public	1,069.5	212.2	657.3	4,112.8	995.2	3,117.6
Forest industry	4,865.7	2,799.7	2,066.1	18,703.2	11,854.5	6,848.7
Farmer	2,550.6	596.7	1,953.9	8,108.3	2,379.5	5,728.8
Miscellaneous private	7,298.9	2,684.7	4,614.2	24,363.6	11,355.2	13,008.5
All ownerships	18,989.7	7,923.0	11,066.7	66,776.3	33,667.2	33,109.2

*Rows and columns may not sum to totals due to rounding.

†International %-inch Rule.

Table 13.—*Volume ofgrowing stock on timberland by species and diameter class, Arkansas, 1988**

Species	All classes	5.0–6.9	7.0–8.9	9.0–10.9	11.0–12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9	29.0 & larger
	Diameter class *(Inches at breast height)*										
	Million cubic feet										
Shortleaf pine	3,593.0	226.7	510.9	695.8	753.1	656.6	393.9	201.3	90.2	58.7	. . .
Loblolly pine	3,982.0	314.6	483.2	512.9	583.3	583.4	471.3	392.5	279.7	344.7	16.5
Redcedar	156.2	48.8	51.0	23.2	17.7	9.5	3.6	1.8	0.5	0.3	. . .
Cypress	191.8	2.6	4.9	7.4	15.0	20.2	18.2	22.9	14.5	38.0	48.2
Total softwoods	7,923.0	592.6	1,050.0	1,239.2	1,369.1	1,269.5	887.0	624.5	384.7	441.6	64.7
Select white oaks†	1,745.4	198.4	308.5	316.7	244.4	229.5	154.2	110.1	82.2	94.0	7.3
Select red oaks‡	908.9	57.4	99.4	119.0	129.6	112.9	95.9	80.8	69.3	126.8	18.0
Other white oaks	1,243.9	134.7	189.1	209.4	155.1	144.9	117.3	86.3	59.8	120.3	27.1
Other red oaks	2,399.4	137.1	265.6	327.6	331.1	317.4	303.7	231.0	172.9	267.0	46.0
Sweet pecan	48.9	3.0	3.2	3.6	2.7	3.6	2.0	2.4	5.0	16.7	6.5
Water hickory	126.3	5.9	13.1	10.9	15.6	10.3	14.1	14.6	9.9	22.1	9.7
Other hickories	984.5	155.8	183.4	180.8	154.5	126.9	75.5	45.5	24.6	33.4	4.1
Persimmon	34.1	6.8	8.4	8.9	6.6	1.3	0.8	1.3	. . .	. . .	. .
Hard maple	53.3	5.8	14.3	13.0	5.2	5.9	4.1	2.3	1.1	1.6	. .
Soft maple	110.8	28.4	21.6	18.9	10.5	8.6	6.4	5.1	6.3	3.3	1.8
