United States
Department of
Agriculture

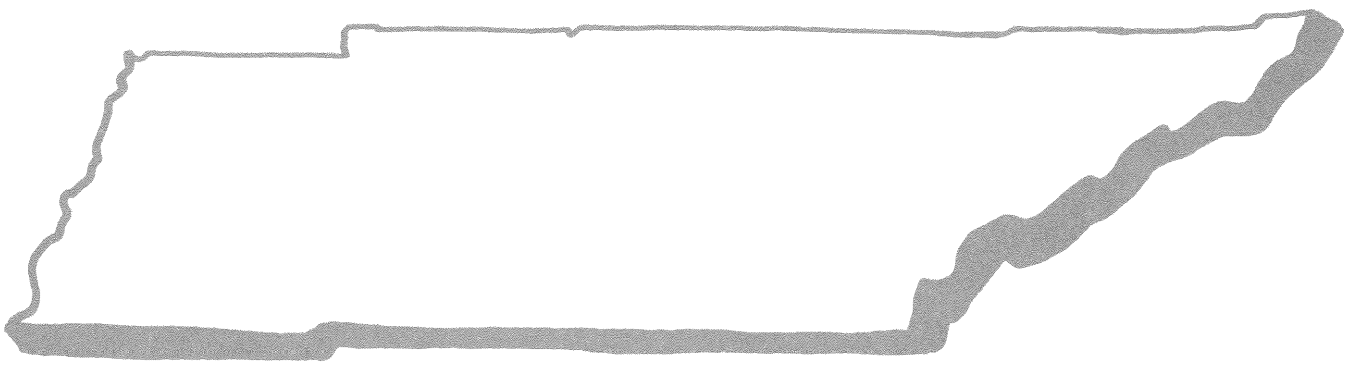
Forest Service

**Southern Forest
Experiment Station**

New Orleans,
Louisiana

Resource Bulletin
SO-90
February, 1983

Tennessee



Forest Resources

Richard A. Birdsey

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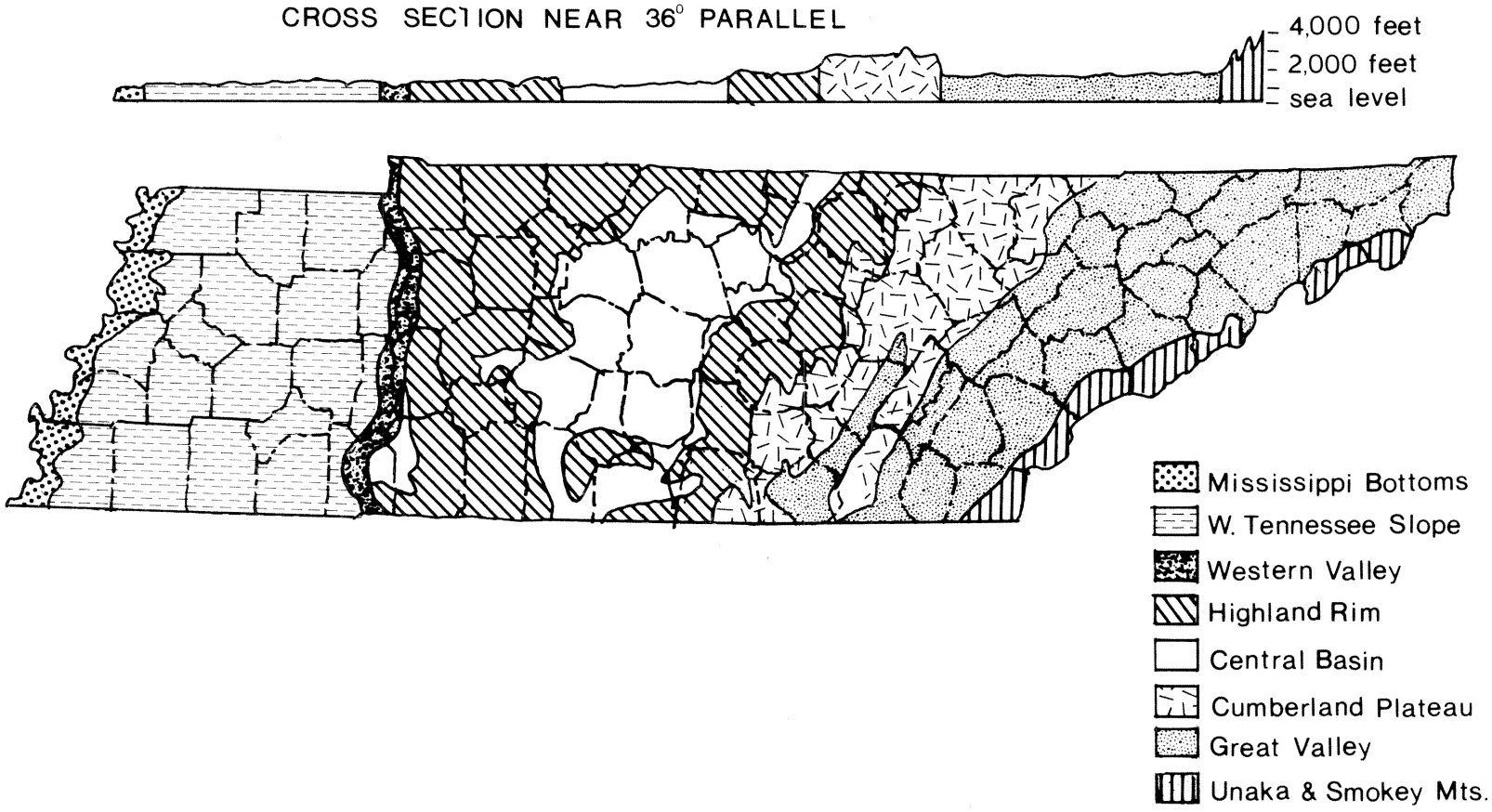

Figure 1.—*Physiographic regions of Tennessee. Source: Sternitzke, 1955.*

Tennessee Forest Resources

Richard A. Birdsey

HIGHLIGHTS

This report presents the principal findings of a new forest survey of Tennessee. Field work was conducted between March 1979 and November 1980. The inventory is reported for 1980. Data for growth and cut are given for the inter-survey period from 1971 to 1980. A canvass of forest products output in 1979 provided additional information on removals.

The amount of land available for timber production has not changed significantly since the last survey, and currently stands at 12.9 million acres. This is a 2 percent increase since the first statewide survey reported in 1950. More than 1 million acres of forest land have been cleared since 1971. Half of the cleared land was for agriculture and half for urban and related development. In the same span of time about 1 million acres of agricultural land reverted to forest.

Private owners hold 91 percent of the commercial forest land. The proportion owned by farmers continued to decline, mainly through land transfers to non-farming individuals who now own 5 million acres. Forest industry ownership rose 9 percent to 1.2 million acres.

Important changes occurred in stand structure statewide. Trees in the 2-inch, 4-inch, and 6-inch diameter classes all declined in number, while 8-inch and larger classes all showed big gains. A large area which reverted to forest in past decades is maturing, resulting in high mortality rates among smaller stand components.

Softwood growing stock increased 34 percent to 2.5 billion cubic feet, and sawtimber volume increased 61 percent. Most of the softwood volume is in shortleaf pine and Virginia pine, although loblolly pine and Virginia pine showed the largest gains. Farmers and miscellaneous private owners control 65 percent of the softwood sawtimber.

Hardwood growing stock increased 21 percent to 12.7 billion cubic feet, and sawtimber volume increased 44 percent. The majority of the volume is in oaks, hickories, and yellow-poplar, with the latter increasing the most. The largest sawtimber gains occurred on farmer-owned and miscellaneous private lands. These owners control 81 percent of the hardwood sawtimber volume.

Softwood and hardwood growing stock has been increasing at an annual rate of 298 million cubic feet. Annual net growth of growing stock averaged 511 million cubic feet, annual removals 214 million cubic feet, and annual mortality 52 million cubic feet. Tennessee's commercial forest land is currently producing timber at about half of its potential.

Timber management is not widely practiced in Tennessee, and there are many opportunities for resource improvement. Many stands are over- or under-stocked. Control of cull hardwoods and hardwood competition could increase standing timber volume. Prompt and successful regeneration of cutover stands with desirable species would vastly improve future timber supplies.

Based on past trends, likely changes in Tennessee's forests include gradual losses in commercial forest land, shifting stand structure and composition, rapidly increasing stand volumes, and declining hardwood quality. Opportunities will improve for expanding industrial use of the timber resource.

OVERVIEW OF TENNESSEE FOREST LAND[1]

Forest Survey Regions

Tennessee encompasses a wide variety of physiographic features ranging from the Appalachian Mountains to the Mississippi bottomlands (fig. 1). Across the state a series of valleys, ridges, and plateaus roughly determine the boundaries of the forest survey regions. The

[1]Most of the material in this section has been summarized from the first Tennessee Forest Resource Report (Sternitzke 1955).

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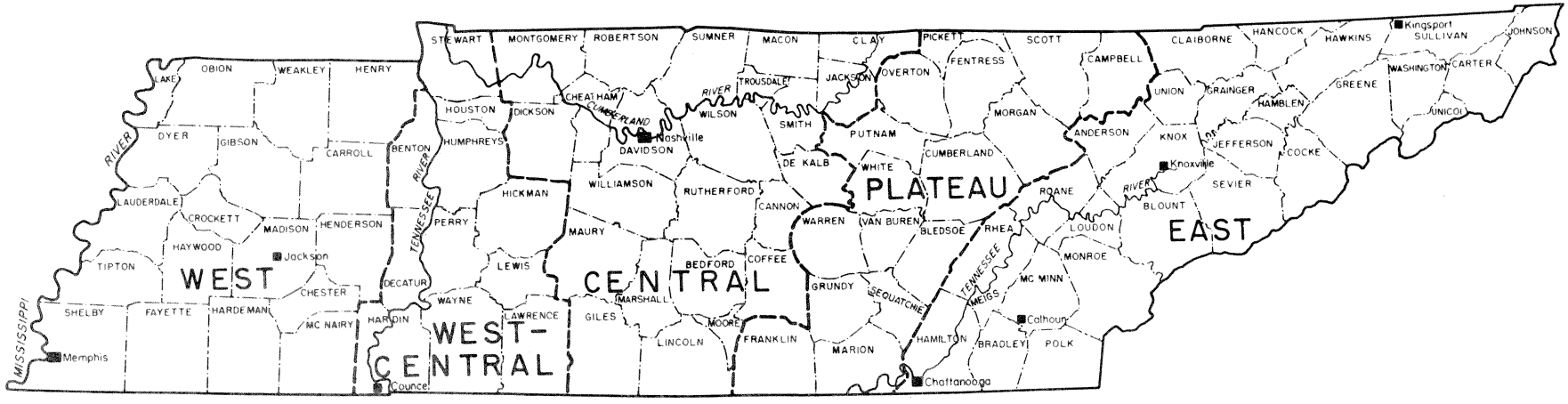


Figure 2.—*Forest resource regions in Tennessee.*

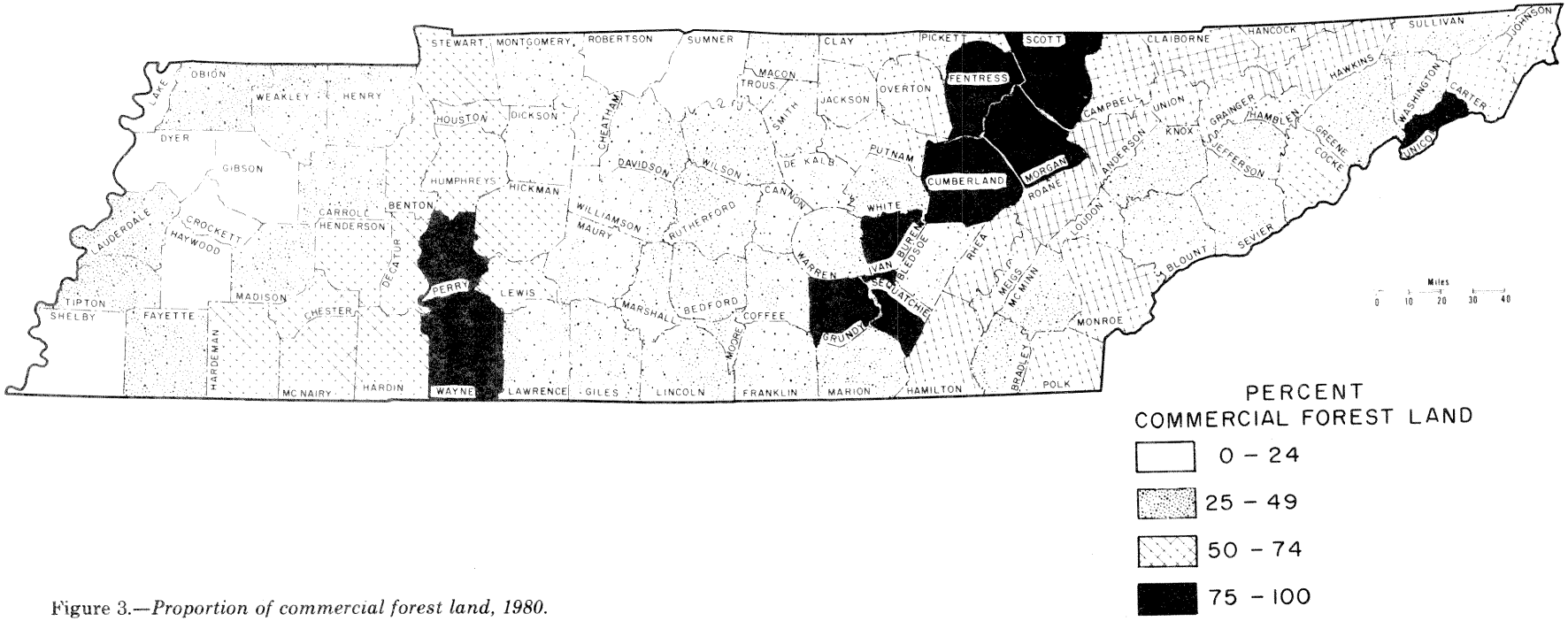


Figure 3.—*Proportion of commercial forest land, 1980.*

boundaries follow county lines for the purposes of data compilation (fig. 2).

