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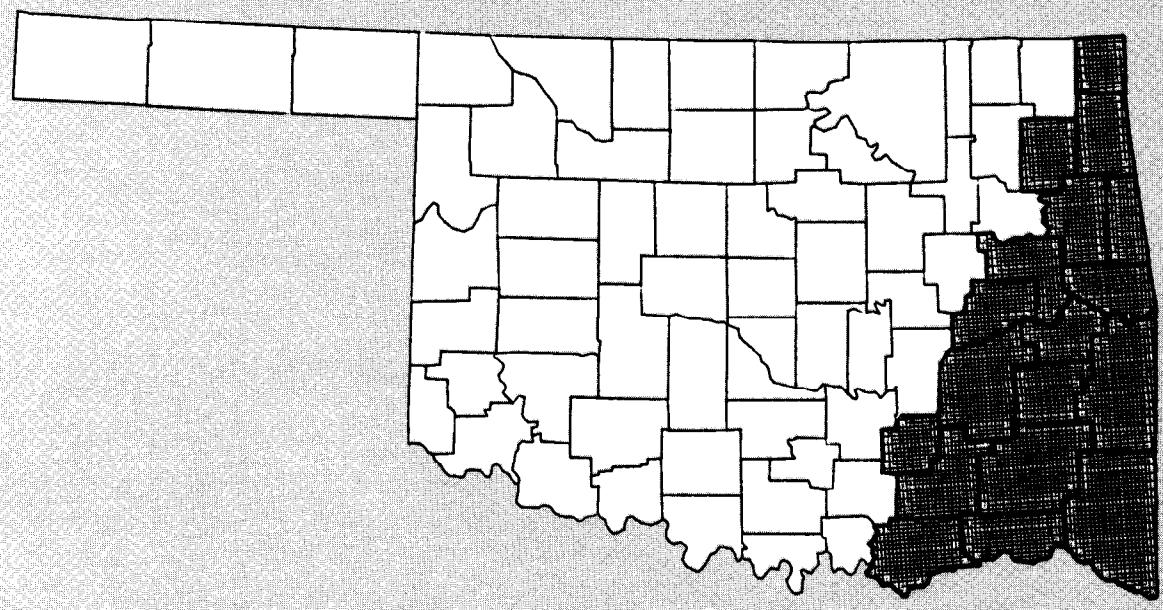
Timber Resources of East Oklahoma

Richard A. Birdsey and Dennis M. May



Contents

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HIGHLIGHTS

This report presents the principal findings of the fifth forest survey of east Oklahoma. To make accurate estimates of forest area, 32,817 photo plots were classified and 2,767 field plot locations were visited to verify the photointerpretation. Detailed classifications of timberland are based on measurements and observations at 1,828 permanent sample plot locations. Field work in east Oklahoma was done between January and April, 1986. Some highlights of the survey are listed below.

- Timberland area in east Oklahoma has increased by 10 percent to 4,748 thousand acres, reversal of the 12 percent decline reported between 1966 and 1976.
- Loblolly pine now accounts for 19 percent of all pines in the State, up from 5 percent in 1976.
- The area of pine plantations has increased from 44 thousand acres in 1976 to 264 thousand acres in 1986.
- An additional 173 thousand acres of oak-pine type showed evidence of artificial regeneration.
- Significant shifts occurred in stand-size and age-class distributions, caused by intensive pine harvesting and maturing hardwoods.
- The volume of softwood growing stock has not changed since the last survey.
- The volume of hardwood growing stock increased by 16 percent since the last survey.
- An increase in softwood removals and a decline in softwood growth caused the growth/removals ratio to fall below 1.0.
- The average net annual growth of hardwood growing stock has declined steeply. Removals have risen, so the hardwood growth/removal ratio is close to 1.0.
- Average annual mortality has nearly doubled since the last survey.
- Almost one-third of east Oklahoma's timberland was significantly disturbed since the last survey.
- Despite heavy cutting, most pine stands retained adequate stocking.
- East Oklahoma's timberland is currently producing timber at only 30 percent of maximum potential. More than half of all timberland is less than 60 percent stocked with growing-stock trees.
- Oklahoma's eastern forests supply more than 50 million cubic feet of timber products each year.
- Production of hardwood saw logs and pulpwood has increased relative to softwoods in recent years.

AN OVERVIEW OF EAST OKLAHOMA'S FORESTS

East Oklahoma is partitioned into two broad resource regions for the forest survey (fig. 1). The Southeast region is 55 percent forested and the Northeast region is 39 percent forested (table I). Most forest industry in Oklahoma is located in the Southeast region. The southern portion of this region is part of the West Gulf Costa1 Plain (fig. 2). North of the Coastal Plain the Ouachita Mountains and Arkansas Valley and Ridges extend westward from Arkansas (U.S. Department of Agriculture, Soil Conservation Service, 1984). The Southeast region contains most of Oklahoma's pine and oak-pine forests (table II). About 53 percent of the timberland is classified as upland or bottomland hardwood type (Birdsey and Bertelson 1987a). All of the State's National Forest land is located in the Southeast. The proportion of forest cover declines from east to west (fig. 3).

Table *I.-Area by land class and forest resource region, east* Oklahoma, 1986

Land class	Forest resource region		
	Total	Southeast	Northeast
	..... *Thousand acres*		
Timberland	4,747.5	3,481.2	1,266.3
Woodland	485.9	367.9	118.0
Reserved timberland	23.0	23.0	0.0
Nonforest land	4,847.6	2,874.7	1,972.9
All land	10,104.0	6,746.8	3,357.2

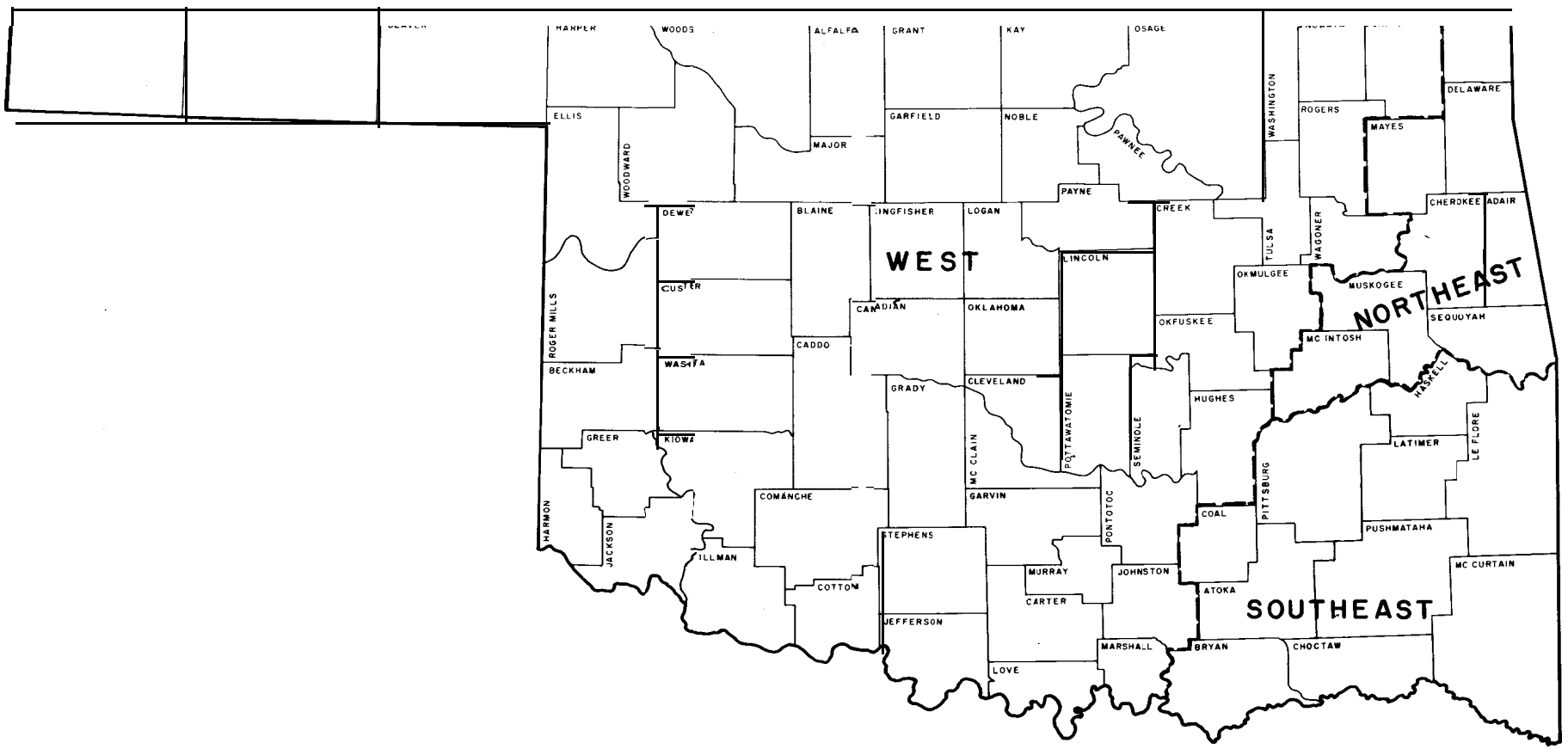

Figure 1.—*Forest resource regions of Oklahoma.*

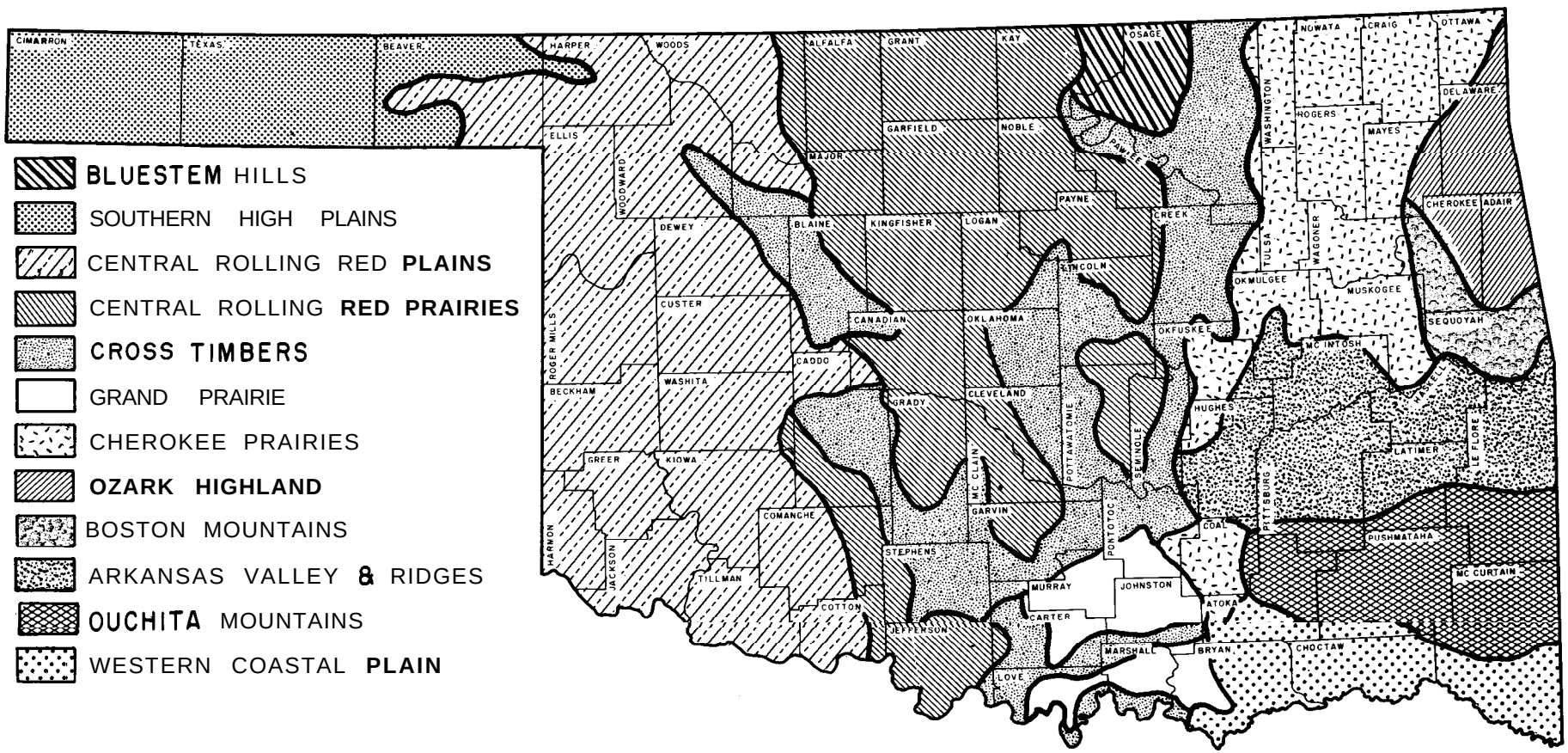

Figure 2.—*Major land resource areas of Oklahoma (U.S. Department of Agriculture, Soil Conservation Service 1984).*

The eastern portion of the Northeast region is physiographically part of the Ozark Highlands and Boston Mountains that extend westward from Arkansas. The region's remaining area is sparsely-forested prairie. The Northeast region contains mostly oak-hickory forest types owned by farmers and other individuals (Birdsey and Bertelson (1987b).