Boxelder	32.2	4.2	6.4	4.5	4.9	3.3	4.4	1.9	1.7	0.9	. . .
Beech	65.2	1.7	2.1	5.1	4.6	5.0	5.9	12.5	6.3	18.0	4.1
Sweetgum	1,494.7	146.6	213.0	255.6	228.3	213.5	158.7	116.3	67.4	75.2	20.0
Blackgum	309.3	31.5	41.5	46.3	45.8	39.7	40.6	23.0	15.2	21.5	4.0
Other gums/tupelos	91.3	3.9	9.5	12.1	5.2	4.1	5.6	6.4	5.1	23.0	16.5
White ash	89.7	9.3	14.8	14.5	14.6	12.8	7.6	4.8	2.2	6.2	2.8
Other ashes	222.3	18.9	33.3	31.4	20.9	24.4	23.6	20.8	14.4	30.2	4.3
Sycamore	87.8	2.9	4.5	8.5	9.0	10.5	9.8	9.9	6.5	23.6	2.5
Cottonwood	107.9	1.1	1.3	5.2	6.7	10.7	14.2	12.6	12.3	32.7	10.9
Basswood	15.6	0.8	0.7	2.2	4.2	2.9	1.1	0.7	0.6	2.5	. . .
Yellow-poplar	11.4	. . .	. . .	0.5	0.5	1.6	2.1	1.4	1.4	2.5	1.4
Magnolia	3.9	. . .	0.5	0.3	0.9	. . .	0.6	1.2	0.5	. . .	. . .
Sweetbay	16.4	2.0	1.9	3.4	3.7	1.7	1.3	0.5	0.8	1.1	. . .
Willow	141.0	3.8	11.9	7.5	8.3	11.8	16.0	25.5	19.1	34.1	3.1
Black walnut	21.7	1.7	4.3	6.2	2.9	1.3	2.7	2.0	0.4	0.2	. .
Black cherry	41.1	7.2	8.5	7.6	4.3	5.9	2.9	1.4	1.9	1.4	. . .
American elm	120.3	12.7	19.1	22.9	13.8	17.3	7.7	7.3	8.5	9.6	1.5
Other elms	190.1	40.3	44.2	39.4	23.4	13.5	8.5	6.9	5.8	6.9	1.2
River birch	22.9	2.5	2.5	3.5	4.2	2.1	1.1	1.4	2.0	2.6	0.9
Hackberry	246.6	14.5	26.8	34.7	22.3	31.4	34.1	30.4	23.7	26.1	2.6
Black locust	7.2	1.1	1.8	1.8	0.7	0.7	0.3	0.7	. . .	. .	. . .
Other locusts	35.1	1.6	4.9	7.5	7.0	5.4	2.3	0.6	1.6	2.9	1.2
Sassafras	5.1	2.2	1.6	0.4	0.2	0.4	. . .	0.3	. . .	. .	. . .
Dogwood	3.0	2.5	0.2	0.3	. . .	. .	. .	. . .	. .	. . .	. . .
Holly	23.6	4.3	5.3	5.2	4.7	2.4	1.8	. . .	. .	. .	. .
Other commercial	5.6	1.5	2.0	1.1	0.3	0.3	. . .	0.4	. .	. . .	. .
Total hardwoods	11,066.7	1,052.3	1,569.3	1,736.6	1,496.8	1,384.0	1,126.9	868.2	628.6	1,006.4	197.6
All species	18,989.7	1,645.0	2,619.3	2,975.8	2,865.9	2,653.5	2,013.9	1,492.7	1,013.3	1,448.0	262.3