The Eastern region includes portions of the Blue Ridge and the Ridge and Valley physiographic provinces. Agriculture is common in the coves and valleys, while the rugged mountain areas are heavily forested. The region is noted for the Great Smokey Mountains National Park and International Biosphere Reserve. The Cherokee National Forest is located adjacent to the park boundaries. Several large urban and industrial centers are found in the Great Valley.

The Plateau region covers the Cumberland Plateau and the eastern Highland Rim. Forests predominate on this land, much of which is unsuitable for agriculture. Most of the state's coal is mined here.

The Central Basin and parts of the surrounding Highland Rim comprise the Central region. Agriculture and livestock production characterize the rural environment, and Nashville, the state Capitol, is an important urban center.

The West Central region includes the western Highland Rim and the western valley of the Tennessee River. The region is predominatly forest, like the Plateau region, with farms scattered along bottomlands where soils are better for agriculture.

The Western region slopes gently to the Mississippi river bluffs and bottomlands. The region supports intensive agriculture, especially cotton and soybeans. Forests are less common here than elsewhere in the state. Erosion is a serious hazard on the loessial soils.

The Original Forests

Hunters and trappers roaming through Tennessee in the 18th century found old growth forests stretching from the eastern mountains to the western bottomlands. Hardwood forests dominated the landscape and included enormous white oak and yellow-poplar trees. Other oaks, chestnut, white ash, and hickory were common, and black walnut was well distributed. Most hardwoods now common were components of the old growth stands.

Softwoods were locally abundant. Large cypress stands were found in the western bottomlands. Shortleaf pine was common in the Cumberland Plateau and the Highland Rim, while white pine, Virginia pine, and hemlock were more common in and near the eastern mountains. Redcedar was most abundant in the central basin, and red spruce and fir could be found in the higher elevations.

It took about 100 years for settlers to clear away half of the state's forests. Small subsistence farms were common in the east. Dairy farms, livestock production, and tobacco dominated the central landscape. Large scale cotton production took place in the west. Uncleared forest lands were modified by cutting for fuel, posts, and timber, and farm animals have foraged through the woodlands. With the exception of some areas in the Great Smokey Mountains National Park, virtually all Tennessee forests were logged over at least once by the early 1900's.

Much of the current forest area has regrown on eroded, unproductive farmland. The cycle of forest clearing for crops or pasture, and eventual reversion to forest, is still continuing. Due to land use shifts and timber removals, current forests are quite different from those cleared by the first settlers. The highest percentage of commercial forest land is now found in the Plateau and West Central survey regions (fig. 3).

Forest Resource Values

Timber production is the most obvious material contribution from Tennessee's forest land. Farmers have always depended heavily on nearby woodlots for fuel, posts, construction materials, and farm

Clean water is an important product of Tennessee's forests.

implements. Timber industries became important in the last century and continue to contribute to the regional economy by providing local wood products and employment. Tennessee is among the leading states in the nation in hardwood lumber manufacturing (Tennessee Forestry Association).

Nontimber values can be as important as timber production. Water is an important natural resource collected on forest land. Erosion prevention, flood control, and water production all have an important place in Tennessee's natural resource management. Visitors and residents enjoy outdoor recreation in many of Tennessee's forests and waters. State, Federal, and private recreational areas are numerous, and outdoor activities bring millions of dollars into the State each year. Abundant wildlife resources are also found in the forested habitat. Hunting and fishing attract great numbers of sportsmen, while the abundance and variety of wildlife attracts many observers, photographers, and others who enjoy nature.

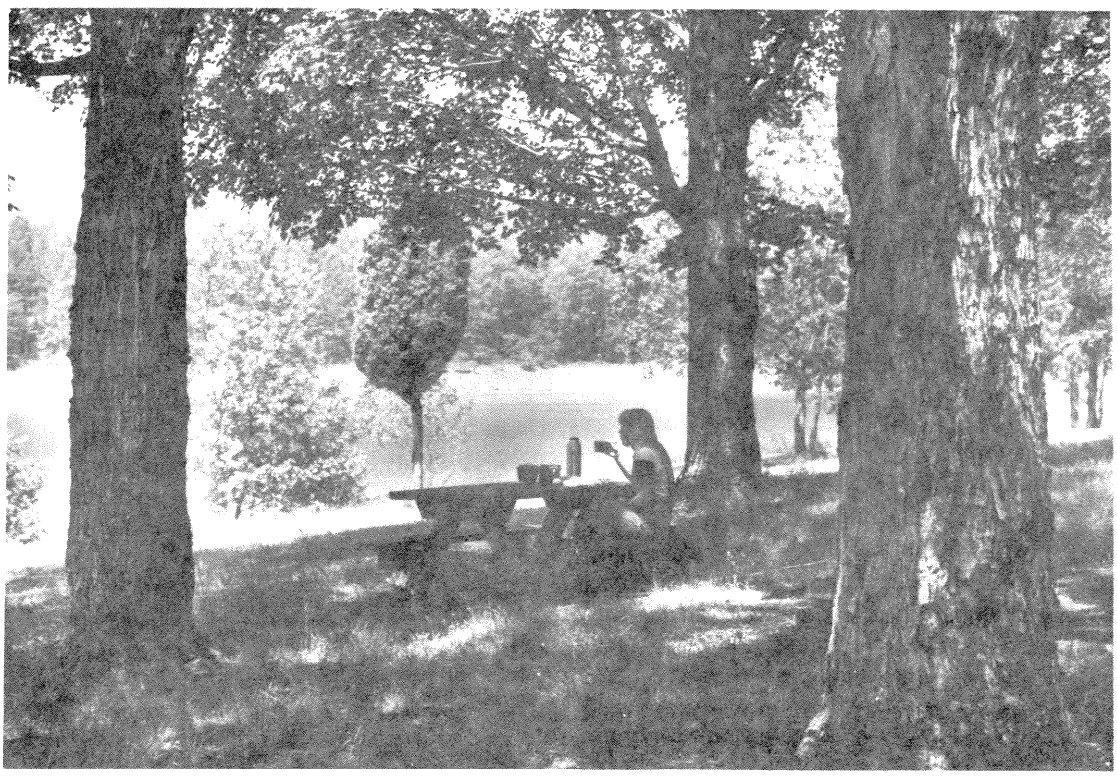
THE TIMBER RESOURCE

Forest Area Trends

Forests occupy 13.3 million acres or half of the land area in Tennessee. About 12.9 million acres of this woodland is commercial forest land, capable of producing crops of industrial wood and not withdrawn from timber utilization. Little overall change in forest area has occurred since the first statewide survey completed in 1950; commercial forests now occupy 2 percent more land than 30 years ago. The second survey, made in 1960-61, reported a 9 percent acreage increase due to marginal, eroded farmland reverting to forest. The results of the third survey a decade later revealed a decline in commercial forest land as land clearing claimed more forest than reversions of nonforest land. The current survey shows a slight increase in commercial forest land.

The small change in total commercial forest land masks a large acreage shift between forest and nonforest land uses (table I). Land clearing for agriculture is down from 1.2 million acres (Murphy 1972) to 0.5 million acres. Most of the new agricultural land is pasture, with soybeans and other crops accounting for the remainder. Urban, industrial, and highway development claimed another half million acres, a 68 percent increase in forest clearing for non-agricultural purposes.

Additions to commercial forest land totaled 1.1 million acres, 30 percent more than the change reported in the last survey. The new forest acreage more than offset diversions to nonforest and accounts for the slight upward trend in commercial forest land area. Most of the reversions to forest



Outdoor recreation opportunities attract many visitors to the state each year, and enhance the quality of life for residents. (Tennessee Division of Forestry).

Table I.—*Changes in commercial forest land, 1971-1980*

Resource region	Total area[1]	Commercial forest	Net change	Additions from:			Diversions to:		
				Total	Agriculture	Other[2]	Total	Agriculture	Other
	thousand acres								
West	6,080.6	2,129.0	+360.5	588.6	537.1	51.5	228.1	153.8	74.3
West Central	3,422.2	2,183.6	-107.3	17.9	17.6	.3	125.2	71.3	53.9
Central	6,305.4	2,139.4	-136.9	110.3	96.8	13.5	247.2	134.4	112.8
Plateau	4,448.7	2,972.6	-104.4	72.0	41.2	30.8	176.4	78.2	98.2
East	6,778.9	3,454.4	+47.3	332.1	263.7	68.4	284.8	103.5	181.3
All regions	27,035.7	12,879.0	+59.2	1,120.9	956.4	164.5	1,061.7	541.2	520.5

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

occurred on cropland or idle farmland in the Eastern and Western survey regions. Both regions showed a net increase in commercial forest land while forest area declined in the West Central, Central, and Plateau regions.

According to these statistics, land use shifts between cropland, pasture, and forest continue to strongly influence Tennessee's commercial forest land base. An increase in agricultural land abandonment and a decrease in forest clearing for pasture or cropland resulted in a net loss of agricultural land.[2] The corresponding gain in commercial forest land was partly offset by an increase in land clearing for urban and related development. This long term withdrawal of land from the State's forest resources is likely to continue as population increases.

Forest Ownership

Private owners hold 91 percent of the commercial forest land in Tennessee. Miscellaneous private owners[3] increased their holdings by 12 percent to 5.9 million acres or 46 percent of the total. Farmers continued to lose acreage as reported in the last survey. A loss of 10 percent has reduced their forested holdings to 4.5 million acres or 35 percent of all commercial forest land. Most of this acreage changed to miscellaneous private ownership. Areas cleared for agriculture generally did not change owners.

Public and forest industry ownership classes each total about 9 percent of the commercial forest land. This represents a re-classification of about 126 thousand acres of public commercial forest land and gain of 101 thousand acres by forest industries. Forest industry lands are principally located in the heavily forested Cumberland Plateau and Western Highland Rim regions.

The private owners controlling most of Tennessee's commercial forest land represent a cross section of society and hold land for a wide variety of purposes. Most of these owners are individuals with relatively small holdings. A recent landowner study in neighboring Kentucky (Birch and Powell 1978) indicated that most forest holdings are part of a farm or residence and are not managed for any particular purpose. Many of these woodland owners use their forests as a source of fenceposts, fuelwood, or other local products. Investment, timber production, and aesthetic enjoyment were less commonly cited as primary ownership objectives.

Private owners in the South are expected to provide an increasing quantity of timber as national requirements for wood products increase. The diversity of landowner objectives implies that not all private woodlands will be available for timber harvest. Nevertheless, 30 percent of Kentucky's private owners harvested timber in the past, and 23 percent of Tennessee's owners harvested timber in Tennessee in the last 10 years. Another study concluded that higher stumpage prices and mature timber would entice many owners to convert some of their growing stock to capital (Binkley 1981). The Kentucky study estimated that 62 percent of the private commercial forest land was available for harvesting.

Forest Composition

Hardwoods dominate Tennessee forests. Statewide, 85 percent of the basal area is in hardwood species. The most common hardwoods are white

[2]The net loss in agricultural land can be confirmed by examining periodic statistics of the Census of Agriculture.

[3]All private owners except farmers and forest industrial landowners.

A typical mixed hardwood stand includes a variety of size classes. (Tennessee Division of Forestry).

and red oaks, hickories, hard and soft maples, gums, yellow-poplar, and beech. Other common hardwood stand components are ash, elm, black cherry, birch, hackberry, sycamore, and black locust. Sassafras and dogwood are common in the understory. Black cherry, black walnut, and other hardwoods are scattered among the more common species.

Softwoods comprise 15 percent of the basal area in Tennessee, and are most common in the Eastern and Plateau survey regions. The native shortleaf and Virginia pines account for most of the current pine growing stock. Loblolly pine now equals shortleaf pine in the smaller diameter classes and will account for a large share of future softwood growing stock increases. Most softwood growing stock larger than 20 inches in diameter at breast height (dbh) is white pine, common in the eastern mountains in association with hemlock, birch, and various maples. Eastern redcedar occurs in the central basin, and cypress is found on bottomland sites, principally in the western survey region.

Forest type is determined by the stocking plurality of various species or species groups. The oak-hickory type occupies 72 percent of the commercial forest land (table II), and pines comprise less than 25 percent of the stocking in this type. The oak-pine type and the loblolly-shortleaf type[4] each occupy about 8 percent of Tennessee's commercial forest land. Pines comprise more than half of the stocking in the loblolly-shortleaf type, and between 25 and 50 percent of the stocking in the oak-pine type. The cedar type and the oak-gum-cypress type each occupy about 5 percent of the commercial forest land.

In this survey, forest type was computed in the same way as the last survey and can be used as an indication of change. Some stands typed oak-pine shifted into the loblolly-shortleaf type, resulting in a 60 thousand acre increase in well-stocked pine stands. More commonly, oak-pine stands grew into the oak-hickory type classification as stands matured and hardwoods increased their dominance. The oak-hickory type had a new increase of 205 thousand acres. Most of the increased pine stocking took place on forest industry lands which generally receive more intensive management than other private forests. The loblolly-shortleaf acreage in miscellaneous private ownership more than doubled as these owners gained forest land from farmers. Miscellaneous private owners now hold half of the state's pine type acreage.

Stand Structure

Dramatic changes occurred in the statewide stand structure (fig. 4). The number of growing stock trees declined in the smaller diameter classes, while the 8-inch and larger classes all showed significant gains. Tennessee's forests are maturing

[4] "Southern pine type" would be more appropriate since Virginia and shortleaf pines are more common than loblolly pine.

Table II.—*Area of commercial forest land by forest type and resource region, 1980*

Forest type	Resource region					
	State	West	West Central	Central	Plateau	East
	thousand acres					
White pine	10.8	0.0	0.0	0.0	5.6	5.2
Loblolly-shortleaf	1,058.3	145.7	101.0	0.0	234.8	576.8
Oak-pine	1,007.6	72.1	39.5	19.6	385.3	491.1
Cedar	651.3	73.9	24.2	392.1	23.8	137.3
Oak-hickory	9,312.6	1,207.7	1,940.8	1,684.0	2,276.3	2,203.8
Oak-gum-cypress	679.7	539.3	66.2	38.7	24.5	11.0
Elm-ash-cottonwood	99.2	71.5	11.9	5.0	10.8	0.0
Maple-beech-birch	59.5	18.8	0.0	0.0	11.5	29.2
All types	12,879.0	2,129.0	2,183.6	2,139.4	2,972.6	3,454.4

and large numbers of smaller trees are dying as larger trees dominate the stand. Land reversions and regeneration efforts continue to add smaller trees, but this influence is overshadowed by stand development on large areas which were reforested decades ago after farming or heavy logging.