TIMBER RESOURCE TRENDS IN EAST OKLAHOMA

The forest survey of Oklahoma has traditionally sampled timberland (formerly "commercial forest land") in east Oklahoma. The region includes 18 counties with forests covering an average of 52 percent of the land surface. Of the total 5,256 thousand acres of forest, 4,748 thousand acres are classified as timberland, 486 thousand acres are classified as woodland, and 23 thousand acres are classified as reserved timberland.

Timberland Area

The first forest survey of Oklahoma in 1936 covered five counties in the Southeast: McCurtain, Pushmataha, LeFlore, Latimer, and Haskell. Forest area was 2,961 thousand acres or 74 percent of the total area. Fifteen percent of the forest was classified as old growth. Pine and mixed pine-hardwoods comprised 47 percent of the forest land (Eldredge 1938).

The first complete survey of east Oklahoma in 1956 included 17 counties (U.S. Department of Agriculture, Forest Service 1957). The five counties that were resurveyed had maintained a forest cover of 2,851 thousand acres. Most of the old-growth pine had been cut and replaced by second-growth pine and mixed pine-hardwood. Total timberland acreage in east Oklahoma in 1956 was 5,184 thousand acres (adjusted to the current productivity threshold for timberland, and including Bryan County, which was first surveyed in 1976).

By 1966, timberland area declined 5 percent to 4,906 thousand acres (adjusted to include Bryan County). Between 1956 and 1966,396 thosuand acres of timberland were cleared for agriculture and other uses, while 169 thousand acres reverted to timberland (Sternitzke and Van Sickle 1968).

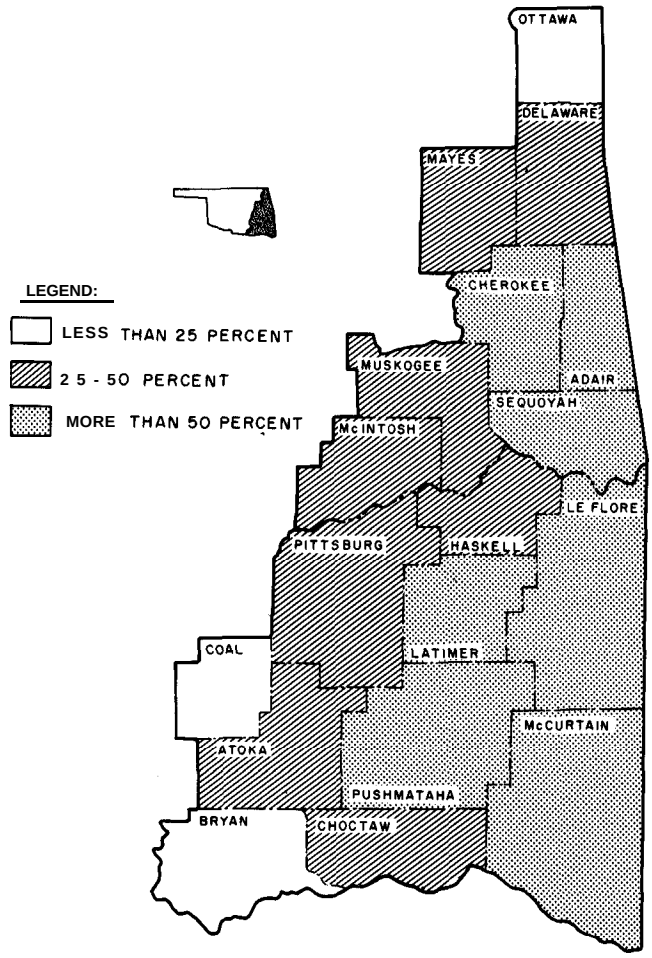

Figure *3.-Proportion of land area in forest, east Oklahoma, 1986.*

The decline in timberland acreage intensified between 1966 and 1976. The last survey showed only 4,323 thosuand acres of timberland, a la-percent decline for the lo-year inter-survey period (Murphy 1977). Most of the losses were in the western and northern parts of the region. A total of 660 thousand acres of timberland were cleared for agriculture and other uses, and only 78 thousand acres reverted to timberland.

The current survey reveals a strong reversal of this trend. Timberland area has increased by 10 percent to 4,748 thousand acres. Clearing of timberland totaled only 94 thousand acres between 1976 and 1986 (table III). Reversions of pasture and idle farmland to timberland added 409 thousand acres. Some forest land was reclassified from woodland (formerly called "unproductive forest") to timberland. With the exception of Bryan County, most of the increase in timberland occurred in the easternmost counties (fig. 4).

Table II.-Area *oftimberland by forest type and resource region, east Oklahoma, 1986*

Forest type	Total	Forest resource region	
		Southeast	Northeast
		Thousand acres	
Loblolly-shortleaf	956.0	939.2	25.8
Oak-pine	757.3	719.2	38.1
Oak-hickory	2,597.1	1487.2	1,109.9
Oak-gum-cypress	358.8	297.9	60.9
Elm-ash-cottonwood	78.4	46.8	31.6
All types	4,747.5	3,481.2	1,266.3

Table *III.-Changes in timberland, east Oklahoma, 1976-1986*

Resource region	Total area[1]	Timberland	Net Change	Additions from: Total	Agriculture	Other	Diversions to: Total	Agriculture	Other
	Thousand acres								
Southeast	6,988.3	3,481.2	235.1	309.7	293.4	16.3	74.6	20.4	54.2
Northeast	3569.1	1,266.3	189.0	208.7	115.6	93.1	19.7	14.2	5.5
All regions	10,557.4	4,747.5	424.1	518.4	409.0	109.4	94.3	34.7	59.7

[1]United States Bureau of the Census, Land and Water Area of the United States. Includes urban, industrial, highway, noncommercial forest, water, rights-of-way, and other land uses.

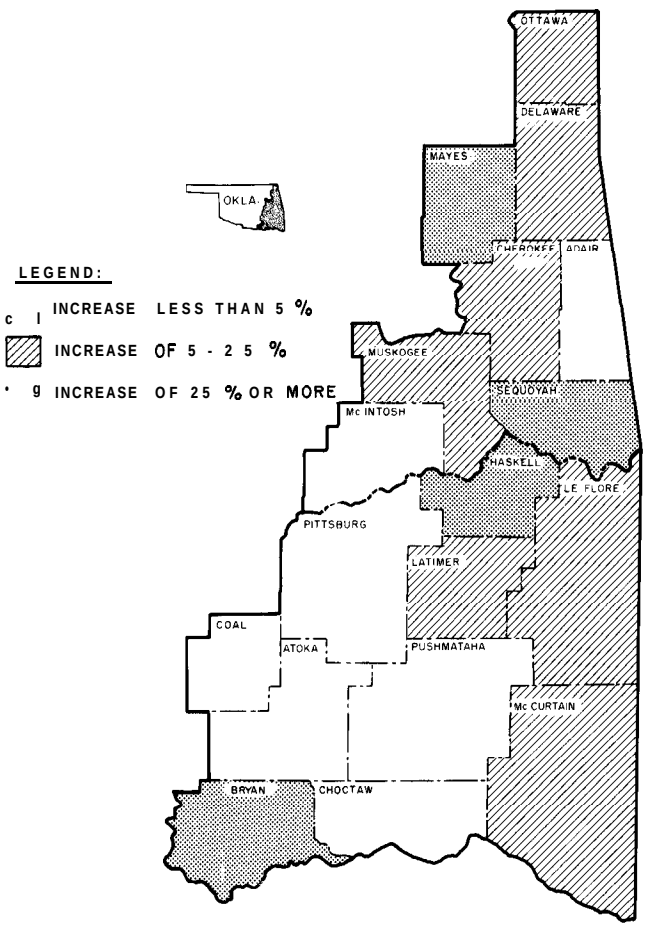

Figure 4.—*Change in timberland area, east Oklahoma, 1976-1986.*

Timberland Ownership

Public owners hold about 12 percent of east Oklahoma's timberland. There has been little change in the area of public timberland over the years. An apparent increase in National Forest timberland is the result of estimating the public forest area from survey sample plots rather than reporting the enumerated areas. The Ouachita National Forest reports an actual timberland area of about 214 thousand acres. All of the National Forest timberland is located in LeFlore and McCurtain Counties.

Forest industries own 22 percent of east Oklahoma's timberland. Most of the forest industry timberland is located in LeFlore, McCurtain, Pushmataha Counties. Forest industry and National Forest owners combined hold 58 percent of the timberland in these three counties. There has been little change in forest industry timberland area since 1976.

The area of timberland owned by farmers has increased by 18 percent since 1976. Most reversions were to the upland hardwood type.

Individual and corporate landowners also increased their timberland holdings. Miscellaneous private individuals comprise the largest and most diverse group of east Oklahoma timberland owners, controlling 38 percent of all timberland.

Species Composition and Forest Type

East Oklahoma's timberland is dominated by hardwoods that comprise, on average, 74 percent of the basal area. In the northeast region, 96 percent of the basal area is in hardwoods, and in the southeast, 66 percent of the basal area is in hardwoods. The most common hardwood species are white oaks, red oaks, hickories, and elms. The most common softwood is shortleaf pine, followed by loblolly pine. Loblolly pine is increasing in importance as pine plantations gradually replace natural pine stands. In 1976, loblolly pines accounted for only 5 percent of all pines. By 1986, loblolly pines accounted for 19 percent of all pines. Most of the decrease in shortleaf pines occurred in the 2-inch size class, while significant increases in numbers of loblolly pines occurred in the 2- through 8-inch classes.

Forest type is based on stocking plurality of individual species or species groups. Pine types, defined as stands with more than 50-percent stocking in pines, have increased from 847 thousand acres in 1976 to 956 thousand acres in 1986. In Oklahoma, the loblolly-shortleaf type is principally composed of the loblolly pine and shortleaf pine associations (table IV). The

Table IV.—*Area of timberland by detailed forest type and stand-size class, east Oklahoma, 1986*

Detailed forest type	All classes	Sawtimber	Poletimber	Sapling-seedling	Nonstocked
	Thousand acres				
Loblolly pine	274.6	33.8	51.4	189.4	0.0
Shortleaf pine	675.4	372.1	180.2	123.1	0.0
Shortleaf pine-oak	562.7	215.3,	202.3	139.1	6.0
Loblolly pine-hardwood	155.3	5.6	11.3	138.4	0.0
Oak hickory	354.6	35.2	64.5	86.6	168.2
Post oak-black oak	752.1	107.6	343.3	194.1	75.2
Oak-hickory-gums	1,439.9	221.9	651.0	427.4	139.6
Southern scrub oak	46.8	6.2	11.6	6.0	23.0
Oak-gum-cypress	142.0	71.8	23.5	34.9	11.8
Sugarberry-elm-ash	160.2	47.7	62.5	22.9	27.1
Overcup oak-water hickory	38.8	12.0	13.2	0.0	13.6
Sycamore-pecan-elm	49.7	19.2	11.5	19.1 ,	0.0
Other types	122.4	21.2	30.0	59.0	12.1
All types	4,747.5	1,169.6	1,661.3	1,440.0	476.6

shortleaf type accounts for 71 percent of all pine type acreage. When pine types are classified by stand-size class, the shift from shortleaf to loblolly pine becomes evident. For sawtimber and poletimber stand-sizes, shortleaf pine accounts for 87 percent of the pine stands. For sapling and seedling stand-sizes, shortleaf pine accounts for only 39 percent of the pine stands.

The oak-pine types contain 25-50 percent of stocking pines. Oak-pine acreage increased from 693 thousand acres to 757 thousand acres between surveys. Some of the young oak-pine was regenerated artifically and will likely shift to the pine plantation category after a few years. Hardwoods often dominate the stocking in young pine plantations until the pine seedlings attain dominance naturally or as a result of hardwood stocking control. A total of 173 thousand acres of oak-pine type showed evidence of artificial regeneration.

The pine and oak-pine types combined show the location and relative density of east Oklahoma's softwood resource (fig. 5). Nearly all of the softwood is concentrated in four southeastern counties and a surrounding fringe of five counties.

The oak-hickory type contains less than 25-percent stocking of pines. Oak-hickory has increased the most between surveys, from 2,357 to 2,597 thousand acres. The oak-hickory type is composed mainly of the oak-hickory, post oak-black oak, and oak-hickory-gum associations. Some of the oak-hickory, 80 thousand acres, shows evidence of artificial pine regeneration.

The bottomland hardwood types, principally the oak-gum-cypress and sugarberry-American elm-green ash associations, changed little between surveys. The total area in 1986 was about 437 thousand acres.