*Rows and columns may not sum to totals due to rounding.

†Includes white, swamp chestnut, and bur oaks.

‡Includes cherrybark and Shumard oaks.

Table 14.—*Volume of* sawtimber *on timberland by species and diameter class, Arkansas, 1988**

Species	All classes	9.0–10.9	11.0–12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9	29.0 & larger
	Diameter class *(Inches at breast height)*								
	Million board feet†								
Shortfleaf pine	15432.1	3,247.8	3,981.2	3,713.8	2,316.1	1,267.5	544.1	362.2	. . .
Loblolly pine	17,081.9	2,191.6	2,921.5	3,154.2	2,675.7	2,295.9	1,666.5	2,077.9	98.6
Redcedar	243.8	90.8	78.0	44.8	16.6	9.4	2.9	1.5	. . .
Cypress	908.7	22.2	56.5	85.9	83.4	120.7	78.0	197.9	264.0
Total softwoods	33,667.2	5,552.3	7,037.3	6,998.7	5,091.9	3,693.5	2,291.4	2,639.4	362.6
Select white oaks‡	4,515.3	. . .	1.014.3	1.116.1	789.8	584.4	453.2	516.7	40.7
Select red oaks§	3,215.4	. . .	'543.5	'550.2	495.6	442.2	386.0	693.2	104.8
Other white oaks	3,541.6	. . .	642.6	699.3	592.3	447.1	326.5	674.4	159.3
Other red oaks	8,256.1	. .	1,336.8	1,493.7	1,546.4	1,224.6	928.2	1,469.8	256.6
Sweet pecan	218.1	. .	12.4	18.6	10.1	12.7	27.3	97.9	39.1
Water hickory	507.1	. . .	64.4	49.6	75.0	77.8	55.2	127.6	57.4
Other hickories	2,282.6	. . .	660.0	622.9	391.1	251.6	141.5	188.6	26.9
Persimmon	47.3	. . .	29.9	6.1	3.8	7.5	. . .	. . .	. . .
Hard maple	101.5	. . .	23.0	27.1	23.3	12.7	6.2	9.1	. . .
Soft maple	195.7	. . .	44.4	39.1	28.8	26.4	33.9	15.5	7.6
Boxelder	75.3	. . .	18.9	15.1	18.5	10.0	7.9	4.9	. .
Beech	302.7	. . .	19.2	23.4	32.3	68.3	34.6	101.7	23.1
Sweetgum	4,283.1	. . .	877.1	1,015.2	833.1	637.1	370.0	437.1	113.4
Blackgum	936.1	. . .	182.5	189.5	209.9	124.8	86.7	118.9	23.8
Other gums/tupelos	243.0	. . .	13.8	12.8	21.1	25.8	19.9	90.1	59.5
White ash	235.3	. . .	58.5	57.4	39.0	28.2	11.4	29.5	11.3
Other ashes	646.6	. . .	81.4	100.8	114.2	101.8	71.4	153.5	23.6
Sycamore	359.5	. . .	33.1	48.5	52.5	51.4	31.1	128.0	15.0
Cottonwood	539.8	. . .	30.1	53.3	73.0	69.9	69.6	186.4	57.6
Basswood	62.9	. . .	19.1	13.7	6.9	3.8	3.1	16.2	. . .
Yellow-poplar	61.3	. . .	2.2	8.1	12.0	7.6	7.6	15.2	8.7
Magnolia	15.9	. .	2.7	. .	3.1	7.2	2.9	. .	. . .
Sweetbay	39.6	. . .	14.3	6.9	7.3	2.4	3.7	4.9	. . .
Willow	612.9	. . .	29.6	55.1	84.7	142.0	101.1	188.1	12.3
Black walnut	43.6	. .	11.1	6.4	12.4	10.7	2.2	0.8	. .
Black cherry	89.3	. . .	20.4	29.8	15.8	7.8	9.0	6.4	. . .
American elm	320.3	. .	60.1	75.8	39.6	39.0	42.7	55.1	8.0
Other elms	326.1	. . .	100.0	67.3	45.1	37.7	28.8	40.6	6.5
River birch	67.5	. . .	19.3	10.4	4.9	7.0	9.7	11.1	5.0
Hackberry	818.0	. . .	84.9	143.4	166.6	152.7	123.0	136.3	11.0
Black locust	10.1	. . .	2.1	3.5	0.8	3.7	. . .	. . .	. . .
Other locust	93.0	. . .	26.5	23.9	10.0	2.6	8.7	14.4	6.9
Sassafras	4.1	. .	0.4	1.9	. . .	1.8	. . .	. .	. .
Holly	37.0	. .	18.4	10.2	8.5	. . .	. . .	. . .	. .
Other Commercial	5.6	. . .	1.2	2.0	. .	2.4	. . .	. . .	. .
Total hardwoods	33,109.2	. . .	6,098.1	6,597.2	5,767.7	4,633.0	3,403.2	5,532.1	1,077.9
All species	66,776.3	5,552.3	13,135.4	13,595.8	10,859.6	8,326.5	5,694.6	8,171.6	1,440.5

*Rows and columns may not sum to totals due to rounding.

†International ¼-inch Rule.

‡Includes white and swamp chestnut oaks.

§Includes cherrybark and Shumard oaks.

Table *E-Volume of sawtimber on timberland by species* and *tree grade, Arkansas, 1988**