Sawtimber stands now account for 38 percent of all commercial forest land, a 49 percent increase since the last survey. Sapling and seedling stands are found on 21 percent of the commercial forest land, a 42 percent reduction. Poletimber-size stands are most common, accounting for 5.2 million acres or 41 percent of all stand sizes. Tennessee's forests are shifting to larger size classes as stands mature and larger trees account for a higher proportion of the stocking.

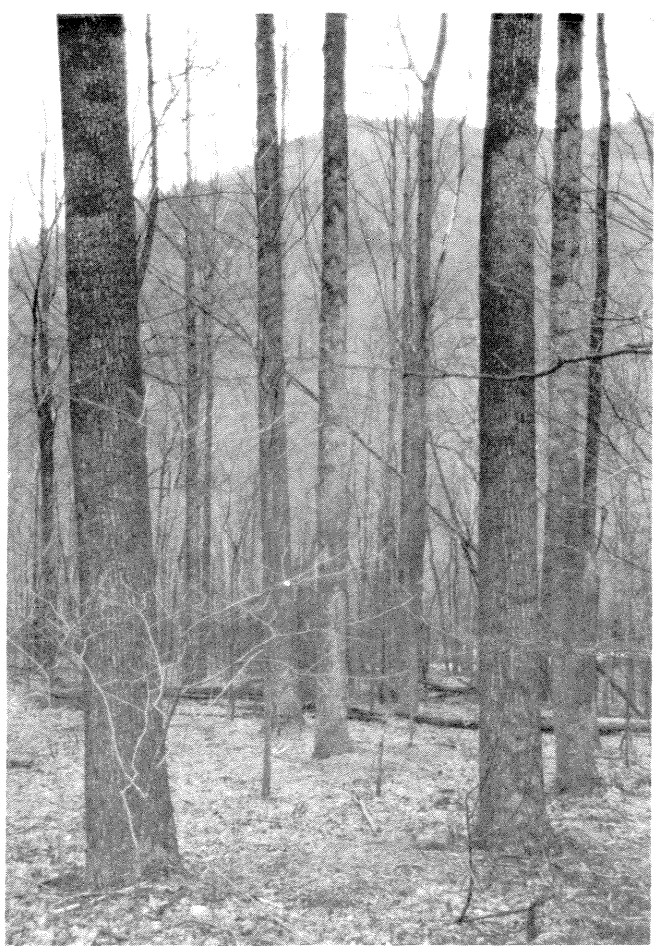
Timber Volume

The commercial forests of Tennessee contain 15.2 billion cubic feet of timber, a 25 percent increase since 1971. This estimate includes the volume of sound wood in all live trees greater than 5 inches dbh, from stump height to a minimum top diameter outside bark of 4 inches, excluding sound cull sections. Growing stock trees in Tennessee contain 12.8 billion cubic feet of sound wood.

Methods of volume estimation have changed since the last survey. The current survey measured a larger sample of trees for volume, and the reported figures are more accurate than in previous surveys. Volumes can be reliably compared at the state or regional level, but volume changes reported for individual species, counties, or other breakdowns may be affected by the estimating procedure.

The softwood growing stock volume increased 34 percent to 2.4 billion cubic feet (table III). The highest rate of increase occurred in the western half of the state, although the Plateau and Eastern regions contain the most softwood volume. Most of the current softwood growing stock volume is in shortleaf pine and Virginia pine (fig. 5) although Virginia pine and loblolly pine gained the most. Growing stock volume increases occurred in all diameter classes and was most pronounced in the 8 inch through 16 inch classes (fig. 6).

About 96 percent of the softwood timber volume is in growing stock trees (fig. 7), with sawtimber trees accounting for 61 percent. The softwood sawtimber



Yellow-poplar can grow to maturity in relatively pure stands.

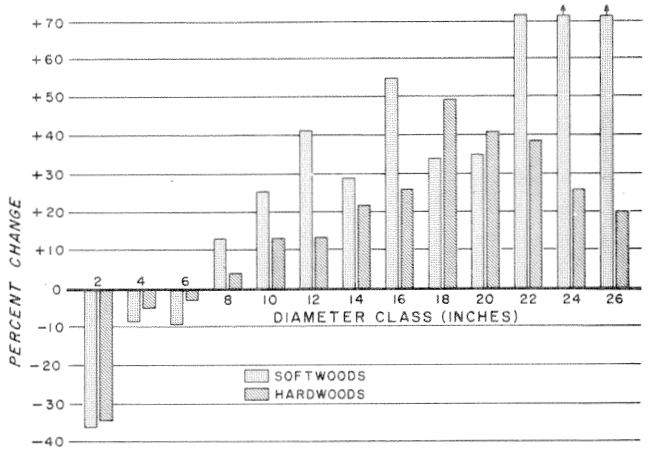


Figure 4.—*Percentage change in number of growing stock trees between surveys.*

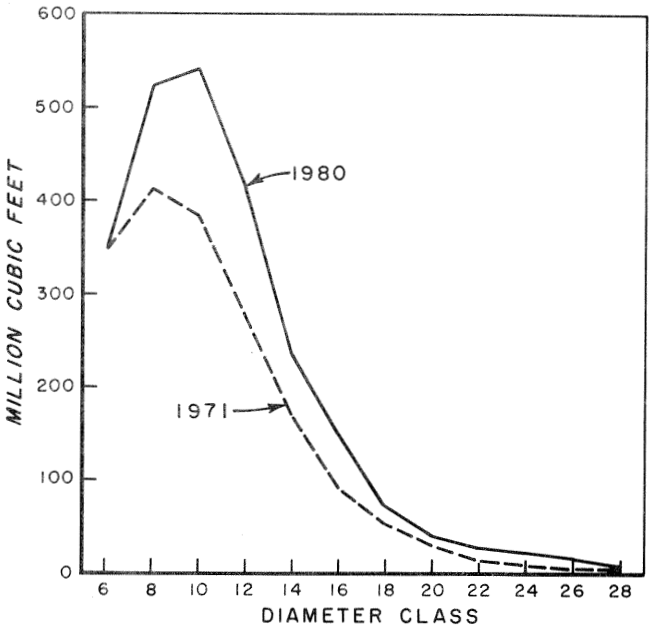


Figure 6.—*Softwood growing stock by diameter class, 1971 and 1980.*

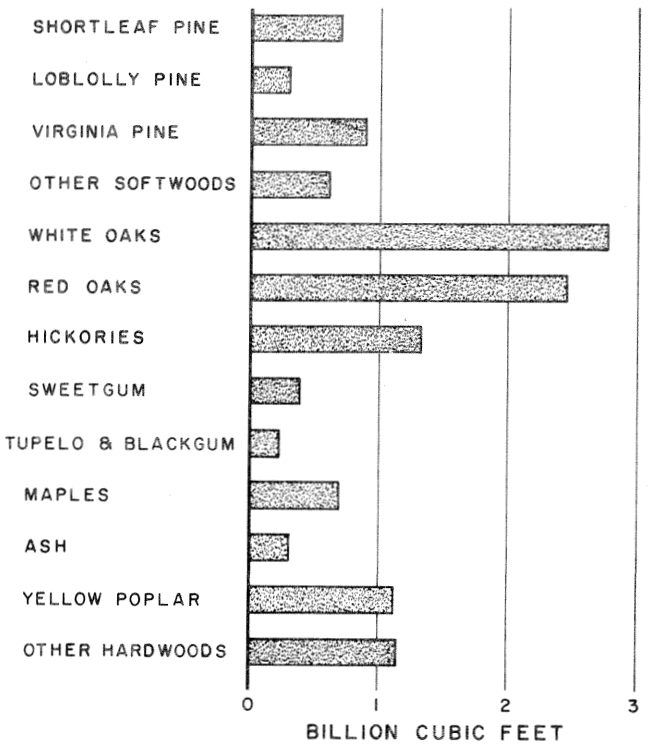


Figure 5.—*Growing stock volume by species.*

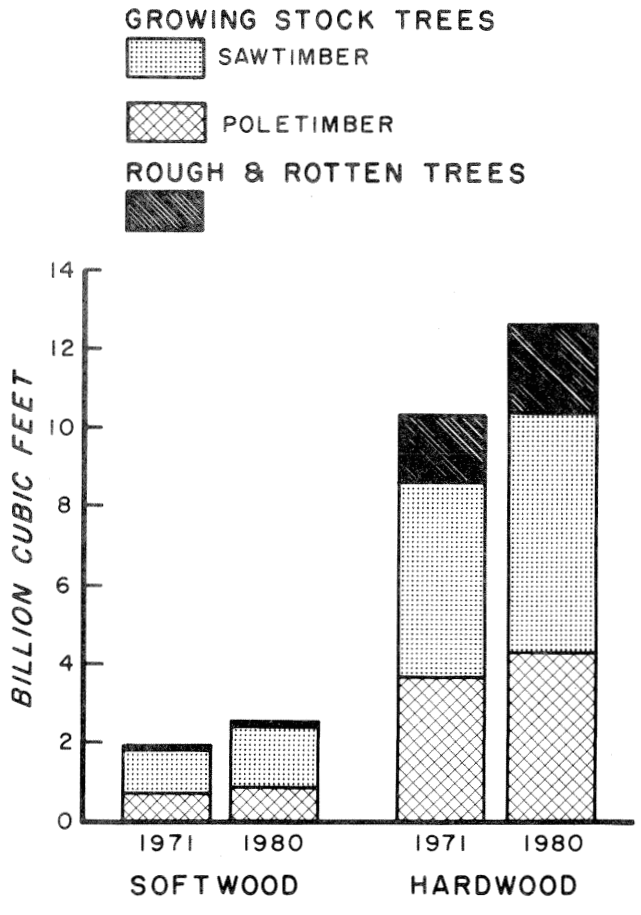


Figure 7.—*Volume of softwoods and hardwoods by class of timber, 1971 and 1980.*

volume rose 64 percent to 7.7 billion board feet (table IV). This large increase occurred because a high percentage of trees reached the minimum sawtimber size of 9 inches dbh.

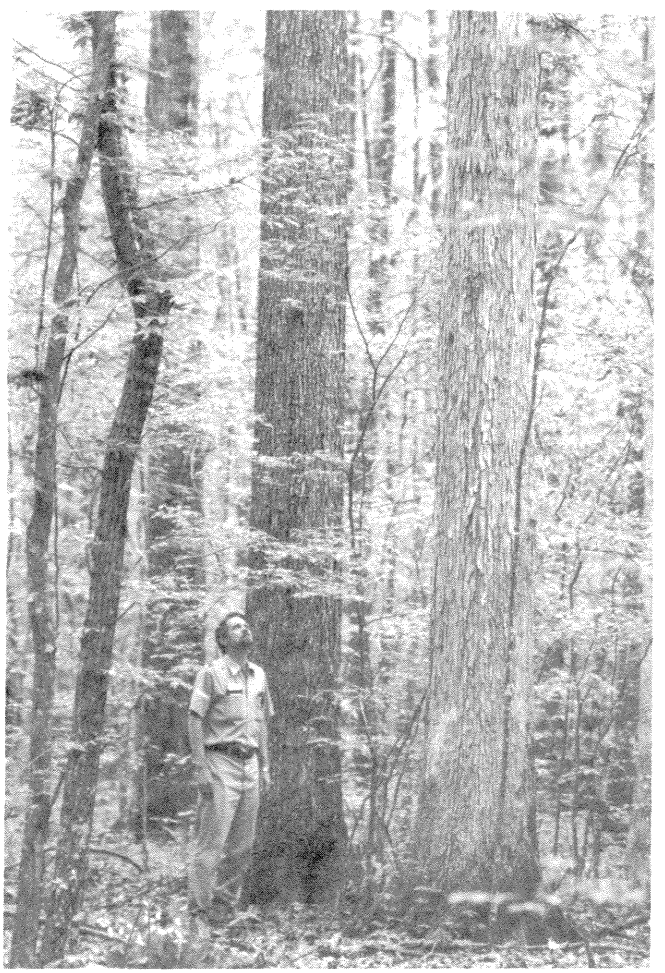
Farmers and miscellaneous private owners hold 65 percent of the softwood sawtimber, up from 58 percent at the last survey. All ownerships showed large average volume increases. The average softwood volume on forest industry lands rose 67 percent to 666 board feet per acre, and on farm and miscellaneous private lands the average softwood volume rose 78 percent to 473 board feet per acre. Statewide, softwood sawtimber constitutes one-fifth of the total sawtimber volume and averages 597 board feet per acre.

Tennessee's hardwood growing stock volume increased 21 percent to 10.4 billion cubic feet (table III). The biggest gains were in the Eastern and Western regions which also gained commercial forest acreage. The three central regions gained volume while losing commercial forest acreage. As with softwood growing stock, most hardwood growing stock volume is found in the Plateau and Eastern units. Volume gains occurred in all diameter classes (fig. 8). Most hardwood volume is in oaks, hickories, and yellow-poplar (fig. 5). Yellow-poplar and the maples showed the largest percentage gains.

Nearly 18 percent of the hardwood timber volume is in rough and rotten trees (fig. 7). This represents a slight decrease in quality, since only 16 percent of the timber volume was in cull trees in 1971. Half of the hardwood timber volume is in sawtimber trees. These trees contain 31.2 billion board feet of sawtimber, an increase of 44 percent since 1971 (table IV).

Farmers and miscellaneous private owners control 81 percent of the hardwood sawtimber volume. For all owners, the average hardwood sawtimber volume is 2,424 board feet per acre or 80 percent of all sawtimber. The average hardwood sawtimber volume increased the most for farmers and miscellaneous private owners, up 49 percent to a statewide average of 2,415 board feet per acre. Forest industry hardwood volume rose 30 percent to 2,279 board feet per acre.

