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# VIRGINIA'S TIMBER, 1977

Southeastern Forest Experiment Station  
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# FOREWORD

This report presents the principal findings of the fourth evaluation of Virginia's forest resources. The field inventory was started in February 1975 and completed in March 1977. Three previous Statewide inventories, completed in 1940, 1957, and 1966, provide reference points for measuring changes and trends over the past 37 years. This analysis focuses mainly on changes and trends since 1966.

Five Survey Unit reports issued as the inventory progressed through the State provide additional breakdowns of the data and contain some county tables. Copies of these reports can be obtained from the Southeastern Forest Experiment Station. A Forest Information Retrieval service is also available at the Southeastern Station; forest statistics are compiled at cost for any geographic area within the Station territory.

Section 9 of the McSweeney-McNary Forest Research Act of 1928, as amended, and the Forest and Rangeland Renewable Resources Planning Act of 1974 authorize these forest resource evaluations. The Southeastern Forest Experiment Station, headquartered at Asheville, North Carolina, administers these forest evaluations in Florida, Georgia, North Carolina, South

Carolina, and Virginia. The primary objective of these periodic evaluations is to develop and maintain the resource information needed for formulating sound forest policies and programs.

The combined efforts of many people have gone into this inventory and evaluation of Virginia's forest resources. Appreciation is expressed to all Work Unit and Station personnel who participated in the field and office work. The Southeastern Station gratefully acknowledges the cooperation and assistance provided by the Virginia Division of Forestry, The Chesapeake Corporation of Virginia, Continental Forest Industries, Weyerhaeuser Company, and Virginia Polytechnic Institute & State University. Special appreciation is also expressed for the excellent cooperation of other forest industries, private landowners, and public agencies in providing information and allowing access to the sample locations.

Finally, the evaluation of many benefits derived from Virginia's forest resources is beyond the scope of this report. The purpose of this report is to evaluate the timber situation.



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**VIRGINIA  
FOREST SURVEY UNITS**

**1. NORTHERN PIEDMONT**

**2. SOUTHERN PIEDMONT**

**3. NORTHERN MOUNTAINS**

**4. SOUTHERN MOUNTAINS**

**5. COASTAL PLAIN**

Map showing Virginia Forest Survey Units, numbered 1 through 5, corresponding to the regions listed on the right. The map includes county names and a scale bar (0 to 60 miles).

**Figure 1. — Forest Survey Units in Virginia.**

# VIRGINIA'S TIMBER, 1977

by

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## HIGHLIGHTS

*Since the third inventory of Virginia's forest resources was completed in 1966—*

*—area classified as commercial timberland increased from 15.8 to almost 16.0 million acres, or less than 1 percent.* Reversion of former agricultural lands to forest, mostly in the Northern Piedmont, and reclassification of some marginal sites on the National Forests in the Mountain Region accounted for most of this small net increase. Acreage of commercial timberland declined slightly in both the Coastal Plain and Southern Piedmont. Prospects for any further increase in acreage available for timber production are dim. Acreage of idle cropland, the primary source of new forest land, is shrinking.

*—the downward trend in forest ownership by farmers continued but at a slower rate.* Between 1957 and 1966, acreage of farm woodland declined from 10.1 to less than 7.0 million acres. The 1977 inventory classified 6.2 million acres as farmer owned. Collectively, farmers and other private, nonindustrial landowners still control 12.3 million acres, or 77 percent of the commercial timberland. Forest industries increased their timberland base to almost 1.7 million acres, or by 7 percent. These statistics indicate, however, that forest industries have slowed their rate of land acquisition. Publicly owned timberland has increased gradually to almost 2.0 million acres.

*—rate of successful pine regeneration averaged almost 71,000 acres annually compared to only 56,000 acres during the preceding decade.* Still, a strong successional trend from pine to hardwood continued. Between 1957 and 1977, acreage of pine forest type declined 24 percent; the average annual loss was 53,000 acres. Hardwoods replaced pines on at least 35 percent of the acre-

age harvested and retained in commercial forest between 1966 and 1977.

*—volume of growing-stock timber on commercial forest land increased from 16.2 to 19.7 billion cubic feet, or by 22 percent.* Although hardwoods accounted for more than 80 percent of the net gain, softwood volume increased 14 percent, reversing the downward trend measured in the 1966 inventory. Pine volume in the Coastal Plain continued to decrease but at a slower rate. The overall volume increase is attributed to a sharp rise in growth and some reduction in removals. Volume of loblolly pine, the primary species featured in timber management, increased less than 10 percent; however, many of the young loblolly plantations are still in the sapling-seedling stage of development. Yellow-poplar increased more than 60 percent in volume and now rivals white oak as the State's most abundant hardwood.

*—rate of net annual growth increased 38 percent to an average of 52 cubic feet per acre of commercial forest.* Hardwood growth, up 44 percent, accounted for more than three-fourths of the increase. Softwood growth increased 28 percent. By region, average growth per acre ranged from a low of 40 cubic feet per year in the Mountains to a high of 60 cubic feet in the Coastal Plain. In the Piedmont, annual growth averaged 56 cubic feet per acre. Statewide, mortality siphoned off 20 percent of the gross softwood growth. Up to 43 percent of this softwood growth loss was attributed to recent outbreaks of pine bark beetles.

*—timber was removed from some 360,000 acres annually through harvesting, intermediate cutting, and forest diversions.* This average estimate bridges a decline in annual timber removals over most of the remeasure-

ment period followed by an upturn in recent years. In 1976, removals of growing stock totaled 496 million cubic feet and included 1,680 million board feet of sawtimber. About 77 percent of the cubic volume removed was converted into timber products; 9 percent was left in the woods as logging residues; and the remaining 14 percent was removed in cultural operations, land clearing, and withdrawals where the timber was not used. Closer timber use, both in the woods and at the processing plants, has boosted product output per cubic foot of wood harvested.

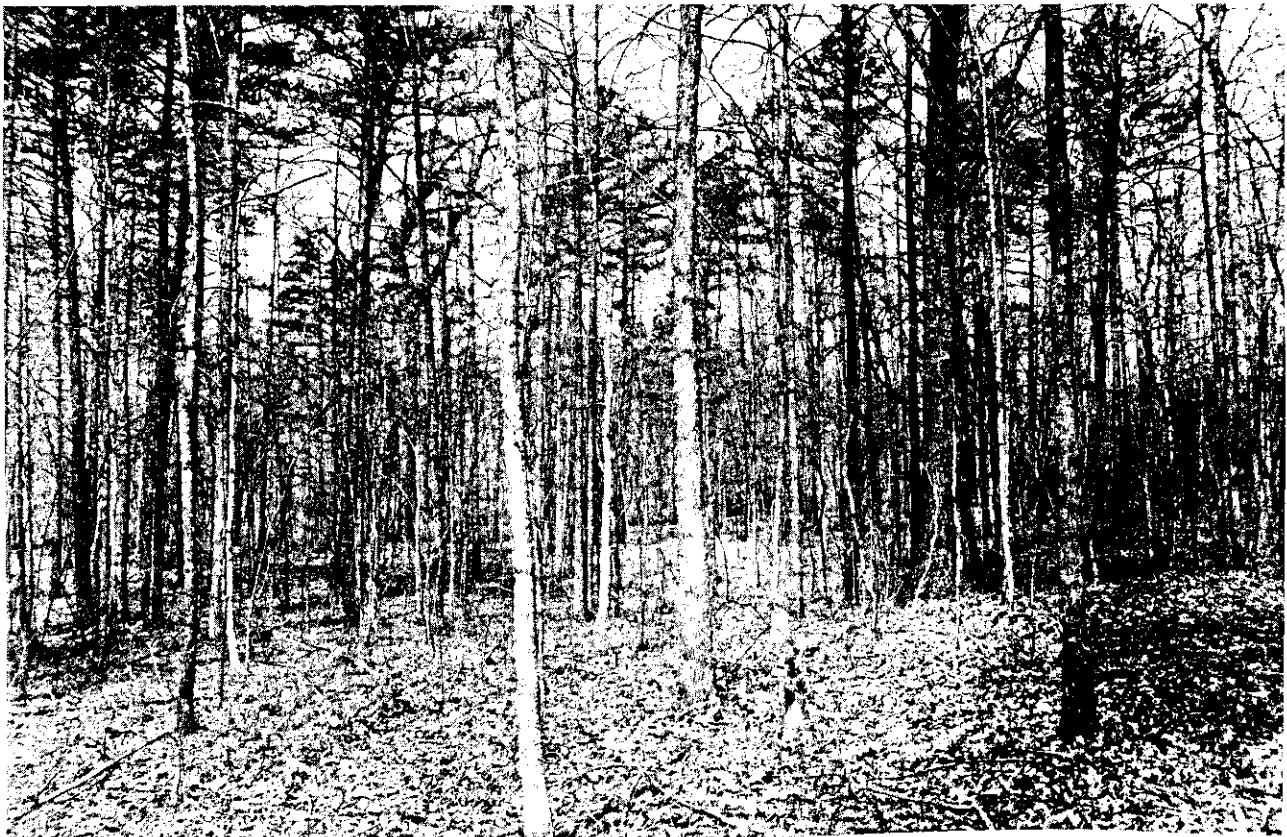
*-pulpwood has surpassed saw logs in total product output.* An increase in production of hardwood roundwood and plant byproducts of all species has more than offset a sharp decline in pine roundwood. In 1976, byproducts accounted for 25 percent of the total pulpwood output compared to 17 percent in 1965. While both number of sawmills and annual lumber production declined between 1965 and 1976, saw logs remained the leading roundwood product. After several decades of continuous decline, there seemingly has been an abrupt turnabout in the use of fuelwood.

*-at least 610,000 acres were artificially regenerated.* About 68 percent of this tree planting occurred on

forest acres recently harvested. Another 11 percent was on old fields or other nonforest land. The remaining 21 percent of the planting effort occurred on the backlog of poorly stocked forest land. Hardwood encroachment poses a problem in some of these young pine plantations, particularly those established on cutover forest land.

*-there was no significant treatment or disturbance on 11.1 million acres, or 70 percent of the land classified as commercial forest in 1977.* About 23 percent of the undisturbed stands were on sites unfavorable for intensive silvicultural practices either because of steep slopes or year-round water problems. Only 13 percent of the treated or disturbed stands occurred on similar sites.

*-the overall outlook for future timber supplies has improved.* For example, a projection based on the 1966 conditions estimated a prospective available cut of some 755 million cubic feet annually by 1995. A similar projection based on the 1977 conditions suggests a prospective available cut of 840 million cubic feet by 1996, with a further increase to 929 million cubic feet by 2006. Although the pine outlook has improved, hardwoods account for more than 90 percent of the prospective increase.



## TIMBER TRENDS

Virginia encompasses 25.5 million acres of land and spans three major physiographic regions: Coastal Plain, Piedmont, and Mountain. The Coastal Plain extends inland about 125 miles to an elevation of 300 feet along its western boundary and contains 25 percent of the land. Major tidal rivers and the Chesapeake Bay divide the northern and central portions of this region into four long peninsulas, one being the Eastern Shore. Although 42 percent of Virginia's population resides in the Coastal Plain, the region is still 64 percent forested.

The Piedmont, with 39 percent of the land, is a gently rolling to hilly plateau extending across the central part of the State between the Coastal Plain and Blue Ridge. Elevations range from 300 feet on the east up to 1,000 feet at the base of the mountains. In width, the region tapers from 150 miles along the North Carolina line, down to 50 miles at the Potomac River. About 37 percent of Virginia's population resides in the Piedmont and is largely concentrated in the north. The Southern Piedmont has the highest proportion of forested land in the State, 67 percent; the Northern Piedmont has the lowest, 61 percent.

The Mountain Region, with 36 percent of the land, has three distinct land formations: the Blue Ridge Mountains on the east, the Appalachian Plateau on the west, and the valley and ridges in between. Within this rugged topography, elevations rise up to 5,700 feet. With only 21 percent of the State's inhabitants, much of the region is sparsely populated. The Northern Mountain Unit is 65 percent forested compared to 63 percent in the Southern Unit, where almost one-fourth of the land is classified as pasture.

This fourth inventory of Virginia's forest resources identified significant differences in recent trends in land use, ownership patterns, forest type, and timber production among the three regions. Also, because of im-

portant sectional differences, this analysis retains the traditional divisions of both the Piedmont and Mountain Regions into southern and northern Survey Units (fig. 1).

### LITTLE CHANGE IN COMMERCIAL FOREST ACREAGE

Statewide, between 1966 and 1977, area classified as commercial timberland increased from 15.8 to almost 16.0 million acres, or less than 1 percent. Reversion of former agricultural lands to forest, mostly in the Northern Piedmont, and reclassification of some marginal sites on the National Forests in the Mountain Region accounted for most of this small net increase. Acreage of commercial forest land declined slightly in both the Coastal Plain and Southern Piedmont. The Coastal Plain loss reflects the withdrawal of some 50,000 acres in the Dismal Swamp from future timber production.

Prospects for any further increase in acreage available for timber production in Virginia are dim. As in the rest of the Southeast, this primary source of new forest land is gradually drying up. For example, between the 1957 and 1966 inventories, almost 650,000 acres of idle agricultural land in Virginia reverted to forest. Between 1966 and 1977, about 450,000 acres of such land reverted. The 1966 inventory classified 660,000 acres as idle cropland; the 1977 inventory 365,000 acres. Meanwhile, diversions of commercial timberland to other uses continue at the rate of 45,000 acres annually (table I).

In addition to the commercial forest land, almost 445,000 acres in Virginia were classified as noncommercial forest. Timber harvesting is prohibited on 84 percent of this land, and the remaining 16 percent is incapable of producing 20 cubic feet of industrial wood per acre per year because of adverse site conditions. Forests with-

Table I. — Changes in area of commercial forest land, by Survey Unit, Virginia, 1966–1977

Survey Unit	Area of commercial forest land in:		Net change	Changes							
				Total gain	Additions from:		Total loss	Diversions to:			
					Non- forest	Noncom- mercial forest		Noncom- mercial forest	Agri- culture	Urban and other	Water
	1966	1977		Non- forest	Noncom- mercial forest	Total loss	Noncom- mercial forest	Agri- culture	Urban and other	Water	
..... <i>Thousand acres</i> .....											
Coastal Plain	4,079.3	4,003.5	- 75.8	91.2	87.2	4.0	167.0	55.7	31.8	77.5	2.0
Southern Piedmont	3,789.9	3,778.4	- 11.5	86.0	86.0	-	97.5	-	57.8	37.9	1.8
Northern Piedmont	2,458.9	2,552.1	+ 93.2	171.9	160.8	11.1	78.7	11.3	25.9	31.1	10.4
Northern Mountain	2,503.3	2,625.7	+122.4	190.3	42.9	147.4	67.9	24.4	33.9	9.6	-
Southern Mountain	2,993.0	3,013.1	+ 20.1	96.4	79.6	16.8	76.3	5.1	30.3	38.7	2.2
State	15,824.4	15,972.8	+148.4	635.8	456.5	179.3	487.4	96.5	179.7	194.8	16.4

drawn from timber production within the Shenandoah National Park, the Great Dismal Swamp National Wildlife Refuge, and along the Blue Ridge Parkway account for well over half of the noncommercial forest land. Timber harvesting and other uses are also restricted to varying degrees on the Mount Rogers National Recreation Area and other parts of the Jefferson and George Washington National Forests.

### DECLINE IN FARM WOODLAND SLOWS

As in other Southeastern States, transfer of forest ownership in Virginia from farmers to other private owners has been common. Twenty years ago, farmers owned 10.1 million acres, or 65 percent of Virginia's commercial timberland. By 1966, acreage of farm woodland had dropped below 7.0 million acres to 44 percent of the total. Since 1966, the decline has continued but at a slower rate. This latest inventory classified 6.2 million acres, or less than 39 percent of the commercial forest land, as farmer owned. Ownership of much of this acreage has shifted to other miscellaneous private owners who vary greatly in their attitudes toward forest management. Collectively, farmers and other private, nonindustrial landowners still control 12.3 million acres, or 77 percent of the commercial timberland.

Since 1966, forest industries have increased their timberland base to almost 1.7 million acres, or by about 7 percent. Compared with earlier trends, these statistics indicate forest industries have slowed down their acquisition of more land. Between the 1957 and 1966 inventories, they increased their land base from 1.2 to almost 1.6 million acres. Although forest industries own less

than 11 percent of the commercial forest land, they control about 25 percent of the acreage of pine forest types.

Almost 2.0 million acres or 12 percent of Virginia's commercial forest land is publicly owned. About three-fourths of this timberland is on the Jefferson and George Washington National Forests, located mainly in the Mountain Region. Other large Federal holdings include the Quantico, A. P. Hill, and Camp Pickett military reservations and forests around the John H. Kerr Reservoir. Collectively, the State, counties, and municipalities control almost 13 percent of the publicly owned timberland. Although changes in forest classification distort the trend, acreage of publicly owned timberland has gradually increased.

### HARDWOODS CONTINUE TO REPLACE PINES

Over the years, Virginia has experienced a strong successional trend from pine to hardwood within its commercial timberland. Because of changes in survey procedure, changes in acreage by forest type between 1957 and 1977 provide the best measure of the trend. In 1966, sample plots were allowed to straddle two or more forest conditions. This procedure inflated the estimate of oak-pine type and consequently affected other types. In both the 1957 and 1977 inventories, sample plots were confined to a single condition.

During this 20-year period, acreage of pine type declined 24 percent; the average annual loss was 53,000 acres. During this period, acreage of hardwood type increased almost 15 percent; the average annual increase



was 79,000 acres. A net annual increase of 26,000 acres in commercial forest land accounts for the difference. Since 60 percent of the nonforest acres reverting to forest between 1966 and 1977 came in with pine, the 53,000 acres of net annual loss in pine type is probably a conservative estimate of the rate of hardwood encroachment.