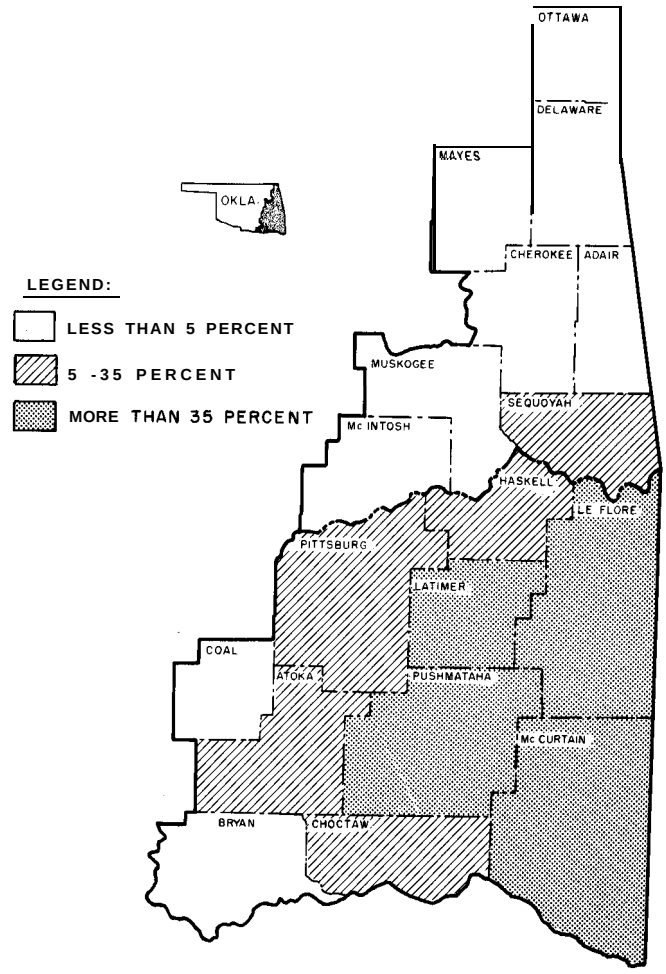

Figure 5.—*Proportion of timberland classified as pine or oak-pine forest type, east Oklahoma, 1986.*

In summary, the major species shift involves the gradual replacement of shortleaf pine with loblolly pine in intensively-managed pine plantations. For all forest types, the average showing evidence of artificial regeneration jumped from 111 thousand acres in 1976 to 517 thousand acres in 1986.

Stand Structure and Age

Some significant shifts appeared in stand-size class distributions since the last survey. Public timberland has shifted to the larger size classes (fig. 6). Forest industry holdings, well-balanced in 1976, now have more than half of all timberland classified as nonstocked or sampling seedling stand sizes. This shift follows intensive harvesting over the past decade. Timberland held by farmer and miscellaneous private owners showed a significant decrease in the area of sapling-seedling stands, and increases in all other classes. This reflects maturing timber in older stands, and the increase in cropland reversions.

The current age-class distribution tells much the same story (table V). For forest industry owners, 41 percent of all timberland has stands less than 10 years old. Timberland held by other private owners tends to be more evenly distributed among age classes through age 60, although there is a noticeable dip in the 21-30 year age class.

The age-class distribution by forest type and stand origin shows how the pine resource is shifting to planted instead of natural pine (table VI). For pine and oak-pine timberland less than 10 years old, 85 percent of the stands showed evidence of artificial regeneration. The large acreage of hardwood less than 10 years old has resulted from increased reversions and lack of adequate pine regeneration after harvest.

Despite an increasing acreage of young pine stands, the number of 2-inch softwoods has dropped sharply since 1976 (fig. 7). A healthy increase in the 4- and 6-inch classes, plus a good regeneration record (see later discussion), indicates that the effect of the decline in 2-inch softwoods may be negligible by the next survey. But should this trend continue, softwood timber production could decline rapidly. The 8- and lo-inch diameter classes showed declines that are the result of intensive softwood timber harvesting.

The changes in the hardwood diameter distribution show the aging of most hardwood stands (fig. 8). The large acreage of reverting pasture is still poorly stocked and has not yet had time to reverse the trend of declining numbers of small hardwoods.

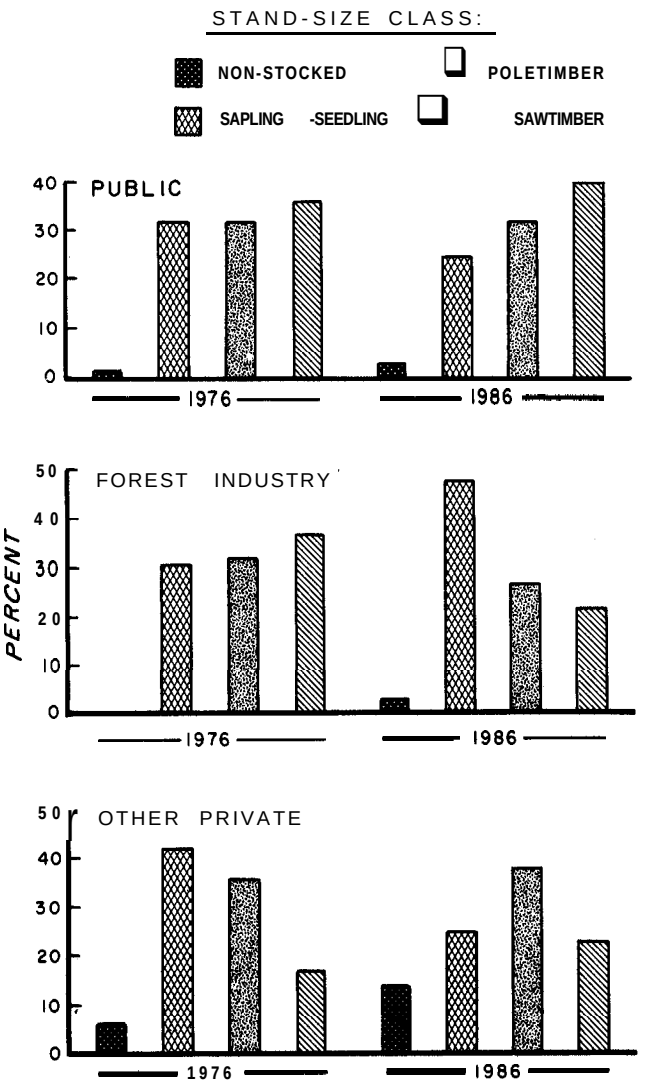

Figure *C-Proportion of timberland by stand-size class and survey date, by owner, east Oklahoma, 1986.*

Table *V.-Area of timberland by age class[1] and owner, east Oklahoma, 1986*

Age class	All owners	Public	Forest industry	Other private
	Thousand acres			
0-10	1,221.5	112.0	426.5	683.0
11-20	699.8	72.3	148.4	479.1
21-30	397.6	53.2	76.4	268.0
31-40	688.7	75.3	128.5	464.9
41-50	841.8	109.3	162.5	570.0
51-60	477.9	84.8	51.7	341.4
61-70	166.9	17.3	40.5	109.1
71-80	114.3	29.2	6.0	79.1
81-90	51.0	12.1	0.0	38.9
90+	88.3	19.8	6.6	62.9
All ages	4,747.5	585.3	1,046.0	3,116.2

[1]Mixed-age stands were given the average age of the dominant stand-size class.

Table *VI.-Area of timberland by age* class[1], *forest type, and stand origin, east Oklahoma, 1986*

Age class	Planted pine	Natural pine	Planted oak-pine	Natural oak-pine	Planted hardwood[2]	Natural hardwood
	Thousand acres					
O-10	179.0	23.9	150.4	35.5	80.0	752.7
11-20	73.9	82.9	22.5	91.0	0.0	429.5
21-30	11.3	119.3	0.0	105.5	0.0	161.5
31-40	0.0	215.8	0.0	125.4	0.0	347.5
41-50	0.0	136.3	0.0	100.8	0.0	604.8
51-60	0.0	59.5	0.0	58.3	0.0	360.1
61-70	0.0	36.1	0.0	18.3	0.0	112.5
71-80	0.0	11.6	0.0	24.4	0.0	78.3
81-90	0.0	0.0	0.0	19.3	0.0	31.6
90+	0.0	6.5	0.0	6.0	0.0	75.8
All ages	264.1	691.8	172.9	584.4	80.0	2,954.3

[1]Mixed-age stands were given the average age of the dominant stand-size class.

*Most planted hardwood represents pine plantations in which hardwoods comprise more than 75 percent of the stocking.

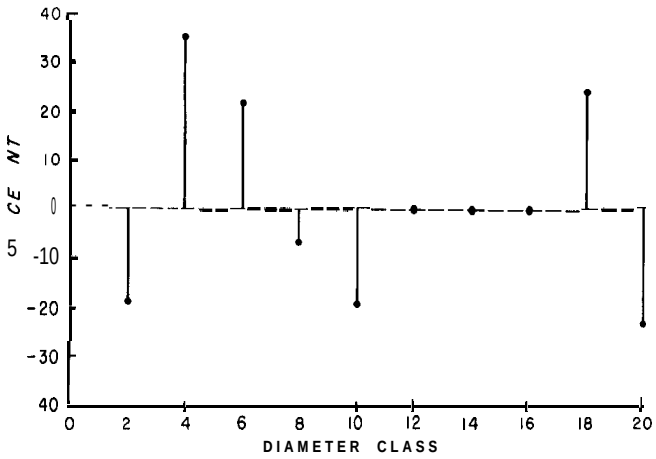

Figure 7.—*Change in number of live softwood trees between surveys, east Oklahoma, 1976-1986.*

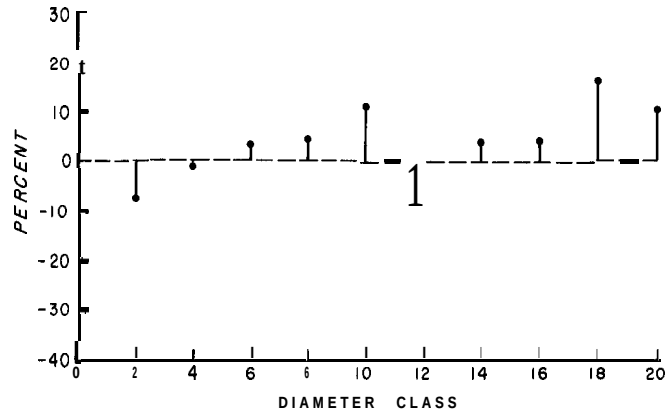

Figure *8.-Change in number of live hardwood trees between surveys, east Oklahoma, 1976-1986.*

Timber Volume

East Oklahoma's timberland contains 1 .0 billion cubic feet of softwood timber, about the same as reported in 1976. The volume of softwood growing stock in the 6-inch and 12-inch classes has increased, while volume in most other classes has decreased (fig. 9). There has been some shift in volume from shortleaf pine to loblolly pine (fig. 10). Very little change occurred in the distribution of softwood timber volume among timber classes (fig. 11).

Forest industry owned more than half of east Oklahoma's softwood growing stock in 1976, but by 1986 the proportion dropped to 35 percent. Losses in softwood volume by forest industry were offset by gains in the other ownership classes. Of four counties with the most pine and oak-pine timberland, only Latimer County showed an increase in the volume of softwood growing stock.

The volume of hardwood growing stock increased by 16 percent during the inter-survey period. The increase involved all diameter classes, but was especially pronounced in the 8- and lo-inch poletimber classes (fig. 12). Oaks and hickories gained the most volume (fig. 10). The volume of hardwood growing stock increased in all timber classes (fig. 11).

Among owners, forest industry showed a 26 percent decline in hardwood growing stock, while other private owners showed a 29 percent increase. Other private owners control 71 percent of all hardwood growing stock in east Oklahoma. Much of the hardwood is located in the same four-county area that has most of the softwood growing stock, but some other counties, notably Cherokee and Adair, also contain significant volumes of hardwood growing stock.