Increasing hardwood and softwood volumes may provide new opportunities for forest industry



A mature bottomland hardwood stand. (Tennessee Division of Forestry).

Table III.—*Growing stock volumes in 1971 and 1980*

Resource region	Softwood		Hardwood	
	1971	1980	1971	1980
	million cubic feet			
West	155.5	281.8	1,484.3	1,950.9
West Central	108.0	154.2	1,710.4	1,938.5
Central	46.0	77.1	1,302.1	1,474.6
Plateau	467.5	605.2	2,056.1	2,372.2
East	1,022.8	1,287.2	2,043.1	2,663.5
All regions	1,799.8	2,405.5	8,596.0	10,399.7

Table IV.—*Sawtimber volume in 1971 and 1980*

Resource region	Softwood		Hardwood	
	1971	1980	1971	1980
	million board feet			
West	450.1	1,091.5	4,415.3	6,721.5
West Central	201.5	415.7	3,434.3	4,957.0
Central	27.2	91.2	3,224.1	4,179.1
Plateau	1,363.4	1,989.2	5,293.5	7,155.0
East	2,656.9	4,096.7	5,273.9	8,200.4
All regions	4,699.1	7,684.3	21,641.1	31,213.0

development in Tennessee. Softwoods are gaining in importance due to past planting and timber management efforts. Both hardwood and softwood volumes are increasing in the larger size classes. Standing timber volume should continue to increase rapidly and, depending on availability, could provide the necessary raw material base for expanding forest products use.

Growth, Removals and Mortality

Growth, removals, and mortality are the principal elements of change affecting the inventory of growing stock. Gross growth includes five components: 1) survivor growth—the net volume increase in growing stock trees surviving from the beginning of the period to the end, 2) ingrowth—the net volume of trees at the time they grew into growing stock status during the period, 3) growth on ingrowth—the net volume increase on trees after growing into growing stock status during the period, 4) growth on removals—the net volume increase on growing stock trees that were cut during the period, and 5) growth on mortality—the net volume increase on trees before death occurred during the period. Net growth is gross growth minus the volume lost due to mortality during the period.

Some changes in the compilation procedure may affect comparisons between surveys. For this survey, removals were estimated from plot data rather than from the canvass of forest industry. The industry canvass only covered a single year, and was often not representative of the average removal rate. All three major components of change are now reported as periodic averages for the entire survey period, making comparisons among the components valid. The method for estimating growth components was also modified, and the method for expanding remeasurement plot growth estimates was based on survey unit averages to increase accuracy at the county level. Finally, the methods and criteria for assessing cause of death were improved.

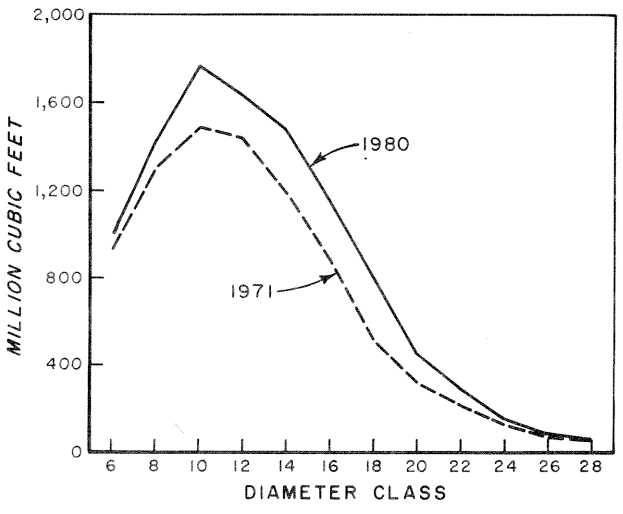


Figure 8.—*Hardwood growing stock by diameter class, 1971 and 1980.*

Current estimates show that annual growth has stabilized at 511 million cubic feet or 40 cubic feet per acre. Annual sawtimber growth increased by 20 percent to 1.7 billion board feet as sawtimber trees became more common.

Since 1971, the growing stock inventory has increased at an annual rate of 298 million cubic feet as growth exceeds removals by a large margin (table V). The highest margin was in the Eastern region where the growth to removals ratio was 4 to 1. The lowest ratio was recorded in the West. Hardwoods accounted for most of the excess growth over removals, and no common species was removed at a rate faster than growth.

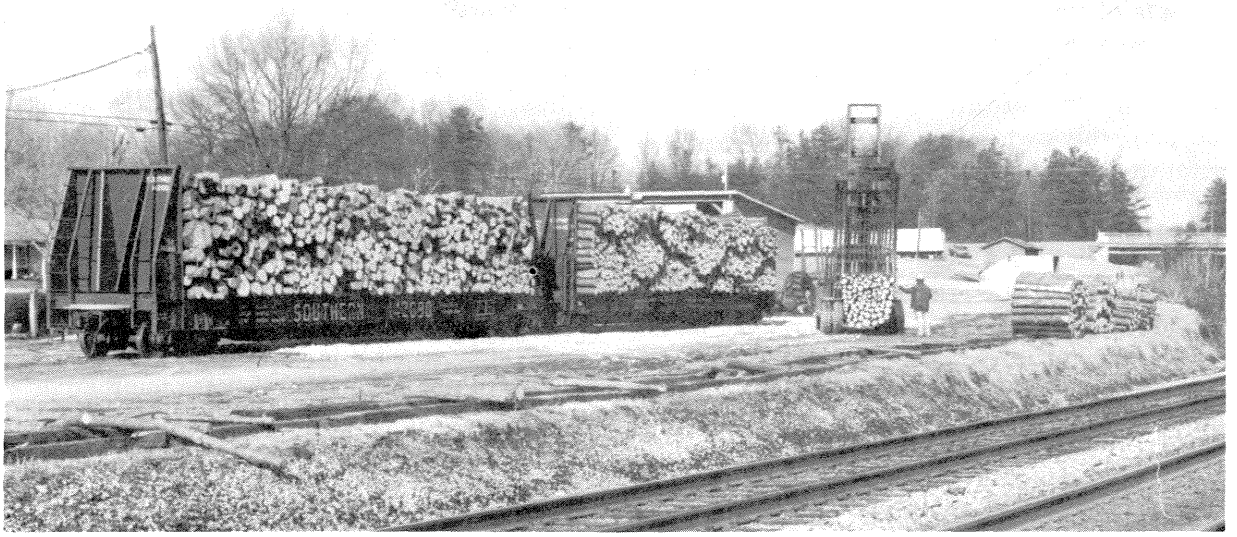
Growth to removal ratios were the highest on National Forest lands, exceeding 10 to 1 for hardwoods. Removals on other public and forest industry lands were closest to the annual growth. Removal rates on farmer-owned land were nearly identical to rates on other non-industrial private lands. Statewide, the large excess of growth over removals indicates that the timber harvest could be greatly increased while sustaining current annual volume increment.

Mortality accounted for a loss of 52 million cubic feet of growing stock, equal to one-fourth of removals. The volume loss due to mortality was caused principally by various diseases. Weather damage was responsible for more sawtimber volume loss than disease. Insects caused the most cubic volume loss among softwoods. The principal cause of mortality of saplings and seedlings was suppression.

Forest Productivity

The average commercial forest acre in Tennessee can produce a net annual growth of 76 cubic feet (table VI), an increase of about 5 cubic feet since the last survey. Stand development and a changing forest land base have caused this change. The highest potential productivity is in the Western region, where the survey showed a high incidence of agricultural land reverting to forest. Among ownership categories, National Forest land has less growth potential than Tennessee's private forest land due to poorer average site quality (table VII).

A comparison of net growth with potential productivity shows that Tennessee's commercial



Tennessee's pulpwood removals have increased in recent years.

Table V.—*Periodic annual components of change in the volume of growing stock on commercial forest land, by resource region and softwood and hardwood, 1971-1980*[1]

Resource region and species group	Gross growth	Mortality	Net growth	Removals	Net change
	million cubic feet per year				
West:					
Softwood	18.5	2.9	15.6	4.7	+10.9
Hardwood	93.7	13.0	80.7	56.3	+24.4
Total	112.3	15.9	96.4	61.0	+35.4
West Central:					
Softwood	7.4	0.3	7.1	3.4	+3.7
Hardwood	88.2	4.9	83.3	38.1	+45.2
Total	95.6	5.2	90.4	41.5	+48.9
Central:					
Softwood	3.2	0.3	2.9	1.4	+1.5
Hardwood	70.3	5.8	64.5	26.3	+38.2
Total	73.4	6.0	67.4	27.7	+39.7
Plateau:					
Softwood	26.0	4.2	21.8	8.3	+13.5
Hardwood	96.5	7.6	88.9	37.8	+51.1
Total	122.5	11.8	110.7	46.1	+64.6
East:					
Softwood	55.9	6.6	49.3	19.8	+29.5
Hardwood	103.3	6.1	97.2	17.5	+79.7
Total	159.2	12.7	146.5	37.4	+109.1
All regions:					
Softwood	111.0	14.3	96.7	37.6	+59.1
Hardwood	452.0	37.4	414.6	176.0	+238.6
Total	563.0	51.6	511.4	213.7	+297.7

[1]Totals may not add due to rounding

forest land is producing at about half of potential. Potential productivity is based on fully stocked, natural stands of appropriate species for the site. Tree growth in the Eastern region is closest to potential. Among owners, growth in the National Forest averages 72 percent of potential, while growth on privately-owned lands averages about half of potential.

Timber Availability

Forest service inventory statistics are estimates of the physical timber resource without regard for its availability for harvest or other use. Often, users of these statistics find that the estimates overstate the actual amount and quality of available wood. The Hardwood Research Council has found that timber buyers are often unable to purchase standing timber because 1) the owner is unwilling to sell, or 2) the timber is not physically or economically available (Lee 1980). In order to estimate the amount of timber actually available, the reported inventory statistics should be modified. Resource analysts in the Southeastern Forest Experiment Station have developed a screening approach which sequentially discounts the reported inventory statistics using selected limiting factors (Knight 1980). Other sources must be consulted for information about owner willingness to sell timber, market conditions, and other economic factors which would influence timber availability in a particular timbershed.

Tennessee's commercial forest land is characterized by a variety of stand and site conditions. Tables VIII and IX show forest area by various volume classes which can be used to derive availability factors. For example, 55 percent of the area of loblolly-shortleaf pine type has less than 3,000 board feet of sawtimber per acre. Tract size is reported in table X, and slope in table XI. Tract size does not necessarily indicate ownership size, which is likely to be more fragmented. These tables show that, for example, 13 percent of all land classed loblolly-shortleaf type is in tracts less than 50 acres in size. Likewise, 13 percent of all loblolly-shortleaf type commercial forest land is found on slopes greater than 33 percent.

Ownership limits timber availability because of the diverse individual objectives for owning land. A study of Kentucky landowners estimated that 62 percent of non-industrial private commercial forest land was available for harvesting (Birch and Powell 1978), and a study done in central Tennessee showed that 58.6 percent of these lands were available (Wells 1977). Further analysis of the Tennessee data showed that, among non-industrial private owners, urban-resident "absentee" owners were less willing to sell timber than rural-resident owners (Wiggins 1977). This group division roughly corresponds to Forest Service "miscellaneous private" and "farmer" groups. These studies suggest that, statewide, about 60 percent of all non-inudstrial private commercial forest land could currently be available for harvest under favorable market conditions, subject to all of the other availability constraints.

A particular timbershed study would necessarily involve a certain harvesting technology and combination of limiting factors. It is important to remember that, when combining several different factors, the same acreage may be discounted for more than one reason.

Table VI.—*Periodic annual net growth and potential productivity[1] of commercial forest land by resource region, 1971-1980*

Resource region	Potential productivity	Net growth	Growth as percent of potential
	cubic feet per acre per year		*percent*
West	90	45	50
West Central	73	41	56
Central	71	32	45
Plateau	76	37	49
East	73	42	58
All regions	76	40	53

[1]Based on site class.

Table VII.—*Periodic annual net growth and potential productivity[1] of commercial forest land by ownership class, 1971-1980*

Ownership class	Potential productivity	Net growth	Growth as percent of potential
	cubic feet per acre per year		*percent*
National forest	68	49	72
Other public	80	44	55
Forest industry	75	37	49
Farmer	79	40	51
Miscellaneous private	75	39	52
All owners	76	40	53

[1]Based on site class.

Table VIII.—*Area of commercial forest land by forest type and sawtimber volume class, 1980*

Forest type	Stand-volume per acre (board feet)[1]					
	All classes	0-1000	1000-2000	2000-3000	3000-5000	More than 5000
	thousand acres					
White pine	10.8	0.0	0.0	0.0	5.6	5.2
Loblolly-shortleaf	1,058.3	345.8	148.2	86.4	246.1	231.8
Oak-pine	1,007.6	242.9	198.0	157.1	164.4	245.2
Cedar	651.3	476.0	76.9	39.0	31.1	28.3
Oak-hickory	9,312.6	2,623.1	1,840.0	1,224.9	1,843.7	1,780.9
Oak-gum-cypress	679.7	92.9	102.3	82.0	144.8	257.7
Elm-ash-cottonwood	99.2	36.9	12.8	12.9	0.0	36.6
Maple-beech-birch	59.5	5.7	26.1	9.4	12.1	6.2
All types	12,879.0	3,823.3	2,404.3	1,611.7	2,447.8	2,591.9

[1]International 1/4-inch rule.