It is still too early to quantify how effective recent pine reforestation efforts have been in curbing the trend toward hardwood. A prime opportunity for regenerating more acreage with pine occurs at time of harvest. Yet, between 1966 and 1977, hardwoods replaced pines on at least 35 percent of the acreage harvested and retained in commercial forest. This process alone accounts for an annual loss of some 24,500 acres of pine forest type.

If all forest types are included, about 2.0 million acres were harvested and retained in commercial forest between 1966 and 1977, excluding thinnings and other intermediate cuttings. When field crews remeasured the sample plots on these cutover lands, pines dominated the stocking on only 24 percent of the acreage. Pines made up at least one-fourth of the stocking on another 14 percent classified as oak-pine forest type. These figures are slightly higher than the pine proportions on all timber-

lands—a possible sign of progress. For example, pines dominate the stocking on 3.4 million acres, or less than 22 percent of all timberland. Pines make up at least one-fourth of the stocking on another 1.9 million acres, or 12 percent, classified as oak-pine.

The age distribution of the pine stands provides some further evidence of progress in pine regeneration. It indicates, on the average, almost 71,000 acres were successfully regenerated with pine annually during the past decade, compared to only 56,000 acres during the preceding decade. These figures include reversions of idle agricultural lands to pine.

### INVENTORY VOLUME UP 22 PERCENT

Between 1966 and 1977, volume of growing-stock timber on commercial forest land increased from 16.2 to 19.7 billion cubic feet, or by 22 percent. Although hardwoods accounted for more than 80 percent of the net gain, softwood volume increased by 14 percent, reversing the downward trend measured in the 1966 inventory. Volume of pine timber in the Coastal Plain continued to decrease, but the rate of loss slowed. The overall volume increase is attributed to a sharp rise in growth and some reduction in removals (fig. 2).

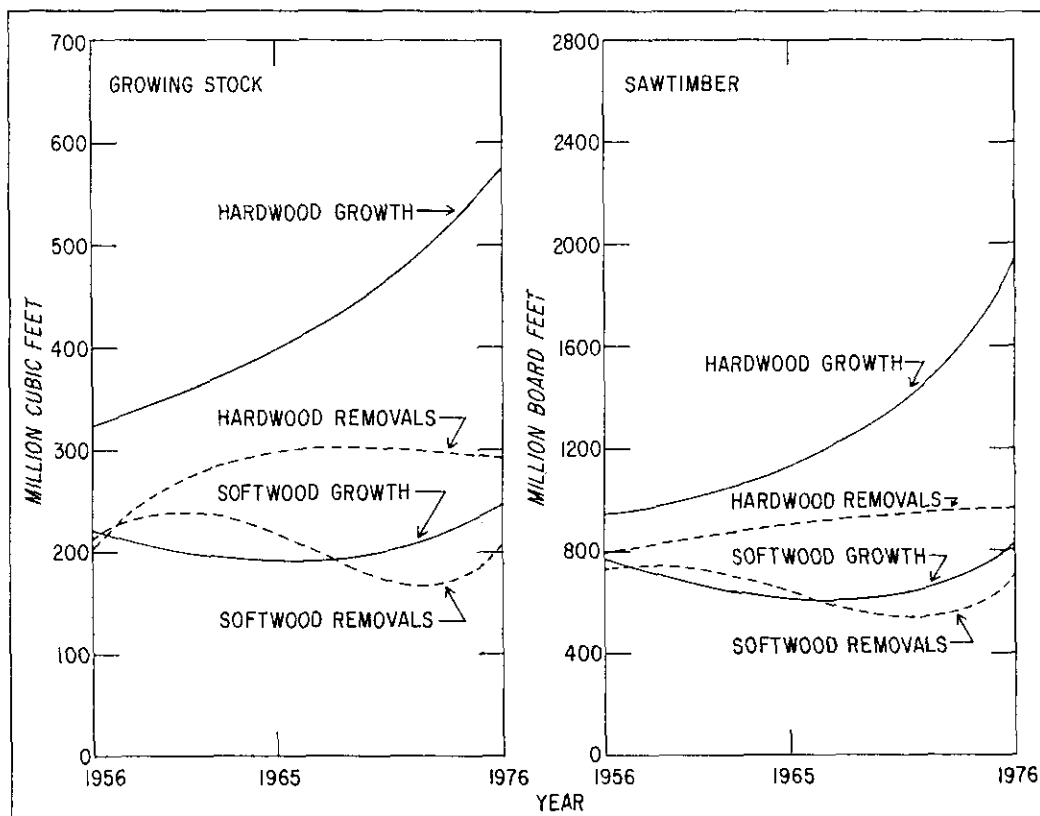


Figure 2. — Trends in net growth and timber removals in Virginia since 1956.

By region, the increase in volume ranged from 4 percent in the Coastal Plain to 33 percent in the Mountains. Volume was up 28 percent in the Piedmont. By ownership, the increase ranged from 5 percent on forest industry lands to 54 percent on National Forests. This small increase for forest industry reflects a rapid conversion of its older natural stands to plantations. Almost 38 percent of its timberland supports young sapling-seedling stands. Sapling-seedling stands occupy less than 12 percent of the acreage on National Forests. Volume was up 20 percent on other private holdings and 40 percent on other public forests.

The volume increases also extended across all tree sizes for both softwoods and hardwoods. The decline in softwood volume between 1957 and 1966 occurred mainly in diameter classes 6 through 12 inches. These diameter classes have now recovered in most of the State. Softwood volume continues to peak in the 8-inch-diameter class, and drops off sharply beyond the 10-inch class (fig. 3). This distribution suggests most pines are cut once they reach these size classes. A similar distribution shows hardwood volume begins to level off at 10 inches, and peaks in the 12-inch-diameter class. Many hardwoods are cut at this size, and volume drops off very sharply beyond 14 inches (fig. 4).

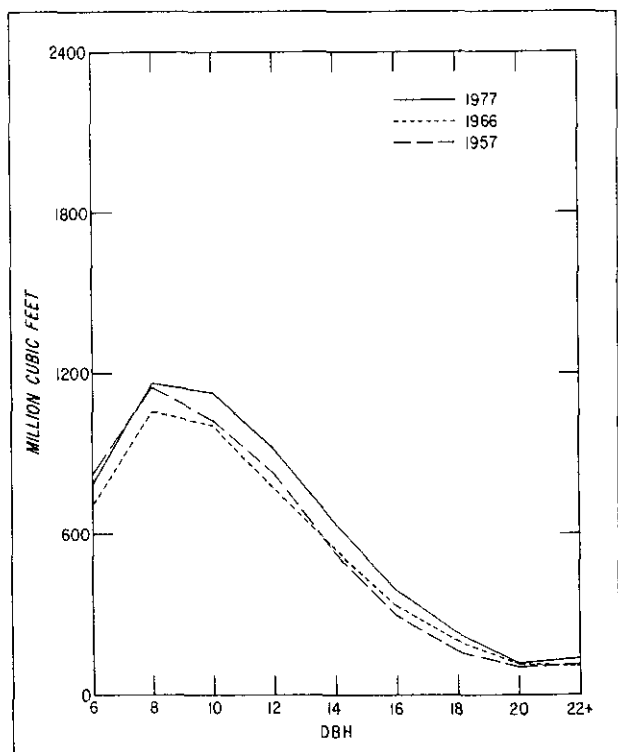


Figure 3. — Volume of softwood growing stock, by tree diameter, 1957, 1966, and 1977.

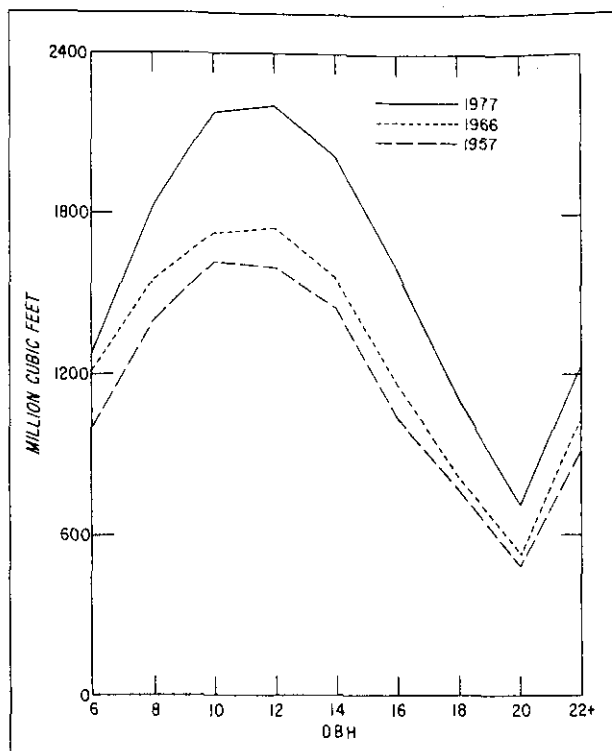


Figure 4. — Volume of hardwood growing stock, by tree diameter, 1957, 1966, and 1977.

The inventory of growing-stock volume includes 53.8 billion board feet of sawtimber, up 25 percent since 1966. By region and ownership, this buildup in sawtimber inventory followed much the same pattern as described for total growing stock. Almost 51 percent of the sawtimber volume is in trees 15.0 inches d.b.h. and larger, compared to 50 percent in 1966 and 48 percent in 1957. About one-fourth of Virginia's timberland supports stands with 5,000 board feet or more per acre.

The inventory also includes 3.5 billion cubic feet of timber in trees failing to qualify as growing stock because of species, poor form, or internal rot. Although these trees are generally unsuitable for saw logs, they contain 15 percent of the volume of all live trees 5.0 inches d.b.h. and larger. About 95 percent of this inferior timber is hardwood.

### SPECIES COMPOSITION CHANGES

The species makeup of Virginia's timber resource varies considerably by region. In terms of volume, loblolly pine and Virginia pine are the leading softwood species (fig. 5). Together, they account for almost 70 percent of the softwood growing stock. Loblolly pine

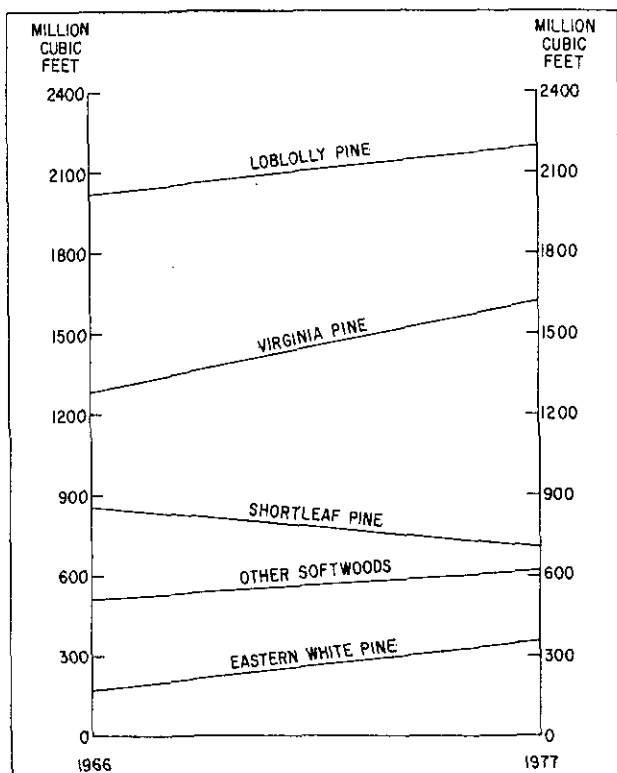


Figure 5. — Change in volume of softwood growing stock, by species, 1966-1977.

predominates in the Coastal Plain and is the primary species featured in timber management. Statewide, volume of loblolly pine has increased less than 10 percent since 1966; however, many loblolly plantations are still in the sapling-seedling stage of development.

Virginia pine is the leading softwood species in the Piedmont and its volume is increasing rapidly. As the pioneer species on much of the agricultural land that has reverted to forest, Virginia pine accounted for half of the net increase in softwood volume between 1966 and 1977. Shortleaf pine volume decreased 17 percent over the same period; its volume is declining throughout most of the Southeast.

In the Mountain Region, pitch pine is the leading softwood species in the Northern Unit, and eastern white pine predominates in the Southern Unit. Statewide, volume of eastern white pine more than doubled between 1966 and 1977.

Hardwoods continue to dominate the species composition in each of the three physiographic regions. In the Coastal Plain, white oak and sweetgum are the most prevalent hardwood species in terms of timber volume.

In the Piedmont, yellow-poplar and white oak are the leading hardwoods. Among a variety of oaks and other hardwoods, chestnut oak and yellow-poplar are the most abundant species in the Mountain Region.

Statewide, all of the major hardwood species except blackgum and tupelo increased in volume since 1966 (fig. 6). Volume of blackgum and tupelo declined 15 percent. Of all the hardwood species, yellow-poplar is increasing fastest. Up more than 60 percent in volume since 1966, yellow-poplar now rivals white oak as the State's most abundant hardwood. Collectively, the wide variety of oaks still account for slightly more than half of the total hardwood growing stock.

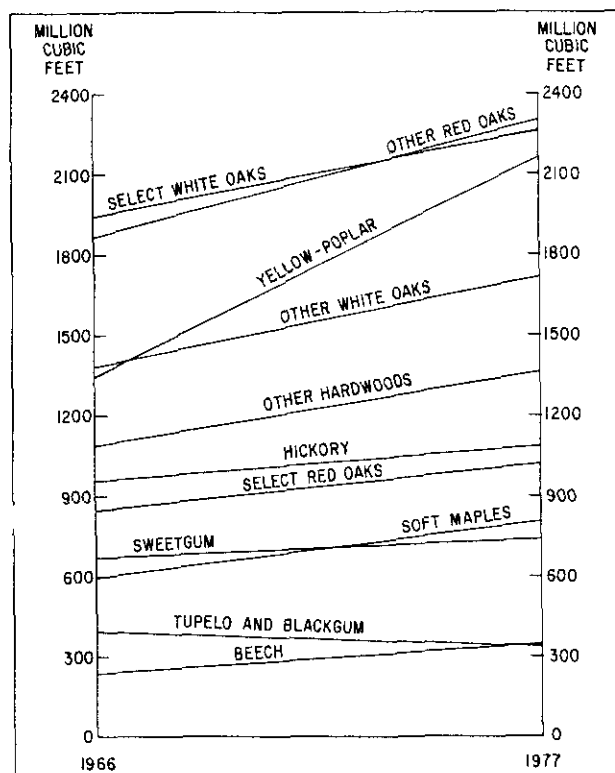


Figure 6. — Change in volume of hardwood growing stock, by species, 1966-1977.

## GROWTH RATE UP 38 PERCENT

In 1976, net growth of growing-stock timber averaged 52 cubic feet per acre of commercial forest land, or 38 percent above the adjusted growth rate in 1965. Hardwood growth was up by 44 percent and accounted for more than three-fourths of the total increase. Softwood growth increased 28 percent. During the latter part of the 11 years between measurements,

pine bark beetles caused extensive mortality in Virginia's forests. Statewide, mortality siphoned off 20 percent of the softwood growth. Up to 43 percent of this softwood growth loss was attributed to the beetle outbreaks.

By region, average annual growth per acre ranged from a low of 40 cubic feet in the Mountains to a high of 60 cubic feet in the Coastal Plain. In the Piedmont, growth averaged 56 cubic feet per acre. Older hardwood stands, together with the relatively high proportion of poor sites, explain the low growth rate in the Mountain Region. The high growth rate in the Coastal Plain reflects considerable effort in more intensive timber management and the relatively high proportion of good sites. More than half of the State's pine plantations have been established in this region. The greatest gain in growth rate, more than 60 percent, occurred in the Piedmont. Here, the statistics reflect the development of many young pine stands established on retired agricultural lands. In the Piedmont, ingrowth of saplings into

the poletimber-size class accounted for 23 percent of the gross softwood growth, compared to only about 14 percent in the other regions.

By ownership class, average growth per acre ranged from a low of 38 cubic feet on the National Forests, up to 63 cubic feet on other public forests. Again, the low growth rate on National Forests is attributed to the prevalence of older hardwood stands and poor sites. On forest industry lands growth averaged 57 cubic feet per acre, compared to 52 cubic feet on other private holdings. A high proportion of sapling-seedling stands tended to pull the industry average down. Within the other private owner classes, the growth rate was slightly higher on farm than on the nonfarm holdings.

A detailed breakdown of gross growth into its various components, by Survey Unit and species group, along with the distribution of mortality and removals, indicates the sources of annual change in timber volume (table II). Survival growth, the volume increment on

**Table II. — Annual components of change in the volume of growing stock on commercial forest land, by Survey Unit and by softwood and hardwood, Virginia, 1976**

Survey Unit and species group	Gross growth	Components of growth					Mortality	Net growth	Removals	Net change
		Survivor growth	Ingrowth	Growth on ingrowth	Growth on removals	Growth on mortality				
..... Million cubic feet .....										
Coastal Plain:										
Softwood	128.9	107.7	16.5	1.8	2.1	0.8	25.4	103.5	111.6	- 8.1
Hardwood	146.8	128.5	15.2	1.2	1.7	0.2	10.0	136.8	95.6	+ 41.2
Total	275.7	236.2	31.7	3.0	3.8	1.0	35.4	240.3	207.2	+ 33.1
Southern Piedmont:										
Softwood	94.1	70.7	19.9	1.6	1.3	0.6	19.7	74.4	57.4	+ 17.0
Hardwood	152.8	134.0	15.4	1.6	1.6	0.2	12.2	140.6	75.1	+ 65.5
Total	246.9	204.7	35.3	3.2	2.9	0.8	31.9	215.0	132.5	+ 82.5
Northern Piedmont:										
Softwood	46.6	34.9	10.2	0.7	0.6	0.2	8.8	37.8	24.9	+ 12.9
Hardwood	115.0	101.2	11.7	0.8	1.1	0.2	11.6	103.4	57.4	+ 46.0
Total	161.6	136.1	21.9	1.5	1.7	0.4	20.4	141.2	82.3	+ 58.9
Northern Mountain:										
Softwood	19.1	15.9	2.8	0.2	0.1	0.1	5.3	13.8	6.8	+ 7.0
Hardwood	89.8	79.2	9.3	0.8	0.3	0.2	9.1	80.7	26.1	+ 54.6
Total	108.9	95.1	12.1	1.0	0.4	0.3	14.4	94.5	32.9	+ 61.6
Southern Mountain:										
Softwood	20.7	17.7	2.6	0.2	0.1	0.1	3.0	17.7	4.5	+ 13.2
Hardwood	129.0	112.2	15.0	1.0	0.5	0.3	14.5	114.5	36.6	+ 77.9
Total	149.7	129.9	17.6	1.2	0.6	0.4	17.5	132.2	41.1	+ 91.1
State:										
Softwood	309.4	246.9	52.0	4.5	4.2	1.8	62.2	247.2	205.2	+ 42.0
Hardwood	633.4	555.1	66.6	5.4	5.2	1.1	57.4	576.0	290.8	+285.2
Total	942.8	802.0	118.6	9.9	9.4	2.9	119.6	823.2	496.0	+327.2

growing-stock trees 5.0 inches d.b.h. and larger in the inventory at the beginning of the year and surviving to its end, accounted for 85 percent of gross growth. In-growth, the net volume of growing-stock trees reaching 5.0 inches d.b.h. during the year, and the subsequent growth on these trees, accounted for another 14 percent. Growth on removals before removal, and growth on mortality before death made up the remaining 1 percent.