Species	All grades	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5†
	Million board feet‡					
Shortfleaf pine	15,432.7	4,719.8	4,163.8	6,467.8	. . .	81.2
Loblolly pine	17,081.9	3,556.3	3,305.7	10,135.8	. . .	84.1
Redcedar	243.8	230.6	. . .	. .	. . .	13.3
Cypress	908.7	274.4	248.0	260.7	. . .	125.6
Total softwoods	33,667.2	8,781.1	7,717.6	16,864.3	. . .	304.2
Select white oaks‡	4,515.3	240.2	759.5	2,286.4	1,018.5	210.7
Select red oaks§	3,215.4	308.4	660.2	1,404.6	624.1	218.1
Other white oaks	3,541.6	114.6	500.6	1,720.5	976.4	229.5
Other red oaks	8,256.1	401.3	1,357.9	3,478.7	2,405.2	613.0
Sweet pecan	218.1	3.7	51.0	148.5	7.1	7.8
Water hickory	507.1	38.0	123.9	249.4	81.6	14.3
Other hickories	2,282.6	97.2	288.0	1,166.9	546.6	183.8
Persimmon	47.3	. .	1.7	43.4	2.2	. . .
Hard maple	101.5	. . .	. .	34.7	43.0	23.9
Soft maple	195.1	2.0	15.6	92.6	42.4	43.0
Boxelder	75.3	2.3	3.1	26.5	32.2	11.2
Beech	302.7	. . .	6.0	70.4	142.5	83.7
Sweetgum	4,283.1	508.9	1,012.8	1,834.5	611.5	255.4
Blackgum	936.1	75.3	183.8	431.5	95.5	150.1
Other gums/tupelos	243.0	16.5	57.2	136.6	1.9	30.8
White ash	235.3	27.3	61.7	111.7	7.6	27.0
Other ashes	646.6	79.6	148.0	323.8	22.5	12.8
Sycamore	359.5	44.6	117.5	132.9	17.1	47.4
Cottonwood	539.8	129.6	136.8	194.6	30.8	48.0
Basswood	62.9	15.2	11.1	36.6	. . .	. . .
Yellow-poplar	61.3	17.9	7.6	21.4	6.8	7.7
Magnolia	15.9	. . .	3.4	11.4	. .	1.0
Sweetbay	39.6	.	. . .	14.8	13.0	11.8
Willow	612.9	14.2	54.8	419.6	66.1	58.1
Black walnut	43.6	5.9	11.8	16.1	4.0	5.8
Black cherry	89.3	7.3	20.4	37.7	3.8	20.1
American elm	320.3	11.8	48.3	156.4	72.6	31.1
Other elms	326.1	24.4	31.0	174.0	77.9	18.8
River birch	67.5	1.6	7.8	38.6	10.3	9.2
Hackberry	818.0	9.6	73.2	493.7	115.5	126.0
Black locust	10.1	. .	1.5	1.0	3.3	4.3
Other locust	93.0	9.2	7.9	40.5	30.8	4.6
Sassafras	4.1	.	1.8	1.9	. . .	0.4
Holly	37.0	.	. . .	7.4	25.4	4.3
Other commercial	5.6	.	2.0	. .	1.2	2.4
Total hardwoods	33,109.2	2,206.6	5,767.8	15,359.6	7,199.2	2,576.0
All species	66,776.3	10,987.7	13,485.4	32,223.9	7,199.2	2,880.1

*Rows and columns may not sum to totals due to rounding

†Volume in trees with at least one 12-foot log or two 8-foot logs, but not able to produce a 12-foot log in the butt 16 feet.

‡International ¼-inch Rule.

Table K-Average ***net annual growth and average annual removals of growing stock on timberland by species, Arkansas, 1978-88****

Species	Growth	Removals
	--------*Million cubic feet*-------	
Yellow pines	377.5	423.9
Other softwoods	9.4	3.3
Total softwoods	386.9	427.1
Select white-red oaks†	103.4	59.2
Other white-red oaks	144.9	112.3
Hickory	33.4	19.6
Hard maple	1.8	0.2
Sweetgum	47.0	34.3
Ash-walnut-black cherry	14.3	5.4
Yellow-poplar	0.5	. . .
Other hardwoods	52.4	27.7
Total hardwoods	397.7	258.6
All species	784.6	685.7

*Columns may not sum to totals due to rounding.

†Includes white, swamp chestnut, bur, cherrybark, and Shumard oaks.

Table 17.—*Average net annual growth and average annual removals of growing stock on timberland by ownership class and by softwoods and hardwoods, Arkansas, 1978-88**

Ownership class	Net annual growth			Annual removals		
	All species	Softwood	Hardwood	All species	Softwood	Hardwood
	Million cubicfeet					
National forest	85.0	41.7	43.4	52.1	36.7	15.4
Other public	33.2	5.8	27.5	12.1	7.7	4.3
Forest industry	257.8	176.4	81.4	330.5	233.1	97.4
Forest industry-leased	1.1	0.6	0.5	0.7	0.7	. .
Other private	407.5	162.5	244.9	290.2	148.8	141.5
All ownerships	784.6	386.9	397.7	685.7	427.1	258.6

*Rows and columns may not sum to totals due to rounding.

Table 18.—*Average net annual growth and average annual removals of sawtimber on timberland by species, Arkansas, 1978-88**

Species	Growth	Removals
	--------Million board feet† -----	
Yellow pines	1,800.3	1,880.7
Other softwoods	22.0	9.9
Total softwoods	1,822.3	1,890.6
Select white-red oaks‡	389.0	191.7
Other white-red oaks	581.6	347.5
Hickory	107.0	55.9
Hard maple	6.3	0.4
Sweetgum	164.1	105.4
Ash-walnut-black cherry	49.7	17.2
Yellow-poplar	3.2	. . .
Other hardwoods	183.8	79.5
Total hardwoods	1,490.7	797.5
All species	3,313.0	2,688.1

*Columns may not sum to totals due to rounding.
†International ?&inch Rule.
‡Includes white, swamp chestnut, cherrybark, and Shumard oaks.