Table IX.—*Area of commercial forest land by forest type and growing stock volume, 1980*

Forest type	Stand-volume per acre (cubic feet)					
	All classes	0-500	500-1000	1000-1500	1500-2000	More than 2000
	thousand acres					
White pine	10.8	0.0	0.0	5.6	0.0	5.2
Loblolly-shortleaf	1,058.3	225.8	183.8	256.8	176.2	215.7
Oak-pine	1,007.6	141.4	265.2	311.2	127.1	162.7
Cedar	651.3	375.9	179.5	49.8	29.7	16.4
Oak-hickory	9,312.6	1,230.9	2,836.6	2,641.5	1,663.3	940.3
Oak-gum-cypress	679.1	51.1	90.2	205.3	116.8	216.3
Elm-ash-cottonwood	99.2	23.5	26.2	22.4	9.5	17.6
Maple-beech-birch	59.5	0.0	11.0	21.3	20.9	6.3
All types	12,879.0	2,048.6	3,592.5	3,513.9	2,143.5	1,580.5

Table X.—*Area of commercial forest land by forest type and size of forest tract, 1980*

Forest type	Size of forest tract (acres)							
	All-classes	1-10	10-50	50-100	100-500	500-2500	2500-5000	More than 5000
	thousand acres							
White pine	10.8	0.0	0.0	0.0	0.0	0.0	5.2	5.6
Loblolly-shortleaf	1,058.3	35.1	101.1	162.2	256.2	322.9	114.8	66.0
Oak-pine	1,007.6	18.8	79.7	87.3	212.5	292.0	213.9	103.4
Cedar	651.3	40.9	112.5	181.3	182.9	85.3	37.9	10.5
Oak-hickory	9,312.6	260.8	748.3	1,056.5	2,608.4	2,646.7	1,289.6	702.3
Oak-gum-cypress	679.1	23.8	86.5	83.4	198.2	148.8	107.8	31.2
Elm-ash-cottonwood	99.2	10.9	20.6	12.2	13.9	41.6	0.0	0.0
Maple-beech-birch	59.5	0.0	0.0	9.4	5.8	21.3	6.3	16.7
All types	12,879.0	390.3	1,148.7	1,592.3	3,477.9	3,558.6	1,775.5	935.7

TIMBER MANAGEMENT OPPORTUNITIES

Much of Tennessee's commercial forest land has the potential for producing timber above current levels. Landowners often do not include timber production as a management objective, or if so, they are unwilling or unable to invest in long-term timber management. A commonly applied practice is to harvest timber as it matures, without regard for regeneration or future cutting. The residual stand is often poorly stocked with a high percentage of cull trees. Many landowners could greatly improve prospects for future timber harvests by applying sound forestry practices to their woodlands.

Current Forest Condition

Despite an increasing volume inventory, Tennessee's commercial forest land is producing timber at only about half of its potential. Low productivity occurs when stocking is less than optimal. More than 2.6 million acres, 20 percent of all commercial forest land, are understocked[5] with growing stock trees, a 700 thousand acre increase since the last survey. When rough and rotten trees are included in stocking, only 100 thousand acres are understocked. For better timber production, increased stocking on all 2.6 million understocked acres would be desirable, mainly by replacing rough and rotten trees with growing stock.

About 1.3 million acres are overstocked[6] with live trees. This area is reduced to 300 thousand acres when only growing stock trees are included, indicating that cull trees are competing with growing stock trees for growing space on one million acres of overstocked commercial forest land. Cost-effective stand improvement measures are needed on these overstocked acres.

Site occupancy by cull trees is a growing problem in Tennessee (table XII). Statewide, 26 percent of the basal area is in rough and rotten trees, mostly hardwoods in the seedling, sapling, and sawtimber size classes. There was a slight quality decrease between surveys which was most pronounced among small hardwood trees. This suggests that hardwood stands are not being properly regenerated after harvest, and forebodes hardwood quality decreases in the future.

Pine Stands

Most artificial regeneration in Tennessee is done with pines, although planting techniques for hardwoods such as yellow-poplar have proven successful (Russell 1977). Although Tennessee is north of the natural range of loblolly pine, the species is planted successfully on favorable sites throughout the state. Loblolly pine is a favorite for planting because of fast growth; however, ice damage and desiccation in some regions of the Plateau or Highland Rim increase the risk of damage to sawtimber.

The most persistent problem with growing pines is control of hardwood competition. The southern pine type occupies more than one million acres in Tennessee; 28 percent of the total basal area on this acreage is occupied by hardwoods. Hardwood control is often expensive, but opportunities for

[5]Less than 60 percent stocked.
[6]More than 133 percent stocked.

increasing softwood timber production in Tennessee are good.

Another common pine problem in the South is failure to regenerate pine stands after harvest. Declining numbers of small softwood trees is often cited as evidence of lack of pine regeneration; however, other causes of small tree decline include mortaility among suppressed trees, more intensive stand management, and declines in reversions. Tennessee data show declining numbers of small live trees for both hardwoods and softwoods, and a slight relative decline in the basal area of softwood seedlings and saplings versus hardwood seedlings and saplings. Since natural pine regeneration is unreliable for most of Tennessee, planting is often required to ensure that a stand will contain adequate pine stocking.

Hardwood Stands

Hardwoods dominate Tennessee's forests, with 72 percent of the commercial forest land typed oak-hickory and another 5 percent typed oak-gum-cypress. Past harvesting practices have left hardwood stands with a large component of cull trees, 28 percent of the basal area in the oak-hickory type. The most common hardwood management problem involves controlling these undesirable cull

Table XI.—*Area of commercial forest land by forest type and slope class, 1980*

Forest type	All classes	Slope class (percent) 0-5	6-10	11-20	21-33	34-50	More than 50
	thousand acres						
White pine	10.8	5.6	0.0	0.0	5.2	0.0	0.0
Loblolly-shortleaf	1,058.3	342.8	236.4	245.3	99.2	72.6	62.0
Oak-pine	1,007.6	240.2	201.3	181.6	166.0	140.3	78.2
Cedar	651.3	272.8	131.9	128.0	66.4	39.0	13.2
Oak-hickory	9,312.6	1,698.6	1,733.7	2,174.3	1,766.2	1,245.9	693.9
Oak-gum-cypress	679.1	636.3	30.2	6.0	0.0	7.2	0.0
Elm-ash-cottonwood	99.2	93.6	0.0	0.0	5.6	0.0	0.0
Maple-beech-birch	59.5	5.7	0.0	20.9	15.6	5.7	11.6
All types	12,879.0	3,295.6	2,333.5	2,756.1	2,124.2	1,510.7	858.9

Table XII.—*Average basal area per acre of live trees by class of timber, 1971 and 1980*[1]

Species group and size class	Tree class 1980 All trees	Growing stock	Rough and rotten	Tree class 1971 All trees	Growing stock	Rough and rotten
	square feet per acre					
Softwoods:						
Sapling and seedling	2.6	2.3	0.4	3.0	2.8	0.3
Poletimber	4.7	4.4	0.4	4.5	4.3	0.3
Sawtimber	5.6	5.1	0.4	4.1	3.8	0.2
All softwoods	12.9	11.8	1.2	11.6	10.9	0.8
Hardwoods:						
Sapling and seedling	18.4	11.3	7.1	20.1	14.1	5.9
Poletimber	26.5	20.5	5.9	24.8	19.6	5.1
Sawtimber	30.3	21.4	8.9	24.5	17.5	7.1
All hardwoods	75.2	53.2	21.9	69.4	51.2	18.1
All trees	88.1	65.0	23.1	81.0	62.1	18.8

[1]Totals may not add due to rounding.

Poor harvesting practices leave a residual stand of suppressed cull trees which will not contribute to future growing stock.

trees. Since remedies can be costly, most situations require a careful appraisal of timber management alternatives.

Management for natural hardwood regeneration is possible on many upland sites. Planting of yellow-poplar, cottonwood, and other hardwood species is practical but not widely practiced. Yellow-poplar is fast-growing and resembles pine in quality and general utility, providing opportunities for substituting this hardwood for traditional softwood products such as plywood veneer or pulp.

Mixed Pine-Hardwood Stands

The third major forest type found in Tennessee is the oak-pine type which occupies one million acres of commercial forest land. Most of the cedar type also falls under this broad type class. In the average oak-pine forest, pines account for 38 percent of the basal area, and cull hardwoods account for 18 percent. Natural stand development will eventually favor the hardwoods. Treatments to control cull hardwoods would benefit all future crop trees; however, stands with a very large component of low-quality hardwoods would be more productive if harvested and regenerated to pine, or mixed pine-hardwood as a low-cost option (Sims et. al. 1981). Management for hardwoods is often appropriate on better sites with good stocking of valuable species.

RESOURCE OUTLOOK

Tennessee's commercial forest land base should gradually decline in the years ahead. Although land use will continue to shift between agriculture and forest, non-agricultural land clearing, which accompanies population growth and urban development, will remove land from production for long periods of time. If past trends continue, farmers will lose more forest land to forest industry and miscellaneous private owners. Changes in ownership objectives may affect timber availability.

Changes in composition and structure of commercial forests will affect timber volume and quality for many years. As Tennessee forests mature, the basal area occupied by large trees is increasing while numbers of small trees decline.

Young poletimber stands with a high percentage of cull trees would benefit greatly from Timber Stand Improvement operations.

Middle or poletimber size classes should begin to decline with reduced ingrowth from smaller diameter classes. In the absence of intensified management, maturing oak-pine forests will shift to oak-hickory type, causing a reduction in the relative softwood to hardwood basal area.

Softwoods are more intensively managed, and their share of growing stock volume will increase despite declining basal area composition. Many young softwoods and hardwoods are entering a period of rapid volume growth. Without sharply increased utilization, standing volumes will continue to increase rapidly. Hardwood quality will decline if harvesting practices continue to remove better trees and leave culls and suppressed trees. Quality decreases in hardwood regeneration also foretell growing stock decreases in the absence of increased management efforts.

These changes are likely under current timber management and harvest levels. Utilization is well below growth, however, and increasing stand volumes could attract forest industries and promote better forest management.

LITERATURE CITED

Binkley, Clark S. Timber supply from private nonindustrial forests. Bulletin No. 92. New Haven, CT: Yale University, School of Forestry and Environmental Studies; 1981. 97 p.

Birch, Thomas W. and Douglas S. Powell. The forest-land owners of Kentucky. Resour. Bull. NE-57. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Environmental Studies; 1981. 97 p.

Knight, Herbert A. A closer look at South Carolina hardwoods. In: Proceedings, Eighth Annual Hardwood Symposium of the Hardwood Research Council; 1980 April 23-26; Cashier, NC: Hardwood Research Council; 1980: 164.

Lee, James H. A closer look at hardwood inventory data. In: Proceedings, Eighth Annual Hardwood Symposium of the Hardwood Research Council; 1980 April 23-26; Cashier, NC: Hardwood Research Council; 1980: 155-158.

Murphy, Paul A. Forest resources of Tennessee. Resour. Bull. SO-35. New Orleans, LA: U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station, 1972. 33 p.

Russell, T.E. Planting yellow-poplar: where we stand today. Gen. Tech. Report SO-17. New Orleans, LA: U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station; 1977. 8 p.

Sims, Daniel H.; McGee, C. E.; Galloway, J.; Richman, B. Mixed pine-hardwood stands — a low-cost option for reforestation. Forest Farmer XL(10): 10-11; 1980.

Sternitzke, Herbert S. Tennessee's timber economy. Forest Resour. Rep. No. 9. Washington, DC: U.S. Department of Agriculture, Forest Service; 1955. 56 p. + map.

Tennessee Forestry Association. Forest practice guidelines for Tennessee. Nashville, TN: Tennessee Forestry Association. 31 p.

Wells, John L. Economics of timber resource availability in a Tennessee timbershed. Knoxville, TN: University of Tennessee; 1977. 94 p. Thesis.

Wiggins, James L. Timber availability and the influence of absentee ownership. Knoxville, TN: University of Tennessee; 1977. 81 p. Thesis.

APPENDIX

Survey Methods

The data on forest acreage and timber volume were secured by a sampling method involving a forest-nonforest classification on aerial photographs and on-the-ground measurements of trees at sample locations. The sample locations were at the intersections of a grid of lines spaced 3 miles apart. In Tennessee, 123,516 photographic classifications were made and 6,941 ground sample locations were visited.

The initial estimates of forest area that were obtained with the aerial photographs were adjusted on the basis of the ground check.

A cluster of 10 variable-radius plots was installed at each ground sample location. Each sample tree on the variable-radius plots represented 3.75 square feet of basal area per acre. Trees less than 5.0 inches in diameter were tallied on fixed-radius plots around the plot centers. Together, these samples provided most of the information for the new inventory.

The plots established by the prior survey were measured to determine the elements of change and were the basis for estimating growth, mortality, removals, and changes in land use.

Reliability of the Data

Reliability of the estimates may be affected by two types of errors. The first stems from the use of a sample to estimate the whole and from variability of the items being sampled. This is termed sampling error; it is susceptible to a mathematical evaluation of the probability of error. The second type — often referred to as reporting or estimating error — derives from mistakes in measurement, judgment, or recording and from limitations of method or equipment. Its effects cannot be appraised mathematically, but the Renewable Resources Research Unit attempts to hold it to a minimum by proper training, good supervision, and emphasis on careful work.

Statistical analysis of the data indicates a sampling error of plus or minus 0.3 percent for the estimate of total commercial forest area, 1.5 percent for total cubic volume, and 2.3 percent for total board-foot volume. As these totals are broken down by forest type, species, tree diameter, and other subdivisions, the possibility of error increases and is greatest for the smallest items. The order of this increase is suggested in the following tabulation which shows the sampling error to which the timber volume and area estimates are liable, two chances out of three:

Sampling errors for commercial forest area, growing-stock and sawtimber volumes, Tennessee, 1980

Commercial forest area	Sampling error[1]	Cubic volume[2]	Sampling error[1]	Board-foot volume[3]	Sampling error[1]
thousand acres	*percent*	*million cubic feet*	*percent*	*million board-feet*	*percent*
12,879.0	0.3	.....	...	.....	....
1,159.1	1.0	12,805.2	1.5	.....	....
289.8	2.0	7,202.9	2.0	38,897.3	2.3
128.8	3.0	3,201.3	3.0	22,863.0	3.0
72.4	4.0	1,800.7	4.0	12,860.4	4.0
46.4	5.0	1,152.5	5.0	8,230.7	5.0
11.6	10.0	288.1	10.0	2,057.7	10.0
5.2	15.0	128.1	15.0	914.5	15.0
2.9	20.0	72.0	20.0	514.4	20.0
1.9	25.0	46.1	25.0	329.2	25.0

[1]By random sampling formula.
[2]Growing-stock volume on commercial forest land.
[3]Sawtimber volume on commercial forest land.