In 1976, mortality of growing stock totaled almost 120 million cubic feet and reduced gross growth by 13 percent. Although hardwoods exceeded softwoods in stocking, inventory volume, annual growth, and volume removed, softwoods accounted for slightly more than half of the mortality. The mortality of pine caused by bark beetles explains this exception. The annual insect kill also included more than 80 million board feet of pine sawtimber.

For both softwoods and hardwoods, relatively little of the mortality was attributed to wildfire. With all of its land under protection, Virginia has one of the most successful fire control records in the South. Over the entire remeasurement period, acreage burned averaged

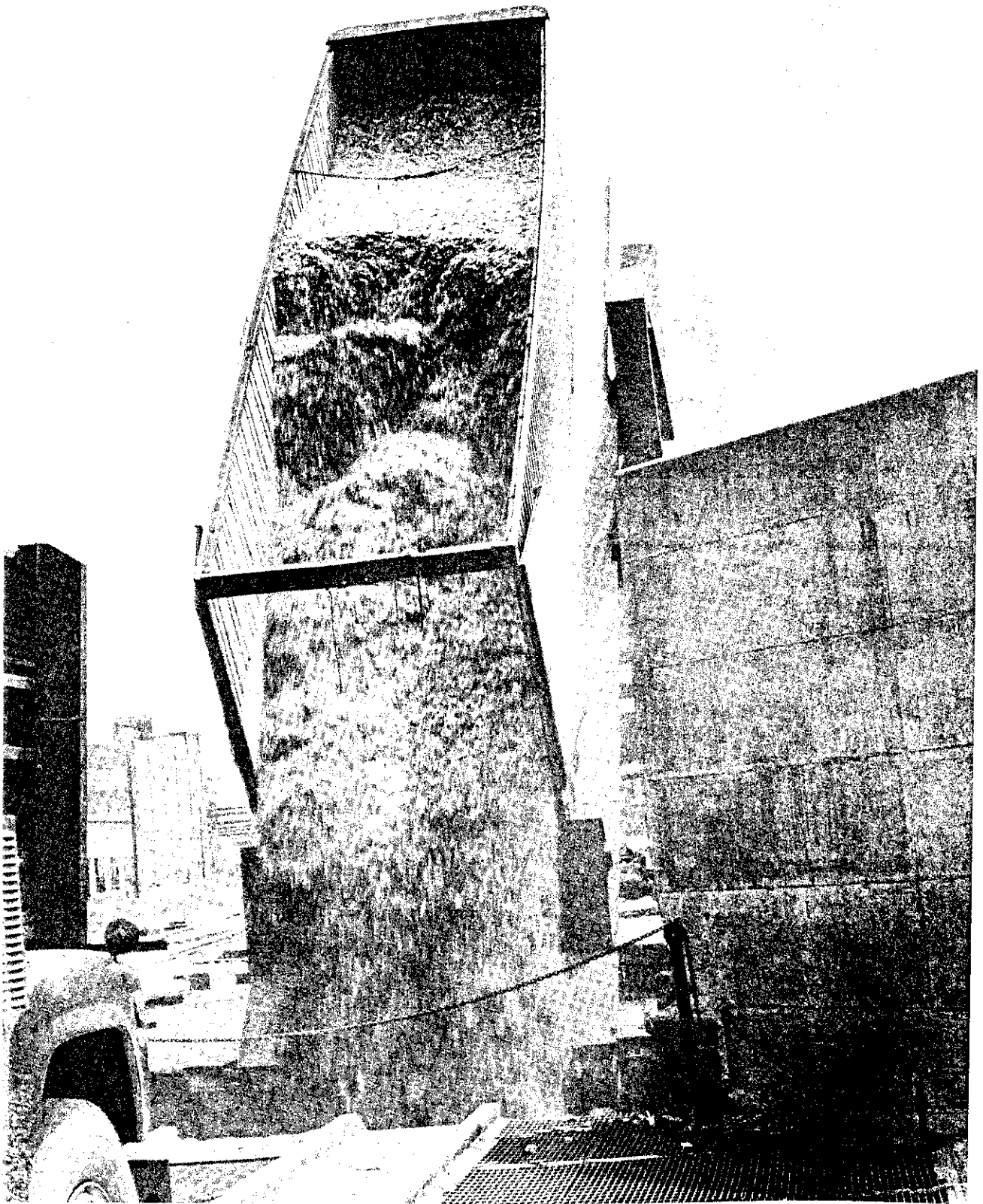
less than 10,000 acres per year (table III).

**Table III. — Area under fire protection, protected area burned, number of fires, and average size of fires, Virginia, 1966-1976<sup>1</sup>**

Year	Area protected <sup>2</sup>		Protected area burned		Fires	Average size of fires
	<i>Macres</i>	<i>Percent</i>	<i>Macres</i>	<i>Percent</i>		
1966	15,711	100	9	0.06	2,149	4
1967	16,172	100	14	0.09	1,970	7
1968	16,187	100	11	0.07	2,779	4
1969	16,206	100	11	0.07	1,990	6
1970	16,204	100	12	0.07	1,893	6
1971	16,222	100	17	0.10	1,716	10
1972	16,173	100	2	0.01	792	3
1973	16,215	100	4	0.02	976	4
1974	20,457	100	9	0.04	2,942	3
1975	20,508	100	5	0.02	2,467	2
1976	20,517	100	15	0.08	5,677	3

<sup>1</sup>Source: U.S. Department of Agriculture, Forest Service, Wildfire Statistics, 1966-1976.

<sup>2</sup>Includes forest and nonforested watershed lands.



## TIMBER PRODUCTS OUTPUT

Results from three separate studies were merged to estimate the output of timber products in Virginia for 1976: (1) The remeasurement of permanent sample locations provided the estimates of total timber removals. (2) Felled trees were measured at a sample of active harvesting operations to develop utilization factors for each of the roundwood products. (3) All primary wood-using plants were canvassed to obtain information on wood receipts, byproducts, and wood residues. Based on these studies, volume of roundwood harvested in Virginia totaled about 464 million cubic feet. The estimate of total timber products output includes an additional 64 million cubic feet of plant byproducts, such as chipped residues used for pulpwood and veneer cores used to manufacture lumber. Altogether, timber products output totaled about 528 million cubic feet.

The canvass of primary wood-using industries showed that 486 mills operated in Virginia during 1976 (fig. 7). These mills received logs, bolts, and other forms of roundwood from which they manufactured lumber, veneer, plywood, chips, pulp, paper, and other products. In addition, an undetermined number of secondary manufacturing plants located within the State were engaged in the remanufacture of these products into finished goods such as furniture, fixtures, and containers. Altogether, the forest products industry in Virginia employs more than 60,000 people and generates an annual payroll of more than \$500 million.

### SAW LOGS ACCOUNT FOR MORE THAN 40 PERCENT OF TOTAL ROUNDWOOD OUTPUT

Although both number of sawmills and annual lumber production declined between 1965 and 1976, saw logs remained the leading roundwood product harvested and accounted for more than 40 percent of the

1976 roundwood output. Number of active sawmills decreased from 870 to 452. Based on Bureau of the Census figures, annual lumber production fluctuated between a high of 1,179 million board feet in 1966 and a low of 867 million board feet in 1975 (fig. 8). This same source showed production back up to 944 million board feet in 1976.

Based on the International ¼-inch log rule, volume of saw logs harvested in Virginia during 1976 exceeded 1,013 million board feet. The solid-wood content of these logs exceeded 189 million cubic feet. Hardwood species provided 58 percent of the saw-log output and softwood species provided 42 percent. These figures still identify considerable imbalance between product output and the species makeup of the timber inventory. Hardwoods make up 70 percent of Virginia's sawtimber inventory and account for 70 percent of the annual sawtimber growth, but they provide less than 60 percent of the saw-log harvest.

### PULPWOOD HAS SURPASSED SAW LOGS IN TOTAL PRODUCT OUTPUT

Although saw logs remain the leading roundwood timber product harvested in Virginia in terms of volume, pulpwood has surpassed saw logs in total output when pulped plant residues are included. In 1976, the round pulpwood harvest totaled 149 million cubic feet; however, other wood-using plants within the State produced another 50 million cubic feet of pulpwood in the form of chips and other byproducts. Based on these figures, byproducts accounted for one-fourth of the total pulpwood output, compared to 17 percent in 1965. This improved utilization, together with an increase in use of hardwood for pulp fiber, helped ease the demand on Virginia's pine timber supplies.

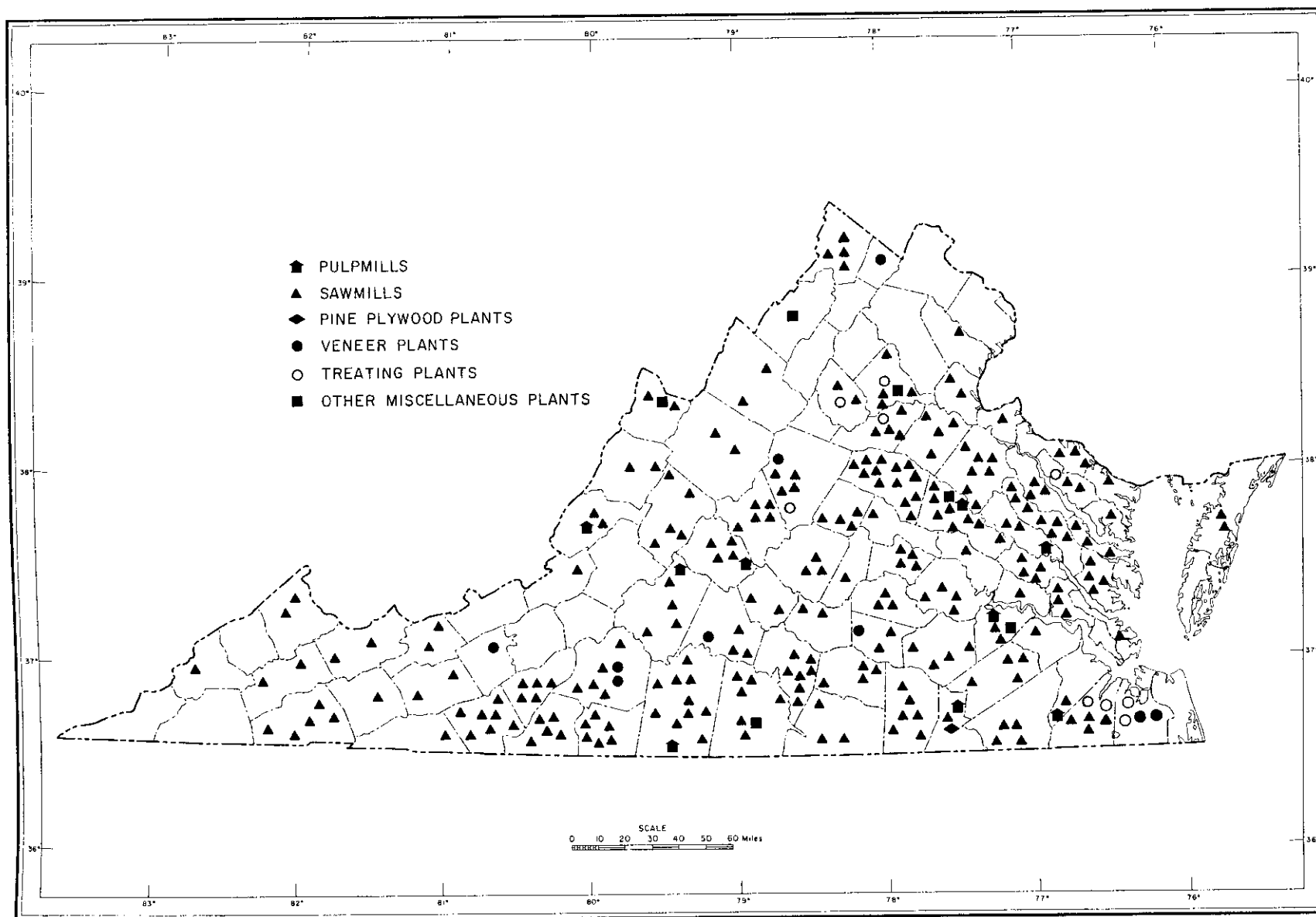


Figure 7. — Location of primary wood-using industries in Virginia, 1976.  
(Sawmills producing less than a million board feet are excluded.)



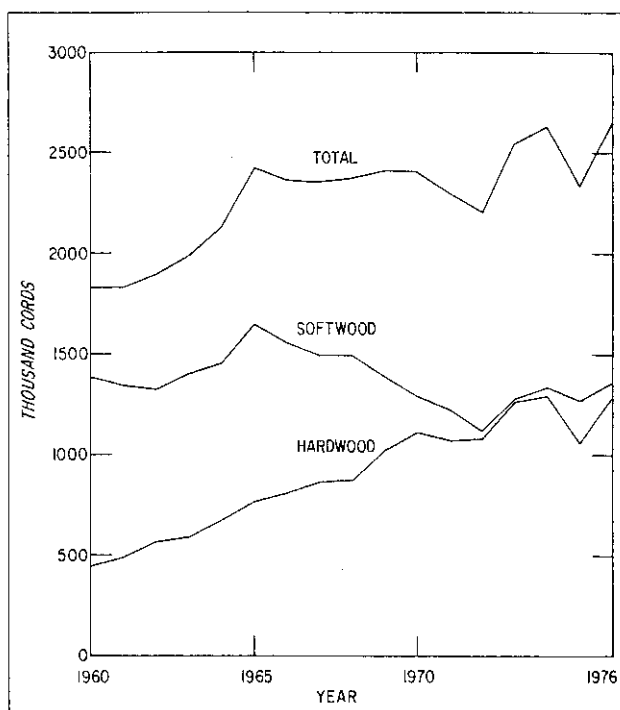


Figure 8. — Lumber production in Virginia, 1960-1976.

Between 1965 and 1972, annual output of softwood pulpwood decreased from the equivalent of 1,650,900 cords down to 1,121,100 cords, or by 32 percent. Since 1972, softwood production has again been on the increase, reaching the equivalent of 1,366,100 cords in 1976. Over this same 11-year period, annual output of hardwood pulpwood increased from 770,100 cords to a record high of 1,295,700 cords in 1976, or by 68 percent (fig. 9). All of these figures include both roundwood and byproducts.

Although the total 1976 pulpwood production figures in this report agree with the Virginia figures published in Resource Bulletin SO-66, "Southern Pulpwood Production, 1976," differences are acknowledged in the breakdown between roundwood and byproducts. With the upward surge in number and kinds of chipping operations, it has become increasingly difficult to maintain a clear separation between volume of roundwood and volume of byproducts. Results from the more complete industry canvass provided higher and more accurate measures of roundwood chipped.

Even with the increased use of hardwood for pulpwood, the strong demand for pine continues to be strong relative to the species composition in Virginia's forest.

For example, 75 percent of the volume of all live timber is hardwood; yet, hardwoods provided only about 50 percent of the round pulpwood harvest in 1976. The pulp industry's need for long fiber limits its increased use of the more abundant hardwood timber supplies. Attention is also called to the estimated 180 million board feet of sawtimber removed as part of the 1976 pulpwood harvest. Nearly 60 percent of this sawtimber used for pulpwood was softwood.

Based on the interstate movement in 1976, Virginia is a net importer of round pulpwood. Nine pulpmills, with a combined daily pulping capacity of 7,158 tons,

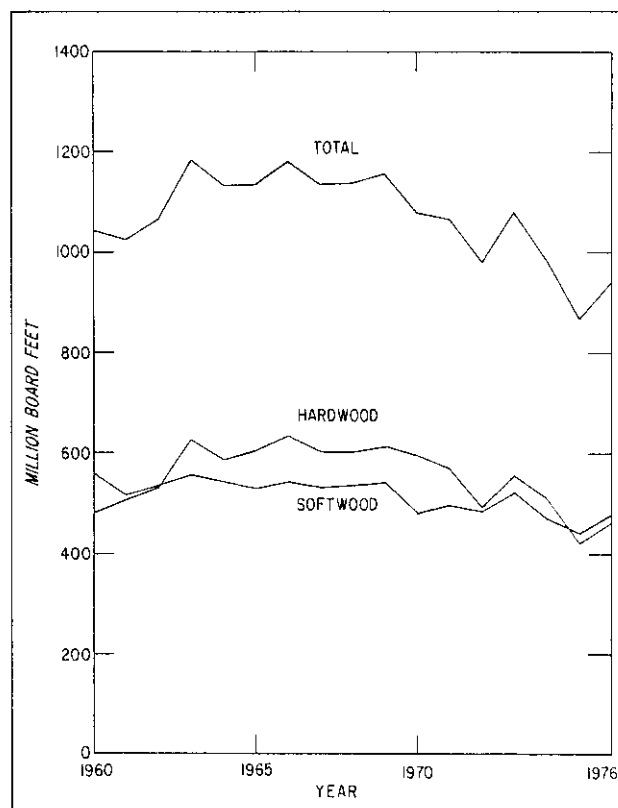


Figure 9. — Pulpwood production in Virginia, including byproducts, 1960-1976.

operated in the State during 1976. Based on the reported sources of roundwood received at these mills, 73 percent came from Virginia, while the remaining 27 percent was brought in from North Carolina and other States. Only 11 percent of the round pulpwood cut in Virginia was transported to mills outside the State. Virginia's pulp industry imported almost 3 cords of roundwood for each cord exported. With expansion projects already underway to increase pulping capacities at some of the existing mills plus announced plans for the construction of one new mill, producers will likely look to Virginia's timberland for a greater quantity of pulpwood.