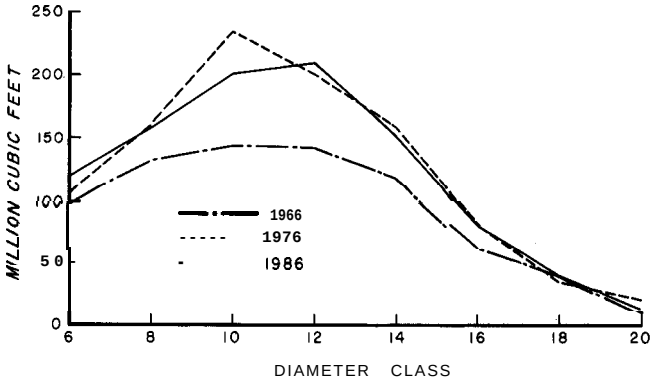

Figure 9.-Volume *of* ***softwood growing stock by tree diameter*** **class,** ***east Oklahoma, 1966-1986.***

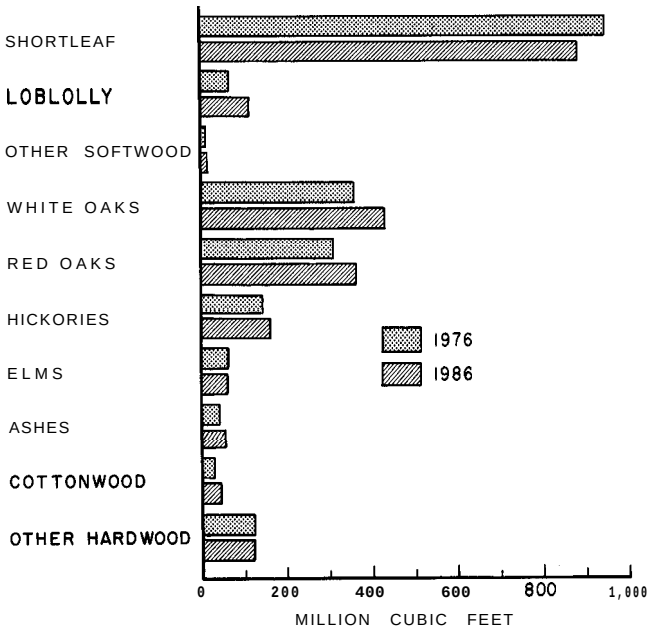

Figure lO.-Volume *of* ***growing stock by species, east Oklahoma, 1976 and 1986.***

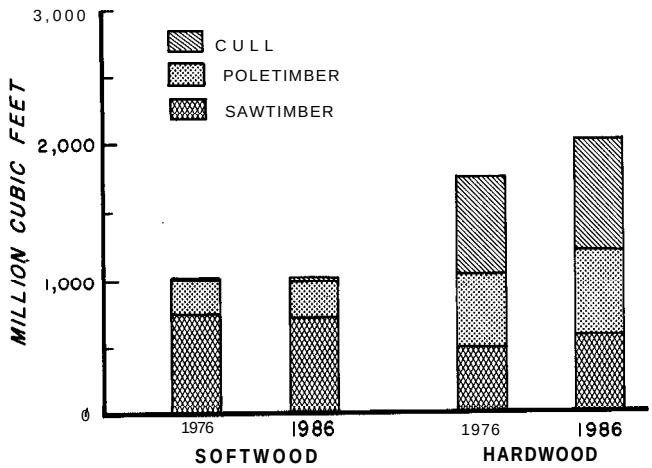

Figure Il.-Volume *of* ***growing stock by class*** *of* ***timber, east Oklahoma, 1976 and 1986.***

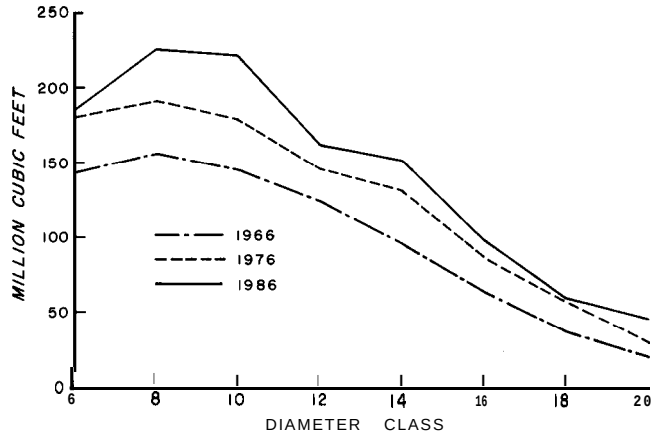

Figure 12.-Volume *of* ***hardwood growing stock by tree diameter class, east Oklahoma, 1966-1986.***

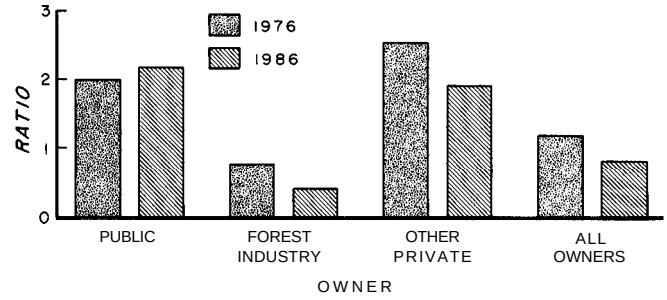

Figure 13.—*Ratio* *of* *softwood growth to removals by ownership class, east Oklahoma, 1976 and 1986.*

Growth, Removals, and Mortality

Average net annual growth of softwood growing stock has declined from 56 to 46 million cubic feet since 1976. Almost all of the decline occurred on forest industry timberland. Other private owners showed a slight increase in average net annual growth.

While net growth was declining, annual softwood removals have increased from 47 to 54 million cubic feet. Most of the increase was on forest industry timberland. Declining net growth and increasing removals of softwood have resulted in an unfavorable growth and drain situation (fig. 13). The softwood growth/removals ratio has dropped below 1.0 for all owners combined, chiefly because of the very low ratio on forest industry timberland.

Although the total volume of softwood growing stock was essentially unchanged between 1976 and 1986, the average rate of change was negative (table (VII). Growth has been declining and removals increasing over the period. Should these conditions persist, a substantial decline in softwood inventory would be inevitable.

Table VII.- *Components of annual change in the volume of growing stock by species group and resource region, east Oklahoma, 1976-1986*

Resource region	Species group	Survivor growth	Ingrowth[1]	Growth on removals	Growth on mortality	Cull increment	Mortality	Timberland removals	Landclearing removals	Net change
		Million cubic feet per year								
Southeast	Softwood	31.6	7.9	8.8	0.8	-0.8	-3.0	-50.5	-1.6	-6.8
	Hardwood	24.6	5.7	3.4	2.4	-4.0	-11.1	-22.4	-2.6	-4.0
	Total	56.2	13.5	12.2	3.3	-4.9	-14.0	-72.9	-4.2	-10.8
Northeast	Softwood	1.4	0.1	0.7	0.0	0.0	-0.1	-3.7	-0.0	-1.6
	Hardwood	17.9	2.5	0.6	0.9	-0.4	-3.6	-2.7	-2.4	12.8
	Total	19.3	2.6	1.3	1.0	-0.3	-3.7	-6.4	-2.4	11.4
East Oklahoma	Softwood	33.0	8.0	9.5	0.8	-0.8	-3.1	-54.2	-1.6	-8.4
	Hardwood	42.5	8.2	4.0	3.3	-4.4	-14.7	-25.1	-5.0	8.8
	Total	75.5	16.1	13.5	4.3	-5.2	-17.7	-79.3	-6.6	0.6

[1]Includes ongrowth trees

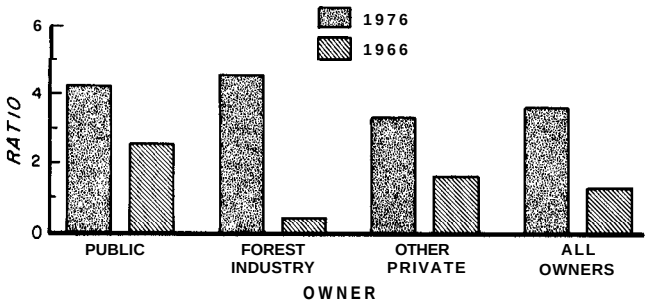

Figure *14.-Ratio of hardwood growth to removals by ownership class, east Oklahoma, 1976 and 1986,*

Average net annual growth of hardwood growing stock has plunged from 61 million cubic feet to 39 million cubic feet. All ownership classes shared some of the decline.

Hardwood removals increased substantially, from an annual rate of 17 million cubic feet in 1976 to 30 million cubic feet in 1986. Declining growth and increasing removals have caused a steep drop in the growth/removal ratio (fig. 14). The ratio declined for all ownership groups, but only forest industry has a ratio below 1.0.

One factor contributing to a declining net annual growth is an increase in mortality. For all species, average annual mortality nearly doubled, from 9 million cubic feet to 17 million cubic feet. The principal causes of mortality were disease and weather.

Net annual growth has also been slowed by an increase in the number of rough and rotten trees, and by an increase in the average of poorly-stocked timber stands. In 1976, 2.1 million acres or 48 percent of all timberland were less than 60 percent stocked with growing-stock trees. By 1986, 2.9 million acres or 60 percent of all timberland were less than 60 percent stocked with growing-stock trees. Most poorly stocked stands are in the hardwood types.

Timberland Disturbance and Regeneration

Almost one-third of east Oklahoma's timberland, excluding additions, was significantly disturbed since the last survey (table VIII). The most common disturbance was partial cutting, followed by clearcuts and other management practices. Clearcuts were most common on forest industry timberland, while partial cutting was the most common disturbance on other private timberland.

The pine and oak-pine types were most likely to be disturbed (table (IX). More than half of all pine type timberland was disturbed, and 40 percent of the oak-pine timberland was disturbed. Clearcutting was most often practiced in pine and oak-pine timberland. Partial cutting affected all types, but affected the most acreage in the upland hardwood type group.

Despite heavy cutting, most pine stands retained adequate stocking (table X). About three-fourths of all harvested pine stands were in the highest pine stocking class. Forest industry owners were a little more successful in regenerating pine than other private owners. Most hardwood stands were not regenerated to pine. Those that were planted with pine roughly offset the pine stands that were not adequately regenerated.

TIMBER MANAGEMENT OPPORTUNITIES FOR EAST OKLAHOMA

East Oklahoma's timberland is currently producing timber at only 30 percent of maximum potential (table XI). Most timberland fails to achieve full growth potential for two reasons: poor stocking, and a high proportion of cull tree stocking. To some extent these conditions are inherent to Oklahoma's timberland because of the prevalence of low-productivity sites, especially north and west of the coastal plain counties. In addition, standards used by the forest survey to measure stocking adequacy may not be appropriate for timberland in the northern and western counties of east Oklahoma because the standards are based on average stand conditions across the South.

Table VIII.-Area *of timberland by disturbance class and ownership class,* east *Oklahoma, 1986*

Disturbance class	All owners	Public	Forest industry	Other private
	Thousand acres			
No disturbance	2,862.3	342.4	452.4	2,067.4
Clearcut	456.4	36.4	374.0	46.0
Partial cut	660.7	55.3	123.2	482.2
Other management	171.8	48.3	79.5	44.0
Natural disturbance	74.5	6.6	11.3	56.7
Additions to timberland	521.8	96.3	5.6	419.9
All classes	4,747.5	585.3	1,046.0	3,116.2

Table *IX.-Area of timberland by disturbance class and past forest type, east Oklahoma, 1986*

Disturbance class	All types	Pine	Oak-pine	Upland hardwood	Bottomland hardwood
	Thousand acres				
No disturbance	2,862.3	436.4	431.3	1,688.0	306.4
Clearcut	456.4	206.6	151.6	82.0	16.4
Partial cut	660.7	175.9	90.5	307.5	86.8
Other management	171.8	57.9	40.6	67.4	6.0
Natural disturbance	74.5	5.6	0.0	63.3	5.6
All classes[1]	4,225.7	882.4	714.0	2,208.2	421.0

[1] Excluding reversions

Table X.-Area *of timberland harvested' by ownership class,* past *forest type, and pine-stocking class², east Oklahoma, 19761986*

Ownership class and past forest type	All classes	Pine stocking class		
		Low	Meduim	High
	Thousand acres			
Public				
Pine types	35.7	6.0	12.0	17.7
Oak-pine	25.0	6.0	6.0	12.9
Hardwood types	31.0	19.4	6.0	5.6
Total	91.7	31.4	24.0	36.2
Forest industry				
Pine types	254.4	22.5	29.2	202.7
Oak-pine	150.4	28.6	58.4	63.4
Hardwood types	92.4	28.9	34.6	28.9
Total	497.2	80.0	122.2	295.0
Other private				
Pine types	92.4	18.2	12.0	62.2
Oak-nine	66.7	36.7	30.0	0.0
Hardwood types	369.1	356.5	12.6	0.0
Total	528.2	378.9	54.6	62.2
Ail owners				
Pine types	382.5	46.7	53.2	282.6
Oak-nine	242.1	71.3	94.4	76.3
Hardwood types	492.5	404.8	53.2	34.5
Total	1,117.1	522.8	200.8	393.4

'Includes clearcuts and partial cuts.

²Low indicates O-30 percent stocked pine. Medium indicates 30-60 percent stocked with pine. High indicates 60+ percent stocked with pine.

Table *XI.-Periodic annual netgrowth and potential productivity' of timberland by resource region, east Oklahoma, 1976-1986*

Resource region	Potential productivity	Net growth	Growth as percent of potential
	Cubic feet per acre per year		*Percent*
Southeast	62.7	18.6	30
Northeast	52.1	15.6	30
East Oklahoma	60.1	17.8	30

'Based on site class.