The sampling error to which the estimates of growth, mortality, and removals are liable, on a probability of two chances out of three, are:

Periodic annual growth and timber removals sampling error, Tennessee, 1971-1980

Periodic annual growth				Periodic annual removals			
Cubic volume	Sampling error[1]	Board-feet volume	Sampling error[1]	Cubic volume	Sampling error[1]	Board-feet volume	Sampling error[1]
million cubic feet	*percent*	*million board feet*	*percent*	*million cubic feet*	*percent*	*million cubic feet*	*percent*
509.5	2.2	1708.1	2.8	.....	....	.....	....
261.7	3.0	1492.5	3.0	.....	....	.....	....
94.2	5.0	537.3	5.0	212.9	5.7	813.6	6.5
23.6	10.0	134.3	10.0	69.2	10.0	343.7	10.0
5.9	20.0	33.6	20.0	17.3	20.0	85.9	20.0

[1]By random sampling formula.

Definitions of Terms

Forest Land Class

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 non-forest use.

Commercial Forest Land—Forest land that is producing, or is capable of producing, crops of industrial wood and not withdrawn from timber utilization.

Nonstocked Land—Commercial forest land less than 16.7 percent stocked with growing-stock trees.

Productive-reserved Forest Land—Productive public forest land withdrawn from timber utilization through statute or administrative regulation.

Deferred Timberland—National Forest lands that meet productivity standards for timberland, but are under study for possible inclusion in the wilderness system.

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

Tree Species

Commercial Species—Tree species currently or prospectively suitable for industrial wood products, excludes so-called weed species such as blackjack oak and blue beech.

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

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

Forest Type

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 southern 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 25-50 percent of the stocking. Common associates include gum, hickory, and yellow-poplar.

Cedar—Forests in which eastern redcedar comprises 25 percent or more of the stocking. Common associates include southern pines, oak, and hickory.

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

Class of Timber

Growing Stock Trees—Sawtimber trees, poletimber trees, saplings, and seedlings; all live trees of commercial species except rough and rotten trees.

Desirable Trees—Growing-stock trees that have no serious defects to limit present or prospective use, are of relatively high vigor, and contain no pathogens that may result in death or serious deterioration before rotation age. They comprise the type of trees that forest managers aim to grow; trees favored in silvicultural operations.

Acceptable Trees—Trees meeting the specifications for growing stock but not qualifying as desirable trees.

Sawtimber Trees—Live trees of commercial species, 9.0 inches and larger in dbh for softwoods and 11.0 inches and larger for hardwoods, containing at least one 12-foot saw log.

Poletimber Trees—Live trees of commercial species, 5.0 to 9.0 inches in dbh for softwoods and 5.0 to 11.0 inches for hardwoods, of good form and vigor.

Saplings—Live trees of commercial species, 1.0 inch to 5.0 inches in dbh and of good form and vigor.

Rough and Rotten Trees—Live trees that are unmerchantable for saw logs currently or potentially because of defect, rot, or species.

Salvable Dead Trees—Standing or down dead trees that are currently or potentially merchantable.

Stand-Size Class

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 stocking exceeding that of sawtimber stocking.

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

Nonstocked Areas—Commercial forest lands 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 by vegetative cover. Stocking is determined by comparing the stand density in terms of number of trees or basal area with a specified standard. Full stocking is assumed to range from 100 to 133 percent of the stocking standard. The tabulation below shows the density standard in terms of trees per acre, by size class, required for full stocking:

Dbh (inches)	Number of trees	Dbh (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 Sawtimber—Net volume of the sawlog portion of live sawtimber trees in board feet of the International rule, ¼ inch kerf.

Volume of Growing Stock—Volume of sound wood in the bole of sawtimber and poletimber trees from stump to a minimum 4.0-inch top outside bark or to the point where the central stem breaks into limbs.

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 dbh from stump to a minimum 4.0-inch top outside bark, or to the point where the central stem breaks into limbs.

Area Condition Class

A classification of commercial forest land based upon stocking by desirable trees and other conditions affecting current and prospective timber growth.

Class 10—Areas 100 percent or more stocked with desirable trees and not overstocked.

Class 20—Areas 100 percent or more stocked with desirable trees and overstocked with all live trees.

Class 30—Areas 60 to 100 percent stocked with desirable trees and with less than 30 percent of the area controlled by other trees, inhibiting vegetation, slash, or nonstockable conditions.

Class 40—Areas 60 to 100 percent stocked with desirable trees and with 30 percent or more of the area controlled by other trees, or conditions that ordinarily prevent occupancy by desirable trees.

Class 50—Areas less than 60 percent stocked with desirable trees, but with 100 percent or more stocking of growing-stock trees.

Class 60—Areas less than 60 percent stocked with desirable trees, but with 60 to 100 percent stocking of growing-stock trees.

Class 70—Areas less than 60 percent stocked with desirable trees and with less than 60 percent stocking of growing-stock trees.

Miscellaneous Definitions

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 as square feet per acre.

Dbh (Diameter Breast High)—Tree diameter in inches, outside bark, measured at 4½ 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 dbh.

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

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

Gross Growth—Annual increase in net volume of trees in the absence of cutting and mortality.

Net Annual Growth—The periodic annual increase in volume of a specified size class. Components of net annual growth include the average increment in net volume of trees at the beginning of the period surviving to its end plus the volume of trees reaching the size class during the period minus the volume of trees that died during the period minus the net volume of trees that become rough or rotten during the period.

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

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 changes in land use.

Species List

Commercial Species

Common name	Species	Genus
balsam fir	*balsamea* var. *balsamea*	*Abies*
Fraser fir	*fraseri*	
Atlantic white-cedar	*thyoides*	*Chamaecyparis*
southern redcedar	*silicola*	*Juniperus*
eastern redcedar	*virginiana*	
black spruce	*mariana*	*Picea*
red spruce	*rubens*	
sand pine	*clausa*	*Pinus*
shortleaf pine	*echinata*	
slash pine	*elliottii*	
spruce pine	*glabra*	
longleaf pine	*palustris*	
ponderosa pine	*ponderosa*	
Table Mountain pine	*pungens*	
pitch pine	*rigida*	
pond pine	*serotina*	
eastern white pine	*strobus*	
loblolly pine	*taeda*	
Virginia pine	*virginiana*	
baldcypress	*distichum* var. *distichum*	*Taxodium*
pondcypress	*distichum* var. *nutans*	
northern white-cedar	*occidentalia*	*Thuja*
eastern hemlock	*canadensis*	*Tsuga*
Carolina hemlock	*caroliniana*	
Florida maple	*barbatum*	*Acer*
boxelder	*negundo*	
black maple	*nigrum*	
red maple	*rubrum* var. *rubrum*	
silver maple	*saccharinum*	
sugar maple	*saccharum*	
Ohio buckeye	*glabra*	*Aesculus*
yellow buckeye	*octandra*	
yellow birch	*alleghaniensis*	*Betula*
sweet birch	*lenta*	
river birch	*nigra*	
gray birch	*populifolia*	
hickory	sp.	*Carya*
water hickory	*aquatica*	
pecan	*illinoensis*	
American chestnut	*dentata*	*Castanea*
Ashe chinkapin	*pumila* var. *ashei*	
catalpa	sp.	*Catalpa*
sugarberry	*laevigata*	*Celtis*
hackberry	*occidentalis*	
flowering dogwood	*florida*	*Cornus*
common persimmon	*virginiana*	
American beech	*grandifolia*	*Fagus*
white ash	*americana*	*Fraxinus*
black ash	*nigra*	
green ash	*pennsylvanica*	
pumpkin ash	*profunda*	
blue ash	*gradrangulata*	
water locust	*aquatica*	*Glenditsia*
honey locust	*tricanthus*	
Kentucky coffeetree	*dioicus*	*Gymnocladus*
Mountain silverbell	*carolina*	*Halesia*
American holly	*opaca*	*Ilex*
butternut	*cinerea*	*Juglans*
black walnut	*nigra*	
sweetgum	*stryaciflua*	*Liquidambar*
yellow-poplar	*tulipifera*	*Liriodendron*
Osage-orange	*pomifera*	*Maclura*
cucumbertree	*acuminata*	*Magnolia*
southern magnolia	*grandiflora*	
sweetbay	*virginiana*	
red mulberry	*rubra*	*Morus*
water tupelo	*aquatica*	*Nyssa*
Ogeechee tupelo	*ogeche*	
black tupelo, blackgum	*sylvatica* var. *sylvatica*	
swamp tupelo	*sylvatica* var. *biflora*	
redbay	*borbonia*	*Persea*
American sycamore	*occidentalis*	*Platanus*
cottonwood	sp.	*Populus*
black cherry	*serotina*	*Prunus*
white oak	*alba*	*Quercus*
swamp white oak	*bicolor*	
scarlet oak	*coccinea*	
Durand oak	*durandii*	
southern red oak	*falcata*	
cherrybark oak	*falcata* var. *pagodaefolia*	
shingle oak	*imbricaria*	
laurel oak	*laurifolia*	
overcup oak	*lyrata*	
bur oak	*macrocarpa*	
swamp chestnut oak	*michauxii*	

chinkapin oak	*muehlenbergii*	
water oak	*nigra*	
nuttall oak	*nuttallii*	
pin oak	*palustris*	
willow oak	*phellos*	
chestnut oak	*prinus*	
northern red oak	*rubra*	
shumard oak	*shumardii*	
post oak	*stellata* var. *stellata*	
Delta post oak	*stellata* var. *mississippiensis*	
black oak	*velutina*	
black locust	*pseudoacacia*	*Robinia*
willow	sp.	*Salix*
Sassafras	*albidum*	*Sassafras*
American basswood	*americana*	*Tilia*
white basswood	*heterophylla*	
winged elm	*alata*	*Ulmus*
American elm	*americana*	
cedar elm	*crassifolia*	
Siberian elm	*pumila*	
slippery elm	*rubra*	
September elm	*serotina*	
rock elm	*thomassii*	

Noncommercial Species

Common name	Species	Genus
serviceberry	sp.	*Amelanchier*
buckeye	sp.	*Aesculus*
ailanthus, tree-of-heaven	*altissima*	*Ailanthus*
chittamwood, gum bumelia	sp.	*Bumelia*
chinkapin	sp.	*Castanopsis*
eastern redbud	*canadensis*	*Cercis*
hawthorn	sp.	*Crataegus*
bigleaf magnolia	*macrophylla*	*Magnolia*
apple	sp.	*Malus*
white mulberry	*alba*	*Morus*
eastern hophornbeam, ironwood	*virginiana*	*Ostrya*
sourwood	*arboreum*	*Oxydendrum*
plums, cherries	sp.	*Prunus*
turkey oak	*laevis*	*Quercus*
blackjack oak	*marilandica*	
live oak	*virginiana*	
bluejack oak	*incona*	
sparkleberry	*arboreum*	*Vaccinium*
bluebeech, American hornbeam	*carolina*	*Carpinus*
chinaberry	*azedarach*	*Melia*
water-elm	*aquatica*	*Planera*
smoketree	*obovatus*	*Cotinus*
mesquite	sp.	*Prosopis*

Standard Tables

Table 1.—*Area by land classes, Tennessee, 1980*

Land class	Area
	thousand acres
Forest	
Commercial	12,879.0
Productive-reserved	400.6
Deferred timberland	23.7
Unproductive	5.2
Total forest	13,308.5
Nonforest	
Cropland[1]	7,756.5
Other[2]	5,385.1
Total nonforest	13,141.6
All land[3]	26,450.1

[1]Census of Agriculture.
[2]Includes pasture and range, industrial and urban area, other nonforest land and 68,769 acres, classed as water by Forest Survey Standards, but defined by the Bureau of the Census as land.
[3]United States Bureau of the Census.

Table 2.—*Area of commercial forest land by ownership classes, Tennessee, 1980*

Ownership class	Area
	thousand acres
Public:	
National forest	557.2
Other federal	267.8
State	318.1
County and municipal	16.7
Total public	1,159.8
Private:	
Forest industry[1]	1,222.8
Farmer	4,548.1
Miscellaneous private:	
Individual	5,023.4
Corporate	924.9
Total private	11,719.2
All ownerships	12,879.0

[1]Not including 25 thousand acres of farmer-owned and miscellaneous private lands leased to forest industry.

Table 3.—*Area of commercial forest land by stand size and ownership classes, Tennessee, 1980*

Stand size class	All ownerships	National forest	Other public	Forest industry	Farmer	Misc. private
	thousand acres					
Sawtimber	4,923.6	258.2	298.5	398.1	1,743.6	2,225.2
Poletimber	5,229.6	203.1	177.9	500.6	1,887.4	2,460.6
Sapling and seedling	2,672.2	89.8	119.7	324.1	900.7	1,237.9
Nonstocked areas	53.6	6.1	6.5	.....	16.4	24.6
All classes	12,879.0	557.2	602.6	1,222.8	4,548.1	5,948.3

Table 4.—*Area of commercial forest land by stand volume and ownership classes, Tennessee, 1980*

Stand volume per acre[1]	All ownerships	National forest	Other public	Forest industry	Farmer	Misc. private
	thousand acres					
Less than 1,500 fbm	5,088.8	138.9	175.6	534.7	1,825.6	2,414.0
1,500 to 5,000 fbm	5,198.3	203.9	255.4	454.7	1,855.8	2,434.1
More than 5,000 fbm	2,591.9	214.4	171.6	233.4	866.7	1,100.2
All classes	12,879.0	557.2	602.6	1,222.8	4,548.1	5,948.3

[1]International ¼-inch rule.