## ERRATA

Knight, Herbert A., and Joe P. McClure  
1978. Virginia's timber, 1977. U.S. Dep. Agric. For.  
Serv., Resour. Bull. SE-44, 53 p. Southeast.  
For. Exp. Stn., Asheville, N.C.

Page 15. The two drawings on this page have been misplaced and should be reversed. Thus, the drawing in the first column, which shows pulpwood production, should appear over the caption in the second column, and the drawing in the second column should appear over the caption in the first column.

Page 24. The last line of the first complete paragraph should read 360,000 acres rather than 360 acres.

## OUTPUT OF PEELER LOGS UP

The timber products output studies measured a further decline in the harvest of hardwood veneer logs; however, the total output of peeler logs was up. An increase in the output of pine peeler logs accounted for the total gain. In 1965, Virginia's first pine plywood plant was just coming on stream. While there is still only one major pine plywood plant in the State, volume of softwood peeler logs harvested in 1976 exceeded 8 million cubic feet—more than three times greater than the output of hardwood peeler logs. Altogether, output of veneer logs totaled 11 million cubic feet and accounted for only 2 percent of total roundwood output. The industry canvass identified nine hardwood veneer plants in Virginia. In 1976, the State was a net importer of both softwood and hardwood veneer logs.

## OUTPUT OF OTHER INDUSTRIAL PRODUCTS DOWN

In 1976, the combined roundwood output for poles, piling, posts, cooperage bolts, particleboard furnish, and other miscellaneous industrial products totaled about 7 million cubic feet. Additional plant byproducts used primarily for particleboard pushed total output up to almost 12 million cubic feet. In 1965, the comparable combination of these timber products totaled about 19 million cubic feet.

The imbalance between the species composition of Virginia's timber inventory and the species source of its major timber products also shows up in these minor products. In 1965, the source of these minor products was divided about equally between softwoods and hardwoods. In 1976, softwoods provided almost 60 percent of their total output.

## FUELWOOD OUTPUT REVERSES ITS HISTORIC DECLINE

After several decades of continuous decline based on the best information available, the 1976 output data indicate an abrupt turnabout in the use of fuelwood. With shortages and rampant increases in the prices of conventional fuels, homeowners and industries alike are again turning to wood to supplement or replace other sources of fuel. While the role of wood in helping to alleviate the energy problem is still uncertain, wood as a renewable resource offers considerable potential in States like Virginia.

Because of the large number of users of relatively small amounts of fuelwood, both the total quantity and source of fuelwood are difficult to measure. The deter-

mination of total timber removals from the remeasurement of permanent sample plots, the utilization study, and information obtained from the canvass of primary wood-using plants ensure a reasonable accuracy for the fuelwood estimates.

Surpassed by only saw logs and pulpwood in terms of volume, fuelwood strengthened its position as the State's third leading timber product in 1976. Fuelwood output totaled almost 113 million cubic feet, plus an additional 7 million cubic feet of plant byproducts used for industrial fuel. When combined, this total output was nearly double the 1965 estimate.

A breakdown of the 1976 output by source contradicts any conception that growing-stock trees are not used for fuelwood. Plant byproducts accounted for only 10 percent of the nearly 120 million cubic feet of total output. Rough, rotten, and dead trees together with saplings, tops, limbs, and trees cut from nonforest land accounted for another 34 percent. More than half of the total output came from trees 5.0 inches and larger meeting minimum standards for growing stock. In all of these figures, bark volume is excluded. About two-thirds of the growing stock used for fuelwood was hardwood.

## TIMBER USE IMPROVES

Reductions in logging residues and plant residues, plus an increase in the use of material other than growing stock, indicate substantial improvement in timber use. These actions extend existing timber supplies. For example, the harvest of almost 464 million cubic feet of roundwood products in 1976 resulted in the removal of only 428 million cubic feet of growing stock based on the merchantability standards applied in the inventory. In 1976, less than 47 million cubic feet of logging residues were left in the woods, compared to more than 75 million cubic feet in 1965. Almost 18 percent of the roundwood output came from rough, rotten, and dead trees and other material outside the merchantability standards for growing-stock volume. In 1965, only 10 percent of the roundwood output came from these sources. The salvage of dead timber killed by pine bark beetles, plus the greater use of fuelwood, accounts for part of the increased output from these sources.

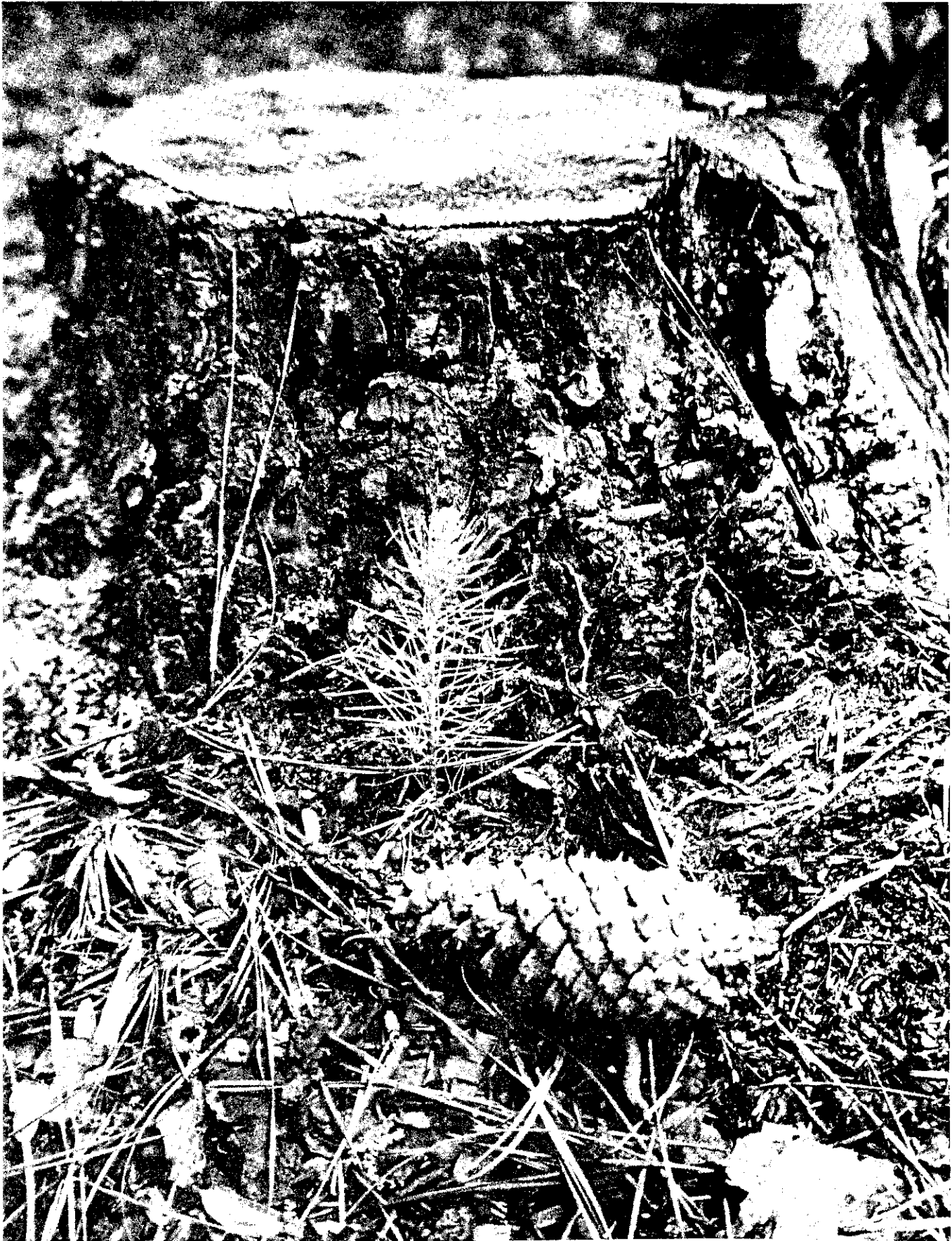
Based on information collected in the industry canvass, primary wood manufacturing plants in Virginia generated 19 million cubic feet of unused wood residues in 1976, compared to an estimated 50 million cubic feet in 1965. These figures suggest almost 80 percent of all wood residues generated at Virginia's primary wood manufacturing plants in 1976 were subsequently used, compared to less than 50 percent in 1965. In the Coastal

Plain, where more than half of the plant wood residues were generated in 1976, the use rate was nearly 90 percent. More than 45 percent of unused residues were generated at plants located in the Piedmont where the use rate was a little better than 70 percent. About two-thirds of the residue volume generated in the Mountain Region was used. For the State as a whole, fine material such as sawdust, shavings, and veneer clippings accounted for almost three-fourths of the unused wood residues. All of these residue estimates exclude bark. Nearly 80 percent of the bark residue generated at primary wood manufacturing plants was also used, mainly as industrial fuel.

In addition to the 428 million cubic feet of growing stock cut during the harvesting of roundwood products, another 68 million cubic feet were removed from the inventory by cultural operations, land clearing, and

other changes in land use. This unused material is called other removals. About 55 percent of this volume was actually removed or destroyed during cultural operations and land clearing. The remaining 45 percent was in trees still standing on lands removed from commercial forest. Shade trees left standing around new homesites and developments are typical examples of the latter kinds of removals. To avoid distortions of trends in timber removals, timber on major withdrawals, such as the Dismal Swamp, is excluded from the estimates of other removals. In contrast to the reductions in logging residues and plant residues, volume of other removals more than doubled since 1965.

Altogether, volumes of logging residues, plant residues, and other removals totaled 134 million cubic feet in 1976, compared to more than 157 million cubic feet in 1965. In both years, more than 70 percent of this unused material was hardwood.



## TIMBER SUPPLY OUTLOOK

Except for possible gains from improved utilization and protection, timber supplies available over the next decade or longer have been determined by actions already taken or foregone. Over a longer period, timber supplies can be increased to the limits established by the growth potential of lands available for timber production. The primary objective in this chapter of the analysis is to bracket future estimates of timber supplies between a *prospective* available cut—the amount available if past trends are extrapolated for 30 years—and a *potential* available cut—the amount attainable through improved timber management. Since softwoods and hardwoods were projected separately, four different projections were made using the Timber Resource Analysis System (TRAS) computer program. The results should not be misinterpreted as bold forecasts; they are reasonable estimates of timber supplies if the stated assumptions hold true.

### ACREAGE OF TIMBERLAND WILL LIKELY DECREASE

With a continued buildup in stocking, both volume and growth of timber per acre will increase over the next 30 years. Past trends, however, point to a probable decrease in acreage of timberland. As stated earlier, the acreage of idle agricultural land, the primary source of new forest land, is declining rapidly. The reversion of this idle agricultural land to forest cannot be expected to offset the diversions of commercial forest land to other uses beyond the next decade. Based on the extrapolation of these trends, no significant reduction in acreage of timberland was assumed for the first decade. Between 1986 and 2006, however, the projections reflect an assumed reduction of 600,000 acres.

Aside from the likely decrease in total acreage, it will become increasingly difficult to sustain pine on 20 to 25 percent of the timberland. As forest industries

complete their conversions of suitable sites to pine plantations and the reversion of idle agricultural lands to pine diminishes, the decline in pine acreage could accelerate rapidly. To prevent this possible decline, each acre of pine harvested should be regenerated with pine.

### TIMBER REMOVALS WILL GRADUALLY INCREASE TO EQUAL GROWTH

Net annual growth provides a maximum estimate of the amount of cut that can be sustained without depleting the inventory. In the projections of timber supplies, growth and mortality rates as determined in this latest inventory were retained throughout the 30-year period. If removals are gradually increased to equal growth, results indicate net annual growth will increase from 52 to 60 cubic feet per acre. When the acreage assumptions are superimposed onto these results, *prospective* annual cut increases from 496 to 929 million cubic feet, including 3,264 million board feet of sawtimber.

### HARDWOODS DOMINATE PROSPECTIVE SUPPLY

With the stated assumptions, hardwoods account for more than 90 percent of the prospective increase in available cut (fig. 10). By the end of the projection period, hardwoods would provide 75 percent of the annual removals, compared to 49 percent in 1956, 58 percent in 1965, and 59 percent in 1976. Additional hardwood markets would be required to accommodate this prospective increase in hardwood timber supplies. In light of the growing concern over energy sources, a renewed use of wood for fuel could provide an outlet for substantial quantities of poor-quality hardwoods.

Some users of this information may need to discount the prospective supply of hardwood. For example, nearly one-fourth of the existing acreage occupied with

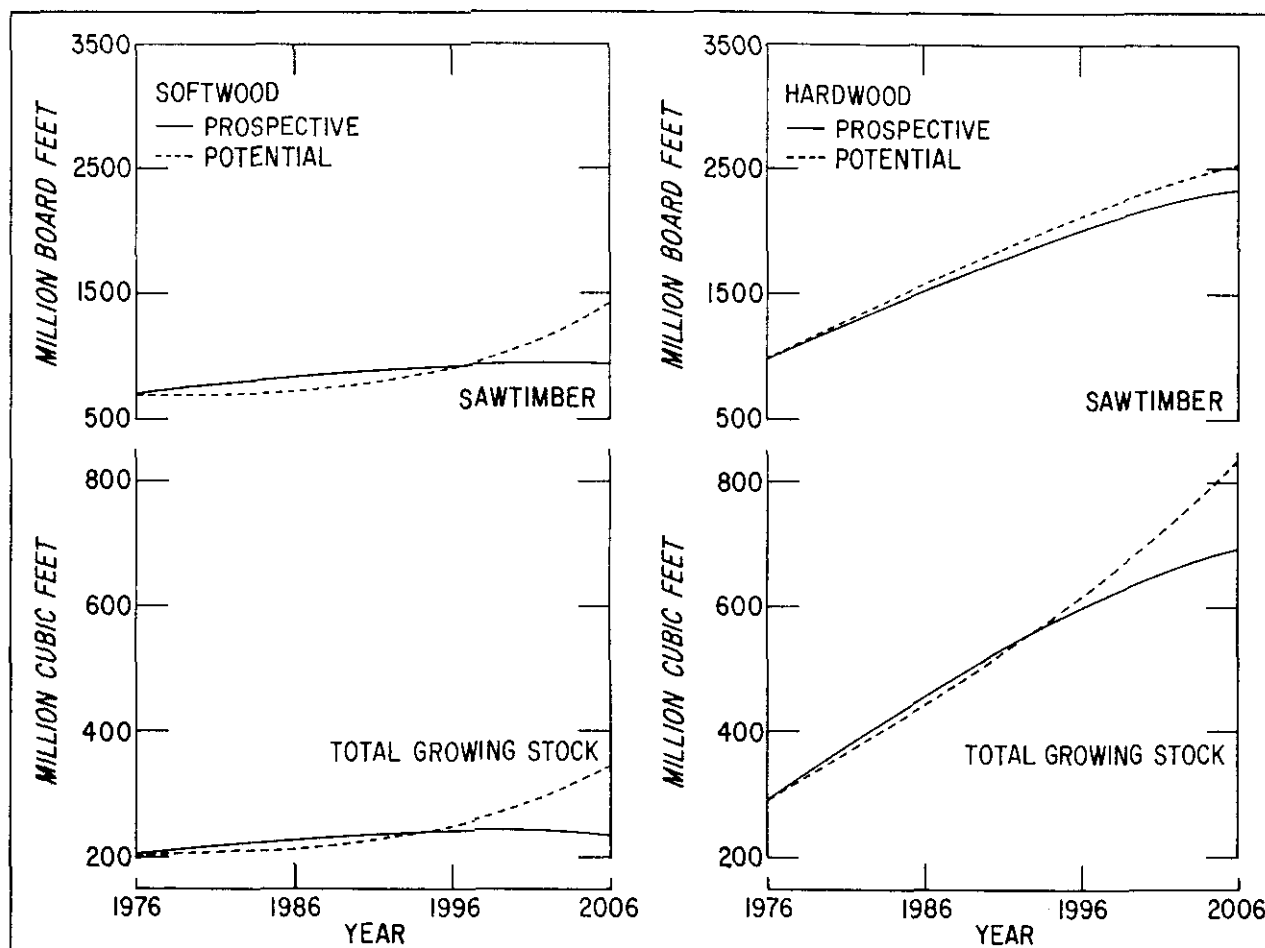


Figure 10. — Prospective and potential available cut, Virginia, 1976-2006.

hardwood types occurs either on slopes 40 percent or steeper or in areas with year-round water problems. It seems reasonable to assume this proportion will hold over the projection period. To harvest timber off these sites often requires special logging techniques.