As mentioned earlier, 60 percent of all timberland has less than 60 percent stocking of growing-stock trees, the minimum threshold for adequate stocking. Furthermore, 76 percent of all timberland has more than 30 percent stocking of rough and rotten trees. The situation is much worse for hardwoods than for softwoods: 11 percent of all softwood basal area is classified as rough or rotten, while 57 percent of all hardwood basal area is in rough and rotten trees.

Management opportunities for east Oklahoma pine timberland were computed from data on stocking of growing-stock trees, stocking of cull trees, stand-size class, timber volume, presence of damaged and offsite trees, and presence of inhibiting vegetation. Key stocking thresholds are 60 percent for adequate stocking with growing-stock trees, and 30 percent for significant competition from cull trees.

Most pine plantations are in relatively good shape and require no treatment (table XII). The most common prescriptions would be control of competing vegetation, followed by regeneration of some poorly-stocked stands. Natural pine stands are in similar condition on the average, except that harvest would be recommended for those stands carrying high volume.

The mixed pine-hardwoods tend to be poorly stocked or stocked with cull trees. Only 28 percent of the mixed stands fell in the "no treatment" category. Most of the 351 thousand acres with a regeneration treatment opportunity actually have between 30 and 60 percent stocking of growing-stock trees. Crop tree release might be more appropriate for marginally-stocked oak-pine and there would be a high probability that these stands would attain full stocking over time (Birdsey and Pitcher 1986).

If the criteria for pine management opportunities were used for hardwoods, most stands would require regeneration or stocking control because of the low average stand density and high site occupancy by rough and rotten trees. About 65 percent of all hardwood stands is poorly stocked, and another 23 percent has significant competition from cull trees. But full stocking according to forest survey standards may be an unrealistic expectation. Furthermore, individual trees tend to have poorer form with low stocking. It might be more realistic to manage the current hardwood forests for products other than the traditional saw log.

Because of the uncertainty about the applicability of management opportunity criteria, no specific recommendations for east Oklahoma's hardwoods will be made in this report. Nevertheless, it is extremely important to note that nearly 1.3 million acres have hardwood stands less than 20 years old. Although these stands have high cull tree occupancy, the average tree has not yet reached a large size. There may now be some excellent opportunities to control stand composition, both species and quality, at an early age.

TIMBER RESOURCE OUTLOOK

East Oklahoma's increasing timberland base sends a strong signal that forestry will continue to be important. Timberland shifts since 1966 have mostly involved hardwood types. The pine region has been less volatile but there are prospects for large acreage shifts among owners as forest industries restructure their timberland holdings. Little permanent clearing of pine timberland has been made, most pine harvests are followed by adequate regeneration.

Due to very heavy cutting in recent years, coupled with currently low growth rates, the volume of softwood growing stock is expected to decline slightly. Removals will fall off rapidly, however, as few pine stands with harvest opportunities still remain. After a short-lived decline, volume and growth should increase rapidly as the current large area of young pine plantations reaches the merchantability threshold. An increasingly rapid shift from natural shortleaf pine to plantation-grown loblolly pine is also expected.

The hardwood outlook is both less stable and less optimistic. Land-use shifts are difficult to predict, but the current agricultural crisis largely precludes significant land clearing for crops in the near future.

Recent declines in the numbers of small hardwood trees, and increases in the larger size classes, indicate that much of the hardwood resource is maturing. Declining volumes in smaller trees will counteract increases in the larger trees. Removals will not likely go up much because so much of the timberland is poorly stocked or stocked with poor-quality trees. The current balance between growth and removals will probably be maintained for some time; thus, volume should stabilize at current levels.

At some point, the large acreage of hardwoods less than 20 years old will become a significant factor. Growth and volume will then increase rapidly as these young stands begin to contain merchantable-size timber.

Table *XII.-Area of timberland by management opportunity class for pine forest types, 'east Oklahoma, 1986*

Management opportunity class	All pine types	Forest type		
		Planted pine	Natural pine	Oak pine
	Thousand acres			
Regeneration	472.8	28.6	93.6	350.6
Conversion	23.0	11.7	0.0	11.3
Poletimber thinning	23.6	5.6	18.0	0.0
Other stocking control	310.2	34.6	99.9	175.7
Harvest	46.8	0.0	41.2	5.6
Salvage	18.2	0.0	18.2	0.0
No treatment	818.7	183.7	421.0	214.0
All classes	1,713.2	264.1	691.8	757.3

TIMBER PRODUCTS OUTPUT.

Oklahoma's eastern forests supply more than 50 million cubic feet of timber products per year to the forest products industry. Although most of the timber product output is comprised of softwoods, the proportion of softwoods to the total output has been declining, falling from 80 percent in 1975 to 75 percent in 1984. Almost all of the softwood harvest originates from the southestern counties of the State, while the hardwood harvest is distributed among the eastern counties of the State. Saw logs and pulpwood are by far the most common products harvested from Oklahoma's eastern forests, accounting for more than three-quarters of the annual harvest. Veneer logs, poles, posts, and miscellaneous products make up the remainder of the annual harvest.

Saw Logs

Oklahoma's saw-log production has stabilized at an annual rate of about 31 million cubic feet (fig. 15). Although the majority of the saw-log harvest is comprised of softwoods, hardwood saw-logs have been gaining favor. Between 1975 and 1984, the proportion of the total saw-log harvest represented by softwoods fell from 82 percent to 71 percent. Shortleaf pine is the predominant softwood species harvested, and the oaks account for the majority of the hardwood harvest. Most of Oklahoma's saw-log production is processed into lumber within the State. A few large mills process more than 85 percent of all saw-log receipts. These large mills process mostly pine saw-logs, while the smaller sawmills mainly process hardwoods. However, the proportion of hardwoods being processed by large sawmills has been increasing, climbing from 8 percent of total saw-log receipts in 1975 to 22 percent in 1984.

Pulpwood

Only a small number of pulpmills draw roundwood from Oklahoma's eastern forests. Consequently, any changes in the pulpwood consumption rate of one or more of these mills (caused by pulping capacity increases, market conditions, labor relations, etc.) will have a major impact upon the yearly production of pulpwood from Oklahoma, as depicted in figure 16. Although the State's pulpwood production has fluctuated over the survey period, on the whole, pulpwood production increased by 65 percent between 1975 and 1985. Another and probably more significant trend has been the increasing importance of hardwoods in meeting the demand for pulping fiber. Between 1975 and 1985, the proportion of hardwood furnish to the total pulpwood production almost doubled, increasing from 16 percent to 29 percent, while the actual volume of hardwood furnish tripled.

Other Products

Oklahoma's production of veneer logs has experienced a general downward trend. Between 1975 and 1984, veneer-log production fell by 18 percent (fig. 15). Almost all of the veneer log production is comprised of softwoods, with minor amounts of hardwood, mostly

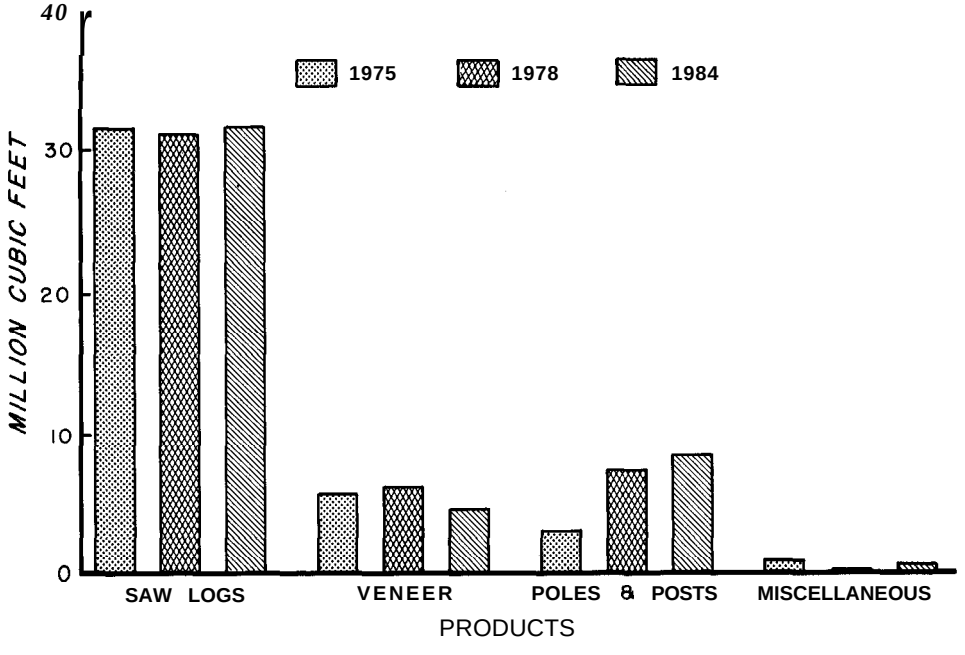

Figure *15.-Roundwood production by product, east Oklahoma, 1975-1984.*

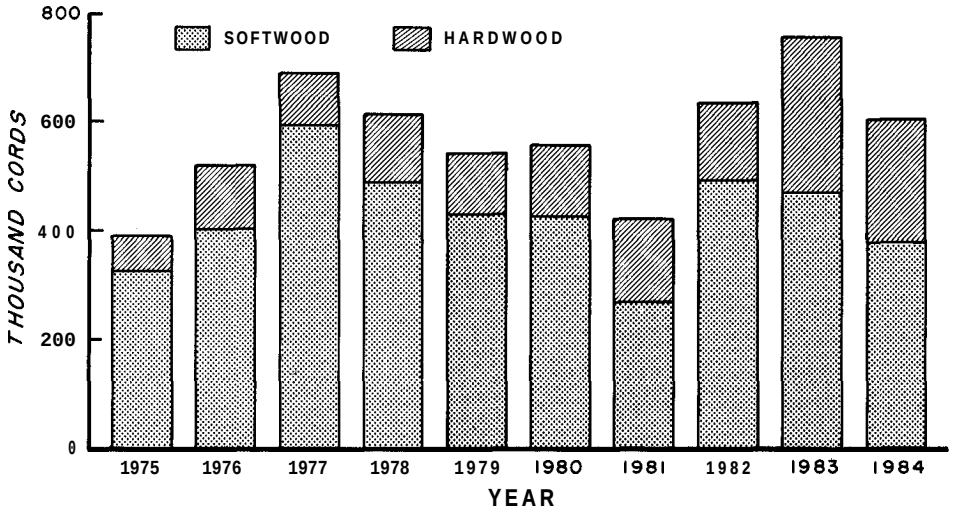

Figure 16.—*Pulpwood production, east Oklahoma, 19751984.*

pecan and walnut, shipped out of state for processing. In contrast to the drop in veneer-log production, pole and post production between 1975 and 1984 tripled (fig. 15). In the same time period, the amount of the pole and post harvest retained and processed within the State increased sixfold. All of the pole and most of the post production is comprised of softwoods. The output of miscellaneous products, such as furniture and handle stock, charcoal wood, and excelsior bolts, has been a relatively minor component of Oklahoma's timber harvest, representing about 1 percent of the total timber product output (fig. 15).

Wood Residues

In converting roundwood into primary products, Oklahoma's forest industries have been generating increasing quantities of wood residues. Between 1975 and 1984, wood residue generation increased 68 percent from 28 to 47 million cubic feet. This is due in part to: advances in technology (chip-n-saws, merchandisers, and onsite chippers), increasing acceptance of wood residues as a source of pulping fiber, and inconsistent responses to the annual pulpwood production surveys. Coarse residues such as slabs, edgings, and cull pieces comprise more than three-quarters of the total wood residue production. Fine residues such as sawdust and shavings make up the remainder. Approximately 95 percent of all wood residues are converted into byproducts. The majority of coarse residues are converted into pulping fiber, while the majority of fine residues are utilized as fuel. In addition, 90 percent of the bark generated by Oklahoma's primary forest industries is also burned as fuel.

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APPENDIX

Survey Methods

Forest resource statistics were obtained by a sampling method employing a forest-nonforest classification on aerial photography and on-the-ground measurements of trees at sample 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 acreage is based on the photointerpretation of recent aerial photography using dot counts on specific plot locations as to a forest or nonforest classification. These dot counts yield the proportion of forest to nonforest areas in each county. Forest area changes are then determined from field observations of permanent 3- by 3-mile grid (measurement plots) locations. Additional plots (intensification plots), for classifying points as to forest or nonforest condition only, are used further to reduce the sampling error for forest area. The field classifications of these two types of plots (3x3 and intensification) are used to correct photointerpretation errors and adjust the county timberland acreage estimate that comes from the dot counts associated with each plot location in the county. The intensity level of the 3- by 3-mile grid layout of permanent measurement plots gives each sample plot an expansion factor representing, on average, 5,760 acres per plot.

Volume estimates come entirely from the 3- by S-mile grid permanent sample plots and measurements of individual trees on these plots. The plots established by the prior survey were remeasured to determine the elements of change. In Oklahoma, 10 points were measured at each plot location. Trees 5.0 inches in diameter and larger were selected with a 37.5 factor prism, thus each tree selected with the prism represented 3.75 square feet of basal area. Trees smaller than 5.0 inches in diameter were tallied on a 1/275 acre circular plot fixed around the first 3 points of the 10-point cluster.