Table 5.—*Area of commercial forest land by stocking class for live tree stand components, Tennessee, 1980*

Stocking percentage	Stocking classified in terms of					
	All trees	Growing-stock trees			Rough and rotten trees	Inhibiting vegetation
		Total	Desirable	Acceptable		
	thousand acres					
160 or more	27.9	6.2	.....	6.2	.....	.....
150 to 160	159.8	45.4	.....	28.0	.....	.....
140 to 150	394.2	104.0	.....	92.1	.....	.....
130 to 140	995.2	211.2	.....	182.4	.....	.....
120 to 130	1,524.1	356.4	.....	247.0	6.5	.....
110 to 120	2,321.1	788.8	.....	583.4	.....	.....
100 to 110	2,903.4	1,080.1	11.3	877.0	11.7	.....
90 to 100	2,193.2	1,556.9	17.2	1,364.2	25.1	.....
80 to 90	1,426.7	2,082.5	11.1	1,788.4	94.9	.....
70 to 80	626.2	2,242.8	23.3	2,195.4	178.3	.....
60 to 70	170.7	1,765.2	50.7	2,029.7	292.8	.....
50 to 60	86.9	1,299.3	100.0	1,521.0	672.2	.....
40 to 50	25.8	734.4	106.8	912.5	1,202.8	.....
30 to 40	10.4	375.1	240.6	574.5	2,441.7	.....
20 to 30	13.4	143.4	498.7	312.9	3,075.9	30.3
10 to 20	.....	58.7	953.3	93.6	2,818.1	37.8
Less than 10	.....	28.6	10,866.0	70.9	2,059.0	12,810.9
All areas	12,879.0	12,879.0	12,879.0	12,879.0	12,879.0	12,879.0

Table 6.—*Area of commercial forest land by area-condition and ownership classes, Tennessee, 1980*

Area-condition class	All ownerships	National forest	Other public	Forest industry	Farmer	Miscellaneous private
	thousand acres					
10	5.6	.....	.....	5.6	.....	.....
20	5.7	5.5	.....	.....	.....	.2
30	5.9	.....	.....	5.9	.....	.....
40	96.4	5.5	20.3	34.5	16.2	19.9
50	2,512.0	246.2	88.4	286.7	823.9	1,066.8
60	7,613.9	244.1	392.1	729.3	2,616.7	3,631.7
70	2,639.5	55.9	101.8	160.8	1,091.3	1,229.7
All classes	12,879.0	557.2	602.6	1,222.8	4,548.1	5,948.3

Table 7.—*Area of commercial forest land by site and ownership classes, Tennessee, 1980*

Site class	All ownerships	National forest	Other public	Forest industry	Farmer	Misc. private
	thousand acres					
165 ft^3 or more	216.8	5.5	12.8	24.6	90.0	84.0
120 to 165 ft^3	717.1	10.0	35.0	57.3	271.4	343.4
85 to 120 ft^3	3,119.7	96.7	191.2	285.8	1,250.6	1,295.4
50 to 85 ft^3	6,285.9	298.9	248.1	598.0	2,156.1	2,984.8
Less than 50 ft^3	2,539.5	146.1	115.5	257.1	780.0	1,240.8
All classes	12,879.0	557.2	602.6	1,222.8	4,548.1	5,948.3

Table 8.—*Area of commercial forest land by forest types and ownership classes, Tennessee, 1980*

Type	All ownerships	National forest	Other public	Forest industry	Farmer	Misc. private
	thousand acres					
White pine	10.8	5.0	.....	.....	.....	5.8
Loblolly-shortleaf	1,058.3	68.2	47.1	188.6	229.0	529.3
Oak-pine	1,007.6	98.8	82.7	129.8	244.2	455.4
Cedar	651.3	26.3	41.5	5.4	313.8	267.1
Oak-hickory	9,312.6	336.4	359.0	807.9	3,427.0	4,382.3
Oak-gum-cypress	679.7	.....	60.6	70.7	271.8	279.6
Elm-ash-cottonwood	99.2	.....	6.7	20.4	42.6	29.5
Maple-beech-birch	59.5	22.5	5.0	.....	19.7	12.3
All types	12,879.0	557.2	602.6	1,222.8	4,548.1	5,948.3

Table 9.—*Area of noncommercial forest land by forest types, Tennessee, 1980*

Type	All areas	Productive reserved areas	Unproductive areas
	thousand acres		
Spruce-fir	20.9	20.9	...
White-pine	74.8	74.8	...
Loblolly-shortleaf pine	15.6	15.6	...
Oak-pine	60.1	60.1	...
Oak hickory	213.5	208.3	5.2
Maple-beech-birch	44.6	44.6	...
All types	429.5	424.3	5.2

Table 10.—*Number of growing-stock trees on commercial forest land by species and diameter classes, Tennessee, 1980*

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 and larger
	Diameter class (inches at breast height)										
	thousand trees										
Softwood:											
Shortleaf pine	71,602	23,583	20,607	14,831	8,642	2,650	1,029	160	93	7	...
Loblolly pine	47,534	24,556	13,496	6,643	1,997	503	204	85	42	8	...
Virginia pine	111,711	48,615	32,676	16,831	8,649	3,402	1,184	270	61	23	...
Pitch pine	8,373	2,635	2,339	1,720	783	432	338	68	23	35	...
Table mountain pine	1,972	347	923	491	146	.....	65	.....	...	...	...
White pine	11,375	3,259	2,213	1,672	1,165	1,242	774	478	242	294	36
Redcedar	45,043	27,377	12,559	3,466	1,159	314	104	64	.....	...	...
Hemlock	6,639	2,395	1,275	1,018	808	362	300	250	60	162	9
Cypress	1,095	.....	123	.....	29	130	205	188	162	212	46
Total	305,344	132,767	86,211	46,672	23,378	9,035	4,203	1,563	683	741	91
Hardwood:											
Select white oak[1]	158,077	55,768	39,458	24,874	16,459	10,614	5,666	2,695	1,470	1,040	33
Select red oaks[2]	47,851	11,936	10,152	8,920	6,284	3,808	3,144	1,764	687	1,011	145
Other white oaks	127,670	45,626	28,743	23,605	11,512	8,528	4,567	2,689	1,202	1,103	95
Other red oaks	164,493	53,147	38,095	28,880	17,576	11,712	7,651	4,202	1,670	1,421	139
Water hickory	359	.....	165	72	51	.....	20	35	.....	16	...
Other hickories	149,335	57,101	37,675	26,663	13,971	7,519	3,662	1,503	731	479	31
Sweetgum	38,237	13,281	9,095	7,474	4,053	2,309	904	562	202	232	25
Tupelo and blackgum	30,425	13,333	7,515	4,698	2,025	1,242	636	200	189	83	4
Hard maple	29,108	12,847	7,015	4,200	2,170	1,376	806	348	142	196	8
Soft maple	53,924	25,627	14,130	7,754	3,029	1,714	786	400	248	226	10
Beech	14,995	5,576	2,811	2,710	1,341	771	629	592	249	302	14
Ash	35,875	16,765	8,727	3,821	2,517	1,960	925	608	218	330	4
Boxelder	5,244	2,141	1,535	925	373	100	103	44	.....	23	...
Persimmon	7,293	5,016	1,350	594	247	49	16	21	.....	...	...
Cottonwood	854	165	93	115	145	.....	41	15	41	188	51
Basswood	2,951	252	757	529	743	356	143	120	9	42	...
Yellow-poplar	79,619	26,341	15,512	12,723	9,013	6,950	4,342	2,477	1,254	972	35
Black walnut	9,923	3,396	2,663	2,003	926	604	201	62	62	...	6
Black cherry	6,906	2,289	2,398	1,047	587	278	283	24	.....	...	...
Willow	1,107	389	223	85	60	49	75	13	99	114	...
Magnolia (*Magnolia* spp)	3,777	1,808	901	325	425	170	63	66	11	8	...
American elm	13,945	5,712	3,831	2,461	972	444	292	89	68	69	7
Other elms	17,327	10,135	3,489	2,032	918	417	193	65	41	27	10
River birch	2,145	846	546	387	162	63	19	70	32	20	...
Other birches	7,971	4,409	2,627	714	53	99	.....	23	.....	39	7
Hackberry	10,963	5,068	2,806	1,359	863	562	159	77	26	43	...
Black locust	14,708	7,659	4,500	1,308	694	312	185	22	28	...	...
Other locusts	1,980	1,184	393	270	55	25	.....	38	.....	15	...
Sassafras	16,071	9,787	3,527	1,809	598	162	116	57	15	...	...
Sycamore	3,587	476	570	970	644	214	265	185	121	117	25
Dogwood	12,502	11,800	619	53	.....	.....	.....	.....	16	14	...
Holly	702	250	358	56	38	.....	.....	.....	.....	...	...
Other hardwood	4,442	2,045	1,223	567	343	88	49	.....	52	75	...
Total	1,074,366	412,275	253,502	174,003	98,847	62,995	35,941	19,066	8,883	8,205	649
All species	1,379,710	545,042	339,713	220,675	122,225	72,030	40,144	20,629	9,566	8,946	740

[1]Includes white, swamp chestnut, swamp white, chinkapin, Durand, and bur oaks.
[2]Includes cherry bark, Shumard, and northern red oaks.

Table 11.—*Volume of timber on commercial forest land by class of timber and by softwoods and hardwood, Tennessee, 1980*

Class of timber	All species	Softwood	Hardwood
	million cubic feet		
Sawtimber trees:			
Saw-log portion	6,426.2	1,353.2	5,073.0
Upper stem portion	1,292.5	179.9	1,112.6
Total	7,718.7	1,533.1	6,185.6
Poletimber trees	5,086.5	872.4	4,214.1
All growing stock	12,805.2	2,405.5	10,399.7
Rough trees	1,576.0	86.4	1,489.6
Rotten trees	793.0	20.2	772.8
Salvable dead trees	9.3	4.9	4.4
All timber	15,183.5	2,517.0	12,666.5

Table 12.—*Volume of growing stock and sawtimber on commercial forest land by ownership classes and by softwoods and hardwoods, Tennessee, 1980*

Ownership class	Growing stock			Sawtimber		
	All species	Softwood	Hardwood	All species	Softwood	Hardwood
	million cubic feet			*million board feet*		
National forest	797.5	281.0	516.5	2,625.4	1,122.4	1,503.0
Other public	686.2	185.1	501.1	2,356.8	786.1	1,570.7
Forest industry	1,193.6	257.8	935.8	3,600.5	814.3	2,786.2
Farmer	4,423.4	595.5	3,827.9	13,359.5	1,793.5	11,566.0
Misc. private	5,704.5	1,086.1	4,618.4	16,955.1	3,168.0	13,787.1
All ownerships	12,805.2	2,405.5	10,399.7	38,897.3	7,684.3	31,213.0

Table 13.—*Volume of growing stock on commercial forest land by species and diameter classes, Tennessee, 1980*

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
	million cubic feet										
Softwood:											
Shortleaf pine	663.8	65.6	131.8	175.7	166.7	71.0	40.1	7.6	4.9	.4	...
Loblolly pine	270.3	55.3	79.3	75.4	34.6	12.4	6.8	4.6	1.7	.2	...
Virginia pine	872.7	149.1	215.6	210.6	150.2	92.5	39.3	10.7	3.0	1.7	...
Pitch pine	76.6	7.1	14.5	15.3	12.5	10.0	10.6	3.7	.8	2.1	...
Table-mountain pine	14.7	1.1	5.1	4.5	2.1	....	1.9	....	...	.....	...
White pine	183.4	8.1	12.9	18.0	19.0	30.8	27.0	21.7	14.3	25.6	6.0
Redcedar	170.9	57.0	57.3	31.0	14.7	5.7	3.1	2.1	....	....	...
Hemlock	86.8	5.0	6.5	12.0	14.1	8.8	9.6	11.7	4.0	14.5	.6
Cypress	66.3	....	1.1	....	.7	3.3	8.9	9.7	11.2	23.6	7.8
Total	2,405.5	348.3	524.1	542.5	414.6	234.5	147.3	71.8	39.9	68.1	14.4
Hardwood											
Select white oaks[1]	1,616.1	146.9	236.2	269.8	281.7	248.7	181.9	106.5	69.1	71.4	3.9
Select red oaks[2]	686.1	35.7	59.3	95.0	103.9	91.6	96.9	72.7	35.5	76.5	19.0
Other white oaks	1,160.7	109.8	153.7	212.3	169.1	167.7	124.7	99.0	51.8	61.3	11.3
Other red oaks	1,757.4	136.2	209.5	283.0	279.6	258.1	232.4	164.7	77.9	98.3	17.7
Water hickory	7.0	.....	.9	.9	1.4	.....	.6	1.8	....	1.4	....
Other hickories	1,331.2	132.8	210.7	278.9	241.2	186.0	127.4	69.4	42.1	38.6	4.1
Sweetgum	392.8	27.8	52.1	78.9	72.7	60.9	33.9	27.3	13.4	22.3	3.5
Tupelo & blackgum	218.0	28.2	39.5	42.1	30.1	35.7	18.2	7.9	9.8	6.4	.1
Hard maple	265.7	36.4	45.3	45.3	36.6	36.0	26.9	15.1	8.0	15.8	.6
Soft maple	379.4	65.4	79.5	78.9	47.7	41.0	22.1	16.7	11.2	15.5	1.4
Beech	175.3	14.7	15.1	29.7	20.8	16.7	19.5	23.6	12.8	20.9	1.5
Ash	316.2	44.2	52.9	39.9	42.1	49.5	29.9	24.9	10.4	22.0	.4
Boxelder	33.5	3.7	7.7	9.3	5.5	2.0	2.6	1.4	....	1.3	....
Persimmon	32.2	11.0	7.2	7.0	4.2	1.2	.5	1.1	....	....	....
Cottonwood	40.1	.4	.4	1.2	2.0	.....	1.7	1.0	3.0	20.4	10.0
Basswood	55.5	1.1	5.8	6.9	15.2	9.9	5.5	6.6	.8	3.7	....
Yellow poplar	1,129.1	74.1	102.7	144.7	167.4	189.3	162.7	125.2	79.4	78.0	5.6
Black walnut	75.2	9.1	12.3	18.1	13.1	11.1	5.9	2.0	2.3	....	1.3
Black cherry	53.6	6.2	11.4	10.2	8.9	6.7	9.2	1.0	....	....	....
Willow	25.7	1.4	1.7	1.4	1.1	1.5	3.2	.9	6.5	8.0	....
Magnolia (*Magnolia* spp.)	33.4	5.6	6.0	2.2	8.9	4.4	1.6	3.3	.8	.6	....
American elm	99.2	12.0	20.5	22.1	14.0	9.8	7.5	3.8	3.4	5.2	.9
Other elms	96.3	21.0	16.6	21.3	13.4	10.3	6.4	2.7	1.4	1.8	1.4
River birch	18.5	2.0	3.5	3.1	2.5	1.5	.8	2.4	1.5	1.2	....
Other birches	45.2	13.2	16.9	6.9	.9	2.0	.....	1.6	....	2.8	.9
Hackberry	70.0	10.0	12.5	11.2	12.4	12.4	4.8	2.4	1.4	2.9	....
Black locust	76.8	17.9	20.8	13.0	10.6	7.6	5.1	.7	1.1	....	....
Other locusts	10.1	2.8	1.3	2.1	.8	.6	.....	1.5	....	1.0	....
Sassafras	75.8	23.0	17.2	16.7	9.7	3.5	2.9	2.1	.7	....	....
Sycamore	67.9	1.9	3.8	9.7	10.3	5.6	8.8	7.6	6.4	10.4	3.4
Dogwood	17.5	14.4	1.8	.1	.....	.....	.....	.....	.6	.6	....
Holly	3.3	.6	1.7	.4	.6	.....	.....	.....	....	....	....
Other hardwoods	34.9	4.5	6.3	5.0	5.7	2.0	1.6	.....	4.1	5.7	....
Total	10,399.7	1,014.0	1,432.8	1,767.3	1,633.8	1,473.3	1,145.2	796.9	455.4	594.0	87.0
All species	12,805.2	1,362.3	1,956.9	2,309.8	2,048.4	1,707.8	1,292.5	868.7	495.3	662.1	101.4

[1]Includes white, swamp chestnut, swamp white, chinkapin, Durand, and bur oaks.
[2]Includes cherry bark, Shumard, and northern red oaks.