### PINE PLANTATIONS WILL PROVIDE MOST OF THE AVAILABLE SOFTWOOD

In contrast to the abundant hardwood supply, the prospective supply of softwoods will accommodate only a modest increase in cut over the next 30 years. Pine plantations will provide an increasing share of the softwood cut. Most of the pine plantations in Virginia were established after the 1965 inventory identified a pine growth deficit. Pine plantations now account for about 60 percent of all softwood stands less than 10 years old. Timber will start to come from these plantations in the 1990's.

Two separate and independent estimates of planta-

tion acreage are presented in this analysis. First, based on annual reports of forest planting and seeding compiled by the U.S. Department of Agriculture Forest Service, an average of 77,500 acres was planted annually during the remeasurement period (table IV). Second, based upon the field crews' determination of stand origin at each sample location visited in this latest inventory, an average of 55,500 acres had been planted annually (table V). Since some planting efforts fail because of poor survival, mortality, and inadequate site preparation, the first estimate must be discounted. On the other hand, the second estimate is probably conservative since some planted stands are difficult to recognize on the ground. By using the average of the two estimates, one might conclude that some 66,500 acres of plantations will start feeding into the prospective softwood supply annually during the last decade of the projection period.

With an assumed average yield of 3,000 cubic feet per acre at 30 years of age, the annual harvest of 66,500

**Table IV. — Acres of forest planting,<sup>1</sup> by ownership class, Virginia, 1966–1976**

Fiscal year	Ownership class				All owner- ships	Accumulative total
	National Forest	Other public	Forest industry	Other private		
..... Acres .....						
						<sup>1</sup> 525,669
1966	2,418	1,707	35,039	25,603	64,767	590,436
1967	2,748	1,412	43,963	26,797	74,920	665,356
1968	2,038	904	36,636	24,590	64,168	729,524
1969	2,006	1,286	41,381	25,706	70,379	799,903
1970	1,364	1,387	38,493	27,461	68,705	868,608
1971	1,804	2,472	35,072	32,539	71,887	940,495
1972	2,157	2,833	39,750	53,087	97,827	1,038,322
1973	1,511	3,966	30,419	47,559	83,455	1,121,777
1974	1,530	2,303	27,338	51,618	82,789	1,204,566
1975	1,407	2,449	24,849	59,218	87,923	1,292,489
1976	1,696	2,294	26,426	55,497	85,913	1,378,402

<sup>1</sup> Includes acres of planting by direct seeding. Source: U.S. Department of Agriculture, Forest Service, *Forest Planting, Seeding, and Silvicultural Treatments in the United States*.

<sup>2</sup> Accumulative total prior to FY 1966.

acres of pine plantations could account for up to 85 percent of the prospective available softwood cut. If hardwoods are included, natural stands would still be providing almost 80 percent of available cut.

Distribution of the acres planted by region suggests 52 percent of the prospective increase in timber supplies from plantations will occur in the Coastal Plain. Another 43 percent of the planting occurred in the Piedmont, and the remaining 5 percent was in the Mountain Region (table V). Statewide, about 55 percent of the pine plantations were located on lands owned or leased by forest industries. Another 44 percent occurred on other private lands, and the remaining 1 percent was on public holdings (table VI). Since most of the artificial reforestation in Virginia has been pine, the acreage difference between table V and table VI calls for an explanation. Because of poor survival and inadequate site preparation, hardwoods had encroached on some 195,000 acres with evidence of planting, to the extent that either an oak-pine or other hardwood forest type was assigned.

The inventory data indicate the problem of hardwood encroachment is more serious in plantations established on cutover forest land than in plantations established on old fields. For example, hardwood stocking exceeded pine in 25 percent of the plantations established on cutover forest land during the 11-year re-measurement period. Hardwood stocking exceeded pine in less than 10 percent of the plantations established on old fields. On the average, these determinations were made some 5 to 6 years following planting. These figures suggest that site preparation practices on cutover forest land are often insufficient for establishing pine plantations.

### GROWTH PER ACRE CAN BE INCREASED BY ALMOST 50 PERCENT

In the projections made to determine prospective timber supplies, growth per acre increased from 52 to 60 cubic feet. A second set of projections estimated the potential timber supplies attainable over the same 30-year period through improved timber management. Here, growth per acre increased from 52 to 77 cubic feet. This rate more nearly reflects the inherent growth potential of Virginia's timberland with fully stocked natural stands.

In the projection of *potential* supplies, management goals were expressed in terms of basal area per acre and a stand-structure quotient for both softwoods and hardwoods. The stand-structure quotient is determined by dividing the number of trees in any 2-inch-diameter class by the number in the next larger class. In even-aged management, this quotient reflects the age distribution of the stands.

The goals selected for projection control would allow average stand densities of growing-stock trees 5.0 inches d.b.h. and larger to increase from 56 to 80 square feet per acre. Although this goal calls for only a 17 percent gain over the prospective increase when all species

**Table V. — Area of commercial forest land, by stand origin and Survey Unit, Virginia, 1977**

Stand origin	State		Survey Unit									
			Coastal Plain		Southern Piedmont		Northern Piedmont		Northern Mountain		Southern Mountain	
	<i>M acres</i>	<i>Percent</i>	<i>M acres</i>	<i>Percent</i>	<i>M acres</i>	<i>Percent</i>	<i>M acres</i>	<i>Percent</i>	<i>M acres</i>	<i>Percent</i>	<i>M acres</i>	<i>Percent</i>
Natural stands with no evidence of artificial regeneration	15,097.8	94.5	3,549.7	88.7	3,522.1	93.2	2,431.1	95.2	2,602.9	99.1	2,992.0	99.3
Stands originating wholly or in part from artificial regeneration since 1966	610.7	3.8	303.7	7.6	186.4	4.9	91.2	3.6	13.4	0.5	16.0	0.5
Stands originating wholly or in part from artificial regeneration prior to 1966	264.3	1.7	150.1	3.7	69.9	1.9	29.8	1.2	9.4	0.4	5.1	0.2
All stands	15,972.8	100.0	4,003.5	100.0	3,778.4	100.0	2,552.1	100.0	2,625.7	100.0	3,013.1	100.0



Table VI. — Area of commercial forest land, by broad management, ownership, and past treatment or disturbance classes, Virginia, 1977

Broad management and ownership classes <sup>1</sup>	Total area	Primary treatment or disturbance between 1966 and 1977							
		Harvesting with artificial regeneration	Harvesting with natural regeneration	Other harvesting	Intermediate cutting	Artificial planting	Natural disturbance	Other <sup>2</sup>	None
.....Thousand acres.....									
Nonstocked forest:									
Public	40.3	—	—	6.9	3.6	—	2.2	—	27.6
Forest industry	37.2	—	—	30.2	—	—	—	—	7.0
Other private	174.9	—	5.6	32.0	8.8	—	—	21.8	106.7
Total	252.4	—	5.6	69.1	12.4	—	2.2	21.8	141.3
Pine plantations:									
Public	4.4	4.2	—	—	—	0.2	—	—	—
Forest industry	371.8	171.5	—	—	3.0	76.6	—	5.8	114.9
Other private	303.5	122.6	—	—	8.9	76.9	7.5	4.3	83.3
Total	679.7	298.3	—	—	11.9	153.7	7.5	10.1	198.2
Natural pine stands:									
Public	217.5	—	5.7	—	24.4	—	6.2	6.9	174.3
Forest industry	418.6	—	23.3	3.5	37.0	—	52.3	3.4	299.1
Other private	2,086.0	—	91.8	22.9	239.5	—	125.0	97.1	1,509.7
Total	2,722.1	—	120.8	26.4	300.9	—	183.5	107.4	1,983.1
Oak-pine stands:									
Public	174.8	—	5.3	8.5	7.2	—	3.6	3.6	146.6
Forest industry	238.5	44.4	10.3	17.2	7.6	10.1	2.8	6.1	140.0
Other private	1,507.6	29.2	95.5	63.9	176.8	15.2	51.2	71.0	1,004.8
Total	1,920.9	73.6	111.1	89.6	191.6	25.3	57.6	80.7	1,291.4
Upland hardwood stands:									
Public	1,501.6	—	84.3	21.2	82.8	4.2	40.2	25.3	1,243.6
Forest industry	548.8	15.6	26.3	61.7	26.3	2.3	14.7	22.4	379.5
Other private	7,674.0	19.5	377.9	489.6	862.5	3.1	163.5	376.6	5,381.3
Total	9,724.4	35.1	488.5	572.5	971.6	9.6	218.4	424.3	7,004.4
Bottomland hardwood stands:									
Public	17.3	—	—	0.8	—	—	3.2	—	13.3
Forest industry	68.7	—	3.0	5.8	—	—	2.4	—	57.5
Other private	587.3	—	9.6	56.4	37.7	—	52.4	9.5	421.7
Total	673.3	—	12.6	63.0	37.7	—	58.0	9.5	492.5
All classes:									
Public	1,955.9	4.2	95.3	37.4	118.0	4.4	55.4	35.8	1,605.4
Forest industry	1,683.6	231.5	62.9	118.4	73.9	89.0	72.2	37.7	998.0
Other private	12,333.3	171.3	580.4	664.8	1,334.2	95.2	399.6	580.3	8,507.5
Total	15,972.8	407.0	738.6	820.6	1,526.1	188.6	527.2	653.8	11,110.9

<sup>1</sup>Forest industry includes lands under long-term lease.

<sup>2</sup>Includes grazing, draining, prescribed burning, site preparation, and other miscellaneous treatments.

are grouped, it would require a gain of almost 30 percent for softwoods to be attained through improved pine regeneration practices. The management goals assumed a stand-structure quotient of 1.7 for both softwoods and hardwoods. Finally, it was assumed that softwood mortality rates could be reduced by 75 percent within 15 years, and hardwood mortality rates could be gradually reduced by 50 percent over the next 30 years. The more optimistic assumption used for softwoods is based on the fact that the base mortality rates reflect an unusually high loss of pines to bark beetles.

If the same assumptions are applied with regard to the decline in acreage as were applied in the prospective projections, *potential* annual cut climbs to 1,179 million cubic feet by year 2006, and would include 3,946 million board feet of sawtimber. The most significant increase over prospective supplies occurs in the volume of softwood (fig. 10). To achieve and sustain an inventory capable of supporting these levels of cut would require some shift in timber use from softwood to hardwood early in the projection period, along with improved regeneration of pine following harvesting.

### **STAND-AGE DISTRIBUTION REFLECTS RECENT PINE PLANTINGS**

The distribution of commercial forest acreage by stand-age class and major forest type provides another indicator of future timber supplies. A stand-age profile of Virginia's timberland clearly shows the acceleration in pine planting during the past decade (fig. 11). For example, pine stands less than 10 years old occupy 708,000 acres, or 21 percent of the total acreage supporting pine forest types. About 60 percent of these young stands are plantations. Young stands are expected to replace natural stands 40 or more years old, which now occupy almost 1 million acres. Because of their age, these natural stands have accumulated average volumes of growing stock in excess of 2,000 cubic feet per acre. If the plantations are harvested 20 to 30 years in the future at ages of 30 to 40 years, they will contain little if any more volume than that which has now accumulated in old natural stands. The age distribution of pine stands, therefore, tends to support the earlier conclusion that only a modest increase can be expected in softwood timber supplies over the next 30 years.

### **70 PERCENT OF THE HARDWOOD STANDS ARE 40 YEARS OF AGE OR OLDER**

Unlike pine stands, hardwood stands are concentrated in the older age classes. Of some 10.3 million acres with a manageable stand of hardwoods, 70 percent supported stands 40 years of age or older. Many of these

stands have already reached maturity and most of the others will reach maturity over the next 30 years. Collectively, these stands offer the greatest opportunity for increasing timber cut over the next several decades.

Over the longer run, acreage deficiencies in the younger age classes, together with some 2.4 million acres so poorly stocked that a manageable stand does not exist, pose problems. Recent rates of hardwood harvesting and regeneration would have to be increased to correct the stocking deficiencies and unbalanced age distribution of the stands on the 12.5 million acres of hardwood type. Existing hardwood markets in Virginia cannot absorb the increase in hardwood harvesting opportunities implied in this age-stand profile. If current trends continue, average hardwood rotations will be extended and a large reserve of overmature stands will accumulate, resulting in substantial growth loss.

Of the 2.3 million acres of hardwood type without a manageable stand, about 53 percent had experienced no significant treatment or disturbance during the 11-year remeasurement period. The poorly stocked conditions on this acreage are not likely to improve without some intervention. Timber cutting or other types of disturbance during the same period contributed to the poor stocking conditions on the remaining 47 percent; therefore, the condition of some of these acres will improve. In both cases, many of the acres formerly supported pine stands.

Average volume per acre shown for each condition or age class in figure 11 excludes the volume in rough and rotten trees and all trees less than 5.0 inches d.b.h. Mortality, thinnings, and other types of intermediate cutting had also removed undetermined amounts of volume from some of the stands. The average volumes demonstrate the minimum performance of reasonably well-stocked stands across the range of sites.

### **185,000 ACRES HARVESTED ANNUALLY EXCLUDING DIVERSIONS AND INTERMEDIATE CUTTINGS**

Measures of recent rates of forestry activities are needed before examining the management opportunities available for closing the gap between prospective and potential timber supplies in Virginia. In this latest inventory, crews determined the most significant treatment or disturbance evidenced at each sample location during the 11-year remeasurement period. A summary of this treatment and disturbance information by broad management and ownership classes provides a measure of recent forestry activities (table VI). Note that the

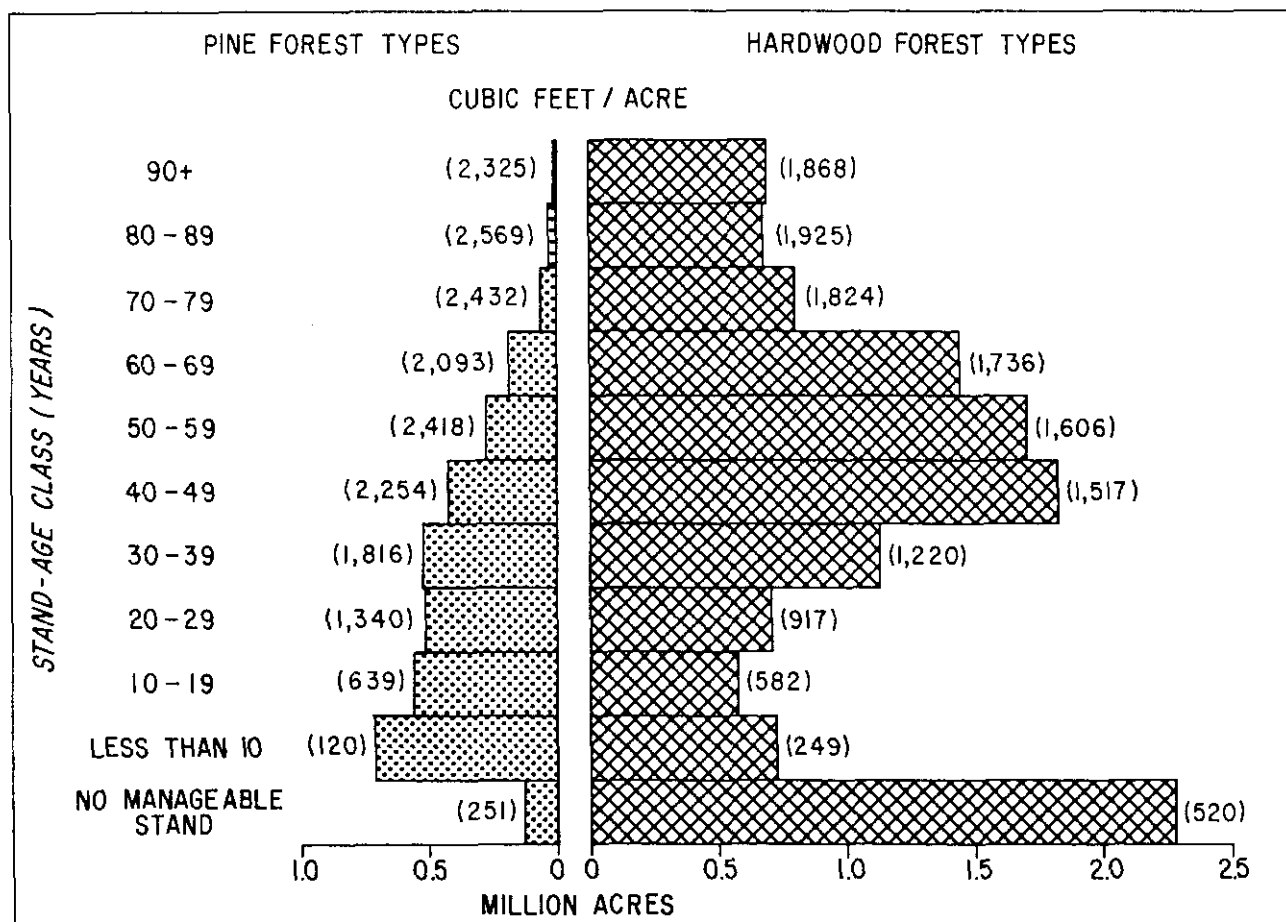


Figure 11. — Profile of area of commercial forest land, by stand-age class, by pine and hardwood forest types, with average volume of growing stock per acre (in parentheses), Virginia, 1977.

management classes describe the stands at the end of the remeasurement period rather than at the beginning.

Timber harvesting was the most common forestry activity observed. Of the nearly 16.0 million acres classified as commercial forest, almost 2.0 million acres had been harvested since the 1966 inventory. On the average, 185,000 acres were harvested annually and retained as commercial forest. Evidence of thinning or other types of intermediate cutting was observed on an additional 1.5 million acres. These figures exclude almost 0.5 million acres withdrawn or diverted to other land uses during the period. Timber on some of this acreage was also harvested. When the estimates of harvesting, intermediate cutting, and diversions are grouped, timber was removed from 360 acres annually.

Observations of recent treatment and disturbance indicated about 610,000 acres had been artificially reforested. A breakdown of this reforestation effort shows 68 percent occurred on forest acres also harvested during the remeasurement period. Another 11 percent was on

old fields or other nonforest land. The remaining 21 percent of the planting effort was on the backlog of acreage needing regeneration.