Forest- survey uses a satellite point system with a large factor prism to get a representative sample of stand conditions at each plot location. This eliminates the effect that vegetation clumping and open gaps would induce if only one point or one fixed plot were used at each plot location.

Volumes in Oklahoma were derived from deterministic measurements of trees on all sample locations. These deterministic measurements include diameter at breast height, total height, bole length, log length, and four upper stem diameters. Volumes for these trees were computed using Smalian's formula. Volume equations were developed for seven species groups and these equations were used to estimate volumes at time of removal or death for trees that did not survive the remeasurement period, and to estimate the past volume for nongrowth trees (see definitions). Procedures for estimating growth are documented elsewhere (May 1988).

Reliability of the Data

A relative standard of accuracy has been incorporated into the forest survey. This satisfies user demands, eliminates as much as possible any elements of error-either human or from instrumentation-and permits the control of costs within prescribed economic limits.

The first type of error, estimating error, involves three basic areas: (1) biased error, caused by instruments not properly calibrated, (2) compensating error, caused by instruments of moderate precision and (3) accidental error, caused by human error in measuring and compiling. All of these are held to a minimum by a system that incorporates training, check plots, and an edit (consistency) check. Field personnel undergo training for 3 to 4 months under the guidance of field-experienced personnel. Field work is checked by supervisors. In Oklahoma 4 percent of the plots were field checked for errors. Editing checks in the office screen out logical and data entry errors on all plots. It is not possible to evaluate estimating error statistically but

Table *XIII.-Sampling errors for estimates of total timberland area, volume, net annualgrowth (1976-1986), and* annual *removals (1976-1986), east Oklahoma.*

Item	Total	Unit	Percent sampling error
Timberland area	4,747.5	Thousand acres	0.7
Growing stock			
Volume	2,219.1	Million cubic feet	4.3
Net annual growth	84.4	Million cubic feet	5.2
Annual removal	83.9	Million cubic feet	7.2
Sawtimber			
Volume	6,688.5	Million cubic feet	5.5
Net annual growth	311.4	Million cubic feet	7.7
Annual removals	285.7	Million cubic feet	8.6

Table XIV.—*Sampling error to which estimates are liable, 2 chances out of 3, east Oklahoma, 1986*

Sampling error[1]	Timberland area	Growing stock			Sawtimber		
		Volume	Net annual growth	Annual removals	Volume	Net annual growth	Annual removals
Percent	*Thousand acres*	*Million cubic feet*			*Million board feet*[2]		
1.0	2,326.3	. . .	. . .	. . .	. . .	. . .	. . .
2.0	581.6	. . .	. . .	. . .	. . .	. . .	. . .
3.0	258.5	. . .	. . .	. . .	. . .	. . .	. . .
4.0	145.4	. . .	. . .	. . .	. . .	. . .	. . .
5.0	93.1	1,641.2	. . .	. . .	. . .	. . .	. . .
10.0	23.3	410.3	22.8	43.5	2,023.3	184.6	211.3
15.0	10.3	182.4	10.1	19.3	899.2	82.1	93.9
20.0	5.8	106.2	5.7	10.9	505.8	46.2	52.8
25.0	3.7	65.6	3.6	7.0	323.7	29.5	33.8

[1]By random sampling formula.
[2]International 1/4-inch rule.

the Forest Inventory and Analysis Unit holds it, to a minimum by adequate training, experienced supervision, 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 2 out of 3 that if the results of a 100 percent census were known the sample results would be within the limits indicated.

Estimates smaller then State totals will have resultant larger sampling errors. The smaller the area examined, the larger the sampling error. In addition, as area or volume totals are stratified by forest type, species, diameter class, ownership, or other subunits, the sampling error increases and is greatest for the smallest divisions. The magnitude of this increase is depicted in table XIV and shows the sampling error to which the estimates are liable, 2 chances out of 3.

Definition of Terms

Forest Land Classes

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, deferred timberland; and noncommercial categories: productive-reserved forest land, unproductive forest land.

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

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

Productive-Reserved Forest Land-Productive public forest land withdrawn from timber utilization through statute or administrative regulations.

Unproductive Forest Land-Forest land incapable of yielding crops of industrial wood because of adverse site conditions.

Tree Classes

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

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

Growing Stock Trees-Live trees of commercial species classified as sawtimber, poletimber, sapling, and seedlings. Trees must have a 12-foot butt log now or prospectively to be classed as growing stock.

Rough Trees-Live trees of commercial species that are unmerchantable for saw logs currently or potentially because of roughness or poor form in the butt log. Also included are all live trees of noncommercial species.

Rotten Trees-Live trees of commercial species that are unmerchantable for saw logs currently or potentially because of rot deduction in the butt log.

Cull Trees--Rough or rotten trees.

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

Softwoods-Coniferous trees, usually evergreen, having needle or scalelike leaves.

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

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

Forest Types

Longleaf-Slash Pine-Forests in which longleaf or slash pine, singly or in combination, comprise a plurality of the stocking. Common associates include other southern pines, oak, and gum.

Loblolly-Shortleaf Pine-Forests in which pine and eastern redcedar (except longleaf or slash pine), singly or in combination, comprise a plurality of the stocking. Common associates include oak, hickory, and gum.

Oak-Pine-Forests in which hardwoods (usually upland oaks) comprise a plurality of the stocking, but in which softwoods, except cypress, comprise 25-49 percent of the stocking. Common associates include gum, hickory, and yellow-poplar.

Oak-Hickory—Forests in which upland oaks or hickory, singly or in combination, comprise a plurality of the stocking except where pines comprise 25-50 percent, in which case the stand would be classified oak-pine. Common associates include yellow-popular, elm, maple, and black walnut.

Oak-Gum-Cypress-Bottomland forests in which tupelo, blackgum, sweetgum, oaks, or southern cypress, singly or in combination, comprise a plurality of stocking except where pines comprise 25-50 percent, in which case the stand would be classified oak-pine. Common associates include cottonwood, willow, ash, elm, hackberry, and maple.

Elm-Ash-Cottonwood-Forest in which elm, ash, cottonwood, singly or in combination comprise a plurality of the stocking. Common associates include willow, sycamore, beech, and maple.

Nontyped-Timberland currently unoccupied with any live trees or seedlings, e.g., very recent clearcut areas.

Dimension Classes of Trees

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

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

Saplings-Trees 1 .O inch to 4.9 inches in d.b.h.

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

Rough, Rotten, and Salvable Dead Trees-See "tree classes."

Stand-Size Classes

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

Poletimber Stands--Stands at least 16.7 percent stocked with growing-stock trees, half or more of this stocking in sawtimber or poletimber trees, and with poletimber trees, and with poletimber stocking exceeding that of sawtimber stocking.

Sapling-Seepling Stands-Stands at least 16.7 percent stocked with growing-stock trees, more than half of this stocking in saplings or seedlings.

Nonstocked Stands-Stands less than 16.7 percent stocked with growing-stock trees.

Stocking

Stocking is a measure of the extent to which the growth potential of the site is utilized by trees or preempted byvegetation cover.Stocking is determined by comparing the stand density in terms of number of trees or basal area with a specified standard. Therefore, full stocking is 100 percent of the stocking standard.

Defined below are arbitrarily defined stocking categories.

Understocked-Stands 0 to 60 percent stocked.

Optimally stocked—Stands 60 to 100 percent stocked.

Overstocked-Stands greater than 100 percent stocked.

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 volume of sound wood in the bole of rough and rotten trees.

Volume of Growing Stock-Volume of sound wood in

the bole of sawtimber and poletimber trees from a 1-foot stump to a minimum 4.0-inch top outside bark or to the point where the central stem breaks into limbs. Rough, rotten, and noncommercial trees are excluded.

Volume of Sawtimber-Net volume of the saw-log portion of live sawtimber trees in board feet of the International rule (1/4-inch kerf). Net volume equals gross volume less deductions for rot, sweep, and other defects that affect use for lumber to the point where the central stem breaks into limbs. Rough, rotten, and noncommercial trees are excluded.

Volume of Timber-The volume of sound wood in the bole of growing stock, rough, rotten, and salvable dead trees 5.0 inches and larger in d.b.h. from stump to a minimum 4.0-inch top outside bark, or to the point where the central stem breaks into limbs.

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

Survivor Trees-Merchantable-and-in at time 1 (previous inventory) and time 2 (current inventory).

Ingrowth Trees-Submerchantable-and-in at time 1 and merchantable-and-in at time 2.

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

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

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

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

Ownership Classes

National Forest Land-Federal lands which have been legally designated as National Forests or purchase units, and other lands under the administration of the Forest Service, including experimental areas.

Other Federal Lund-Federal lands other than National Forests; lands administered by the Bureau of Land Management and Indian Lands.

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

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

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

Nonindustrial Private Land-Individual-Lands privately owned by individuals other than forest industry, farmer owned, or miscellaneous private corporations.

Nonindustrial Private Land-Corporate-Lands privately owned by private corporations other than forest industry and incorporated farms.

Miscellaneous Definitions

Agricultural Land-Agricultural land is land used primarily for the production of crops or livestock.

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

Cull Increment-The net volume in growing-stock trees that change tree class during a specified period.

D.b.h. (Diameter at breast height)-Tree diameter in inches, outside bark, measured at 4 1/2 feet above ground.

Diameter Classes-The 2-inch diameter classes extend from1 .0 inch below to 0.9 inches above the stated midpoint.Thus, 12-inch class included trees 11 .O inches through 12.9 inches d.b.h.

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

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

Plantations-Stands evidenced by regeneration from planting or seeding. Forest Survey categorizes plantations by forest type based upon plot tally.

Saw-Log Portion-That part of the bole of a sawtimber tree between a l-foot stump and the saw-log top.

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

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

Timber 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.

Tree Grade-The grade assigned to the entire log length of a sawtimber tree, which is based upon the grade of the butt-log portion (the first 16 feet) only. In

past surveys, a log grade was assigned to each upper log based upon log grade standards.

Upper-stem Portion-That part of the main stem or fork of a sawtimber tree above the saw-log top to a diameter outside bark of 4.0 inches to the point where the main stem or fork breaks into limbs.

Species List

Scientific and common names of tree species sampled in Oklahoma[1].

Commercial Species

Genus	Species	Common Name
Softwoods		
Juniperus	*viginiana*	eastern redcedar
Pinus	*echinata*	shortleaf pine
	taeda	loblolly pine
Taxodium	*distichum* var. *distichum*	baldcypress

Hardwoods

Genus	Species	Common Name
Acer	*barbatum*	Florida maple
	negundo	boxelder
	rubrum var. *rubrum*	red maple
	saccharinurn	silver maple
	saccharum	sugar maple
Betula	*nigra*	river birch
Carya	sp.	hickory
	aquatica	water hickory
	illinoensis	pecan
Cel tis	*laevigata*	sugarberry
	occidentalis	hackberry
Cornus	*florida*	flowering dogwood
Diospyros	*virginiana*	common persimmon
Fagus	*grandifolia*	American beech
Fraxinus	*americana*	white ash
	Pennsylvania	green ash
Gleditsia	*aquatica*	water locust
	triacanthus	honey locust
Gymnocladus	*dioicus*	Kentucky coffeetree
Ilex	*opaca*	American holly
Juglans	*nigra*	black walnut
Liquidambar	*styraciflua*	sweet gum
Maclura	*pomifera*	Osage-orange
Morus	*rubra*	red mulberry
Nyssa	*aquatica*	water tupelo
Plantanus	*occidentalis*	American sycamore
Popul us	sp.	cottonwood
Prunus	*serotina*	black cherry
Quercus	*alba*	white oak
	bicolor	swamp white oak
	falcata var. *falcata*	southern red oak
	falcata var. *pagodifolia*	cherrybark oak
	laurifolia	laurel oak
	lyrata	overcup oak
	macrocarpa	bur oak
	muehlenbergii	chinkapin oak
	nigra	water oak
	nuttallii	nut t all oak
	palustris	pin oak
	phellos	willow oak
	shumardii	Shumard oak
	stellata var. *stellata*	post oak
	velutina	black oak
Robinia	*pseudoacacia*	black locust
Salix	sp.	willow
Sassafras	*albidum*	sassafras
Tilia	*heterophylla*	white basswood
Ulmus	*alata*	winged elm
	americana	American elm
	crassifolia	cedar elm
	rubra	slippery elm
	serotina	September elm
	thomassii	Rock elm

Noncommercial Species

Genus	Species	Common Name
Anelanchier	sp.	serviceberry
Bumelia	sp.	chittamwood, gum bumelia
Carpinus	*caroliniana*	bluebeech, American hornbeam
Castanea	sp.	chinkapin
Cercis	*canadensis*	eastern redbud
Cotinus	*obovatus*	smoketree
Cra taegus	sp.	hawthorn
Morus	*alba*	white mulberry
Ostrya	*virginiana*	eastern hophorn-beam, ironwood
Planera	*aquatica*	water-elm
Prunus	sp.	plums, cherries
Quercus	*incana*	bluejack oak
	marilandica	blackjack oak
Vaccinium	*arboreum*	sparkleberry

[1]Names according to: Little, Elbert L., Jr. Checklist of United States Trees (Native and Naturalized). 1978. U.S. Dept. Agr. Handbook No. 541,375~.