Table 14.—*Volume of sawtimber trees on commercial forest land by species and diameter classes, Tennessee, 1980*

Species	Diameter class (inches at breast height)								
	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
	million board feet								
Softwood:									
Shortleaf pine	2,403.7	798.2	894.9	392.5	237.6	50.3	27.5	2.7	....
Loblolly pine	629.4	310.8	172.3	68.7	38.2	28.6	9.5	1.3	....
Virginia pine	2,476.4	953.6	734.5	491.1	213.8	55.9	16.4	11.1	....
Pitch pine	275.7	62.2	63.9	53.6	54.9	21.5	6.1	13.5	....
Table-mountain pine	33.1	16.0	8.0	.....	9.1	.....	....	.....	....
White pine	827.3	70.4	89.4	155.5	142.2	114.4	74.7	148.1	32.6
Red cedar	244.8	126.7	65.1	27.8	14.9	10.3	....	.....	....
Hemlock	398.2	51.5	67.1	44.9	48.6	66.5	27.0	89.7	2.9
Cypress	395.7	.....	3.2	18.6	52.1	56.3	70.4	147.5	47.6
Total	7,684.3	2,389.4	2,098.4	1,252.7	811.4	403.8	231.6	413.9	83.1
Hardwood:									
Select white oaks[1]	4,788.4	.....	1207.6	1213.9	959.2	576.9	383.6	424.3	22.9
Select red oaks[2]	2,554.1	.....	427.9	461.6	508.9	395.5	195.3	448.9	116.0
Other white oaks	3,433.4	.....	721.5	803.5	657.0	535.9	293.4	355.3	66.8
Other red oaks	5,690.9	.....	1,181.0	1,261.5	1,237.7	888.4	443.0	571.3	108.0
Water hickory	27.2	.....	6.5	.....	2.5	10.4	.....	7.8	.....
Other hickories	3,628.0	.....	1,075.9	946.5	690.7	408.0	248.9	234.0	24.0
Sweetgum	1,163.9	.....	291.8	299.2	180.2	152.7	83.9	134.7	21.4
Tupelo & blackgum	531.3	.....	114.3	169.8	104.7	46.5	54.1	39.6	2.3
Hard maple	681.1	.....	156.0	172.7	135.4	79.0	46.8	86.9	4.3
Soft maple	723.0	.....	197.8	190.6	104.0	79.6	59.2	85.2	6.6
Beech	607.1	.....	93.7	74.5	100.7	129.9	69.3	129.4	9.6
Ash	885.4	.....	184.5	233.5	162.2	136.2	53.9	113.9	1.2
Boxelder	53.4	.....	18.9	9.6	9.7	7.7	.....	7.5	.....
Persimmon	32.9	.....	17.9	5.5	2.8	6.7	.....	.....	.....
Cottonwood	233.3	.....	5.8	.....	8.8	5.6	19.4	136.5	57.2
Basswood	200.0	.....	61.4	48.7	29.3	36.0	5.0	19.6	.....
Yellow poplar	4,232.9	.....	721.2	946.6	883.8	712.6	467.3	464.6	36.8
Black walnut	166.9	.....	56.0	50.7	31.1	8.3	13.7	.....	7.1
Black cherry	123.7	.....	40.7	27.5	49.4	6.1	.....	.....	.....
Willow	134.6	.....	6.0	8.2	22.8	5.7	41.6	50.3	.....
Magnolia (*Magnolia* spp.)	92.4	.....	35.7	23.4	8.1	17.7	4.7	2.8	.....
American elm	210.1	.....	60.1	44.0	34.2	20.9	14.2	30.9	5.8
Other elms	179.7	.....	61.6	47.2	31.5	13.0	7.6	9.0	9.8
River birch	46.9	.....	9.1	7.4	5.2	13.6	7.9	3.7	.....
Other birches	48.8	.....	4.5	10.3	.....	9.3	.....	18.4	6.3
Hackberry	160.1	.....	52.5	54.2	23.3	11.8	7.4	10.9	.....
Black locusts	110.5	.....	42.1	34.4	24.3	4.1	5.6	.....	.....
Other locusts	20.2	.....	2.9	2.8	.....	9.4	.....	5.1	.....
Sassafras	89.3	.....	40.2	18.0	16.9	10.5	3.7	.....	.....
Sycamore	252.8	.....	40.1	25.8	47.2	31.6	29.9	61.9	16.3
Dogwood	5.7	.....	.....	.....	.....	.....	3.0	2.7	.....
Holly	2.2	.....	2.2	.....	.....	.....	.....	.....	.....
Other hardwoods	102.8	.....	22.6	8.5	8.9	.....	26.5	36.3	.....
Total	31,213.0	.....	6,960.0	7,200.1	6,080.5	4,369.6	2,588.9	3,491.5	522.4
All species	38,897.3	2,389.4	9,058.4	8,452.8	6,891.9	4,773.4	2,820.5	3,905.4	605.5

[1]Includes white, swamp chestnut, swamp white, chinkapin, Durand, and bur oaks.
[2]Includes cherry bark, Shumard, and northern red oaks.

Table 15.—*Volume of sawtimber on commercial forest land by species and log grade, Tennessee, 1980.*

Species	All grades	Grade 1	Grade 2	Grade 3	Grade 4
	million board feet				
Softwood					
Yellow pines	5,509.5	382.9	471.4	4,655.2	.....
Cypress	395.7	78.6	68.7	248.4	.....
Redcedar	951.8	270.7	65.3	615.8	.....
Other softwoods	827.3	27.9	74.4	725.0	.....
Total	7,684.3	760.1	679.8	6,244.4	.....
Hardwood:					
Select white and red oaks	7,342.5	988.0	1,297.9	3,438.4	1,618.2
Other white and red oaks	9,124.3	1,062.6	1,440.0	4,370.7	2,251.0
Hickory	3,655.2	343.7	556.6	1,927.6	827.3
Yellow birch	33.7	4.9	9.0	15.6	4.2
Hard maple	681.1	59.7	92.4	288.4	240.6
Sweetgum	1,163.9	131.3	213.4	562.8	256.4
Tupelo and blackgum	531.3	70.6	96.4	280.5	83.8
Ash-walnut-black cherry	1,176.0	173.6	238.6	595.8	168.0
Yellow-poplar	4,232.9	465.2	608.2	1.710.9	1,448.6
Other hardwoods	3,272.1	353.4	455.2	1.527.8	935.7
Total	31,213.0	3,653.0	5,007.7	14,718.5	7,833.8
All species	38,897.3	4,413.1	5,687.5	20,962.9	7,833.8

Table 16.—*Periodic annual growth and removals of growing stock on commercial forest land by species, Tennessee, 1971-1980*[1]

Species	Periodic annual growth	Periodic annual removals
	million cubic feet	
Yellow pines	76.0	30.7
White pine	8.1	2.5
Cypress	0.5	0.1
Other softwoods	12.1	4.2
Total	96.7	37.6
Select white and red oaks	99.7	42.1
Other white and red oaks	110.4	57.3
Hickory	50.1	19.7
Hard maple	11.9	3.2
Sweetgum	17.8	11.3
Ash-walnut-black cherry	15.6	6.8
Yellow poplar	50.5	12.1
Tupelo and blackgum	6.2	4.1
Other hardwoods	52.3	19.5
Total	414.6	176.0
All species	511.4	213.7

[1]Totals may not add due to rounding.

Table 17.—*Periodic annual growth and removals of growing stock on commercial forest land by ownership classes and by softwoods and hardwoods, Tennessee, 1971-1980*[1]

Ownership class	Periodic annual growth			Periodic annual removals		
	All species	Softwood	Hardwood	All species	Softwood	Hardwood
	million cubic feet					
National forest	27.4	9.3	18.1	3.3	1.7	1.6
Other public	26.8	7.0	19.8	24.7	7.1	17.6
Forest industry	44.9	11.0	33.9	24.8	5.6	19.2
Farmer	180.3	22.8	157.5	69.9	9.5	60.4
Misc. private	232.0	46.7	185.3	90.9	13.7	77.2
All ownerships	511.4	96.8	414.6	213.7	37.6	176.0

[1]Totals may not add due to rounding.

Table 18.—*Periodic annual growth and removals of sawtimber on commercial forest land by species, Tennessee, 1971-1980*[1]

Species	Periodic annual growth	Periodic annual removals
	million board feet	
Yellow pines	287.9	95.5
White pine	40.2	12.5
Cypress	3.2	0.6
Other softwoods	37.8	10.4
Total	369.3	119.0
Select white and red oaks	346.2	176.1
Other white and red oaks	295.0	219.5
Hickory	173.3	73.5
Hard maple	37.4	14.4
Sweetgum	58.5	48.4
Ash, walnut and black cherry	52.3	24.8
Yellow poplar	207.7	50.6
Tupelo and blackgum	17.3	12.4
Other hardwoods	151.6	77.3
Total	1,339.2	696.9
All species	1,708.5	815.9

[1]Totals may not add due to rounding.

Table 19.—*Periodic annual growth and removals of sawtimber on commercial forest land by ownership classes and by softwoods and hardwoods, Tennessee, 1971-1980*[1]

Ownership class	Periodic annual growth			Periodic annual removals		
	All species	Softwood	Hardwood	All species	Softwood	Hardwood
	million board feet					
National forest	73.9	46.2	27.7	11.6	6.0	5.6
Other public	102.0	34.2	67.8	84.6	19.3	65.3
Forest industry	159.6	39.7	119.9	84.0	18.3	65.7
Farmer	592.6	83.9	508.7	291.8	37.0	254.8
Misc. private	780.4	165.3	615.1	343.9	38.4	305.5
All ownerships	1,708.5	369.3	1,339.2	815.9	119.0	696.9

[1]Totals may not add due to rounding.

Table 20.—*Periodic annual mortality of growing stock and sawtimber on commerical forest land by species, Tennessee, 1971-80*[1]

Species	Growing stock	Sawtimber
	million cubic feet	*million board feet*
Yellow pine	11.5	18.8
White pine	0.6	1.9
Cypress	0.1	0.5
Other softwoods	2.1	3.6
Total	14.3	24.8
Select white and red oaks	3.8	9.8
Other white and red oaks	7.2	14.7
Hickory	6.0	15.3
Hard maple	0.7	1.0
Sweetgum	2.0	3.0
Ash-walnut-black cherry	2.7	3.2
Yellow poplar	1.0	2.7
Tupelo and blackgum	1.4	2.3
Other hardwoods	12.6	25.0
Total	37.4	77.0
All species	51.6	101.9

[1]Totals may not add due to rounding.

Table 21.—*Periodic annual mortality of growing stock and sawtimber on commercial forest land by ownership classes and by softwoods and hardwoods, Tennessee, 1971-1980*[1]

Ownership class	Growing stock			Sawtimber		
	All species	Softwood	Hardwood	All species	Softwood	Hardwood
	million cubic feet			*million board feet*		
National forest	2.7	1.3	1.4	5.8	3.3	2.5
Other public	6.4	3.5	2.9	15.2	6.6	8.6
Forest industry	3.0	0.8	2.2	8.0	2.0	6.0
Farmer	17.4	4.3	13.1	30.6	5.8	24.8
Misc. private	22.1	4.3	17.8	42.2	7.1	35.1
All ownerships	51.6	14.3	37.4	101.9	24.8	77.0

[1]Totals may not add due to rounding.

Table 22.—*Periodic annual mortality of growing stock and sawtimber on commercial forest land by causes and by softwoods and hardwoods, Tennessee, 1971-1980*[1]

Cause of death	Growing stock			Sawtimber		
	All species	Softwood	Hardwood	All species	Softwood	Hardwood
	million cubic feet			*million board feet*		
Insects	4.8	3.9	0.9	7.5	4.7	2.8
Disease	20.3	3.5	16.9	31.1	6.9	24.2
Fire	0.7	0.1	0.6	1.6	0.0	1.6
Beaver	0.3	0.0	0.3	0.7	0.0	0.7
Weather	14.6	3.6	10.9	39.7	9.5	30.2
Suppression	1.7	1.0	0.7	0.0	0.0	0.0
Other	9.4	2.4	6.8	21.5	3.7	17.8
All causes	51.6	14.3	37.4	101.9	24.8	77.0

[1]Totals may not add due to rounding.

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Forest area in Tennessee changed very little between 1971 and 1980 and currently stands at 12.9 million acres. Softwood growing stock increased 34 percent to 2.5 billion cubic feet, and hardwood growing stock increased 21 percent to 12.7 billion cubic feet. Softwood and hardwood growing stock has been increasing at an annual rate of 298 million cubic feet.

Additional keywords: timber volume, forest acreage, timber removals, timber growth, forest productivity.

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