Other significant treatments or disturbances by man were observed on 654,000 acres. These practices included forest grazing, draining, prescribed burning, site preparation, and other miscellaneous disturbances. Finally, conditions observed on an additional 527,000 acres had been significantly affected by natural disturbances. These natural disturbances included insect infestations, wildfire, disease, and weather. Estimates fail to reflect the full extent of these treatments and disturbances because one type of treatment or disturbance often masks another that may have occurred in the same stand.

### 70 PERCENT OF THE STANDS WERE UNDISTURBED

No evidence of significant treatment or disturbance within the remeasurement period was found on 11.1 million acres, or 70 percent of the land classified as com-

mercial forest. By region, the proportion of undisturbed stands ranged from a high of 79 percent in the Mountains to a low of 64 percent in the Piedmont. In the Coastal Plain, 65 percent of the stands had not been disturbed. By ownership class, the proportion of undisturbed stands ranged from a high of 82 percent on public lands to a low of 59 percent on lands owned or leased by forest industries. The proportion was 69 percent on other private lands. By broad management class,

the proportion undisturbed ranged from 73 percent for both natural pine and bottomland hardwood stands to only 29 percent for pine plantations.

About 23 percent of the undisturbed stands were on sites unfavorable for intensive silvicultural practices either because of steep slopes or year-round water problems. Only 13 percent of the treated or disturbed stands occurred on similar sites.



## MANAGEMENT OPPORTUNITIES

As projected, future timber requirements to meet the Nation's needs challenge the inherent growth capacity of all available timberland. Diminishing acreage, greater environmental concern, wider diversity among owner attitudes, and the increasing cost of intensive forest practices place additional strain on timber management. Ramifications of the energy crisis and forestry's role in its solution add still more uncertainty to the adequacy of prospective timber supplies. All of these factors stress the need for a sound statistical base of relative forest conditions. This fourth Statewide evaluation of Virginia's forest resources provides such a base (table VII).

### ADVERSE SITES LIMIT OPPORTUNITIES ON 3.2 MILLION ACRES

Slopes 40 percent or steeper or year-round water problems limit the practice of intensive forestry on 3.2 million acres, or 20 percent of Virginia's timberland. While timber can be harvested off these relatively fragile sites, they seldom attract silvicultural investments. Over the past 11 years, less than 16 percent of this acreage experienced any cutting or treatment. On these adverse sites, volume of growing stock averaged 1,220 cubic feet per acre. Hardwood stands occupied more than 95 percent of the acreage.

By region, the proportion of total commercial forest land classified as adverse ranged from a high of 45 percent in the Mountains to a low of 5 percent in the Coastal Plain. Adverse sites limit timber management opportunities on about 7 percent of the acreage in the Piedmont. By ownership class, the proportion of adverse sites ranged from 33 percent on public lands to less than 7 percent on forest industry holdings. Almost 20 percent of other privately owned timberland is on sites unsuitable for intensive management.

### OVER 7.6 MILLION ACRES SUPPORTED STANDS IN GOOD CONDITION

More than 7.6 million acres, or 48 percent of the commercial forest land, supported stands in relatively good condition on manageable sites. Generally, these stands were 60 percent or better stocked with immature trees of acceptable quality, free from significant damage or competition. On these lands, volume of growing stock averaged 1,325 cubic feet per acre. Hardwood stands occupied 71 percent of the acreage, natural pine stands 22 percent, and pine plantations the remaining 7 percent. Protection and the prompt regeneration of acreage harvested should sustain a high rate of timber growth on these lands.

By region, the proportion of acreage suitable for timber management supporting stands in good condition ranged from 65 percent in the Mountains to less than 56 percent in the Coastal Plain. In the Piedmont, 60 percent of the acreage on manageable sites supported stands in good condition. By ownership class, 63 percent of the stands on public and forest industry acreage suitable for timber management were in good condition, compared to less than 59 percent on other private holdings.

### OPPORTUNITIES IDENTIFIED ON 5.2 MILLION ACRES

Conditions on the remaining 5.2 million acres, or 32 percent of the timberland, were inadequate for optimum timber production. Without treatment, considerable growth loss will occur on these acres. This evaluation identified six management opportunities for improving existing conditions: (1) Salvage and regenerate seriously damaged stands on 98,700 acres. (2) Harvest and regenerate overmature stands on 945,600 acres. (3) Thin young, immature stands densely stocked with merchantable-size trees on 503,200 acres. (4) Remove undesirable

Table VII. — Area of idle cropland and commercial forest land, by broad management, ownership, and treatment opportunity classes, Virginia, 1977

Broad management and ownership classes <sup>1</sup>	Total area	Broad treatment opportunity classes							
		Salvage	Harvest	Com- mercial thinning	Other stand improve- ment	Stand con- version <sup>2</sup>	Regen- eration	Stands in relatively good condition	Adverse sites or condi- tions <sup>3</sup>
.....Thousand acres.....									
Idle cropland:									
Public	—	—	—	—	—	—	—	—	—
Forest industry	—	—	—	—	—	—	—	—	—
Other private	366.3	—	—	—	—	—	366.3	—	—
Total	366.3	—	—	—	—	—	366.3	—	—
Nonstocked forest:									
Public	40.3	—	—	—	—	—	15.0	—	25.3
Forest industry	37.2	—	—	—	—	—	31.2	—	6.0
Other private	174.9	—	—	—	—	—	124.4	—	50.5
Total	252.4	—	—	—	—	—	170.6	—	81.8
Pine plantations:									
Public	4.4	—	—	—	—	—	—	4.4	—
Forest industry	371.8	—	—	50.9	17.5	—	3.5	299.9	—
Other private	303.5	—	—	44.1	10.1	—	8.3	241.0	—
Total	679.7	—	—	95.0	27.6	—	11.8	545.3	—
Natural pine stands:									
Public	217.5	—	7.1	44.9	13.6	2.5	—	116.2	33.2
Forest industry	418.6	33.1	19.4	40.2	50.6	8.9	3.5	256.0	6.9
Other private	2,086.0	32.4	99.3	282.9	136.3	93.7	59.3	1,295.5	86.6
Total	2,722.1	65.5	125.8	368.0	200.5	105.1	62.8	1,667.7	126.7
Oak-pine stands:									
Public	174.8	—	6.3	3.8	6.2	10.4	—	80.9	67.2
Forest industry	238.5	2.8	6.3	3.7	27.8	27.4	21.5	136.9	12.1
Other private	1,507.6	9.7	70.8	6.9	145.8	148.8	128.9	846.5	150.2
Total	1,920.9	12.5	83.4	14.4	179.8	186.6	150.4	1,064.3	229.5
Upland hardwood stands:									
Public	1,501.6	—	142.4	—	91.1	30.8	100.3	624.6	512.4
Forest industry	548.8	—	40.7	—	29.2	47.5	79.8	277.6	74.0
Other private	7,674.0	20.7	486.1	25.8	443.1	564.1	911.5	3,215.1	2,007.6
Total	9,724.4	20.7	669.2	25.8	563.4	642.4	1,091.6	4,117.3	2,594.0
Bottomland hardwood stands:									
Public	17.3	—	4.2	—	—	—	4.2	8.1	0.8
Forest industry	68.7	—	16.1	—	5.9	6.5	9.0	16.5	14.7
Other private	587.3	—	46.9	—	15.6	23.4	149.0	223.0	129.4
Total	673.3	—	67.2	—	21.5	29.9	162.2	247.6	144.9
All classes:									
Public	1,955.9	—	160.0	48.7	110.9	43.7	119.5	834.2	638.9
Forest industry	1,683.6	35.9	82.5	94.8	131.0	90.3	148.5	986.9	113.7
Other private	12,699.6	62.8	703.1	359.7	750.9	830.0	1,747.7	5,821.1	2,424.3
Total	16,339.1	98.7	945.6	503.2	992.8	964.0	2,015.7	7,642.2	3,176.9

<sup>1</sup> Forest industry includes lands under long-term lease.

<sup>2</sup> Areas occupied with species unsuitable for the site from the standpoint of timber production.

<sup>3</sup> Areas where management opportunities are severely limited because of steep slopes or poor drainage.

trees and competing vegetation from other immature stands on 992,800 acres. (5) Convert stands with species obviously incompatible with the site from the standpoint of timber production to more suitable species on 964,000 acres. (6) Regenerate 1,649,400 acres too poorly stocked with acceptable trees to manage for timber production.

The makeup of this extensive and persistent backlog of treatment opportunities varied by region and ownership class. Although less than one-third of the treatment opportunities identified occurred in the Coastal Plain, more than 40 percent of the damaged and overmature stands were in this region. Some 39 percent of the immature stands offering thinning or other intermediate stand improvement opportunities also occurred in the Coastal Plain. Only 26 percent of the conversion and regeneration opportunities were located in this region. More than half of these conditions were in the Piedmont, where regeneration efforts were often inadequate following harvesting on many private, nonindustrial holdings. Statewide, almost 85 percent of the conversion and regeneration opportunities identified were in this owner class. Although less than 10 percent of all treatment opportunities occurred on public lands, this owner class contained more than 15 percent of the high-risk overmature stands.

In addition to the treatment opportunities identified on 5.2 million acres of commercial forest land, almost 0.4 million acres were classified as idle cropland and included as part of the regeneration opportunity in table VII. In the past, these lands have been the primary source of new forest acreage. Owners receptive to the idea of planting trees on these idle lands should be encouraged to do so. Site preparation and planting costs are considerably less on these acres than on cutover or poorly stocked forest land. About one-half of these idle lands are in the Piedmont.

## REGENERATE ACREAGE HARVESTED

Up to this point, the analysis has focused on opportunities for improving existing conditions on an accumulation of 5.2 million acres of treatment need. Another way to increase prospective timber supplies is to prevent development of poor conditions on other lands. Poor stocking results largely from inadequate regeneration

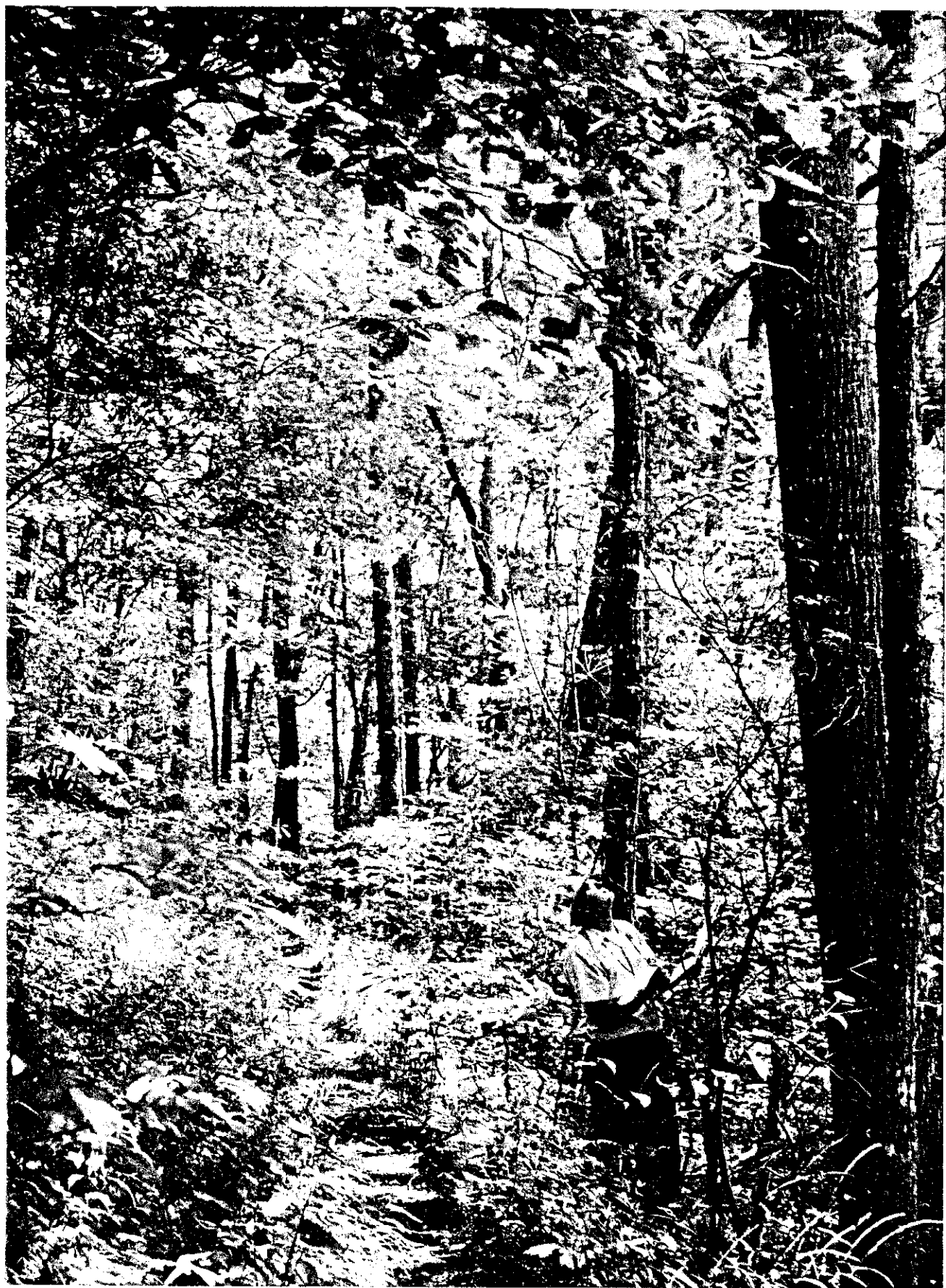
following harvesting of private, nonindustrial lands. If the landowner is to control the species composition and condition of his forests, it is vital he exercise this control at time of harvest.

Between 1966 and 1977, almost 2 million acres were harvested and retained in commercial forest excluding thinnings and other intermediate cuttings. This finding suggests about 185,000 acres must be regenerated annually just to replace harvested stands. Among all the timber management opportunities available, priority must be given to the prompt and adequate regeneration of each acre harvested and retained in commercial forest. Otherwise, the accumulation of poorly stocked conditions will persist, causing substantial loss in timber growth. The longer the delay in regenerating acres harvested, the greater the costs will be for site preparation and other corrective actions.

Currently, Virginia's Reforestation of Timberlands Act provides one source of assistance for the private, nonindustrial owner to regenerate his harvested stands. In addition, some forest products companies offer landowner technical assistance through various agreements made at time of harvest. The Forestry Incentives Program also provides assistance to the small private owner; however, this assistance has not been available for regenerating lands harvested within the past 5 years. Finally, the professional advice and services available through forestry consultants and the Virginia Division of Forestry are invaluable to the private landowner, particularly when he sells his timber. Forestry interests must effectively communicate the availability of these various sources of assistance to the private forest owners. It must not be taken for granted that all of these owners are aware of the various options available to them.

In conclusion, it is important for forestry interests to fully recognize the fact that private, nonindustrial owners possess 77 percent of Virginia's timberland. The management of these lands largely determines the adequacy of Virginia's timber supplies. The total public benefit from timber produced on these lands extends well beyond stumpage prices paid to individual owners. Jobs, payrolls, and value added to this renewable resource justify the cost of forestry assistance programs to supplement the voluntary investments in improved forestry practices.





# APPENDIX

## PROCEDURE

The procedure used in the fourth Statewide inventory and evaluation of Virginia's forest resources included these basic steps:

1. Initial estimates of forest and nonforest acreages were developed from the classification of 81,505 sample clusters systematically spaced on the latest aerial photographs available. Field crews checked a subsample of 6,560 of these 16-point clusters on the ground. A linear regression was fitted to the data to develop the relationship between the photo and ground classification of the subsample. This procedure provided a means for adjusting the initial acreage estimates for change in land use since date of photography and for photo misclassifications.

2. Estimates of timber volume and forest classifications were determined from measurements recorded at 4,091 ground sample locations systematically distributed within the commercial forest land. A 10-point cluster of plots, measured with a basal area factor of 37.5 square feet per acre, was systematically spaced on an acre at each of these locations. Trees less than 5.0 inches d.b.h. were tallied on fixed-radius plots around the point centers.

3. Equations developed from detailed measurements of standing trees in Virginia and throughout the Southeast were used to compute volumes of individual tally trees. A mirror caliper and sectional aluminum poles were used to obtain the additional measurements on standing trees required to construct the volume equations. In addition, felled trees were measured at 85 active cutting operations to provide utilization factors for the different timber products and species groups, and to supplement the standing-tree volume study.

4. Estimates of growth, removals, and mortality were determined from the remeasurement of 4,238 permanent sample plots established in the 1966 inventory. A 1976 survey of timber products output, conducted by the Virginia Division of Forestry, along with the annual pulpwood production study in the South provided additional information for breakdowns of removals by product. The Virginia Polytechnic Institute and State University and Lumber Manufacturers Association of Virginia assisted in the survey of products output.

5. Ownership information was collected from public records and through correspondence and direct contacts in the

field. In those counties where the sample missed a particular ownership class, temporary samples were added and measured to describe forest conditions within the ownership class.

6. All field data were sent to Asheville for editing and were punched on cards and stored on magnetic tape for computer processing, sorting, and tabulation. Final estimates were based on statistical summaries of the data.

7. As each of the five Survey Units in Virginia was completed, special summaries of the information were added to a master data bank of forest resource statistics maintained in Asheville for the entire Southeast. A Forest Information Retrieval (FIR) program is available for compiling the information for any area of interest as a cooperative service.

## RELIABILITY OF THE DATA

Statistical analysis of the data indicates a sampling error of  $\pm 0.23$  percent for the estimate of total commercial forest area, 1.12 percent for the total cubic-foot volume, 1.22 percent for total cubic-foot volume growth, and 3.77 for total cubic-foot removals. As the totals are broken down by forest type, species, tree diameter, and other subdivisions, the sampling error increases. If homogeneity of variances is assumed, the order of this increase is suggested in the following tabulation showing the sampling errors in terms of one standard error, or two chances out of three.