Standard Tables

Table 1 .-*Area by land classes, east Oklahoma, 1986*

Landclass	Area
	Thousand acres
Forest	
Commercial	
Timberland	4,747.5
Deferred timberland	...
Noncommercial	
Productive-reserved	23.0
Unproductive	485.9
Total forest	5,256.4
Nonforest	
Cropland[1]	1,985.7
Other	2,861.9
Total nonforest	4,847.6
All land"	10104.0

'U.S. Department of Commerce, Bureau of the Census, 1982 Census of Agriculture, Volume 1 : State and County Data.
[2]Bureau of Census, 1980.

Table *2.-Area of timberland by ownership classes, east Oklahoma, 1986*

Ownership class	Area
	Thousand acres
Public:	
National forest	242.6
Other federal	221.4
State	114.7
county	6.6
Total public	585.3
Private	
Forest industry	1,046.0
Farmer	1,295.6
Miscellaneous private	
Individual	1,604.2
Corporate	216.4
Total private	
All ownerships	4,747.5

Table *3.-Area of timberland by stand size and ownership* classes, *east Oklahoma, 1986*

Stand size class	All ownerships	National forest	Other public	Forest industry	Farmer	Miscellaneous private
	Thousand acres					
Sawtimber	1,169.6	123.1	110.3	226.8	327.4	328.0
Poletimber stands	1,661.3	66.0	121.2	284.5	440.7	749.0
Sapling and seedling	1,440.0	53.5	92.8	500.2	351.2	442.3
Nonstocked areas	476.6	...	18.4	34.5	176.3	247.3
All classes	4,747.5	242.6	342.7	1,046.0	1,295.6	1,820.7

Table *4.-Area of timberland by stand volume and ownership classes, east Oklahoma, 1986*

Standvolume per acre	All ownerships	National forest	Other public	Forest industry	Farmer	Miscellaneous private
Board feet	*Thousand acres*					
Less than 1,500	3,419.9	107.4	245.1	715.4	941.5	1,410.6
1,600 to 5,000	1,039.8	72.0	74.8	244.2	297.9	350.9
More than 5,000	287.8	63.2	22.8	86.6	56.2	69.1
All classes	4,747.5	242.6	342.7	1,046.0	1,295.6	1,820.7

Table ***B.-Area of timberland by percent growing-stock trees and cull trees, east Oklahoma, 1986***

Growing-stock Trees	Total	Cull trees percent stocking						
		O-10	10-20	20-30	30-40	40-50	50-60	60+
Percent stocking		***Thousand acres***						
O-10	179.7	...	...	18.4	6.8	6.0	...	148.5
10-20	465.3	...	...	6.9	9.7	28.8	107.5	312.5
20-30	470.5	6.4	...	11.7	19.8	22.1	83.2	327.4
30-40	548.6	6.0	12.4	4.6	36.3	111.6	85.2	292.5
40-50	628.0	...	...	23.5	50.6	153.5	188.4	212.0
50-60	571.5	6.0	16.5	39.8	102.2	118.9	202.2	85.9
60-70	459.4	...	16.6	82.9	125.2	133.4	59.3	42.1
70-80	430.8	6.0	42.0	122.6	94.3	87.7	41.6	36.7
80-90	400.8	24.0	59.5	153.2	77.3	41.1	28.5	17.3
90-100	257.2	23.7	100.8	62.3	46.6	17.6	6.2	...
100-110	161.4	10.5	47.8	61.1	24.3	17.6	...	...
110-120	82.6	23.9	17.8	18.4	22.5	...	...	.
120-130	50.8	17.2	16.9	16.7	...	...	...	...
130-140	17.7	17.7	...	...	...	...	...	...
140-150	23.3	6.0	17.3	...	...	...	...	...
150-160	...	...	...	...	...	...	...	...
160+	...	...	...	...	..	...	...	..
Total	4,747.5	147.3	347.5	622.1	615.7	738.1	802.0	1,474.9

Table ***B.-Average basal area of live trees on timberland by ownership, tree class, species, and tree size class, east Oklahoma, 1986***

Owner and tree classes	All species	Softwood			Hardwood		
		Sapling & seedling	Poletimber	Sawtimber	Sapling & seedling	Poletimber	Sawtimber
		Square feet per acre					
National forest							
Growing stock	62.9	6.9	11.0	21.8	5.4	7.9	10.0
Rough and rotten	29.3	3.2	0.3	0.6	9.7	7.4	8.1
Total	92.2	10.1	11.2	22.4	15.1	15.3	18.1
Other public							
Growing stock	35.5	0.9	3.7	6.0	4.6	10.3	10.0
Rough and rotten	35.1	0.5	0.6	0.3	11.2	9.7	12.8
Total	70.6	1.5	4.3	6.3	15.8	20.1	22.7
Forest industry							
Growing stock	39.0	7.3	8.0	10.3	3.5	6.7	3.2
Rough and rotten	16.2	1.9	0.5	0.4	6.6	3.6	3.0
Total	55.2	9.2	8.5	10.7	10.1	10.3	6.3
Farmer							
Growing stock	32.7	1.3	1.7	3.7	4.4	12.3	9.3
Rough and rotten	32.4	0.4	0.2	0.2	8.5	10.3	12.8
Total	65.0	1.6	1.9	3.9	12.9	22.6	22.1
Miscellaneous private							
Growing stock	34.4	3.0	4.0	6.3	4.1	11.1	6.1
Rough and rotten	35.1	1.0	0.5	0.4	10.2	12.0	11.1
Total	69.5	4.0	4.4	6.6	14.2	23.1	17.2
All owners							
Growing stock	36.5	3.5	4.6	7.2	4.1	10.2	6.8
Rough and rotten	29.9	1.1	0.4	0.3	9.0	9.3	9.7
Total	66.4	4.6	5.0	7.6	13.1	19.5	16.5

Table 7.—*Area of timberland by site and ownership classes, east Oklahoma, 1986*

Site class	All ownerships	National forest	Other public	Forest industry	Farmer	Miscellaneous private
			Thousand acres			
165 ft or more	16.4	5.6	5.1	5.6	...	...
120 to 165 ft	127.1	33.8	...	28.5	34.9	30.0
85 to 120 ft	386.6	22.9	34.4	182.5	55.8	91.0
50 to 85 ft	2,359.8	95.8	149.9	670.4	615.6	828.2
Less than 50 ft	1,857.6	84.5	153.3	158.9	589.3	871.6
All classes	4,747.5	242.6	342.7	1,046.0	1,295.6	1,820.7

Table *B.-Area of timberland by forest types and ownership classes, east Oklahoma, 1986*

Type	All ownerships	National forest	Other public	Forest industry	Farmer	Miscellaneous private
			Thousand acres			
Loblolly-shortleaf pine	956.0	106.2	42.2	492.6	92.6	222.4
Oak-pine	757.3	60.0	36.5	294.9	90.8	275.1
Oak-hickory	2,597.1	65.2	189.2	236.7	901.6	1,205.5
Oak-gum-cypress	358.8	11.3	45.6	22.9	173.9	105.1
Elm-ash-cottonwood	78.4	...	29.1	...	36.7	12.6
All classes	4,747.5	242.6	342.7	1,046.0	1,295.6	1,820.7

Table *O.-Area of noncommercial forest land by forest types, east Oklahoma, 1986*

Type	All areas	Productive reserved areas	Unproductive areas
	Thousand acres		
Loblolly-shortleaf pine	14.1	14.1	...
Softwood total	14.1	14.1	...
Oak-hickory	494.8	8.9	485.9
Hardwood total	494.8	8.9	485.9
All types	508.9	x3.0	485.Y

Table 10.—*Number of growing-stock trees on timberland by detailed species and diameter class, east Oklahoma, 1986*

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	112,259	43,645	27,818	18,662	12,727	6,051	2,397	745	164	50	...
Loblolly pine	19,458	14,549	2,244	767	716	488	216	217	79	181	...
Redcedar	2,670	1,534	802	173	63	86	...	13	...	...	...
Total softwoods	134,387	59,728	30,864	19,602	13,507	6,625	2,613	975	243	231	...
Select white oaks	16,803	7,394	4,427	2,762	945	572	353	191	73	83	3
Select red oaks	9,697	3,954	2,051	1,620	861	495	251	204	85	138	39
Other white oaks	68,333	34,763	18,266	8,163	3,429	2,160	970	340	123	118	...
Other red oaks	34,477	11,982	9,291	5,584	3,106	2,128	1,106	693	351	225	10
Sweet pecan	783	319	142	99	31	92	17	14	11	55	3
Water hickory	5	...	...	...	...	...	...	...	...	5	...
Other hickories	31,296	16,642	7,784	3,789	1,613	920	401	96	21	29	...
Persimmon	666	640	...	...	25	...	...	...	...	...	...
Hard maple	114	...	...	42	27	45	...	...	...	...	...
Soft maple	1,373	793	215	127	94	46	39	...	59	...	...
Boxelder	483	202	132	95	...	36	18	...	...	...	...
Sweetgum	2,489	1,066	416	363	255	222	95	48	...	24	...
Blackgum	1,928	675	467	214	179	232	116	12	33	...	...
White ash	2,456	1,001	575	426	168	173	63	24	20	6	...
Other ashes	4,899	1,937	1,578	464	473	133	141	125	32	16	...
Sycamore	1,466	320	407	272	204	51	117	16	48	27	5
Cottonwood	2.044	451	631	330	198	111	30	52	63	173	4
Basswood	54	...	54	...	...	...	...	...	...	...	...
Willow	313	155	...	30	...	40	65	13	11	...	...
Black walnut	249	...	73	37	33	49	15	14	11	18	...
Black cherry	435	112	123	130	33	20	17	...	...	...	...
American elm	2,165	1,160	211	358	182	138	53	15	30	16	...
Other elms	9,741	5,259	2,142	1,619	431	201	49	11	20	9	...
River birch	290	135	87	...	...	37	17	...	...	14	...
Hackberry	3,317	1,275	836	781	178	188	48	...	11	...	...
Black locusts	102	102	...	...	...	...	...	...	...	...	...
Other locusts	678	...	342	240	56	22	19	...	...	...	...
Sassafras	532	407	70	54	...	...	...	...	...	...	...
Other commercial	349	196	102	51	...	...	...	...	...	...	...
Total hardwoods	197,537	90,942	50,421	27,650	12,521	8,ill	4,002	1,868	1,002	956	63
All species	331,924	150,670	81,285	47,252	26,028	14,736	6,615	2,843	1,245	1,187	63

Table Il.-Volume *of timber on timberland by classes of timber and by softwoods and hardwoods, east Oklahoma, 1986*

Class of timber	All species	Softwood	Hardwood
	Million cubic feet		
Sawtimber trees:			
Saw-log portion	1,155.7	647.5	508.2
Upper-stem portion	153.7	73.4	80.3
Total	1,309.4	720.9	588.5
Poletimber trees	909.7	276.5	633.2
All growing stock	2,219.1	997.4	1,221.7
Rough trees	705.7	33.4	672.3
Rotten trees	138.2	2.5	135.7
Salvable dead trees	24.6	6.6	18.0
All timber	3,087.6	1,039.9	2,047.7

Table 12.—*Volume of growing stock and sawtimber on timberland by ownership classes and by softwoods and hardwoods, east Oklahoma, 1986*

Ownership class	Growing stock			Sawtimber		
	All species	softwood	Hardwood	All species	Softwood	Hardwood
	Million cubic feet			*Million board feet*		
National forest	249.5	169.0	80.5	985.8	712.2	273.5
Other public	175.7	56.7	119.1	604.2	191.6	412.7
Forest industry	507.1	349.9	157.2	1,594.4	1,264.1	330.3
Farmer	548.2	124.6	423.6	1,540.2	489.2	1,051.1
Miscellaneous private	738.6	297.2	441.4	1,963.8	1,023.1	940.7
All ownerships	2,219.1	997.4	1,221.7	6,688.5	3,680.2	3,008.3

Table 13.—*Volume of growing stock on timberland by species and diameter class, east Oklahoma, 1986*