Table 19.—*Average net annual growth and average annual removals of sawtimber on timberland by ownership class and by softwoods and hardwoods, Arkansas, 1978-88**

Ownership class	Net annual growth			Annual removals		
	All species	Softwood	Hardwood	All species	Softwood	Hardwood
	----------Million board feet†---					
National forest	416.1	245.9	170.1	185.6	152.9	32.7
Other public	144.0	27.1	116.9	50.1	35.0	15.1
Forest industry	1,067.0	7645	302.5	1,410.2	1,111.4	298.8
Forest industry-leased	5.2	29	2.3	3.8	3.8	. . .
Other private	1,680.7	781.9	898.9	1,038.3	587.6	450.8
All ownerships	3,313.0	1,822.3	1,490.7	2,688.1	1,890.6	797.5

*Rows and columns may not sum to totals due to rounding.
†International ¼-inch Rule.

Table 20.—*Average annual mortality of growing stock and sawtimber on timberland by species, Arkansas, 1978-88**

Species	Growing stock	Sawtimber
	Million cubic feet	*Million board feet*†
Yellow pines	41.2	103.2
Other softwoods	1.5	3.1
Total softwoods	42.7	106.3
Select white-red oaks‡	17.0	43.8
Other white-red oaks	32.7	76.3
Hickory	10.4	25.7
Hard maple	0.2	0.3
Sweetgum	12.8	37.2
Ash-walnut-black cherry	3.4	7.9
Other hardwoods	22.8	67.6
Total hardwoods	99.4	258.7
All species	142.1	365.0

*Columns may not sum to totals due to rounding.
†International ¼-inch Rule.
*Includes white, swamp chestnut, bur, cherrybark, and Shumard oaks.

Table 21.—*Average annual mortality of growing stock and sawtimber on timberland by ownership class and by softwoods and hardwoods, Arkansas, 1978-88**

Ownership class	Growing stock			Sawtimber		
	All species	Softwood	Hardwood	All species	Softwood	Hardwood
	Million cubic feet			*Million board feet*†		
National forest	19.5	5.5	14.0	45.2	13.0	32.2
Other public	8.8	0.7	8.1	29.4	1.0	28.4
Forest industry	31.1	15.1	16.0	87.0	41.2	45.7
Farmer	26.7	4.5	22.1	66.1	10.7	55.4
Miscellaneous private	56.0	16.9	39.1	137.3	40.3	97.0
All ownerships	142.1	42.7	99.4	365.0	106.3	258.7

*Rows and columns may not sum to totals due to rounding.
†International ¼-inch Rule.

Table 22.-Average annual ***mortality*** *of* ***growing stock and sawtimber on timberland by cause*** *of* ***death and by softwoods and hardwoods, Arkansas, 1978-88****

Cause of death	Growing stock			Sawtimber		
	All species	Softwood	Hardwood	All species	Softwood	Hardwood
	--Million cubic feet			*--Million board feet*†		
Bark beetles	7.1	7.1	. . .	26.7	26.7	
Other insects	0.8	0.4	0.5	3.9	1.8	2.1
Disease	94.2	20.4	73.8	240.4	50.4	190.0
Fire	2.8	1.0	1.8	3.7	0.2	3.5
Beaver	2.6	. .	2.6	6.2	. . .	6.2
Other animals	0.1	. . .	0.1	0.4	. .	0.4
Weather	19.7	5.3	14.5	67.4	19.4	48.0
Suppression	9.2	6.6	2.7	4.7	2.3	2.4
Other	5.6	2.1	3.5	11.6	5.6	6.1
All causes	142.1	42.7	99.4	365.0	106.3	258.7

*Rows and columns may not sum to totals due to rounding.
†International ?&inch Rule.

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The principal findings of the sixth forest survey of Arkansas (1988) and changes that have occurred since earlier surveys are presented in this report. Topics examined include the status and trends in forest area, timber volume, growth, removals, mortality, and timber products output.

Keywords: Forest inventory, timberland, volume.