Sampling error <sup>1</sup>	Commercial forest area	Volume of growing stock		
		Inventory	Net growth	Removals
Percent	M acres	. . . . Million cubic feet . . . .		
1	845.0	—	—	—
2	211.2	6,164.3	306.3	—
3	93.9	2,739.7	136.1	—
4	52.8	1,541.1	76.6	440.6
5	33.8	986.3	49.0	282.0
10	8.4	246.6	12.3	70.5
15	3.8	109.6	5.4	31.3
20	2.1	61.6	3.1	17.6
25	1.4	39.5	2.0	11.3

<sup>1</sup> By random-sampling formula.

## DEFINITIONS OF TERMS

*Acceptable trees.*—Growing-stock trees of commercial species that meet specified standards of size and quality, but not qualifying as desirable trees.

*Available cut.*—The volume of timber that would be available for cutting on commercial forest land during a given period under specified assumptions concerning growth, cut, mortality, and forest management practices.

*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 of basal area per acre.

*Commercial forest land.*—Forest land producing or capable of producing crops of industrial wood and not withdrawn from timber utilization.

*Commercial species.*—Tree species suitable for industrial wood products.

*Cropland.*—Land under cultivation within the past 24 months, including orchards and land in soil-improving crops, but excluding land cultivated in developing improved pasture. Also includes idle farmland.

*Desirable trees.*—Growing-stock trees of commercial species having no serious defects in quality that limit present or prospective use for timber products, of relatively high vigor, and containing no pathogens that may result in death or serious deterioration before rotation age.

*Diameter class.*—A classification of trees based on diameter outside bark (d.o.b.), measured at breast height (4½ feet above the ground). D.B.H. is the common abbreviation for "diameter at breast height." Two-inch-diameter classes are commonly used in Forest Survey, with the even inch the approximate midpoint for a class. For example, the 6-inch class includes trees 5.00 through 6.99 inches d.b.h., inclusive.

*Farm.*—Either a place operated as a unit of 10 or more acres from which the sale of agricultural products totaled \$50 or more annually, or a place operated as a unit of less than 10 acres from which the sale of agricultural products for the year amounted to at least \$250.

*Farm operator.*—A person who operates a farm, either doing the work himself or directly supervising the work.

*Farmer-owned lands.*—Lands owned by farm operators.

*Forest industry lands.*—Lands owned by companies or individuals operating wood-using plants.

*Forest land.*—Land at least 16.7 percent stocked by forest trees of any size, or formerly having had such tree cover, and not currently developed for nonforest use.

*Forest type.*—A classification of forest land based upon the species forming a plurality of live-tree stocking.

*White-red-jack pine.*—Forests in which eastern white pine, red pine, or jack pine, singly or in combination, comprises a plurality of the stocking. (Common associates include hemlock, aspen, birch, and maple.)

*Spruce-fir.*—Forests in which spruce or true firs, singly or in combination, comprise a plurality of the stocking. (Common associates include white cedar, tamarack, maple, birch, and hemlock.)

*Longleaf-slash pine.*—Forests in which longleaf or slash pine, singly or in combination, comprises a plurality of the stocking. (Common associates include oak, hickory, and gum.)

*Loblolly-shortleaf pine.*—Forests in which loblolly pine, shortleaf pine, or other southern yellow pines, 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 pines comprise 25 to 50 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 to 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 forest in which tupelo, blackgum, sweetgum, oaks, or southern cypress, singly or in combination, comprise a plurality of the stocking, except where pines comprise 25 to 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, comprises a plurality of the stocking. (Common associates include willow, sycamore, beech, and maple.)

*Maple-beech-birch.*—Forests in which maple, beech, or yellow birch, singly or in combination, comprises a plurality of the stocking. (Common associates include hemlock, elm, basswood, and white pine.)

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

*Growing-stock trees.*—Live trees of commercial species qualifying as desirable or acceptable trees.

*Growing-stock volume.*—Net volume in cubic feet of growing-stock trees 5.0 inches d.b.h. and over from a 1-foot stump to a minimum 4.0-inch top diameter outside bark of the central stem, or to the point where the central stem breaks into limbs. (Net volume in primary forks is included.)

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

*Soft hardwoods.*—Soft-textured hardwoods, such as boxelder, red and silver maple, hackberry, loblolly-bay, sweetgum, yellow-poplar, magnolia, sweetbay, water tupelo, blackgum, sycamore, cottonwood, black cherry, willow, basswood, and elm.

*Hard hardwoods.*—Hard-textured hardwoods such as sugar maple, birch, hickory, dogwood, persimmon (forest grown),

black locust, beech, ash, honeylocust, holly, black walnut, mulberry, and all commercial oaks.

*Idle farmland.*—Includes former croplands, orchards, improved pastures and farm sites not tended within the past 2 years, and presently less than 16.6 percent stocked with trees.

*Improved pasture.*—Land currently improved for grazing by cultivation, seeding, irrigation, or clearing of trees or brush.

*Industrial wood.*—All roundwood products except fuelwood.

*Ingrowth.*—The number or net volume of trees that grow large enough during a specified year to qualify as saplings, pole-timber, or sawtimber.

*Inhibiting vegetation.*—Cover sufficiently dense to prevent the establishment of tree seedlings.

*Land area.*—The area of dry land and land temporarily or partly covered by water such as marshes, swamps, and river flood plains (omitting tidal flats below mean high tide), streams, sloughs, estuaries, and canals less than 1/8 of a statute mile in width, and lakes, reservoirs, and ponds less than 40 acres in area.

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

*Logging residues.*—The unused portions of trees cut or killed by logging.

*Miscellaneous Federal lands.*—Federal lands other than National Forests, lands administered by the Bureau of Land Management, and Indian lands.

*Miscellaneous private lands—corporate.*—Lands owned by private corporations other than forest industry.

*Miscellaneous private lands—individual.*—Privately owned lands other than forest industry, farmer-owned, or corporate lands.

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

*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 and Bankhead-Jones Title III lands.

*Net annual growth.*—The increase in volume for a specific year.

*Net volume.*—Gross volume of wood less deductions for rot, sweep, or other defect affecting use for timber products.

*Noncommercial forest land.*—(a) Unproductive forest land incapable of yielding crops of industrial wood because of adverse site conditions, and (b) productive-reserved forest land.

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

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

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

*Other Federal lands.*—Federal lands other than National Forests, including lands administered by the Bureau of Land Management, Bureau of Indian Affairs, and other Federal agencies.

*Other public lands.*—Publicly owned lands other than National Forests.

*Other removals.*—The net volume of growing-stock trees removed from the inventory by cultural operations, such as timber stand improvement, land clearing, and other changes in land use that result in the removal of the trees from the commercial forest.

*Overstocked areas.*—Areas where growth of trees is significantly reduced by excessive numbers of trees.

*Plant byproducts.*—Wood products such as pulp chips, obtained incidental to production of other manufactured products.

*Plant residues.*—Wood materials from manufacturing plants not utilized for some product.

*Poletimber trees.*—Growing-stock trees of commercial species at least 5.0 inches in d.b.h. but smaller than sawtimber size.

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

*Quality class.*—A classification of sawtimber volumes by log or tree grades.

*Rangeland.*—Land on which the natural plant cover is composed principally of native grasses, forbs, or shrubs valuable for forage.

*Rotten trees.*—Live trees of commercial species that do not contain at least one 12-foot saw log, or two noncontiguous saw logs, each 8 feet or longer, now or prospectively, primarily because of rot or missing sections, and with less than one-third of the gross tree volume in sound material.

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

*Roundwood products.*—Logs, bolts, or other round sections cut from trees for industrial or consumer uses.

*Salvable dead trees.*—Standing or down dead trees that are considered merchantable by Forest Survey standards.

*Saplings.*—Live trees 1.0 inch to 5.0 inches in diameter at breast height.

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

*Saw-log portion.*—That part of the bole of sawtimber trees between the stump and the saw-log top.

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

*Sawtimber trees.*—Live trees of commercial species containing at least a 12-foot saw log, or two contiguous saw logs, each 8 feet or longer, and with at least one-third of the gross board-foot volume between the 1-foot stump and minimum saw-log top being sound. Softwoods must be at least 9.0 inches and hardwoods at least 11.0 inches in diameter at breast height.

*Sawtimber volume.*—Net volume of the saw-log portion of live sawtimber in board-foot International ¼-inch rule.

*Seedlings.*—Live trees less than 1.0 inch in diameter at breast height that are expected to survive and develop.

*Site class.*—A classification of forest land in terms of inherent capacity to grow crops of industrial wood based on fully stocked natural stands.

*Class 1.*—Sites capable of producing 165 or more cubic feet per acre annually.

*Class 2.*—Sites capable of producing 120 to 165 cubic feet per acre annually.

*Class 3.*—Sites capable of producing 85 to 120 cubic feet per acre annually.

*Class 4.*—Sites capable of producing 50 to 85 cubic feet per acre annually.

*Class 5.*—Sites incapable of producing 50 cubic feet per acre annually, but excluding unproductive sites.

*Softwoods.*—Coniferous trees, usually evergreen, having needles or scale-like leaves.

*Pines.*—Yellow pine species which include loblolly, longleaf, slash, pond, shortleaf, pitch, Virginia, and Table-Mountain pine.

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

*Stand-size class.*—A classification of forest land based on the diameter class of growing-stock trees on the area.

*Sawtimber stands.*—Stands at least 16.7 percent stocked with growing-stock trees, with half or more of total stocking in sawtimber and pole-timber trees, and with sawtimber stocking at least equal to poletimber stocking.

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

*Sapling-seedling stands.*—Stands at least 16.7 percent stocked with growing-stock trees of which more than half of the stocking is saplings and seedlings.

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

*Stocking.*—The degree of occupancy of land by trees, measured by basal area or the number of trees in a stand and spacing in the stand, compared to a minimum standard, depending on tree size, to fully utilize the growth potential of the land. (See table at end of definitions.)

*Fully stocked.*—100 percent or more stocking

*Medium stocked.*—60 to 100 percent stocking

*Poorly stocked.*—Less than 60 percent stocking

*Survivor growth.*—The increase in volume of growing-stock trees that survive cutting and mortality for a specified year.

*Timber products.*—Roundwood products and plant by-products.

*Timber removals.*—The net volume of growing-stock trees removed from the inventory by harvesting; cultural operations, such as stand improvement; land clearing, or changes in land use.

*Unproductive forest land.*—Forest land incapable of producing 20 cubic feet per acre of industrial wood under natural conditions, because of adverse site conditions.

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

*Urban and other areas.*—Areas within the legal boundaries of cities and towns, suburban areas developed for residential, industrial, or recreational purposes; school yards, cemeteries; roads; railroads; airports; beaches; powerlines and other rights-of-way; or other nonforest land not included in any other specified land use class.

### Stocking Standard

D.b.h. class	Minimum number of trees per acre for full stocking	Minimum basal area per acre for full stocking	Percent stocking assigned each tally tree <sup>1</sup>
Seedlings	600	—	5.0
2	560	—	5.4
4	460	—	6.5
6	340	67	5.8
8	240	84	4.8
10	155	85	4.3
12	115	90	4.0
14	90	96	3.8
16	72	101	3.7
18	60	106	3.5
20	51	111	3.5

<sup>1</sup> Trees less than 5.0 inches d.b.h. were tallied on a 10-point cluster of circular, 1/300-acre plots at each sample location. Trees 5.0 inches d.b.h. and larger were tallied on a 10-point cluster of variable plots using a basal area factor of 37.5 at each sample location.

Overstocked—over 130 percent.

Fully stocked—100–130 percent

Medium stocked—60–99 percent

Poorly stocked—16.7–59 percent

Nonstocked—less than 16.7 percent

### Conversion Factors Cubic feet of wood per average cord (excluding bark)

D.b.h.	Pine	Other softwoods	Hardwood
6	61.0	68.2	10.0
8	68.1	76.0	68.4
10	73.1	81.4	73.4
12	76.7	85.2	76.4
14	79.4	88.2	78.4
16	81.6	90.4	79.8
18	83.3	92.3	80.8
20	84.8	93.8	81.5
22	86.0	95.1	82.1
24+	87.4	97.5	83.1
Average	72.1	83.7	74.2

Rough cords per M cubic feet (without bark) =

$$a + b\left(\frac{1}{D.b.h.}\right) + c\left(\frac{1}{D.b.h.}\right)^2$$

Where	Pine	Other softwoods	Hardwood
a =	10.01850	9.15960	11.68410
b =	34.42135	28.75793	3.74431
c =	22.73994	25.54418	157.39417

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Table 1. — Area by land classes,  
Virginia, 1977

Land class	Area
<i>Acres</i>	
Forest land:	
Commercial	15,972,793
Productive-reserved	374,561
Unproductive	70,025
Total	16,417,379
Nonforest land:	
Cropland	3,098,623
Pasture and range	3,641,844
Other <sup>1</sup>	2,354,550
Total	9,095,017
All land <sup>2</sup>	25,512,396

<sup>1</sup>Includes swampland, industrial and urban areas, other nonforest land, and 215,894 acres classed as water by Forest Survey standards but defined by Bureau of Census as land.

<sup>2</sup>From U.S. Bureau of the Census, Land and Water Area of the United States, 1970.

Table 3. — Area of commercial forest land, by stand-size and ownership classes, Virginia, 1977

Stand-size class	All ownerships	National Forest	Other public	Forest industry	Farmer and misc. private
<i>Acres</i>					
Sawtimber	6,355,494	670,765	257,089	483,467	4,944,173
Poletimber	6,004,554	583,285	172,848	517,703	4,730,718
Sapling and seedling	3,360,391	172,408	59,283	632,477	2,496,223
Nonstocked	252,354	31,531	8,721	35,971	176,131
All classes	15,972,793	1,457,989	497,941	1,669,618	12,347,245

Table 4. — Area of commercial forest land, by stand volume and ownership classes, Virginia, 1977

Stand volume per acre <sup>1</sup>	All ownerships	National Forest	Other public	Forest industry	Farmer and misc. private
<i>Acres</i>					
Less than 1,500 fbm	5,955,853	475,415	201,476	891,780	4,387,182
1,500 to 5,000 fbm	6,087,613	608,024	116,880	396,418	4,966,291
More than 5,000 fbm	3,929,327	374,550	179,585	381,420	2,993,772
All classes	15,972,793	1,457,989	497,941	1,669,618	12,347,245

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

Table 2. — Area of commercial forest land, by ownership classes, Virginia, 1977

Ownership class	Area
<i>Acres</i>	
National Forest	1,457,989
Other Federal:	
Bureau of Land Management	—
Indian	485
Miscellaneous Federal	245,126
Total other Federal	245,611
State	183,345
County and municipal	68,985
Forest industry <sup>1</sup>	1,669,618
Farmer-owned	6,209,938
Miscellaneous private:	
Individual	4,971,914
Corporate	1,165,393
Total miscellaneous private	6,137,307
All ownerships	15,972,793

<sup>1</sup>Not including 13,996 acres of farmer-owned and miscellaneous private lands leased to forest industry.

Table 5. — Area of commercial forest land, by stocking classes based on selected stand components, Virginia, 1977

Stocking percentage	Stocking classified in terms of:					
	All live trees	Growing-stock trees			Rough and rotten trees	Inhibiting vegetation
		Total	Desirable	Acceptable		
Acres.						
160	—	—	—	—	—	—
150-159	52,473	16,150	—	6,253	—	—
140-149	124,886	66,119	—	21,500	—	—
130-139	1,825,604	353,333	10,797	100,587	—	—
120-129	1,615,796	546,647	20,655	130,658	5,471	—
110-119	2,344,921	944,262	10,812	362,516	9,725	—
100-109	4,569,685	1,900,962	286,031	545,418	21,699	—
90-99	2,040,531	2,056,155	96,221	802,048	95,328	6,552
80-89	1,397,976	2,274,483	193,403	1,269,117	170,438	4,440
70-79	865,627	2,125,597	287,826	1,563,873	314,488	8,121
60-69	520,493	1,901,905	431,206	1,967,008	505,794	17,793
50-59	256,033	1,363,167	739,997	2,209,870	909,887	30,712
40-49	155,693	925,414	1,245,871	2,131,758	1,402,293	46,002
30-39	72,465	743,576	1,913,043	1,700,445	1,967,471	121,879
20-29	39,818	383,385	2,207,504	1,373,625	2,578,817	219,130
10-19	37,474	211,750	2,546,592	798,726	3,301,970	645,743
Less than 10	53,318	159,888	5,982,835	989,391	4,689,412	14,872,421
Total	15,972,793	15,972,793	15,972,793	15,972,793	15,972,793	15,972,793



Table 6. -- Area of commercial forest land, by ownership and stocking classes<sup>1</sup> with percent occupancy by selected stand components, Virginia, 1977

Ownership and stocking class	Area	Stand components					
		Growing-stock trees			Rough and rotten trees	Inhibiting vegetation	Nonstocked
		Total	Desirable	Acceptable			
		<i>Acres</i>	<i>Percent of area</i>				
National Forest:							
Fully stocked stands	194,482	92.4	18.2	74.2	7.6	—	—
Medium stocked stands	752,073	70.2	15.0	55.2	27.1	0.8	1.9
Poorly stocked stands	511,434	39.5	4.2	35.3	48.5	4.3	7.7
All stands	1,457,989	62.8	11.8	51.0	31.7	1.9	3.6
Other public:							
Fully stocked stands	152,472	94.0	31.1	62.9	6.0	—	—
Medium stocked stands	226,975	75.4	20.2	55.2	21.5	1.1	2.0
Poorly stocked stands	118,494	35.7	8.5	27.2	40.8	9.2	14.3
All stands	497,941	73.1	21.3	51.8	20.4	2.5	4.0
Forest industry:							
Fully stocked stands	709,481	95.4	41.8	53.6	4.6	—	—
Medium stocked stands	662,332	75.9	27.0	48.9	21.2	0.8	2.1
Poorly stocked stands	297,805	39.4	14.2	25.2	35.4	4.8	20.4
All stands	1,669,618	78.9	31.6	47.3	15.9	1.1	4.1
Farmer & misc. private:							
Fully stocked stands	2,771,038	93.5	29.4	64.1	6.5	—	—
Medium stocked stands	6,716,760	75.2	22.6	52.6	20.5	1.2	3.1
Poorly stocked stands	2,859,447	39.8	11.7	28.1	41.6	7.2	11.4
All stands	12,347,245	72.6	22.1	50.5	21.2	2.2	4.0
All ownerships:							
Fully stocked stands	3,827,473	93.9	31.5	62.4	6.1	—	—
Medium stocked stands	8,358,140	74.9	22.3	52.6	21.1	1.2	2.8
Poorly stocked stands	3,787,180	39.5	10.8	28.7	41.9	6.8	11.8
All stands	15,972,793	72.6	22.4	50.2	21.4	2.0	4.0

<sup>1</sup> Based on degree of growing-stock stocking.