Species	Diameter class (inches at breast height)										
	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	X 0 - 28.9	29.0& larger
	Million cubic feet										
Shortleaf pine	875.8	94.7	145.4	191.1	195.8	136.6	71.2	29.1	8.3	3.6	...
Loblolly pine	110.8	21.8	8.5	8.5	12.8	13.2	8.4	11.2	6.4	19.9	...
Redcedar	10.8	3.1	3.0	1.8	0.9	1.6	...	0.5	...	...	...
Total softwoods	997.4	119.6	157.0	201.3	209.5	151.4	79.7	40.8	14.7	23.4	...
Select white oaks	115.8	19.5	22.4	25.6	13.7	12.5	8.0	6.7	2.8	4.4	0.2
Select red oaks	88.5	8.9	10.4	14.4	12.2	9.8	7.5	6.7	4.1	8.6	6.0
Other white oaks	310.6	68.7	75.6	59.0	37.8	33.1	19.5	8.6	3.7	4.6	...
Other red oaks	272.3	24.5	42.5	45.7	42.0	40.0	27.0	22.6	15.3	11.9	0.9
Sweet pecan	10.1	0.8	0.7	0.7	0.4	1.8	0.6	0.5	0.4	3.7	0.5
Water hickory	0.5	...	...	...	...	...	...	...	...	0.5	...
Other hickories	145.9	29.2	33.4	29.1	19.9	18.0	9.9	3.1	1.1	2.4	...
Persimmon	1.6	1.2	..	...	0.4	...	...	...	...	...	...
Hard maple	1.5	...	...	0.4	0.4	0.7	...	...	...	...	...
Soft maple	11.1	1.7	1.1	1.1	1.5	1.0	1.2	...	3.5	...	...
Boxelder	3.2	0.5	0.6	1.0	...	0.8	0.4	...	...	...	...
Sweetgum	24.0	2.1	2.3	3.2	4.9	5.2	3.2	1.5	...	1.7	...
Blackgum	16.9	1.6	1.9	1.5	2.1	4.5	3.4	0.2	1.7	...	...
White ash	16.8	2.8	2.4	3.4	2.0	3.0	1.4	0.7	0.9	0.2	...
Other ashes	38.1	5.1	9.0	4.9	6.4	2.7	3.7	3.8	1.2	1.2	...
Sycamore	23.8	1.3	3.0	3.1	4.3	1.4	4.0	0.6	2.5	2.7	1.1
Cottonwood	40.9	0.8	3.2	3.2	3.3	2.7	1.3	3.0	5.0	17.9	0.6
Basswood	0.2	...	0.2	...	...	...	...	...	...	...	...
Willow	4.1	0.2	....	0.2	...	1.0	1.9	0.3	0.4	...	...
Black walnut	3.8	...	0.3	0.3	0.4	0.9	0.6	0.2	0.5	0.8	...
Black cherry	2.9	0.3	0.6	0.9	0.4	0.4	0.4	...	...	...	...
American elm	14.3	2.0	0.8	2.9	2.2	2.4	1.3	0.4	1.5	0.7	...
Other elms	45.2	10.7	9.7	12.9	5.1	4.1	1.1	0.5	0.5	0.5	...
River birch	2.5	0.2	0.4	...	...	0.9	0.4	...	...	0.6	...
Hackberry	18.9	2.4	3.0	5.5	2.3	3.9	1.5	...	0.3	...	...
Blask locust	0.3	0.3	...	...	...	...	...	...	...	...	...
Other locusts	5.1	...	1.6	1.9	0.6	0.4	0.5	...	...	...	...
Sassafras	1.4	0.8	0.4	0.3	...	...	...	...	...	...	...
Other commercial	1.4	0.7	0.5	0.3	...	...	...	...	...	...	...
Total hardwoods	1,221.7	186.0	225.9	221.3	162.2	151.0	98.8	59.5	45.5	62.3	9.2
All species	2,219.1	305.5	382.9	422.6	371.7	302.4	178.4	100.3	60.2	85.8	9.2

Table 14.—*Volume of sawtimber on timberland by species and diameter class,* east *Oklahoma, 1986*

Species	All classes	9.0-10.9	11.0-12.9	Diameter-class (inches at breast height) 13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9	29.0& larger
				Million board feet					
Shortleaf pine	3204.9	831.3	983.5	738.8	407.7	170.0	50.5	23.0	...
Loblolly pine	454.7	37.7	63.2	71.8	48.7	67.1	41.9	124.3	...
Redcedar	20.6	6.9	3.8	7.7	...	2.3	...	...	...
Total softwoods	3,680.2	876.0	1,050.4	818.2	456.4	239.4	92.5	147.4	...
Select white oaks	242.9	...	59.2	60.7	42.9	38.1	16.4	24.7	0.9
Select red oaks	290.0	...	55.6	48.3	39.7	37.9	23.3	51.7	33.5
Other white oaks	557.8	...	179.8	171.0	108.3	48.7	22.2	27.8	...
Other red oaks	801.3	...	172.7	200.4	139.4	123.8	88.9	70.5	5.5
Sweet pecan	38.9	...	1.3	9.5	2.6	2.8	2.4	18.1	2.2
Water hickory	2.8	...	...	...	...	...	...	2.8	...
Other hickories	269.7	...	87.4	89.9	53.7	16.7	6.4	15.6	...
Persimmon	1.6	...	1.6	...	...	...	...	...	...
Hard maple	6.3	...	2.0	4.3	...	...	...	...	...
Soft maple	36.4	...	5.2	5.5	5.7	...	20.0	...	...
Boxelder	6.1	...	...	3.9	2.2	...	...	...	..
Sweetgum	80.4	...	20.7	24.6	17.2	8.2	...	9.6	...
Blackgum	57.2	...	8.8	19.7	17.3	1.2	10.2	...	...
White ash	42.7	...	8.2	15.9	7.9	4.3	4.8	1.6	...
Other ashes	95.3	...	27.3	12.1	19.7	22.9	6.7	6.6	...
Sycamore	81.9	...	17.0	6.1	21.2	3.4	14.1	16.3	3.8
Cottonwood	197.3	...	13.2	12.3	5.9	18.1	32.2	112.3	3.4
Willow	17.5	...	...	4.1	9.8	1.7	1.9	...	...
Black walnut	16.8	...	1.0	3.6	3.4	1.4	2.9	4.5	...
Black cherry	5.6	...	1.4	2.0	2.2	...	...	...	...
American elm	45.0	...	11.0	13.0	6.2	2.2	8.8	3.8	...
Other elms	61.6	...	24.6	21.5	6.5	2.5	2.9	3.6	.
River birch	10.7	...	...	4.5	2.3	...	...	3.9	...
Hackberry	36.5	...	9.4	18.4	7.4	...	1.4	...	...
Other locusts	6.0	...	2.3	1.5	2.2	...	...	...	...
Total hardwoods	3,008.3	...	709.7	752.7	523.8	334.0	265.5	373.5	49.2
All species	6,688.5	876.0	1,760.1	1,570.9	980.1	573.4	358.0	520.9	49.2

Table *15.-Volume of sawtimber on timberland by species and tree grade, east Oklahoma, 1986*

Species	All grades	Grade 1	Grade 2	Grade 3	Grade 4
			Million board feet		
Yellow pines	3,659.5	451.3	781.0	2,427.3	...
Redcedar	20.6	20.6	...	...	...
Total softwoods	3,680.2	471.9	781 .o	2,427.3	...
Select white-red oaks	532.9	52.0	134.3	198.2	148.4
Other white-red oaks	1,359.1	45.5	190.3	603.7	519.7
Hickory	311.4	15.0	49.0	132.9	114.5
Hard maple	6.3	...	...	...	6.3
Sweetgum	80.4	4.4	23.7	36.7	15.6
Tupelo and blackgum	57.2	3.3	17.5	25.2	11.1
Ash-walnut-black cherry	160.4	36.9	42.5	72.7	8.3
Other hardwoods	500.6	155.1	122.2	161.0	62.3
Total hardwoods	3,008.3	312.2	579.5	1,230.4	886.2
All species	6,688.5	784.1	1,360.5	3,657.7	886.2

Table 16.—*Average net annual growth and average annual removals ofgrowing stock on timberland, by species, east Oklahoma, 1986*

Species	Growth	Removals
	Million cubic feet	
Yellow pines	45.2	53.8
Cypress	...	0.1
Redcedar	0.7	0.5
Total softwoods	45.9	54.4
Select white-red oaks	7.1	3.2
Other white-red oaks	21.7	17.0
Hickory	4.1	3.5
Hard maple	0.1	...
Sweetgum	0.6	1.4
Tupelo and blackgum	0.1	0.5
Ash-walnut-blackcherry	2.1	0.9
Other hardwoods	2.7	3.1
Total hardwoods	38.5	29.5
All species	84.4	83.9

Table 17.—*Net annual growth and removals of growing stock on timberland by ownership classes and by softwoods and hardwoods, east Oklahoma, 1986*

Ownership class	Net annual growth			Annual removals		
	All species	Softwood	Hardwood	All species	Softwood	Hardwood
	Million cubic feet					
National forest	7.5	5.7	1.8	4.3	2.7	1.6
Other public	7.7	2.2	5.5	2.2	0.9	1.2
Forest industry	22.0	17.4	4.6	50.7	40.0	10.7
Farmer	19.1	5.4	13.7	11.3	1.2	10.2
Miscellaneous private	28.2	15.3	12.9	15.4	9.6	5.8
All ownerships	84.4	45.9	38.5	83.9	54.4	29.5

Table 18.—*Average net annual growth and average annual removals of sawtimber on timberland, by species, east Oklahoma, 1986*

Species	Growth	Removals
	Million board feet	
Yellow pines	188.1	203.6
Cypress	0.1	0.4
Redcedar	0.5	0.2
Total softwoods	188.7	204.2
Select white-red oaks	22.0	8.8
Other white-red oaks	62.1	44.7
Hickory	9.0	10.8
Hard maple	0.5	...
Sweetgum	4.2	4.3
Tupelo and blackgum	0.9	2.0
Ash-walnut-blackcherry	8.3	1.5
Other hardwoods	15.8	9.4
Total hardwoods	122.7	81.5
All species	311.4	285.7

Table 19.—*Net annualgrowth and removals of iawtimber on timberland by ownership classes and by softwoods and hardwoods, east Oklahoma, 1986*

Ownership class	Net annualgrowth			Annualremovals		
	All species	Softwood	Hardwood	All species	Softwood	Hardwood
	Million board feet					
National forest	32.7	26.3	6.4	12.9	9.5	3.5
Other public	33.1	8.8	24.3	4.5	2.3	2.1
Forest industry	77.5	66.9	10.6	183.3	155.3	28.0
Farmer	74.0	26.1	47.9	38.9	4.1	34.8
Miscellaneous private	94.1	60.5	33.6	46.1	33.0	13.1
All ownerships	311.4	188.7	122.7	285.7	204.2	81.5

Table 20.—*Average annual mortality ofgrowing stock and sawtimber on timberland, by species, east Oklahoma, 1986*

Species	Growing stock	Sawtimber
	Million cubic feet	*Million board feet*
Yellow pines	2.8	8.2
Total softwoods	2.8	8.2
Select white-red oaks	1.2	3.4
Other white-red oaks	4.5	9.5
Hickory	2.1	6.6
Sweetgum	...	...
Tupelo and blackgum	...	...
Ash-walnut-blackcherry	0.6	1.2
Other hardwoods	5.7	19.8
Total hardwoods	14.1	40.6
All species	16.9	48.8

Table 21—*Average annual mortality ofgrowing stock and sawtimber on timberland by ownership classes and by softwoods and hardwoods, east Oklahoma, 1986*

Ownership class	Growing-stock			Sawtimber		
	All species	Softwood	Hardwood	All species	Softwood	Hardwood
	Million cubic feet			*Million board feet*		
National forest	0.8	0.4	0.4	2.4	1.5	0.9
Other public	1.6	...	1.6	5.3	0.2	5.1
Forest industry	3.4	1.4	2.0	11.7	4.1	7.7
Farmer	4.2	0.1	4.1	10.0	0.5	9.5
Miscellaneous private	6.9	0.8	6.1	19.3	1.9	17.4
All ownerships	16.9	2.8	14.1	48.8	8.2	40.6

Table 22—*Average annual mortality of growing stock and sawtimber on timberland by causes of death and by softwoods and hardwoods, east Oklahoma, 1986*

Ownership class	Growing-stock			Sawtimber		
	All species	Softwood	Hardwood	All species	Softwood	Hardwood
	Million cubic feet			*Million board feet*		
Bark beetles	0.8	0.8	...	3.1	3.1	...
Other insects	0.1	0.1	...	...	...	...
Disease	11.5	0.9	10.5	31.4	2.2	29.3
Fire	0.5	0.2	0.3	0.2	0.2	...
Beaver	0.3	...	0.3	0.2	...	0.2
Weather	2.8	0.6	2.3	11.9	2.3	9.6
Suppression	0.1	0.1	0.1	...	...	...
Other	0.7	0.1	0.6	2.0	0.5	1.5
All causes	16.9	2.8	14.1	48.8	8.2	40.6

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Presents the principal findings of the fifth forest survey of east Oklahoma and the changes that have occurred since earlier surveys. Trends in forest area, ownership, forest type, stand structure, stocking, timber volume, growth, removals, mortality, management opportunities, and timber products output are discussed.

Additional keywords: forest inventory, tree distribution, basal area.

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