Table 8. -- Area of commercial forest land, by forest types and ownership classes, Virginia, 1977

Type	All ownerships	Public	Private
	<i>Acres</i>		
Softwood types:			
White pine-hemlock	152,109	12,826	139,283
Loblolly pine	1,575,469	55,302	1,520,167
Shortleaf pine	287,724	14,561	273,163
Virginia pine	1,216,610	68,320	1,148,290
Eastern redcedar	76,067	3,097	72,970
Pond pine	2,590	—	2,590
Pitch pine	83,826	47,789	36,037
Table-Mountain pine	43,093	22,212	20,881
Total	3,437,488	224,107	3,213,381
Hardwood types:			
Oak-pine	1,931,626	174,804	1,756,822
Oak-hickory	9,284,511	1,320,386	7,964,125
Chestnut oak	475,553	205,831	269,722
Oak-gum-cypress	363,975	9,447	354,528
Elm-ash-cottonwood	349,328	8,070	341,258
Maple-beech-birch	130,312	13,285	117,027
Total	12,535,305	1,731,823	10,803,482
All types	15,972,793	1,955,930	14,016,863

Table 7. -- Area of commercial forest land, by site and ownership classes, Virginia, 1977

Site class	All ownerships	National Forest	Other public	Forest industry	Farmer and misc. private
	<i>Acres</i>				
165 ft <sup>3</sup> or more	21,903	—	—	—	21,903
120 to 165 ft <sup>3</sup>	127,697	8,936	6,000	16,169	96,592
85 to 120 ft <sup>3</sup>	1,701,667	35,105	74,277	193,554	1,398,731
50 to 85 ft <sup>3</sup>	10,777,825	638,460	355,515	1,296,923	8,486,927
Less than 50 ft <sup>3</sup>	3,343,701	775,488	62,149	162,972	2,343,092
All classes	15,972,793	1,457,989	497,941	1,669,618	12,347,245

Table 9. — Area of noncommercial forest land, by forest types, Virginia, 1977

Type	All areas	Productive-reserved areas	Unproductive areas
..... Acres .....			
Loblolly-shortleaf pine	27,110	27,110	—
Oak-pine	9,786	9,786	—
Oak-hickory	361,298	291,273	70,025
Oak-gum-cypress	46,392	46,392	—
All types	444,586	374,561	70,025

Table 10. — Number of growing-stock trees on commercial forest land, by species and diameter class, 1977

Species	All classes	Diameter class (inches at breast height)									
		5.0- 6.9	7.0- 8.9	9.0- 10.9	11.0- 12.9	13.0- 14.9	15.0- 16.9	17.0- 18.9	19.0- 20.9	21.0- 28.9	29.0 and larger
..... Thousand trees .....											
Softwood:											
Longleaf pine	—	—	—	—	—	—	—	—	—	—	—
Slash pine	—	—	—	—	—	—	—	—	—	—	—
Shortleaf pine	89,357	36,896	27,107	15,063	6,837	2,487	683	166	81	37	—
Loblolly pine	227,840	104,500	52,741	29,339	19,581	11,290	6,055	2,717	1,018	593	6
Pond pine	1,050	101	242	167	268	111	92	41	26	—	2
Virginia pine	242,001	116,582	74,082	34,029	12,998	3,429	718	121	33	9	—
Pitch pine	26,818	6,958	6,500	6,067	4,018	1,988	828	356	56	47	—
Table-Mountain pine	10,848	4,175	2,901	1,914	983	639	149	64	23	—	—
Spruce pine	—	—	—	—	—	—	—	—	—	—	—
Sand pine	—	—	—	—	—	—	—	—	—	—	—
Eastern white pine	31,956	10,683	7,568	5,163	3,283	2,568	1,360	666	321	331	13
Eastern hemlock	10,160	3,941	2,333	1,386	859	673	292	286	149	188	53
Spruce and fir	253	—	116	30	76	19	12	—	—	—	—
Baldcypress	1,365	139	133	174	233	241	162	65	85	117	16
Pondcypress	108	—	—	17	26	—	15	25	5	16	4
Cedars	19,024	13,336	4,130	1,146	287	101	11	13	—	—	—
Total softwoods	660,780	297,311	177,853	94,495	49,449	23,546	10,377	4,520	1,797	1,338	94
Hardwood:											
Select white oaks <sup>1</sup>	193,398	70,094	45,861	30,818	19,230	12,446	7,347	3,805	1,892	1,773	132
Select red oaks <sup>2</sup>	61,597	17,690	13,306	9,222	7,465	5,418	3,179	1,964	1,351	1,758	244
Chestnut oak	143,045	49,728	35,754	22,427	13,625	8,738	5,849	3,152	1,720	1,909	143
Other white oaks	11,930	5,054	2,948	1,540	1,144	790	224	67	84	67	12
Other red oaks	210,274	73,584	52,300	35,158	20,955	13,882	7,336	3,667	1,737	1,521	134
Hickory	107,627	42,578	26,117	17,612	9,538	5,905	3,114	1,619	607	504	33
Yellow birch	377	90	137	29	—	42	28	34	—	17	—
Hard maple	11,501	4,692	2,660	1,810	939	542	394	207	137	110	10
Soft maple	90,339	41,843	21,601	13,067	6,464	3,180	2,075	1,023	497	550	39
Beech	20,795	7,367	3,640	2,804	2,234	1,612	1,176	858	533	529	42
Sweetgum	79,024	35,615	19,471	10,866	6,252	3,496	1,670	851	422	365	16
Tupelo and blackgum	33,271	13,945	7,022	5,138	3,075	2,002	1,147	470	215	237	20
Ash	16,075	6,061	3,676	2,232	1,820	1,093	676	281	103	115	18
Cottonwood	417	143	145	71	16	—	23	—	—	19	—
Basswood	6,074	1,203	1,231	1,080	1,070	634	428	201	78	142	7
Yellow-poplar	157,832	49,859	34,088	26,922	19,669	12,635	7,290	3,849	1,731	1,676	113
Bay and magnolia	8,490	3,652	2,661	1,281	458	212	57	39	82	44	4
Black cherry	3,460	1,490	921	395	281	228	64	44	15	22	—
Black walnut	6,775	2,210	1,719	928	842	551	255	157	85	15	13
Sycamore	6,947	1,219	1,429	1,087	1,325	662	521	266	174	226	38
Black locust	20,036	6,116	6,448	3,899	1,946	969	393	161	50	54	—
Elm	9,112	3,589	2,808	1,132	679	391	272	77	79	75	10
Other eastern hardwoods	36,132	16,227	9,094	4,935	2,563	1,611	760	420	189	313	20
Total hardwoods	1,234,528	454,049	295,037	194,453	121,590	77,039	44,278	23,212	11,781	12,041	1,048
All species	1,895,308	751,360	472,890	288,948	171,039	100,585	54,655	27,732	13,578	13,379	1,142

<sup>1</sup> Includes white, swamp white, swamp chestnut, and chinkapin oaks.

<sup>2</sup> Includes cherrybark and northern red oaks.

**Table 11. — Volume of timber on commercial forest land, by class of timber and by softwood and hardwood, Virginia, 1977**

Class of timber	All species	Softwood	Hardwood
<i>..... Thousand cubic feet .....</i>			
Sawtimber trees:			
Saw-log portion	10,337,732	2,986,008	7,351,724
Upper-stem portion	2,071,165	571,660	1,499,505
Total	12,408,897	3,557,668	8,851,229
Poletimber trees	7,247,563	1,954,428	5,293,135
All growing-stock trees	19,656,460	5,512,096	14,144,364
Rough trees:			
Sawtimber-size trees	1,276,365	72,797	1,203,568
Poletimber-size trees	1,754,610	108,207	1,646,403
Total	3,030,975	181,004	2,849,971
Rotten trees:			
Sawtimber-size trees	398,888	5,702	393,186
Poletimber-size trees	58,974	848	58,126
Total	457,862	6,550	451,312
Salvable dead trees:			
Sawtimber-size trees	18,342	10,597	7,745
Poletimber-size trees	20,798	12,708	8,090
Total	39,140	23,305	15,835
Total, all timber	23,184,437	5,722,955	17,461,482

**Table 12. — Volume of growing stock and sawtimber on commercial forest land, by ownership classes, and by softwood and hardwood, Virginia, 1977**

Ownership class	Growing stock			Sawtimber		
	All species	Softwood	Hardwood	All species	Softwood	Hardwood
<i>..... Thousand cubic feet .....</i>				<i>..... Thousand board feet<sup>1</sup> .....</i>		
National Forest	1,802,592	290,444	1,512,148	4,978,218	1,023,726	3,954,492
Other public	820,855	275,232	545,623	2,423,338	824,818	1,598,520
Forest industry	1,810,739	877,157	933,582	5,041,372	2,589,548	2,451,824
Farmer and misc. private	15,222,274	4,069,263	11,153,011	41,327,707	11,695,993	29,631,714
All ownerships	19,656,460	5,512,096	14,144,364	53,770,635	16,134,085	37,636,550

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

Table 13. -- Volume of growing stock on commercial forest land, by species and diameter class, 1977

Species	All classes	Diameter class (inches at breast height)									
		5.0- 6.9	7.0- 8.9	9.0- 10.9	11.0- 12.9	13.0- 14.9	15.0- 16.9	17.0- 18.9	19.0- 20.9	21.0- 28.9	29.0 and larger
Thousand cubic feet											
Softwood:											
Longleaf pine	—	—	—	—	—	—	—	—	—	—	—
Slash pine	—	—	—	—	—	—	—	—	—	—	—
Shortleaf pine	709,143	95,544	181,993	186,595	130,476	70,136	27,127	8,461	5,095	3,716	—
Loblolly pine	2,199,901	252,144	335,776	365,007	395,307	332,636	244,247	145,320	70,844	57,345	1,275
Pond pine	16,610	299	1,341	1,705	3,856	2,880	3,115	1,421	1,713	—	280
Virginia pine	1,622,138	347,199	507,093	410,643	235,477	88,855	24,818	5,447	1,931	675	—
Pitch pine	272,179	16,171	35,692	59,730	62,418	46,679	28,417	16,289	3,084	3,699	—
Table-Mountain pine	93,440	13,703	18,457	22,231	16,442	14,355	4,114	2,870	1,268	—	—
Spruce pine	—	—	—	—	—	—	—	—	—	—	—
Sand pine	—	—	—	—	—	—	—	—	—	—	—
Eastern white pine	359,796	28,147	47,630	54,697	53,574	59,135	42,549	28,794	17,664	25,517	2,089
Eastern hemlock	119,941	9,058	12,295	12,475	11,442	15,511	9,954	12,539	8,050	17,975	10,642
Spruce and fir	3,252	—	474	470	1,381	500	427	—	—	—	—
Baldcypress	44,227	649	1,034	2,365	4,725	7,468	6,762	3,289	5,127	10,056	2,752
Pondcypress	4,610	—	—	198	557	—	574	1,173	286	1,176	646
Cedars	66,859	28,841	20,888	10,419	3,782	2,261	275	393	—	—	—
Total softwoods	5,512,096	791,755	1,162,673	1,126,535	919,437	640,416	392,379	225,996	115,062	120,159	17,684
Hardwood:											
Select white oaks <sup>1</sup>	2,263,647	197,252	283,839	349,214	350,217	330,292	268,939	182,977	116,785	158,450	25,682
Select red oaks <sup>2</sup>	1,019,982	58,028	87,830	106,136	134,383	142,448	113,518	94,224	80,242	158,889	44,284
Chestnut oak	1,615,193	138,771	209,598	236,352	225,780	209,883	189,622	134,252	93,120	152,563	25,252
Other white oaks	104,058	12,951	16,249	14,923	18,797	19,103	7,284	2,825	4,872	5,577	1,477
Other red oaks	2,296,348	208,887	315,662	380,277	361,926	345,875	256,653	169,829	103,945	130,037	23,257
Hickory	1,089,704	113,273	153,584	191,810	173,573	159,535	118,063	84,002	39,436	49,967	6,146
Yellow birch	6,628	422	1,158	320	—	870	928	1,399	—	1,531	—
Hard maple	134,256	15,697	17,581	20,609	17,499	14,198	14,649	10,507	9,791	11,211	2,514
Soft maple	808,074	130,900	137,539	148,899	114,851	80,761	71,216	45,348	28,171	43,322	7,067
Beech	342,314	21,655	22,958	32,509	42,904	43,795	43,663	42,870	34,514	49,609	7,837
Sweetgum	739,886	80,462	121,001	130,408	128,304	103,887	67,010	45,060	27,941	32,622	3,191
Tupelo and blackgum	336,158	36,957	42,694	54,497	56,714	51,339	39,172	20,016	12,048	18,469	4,252
Ash	188,261	18,127	23,938	26,142	33,970	29,487	24,044	13,928	6,079	9,578	2,968
Cottonwood	5,117	610	1,101	803	340	—	975	—	—	1,288	—
Basswood	111,805	4,162	8,970	13,311	21,363	18,327	17,078	10,204	4,932	12,220	1,238
Yellow-poplar	2,163,441	149,564	225,499	320,760	376,724	347,115	272,754	191,265	108,872	148,739	22,149
Bay and magnolia	68,332	9,615	16,512	14,245	8,401	6,134	2,064	1,944	4,785	4,122	510
Black cherry	31,872	4,104	5,609	3,958	5,398	5,960	2,103	2,154	1,029	1,557	—
Black walnut	77,145	6,650	10,465	9,345	13,635	13,013	8,328	7,200	5,191	1,465	1,853
Sycamore	139,247	4,719	10,791	14,257	25,601	17,559	18,535	12,038	10,069	19,121	6,557
Black locust	174,091	16,732	37,138	39,432	32,416	22,530	12,799	6,426	2,726	3,892	—
Elm	91,825	9,427	17,308	12,995	13,202	10,653	10,318	4,273	4,908	6,921	1,820
Other eastern hardwoods	336,980	49,892	60,285	55,767	46,013	39,083	26,415	19,324	10,675	25,878	3,648
Total hardwoods	14,144,364	1,288,857	1,827,309	2,176,969	2,202,011	2,011,847	1,586,130	1,102,065	710,131	1,047,028	192,017
All species	19,656,460	2,080,612	2,989,982	3,303,504	3,121,448	2,652,263	1,978,509	1,328,061	825,193	1,167,187	209,701

<sup>1</sup>Includes white, swamp white, swamp chestnut, and chinkapin oaks.<sup>2</sup>Includes cherrybark and northern red oaks.

Table 14. — Volume of sawtimber on commercial forest land, by species and diameter class, 1977

Species	All classes	Diameter class (inches at breast height)							
		9.0- 10.9	11.0- 12.9	13.0- 14.9	15.0- 16.9	17.0- 18.9	19.0- 20.9	21.0- 28.9	29.0 and larger
Thousand board feet									
Softwood:									
Longleaf pine	—	—	—	—	—	—	—	—	—
Slash pine	—	—	—	—	—	—	—	—	—
Shortleaf pine	1,881,146	686,858	583,154	355,417	150,826	49,581	31,231	24,079	—
Loblolly pine	7,751,088	1,287,517	1,747,918	1,682,628	1,349,634	857,816	439,599	376,894	9,082
Pond pine	75,787	6,491	17,023	14,581	17,107	8,218	10,381	—	1,986
Virginia pine	2,957,684	1,421,038	966,733	406,110	121,490	28,145	10,363	3,805	—
Pitch pine	985,602	196,809	263,652	230,402	155,715	95,586	19,221	24,217	—
Table-Mountain pine	287,431	88,727	76,547	74,457	23,001	16,829	7,870	—	—
Spruce pine	—	—	—	—	—	—	—	—	—
Sand pine	—	—	—	—	—	—	—	—	—
Eastern white pine	1,365,031	195,829	231,362	286,325	222,052	158,797	102,056	154,970	13,640
Eastern hemlock	505,339	42,295	46,972	72,516	50,884	68,035	45,654	109,252	29,731
Spruce and fir	12,432	1,808	5,839	2,424	2,361	—	—	—	—
Baldcypress	212,091	7,152	17,630	32,769	32,636	16,806	27,988	58,859	18,251
Pondcypress	24,420	696	2,265	—	2,867	6,152	1,587	6,813	4,040
Cedars	76,034	42,251	17,927	12,002	1,516	2,338	—	—	—
Total softwoods	16,134,085	3,977,471	3,977,022	3,169,631	2,130,089	1,308,303	695,950	758,889	116,730
Hardwood:									
Select white oaks <sup>1</sup>	5,997,793	—	1,143,541	1,274,184	1,156,476	851,163	575,881	842,415	154,133
Select red oaks <sup>2</sup>	3,241,014	—	432,641	530,448	463,515	413,581	369,600	790,584	240,645
Chestnut oak	4,244,121	—	712,353	780,463	785,713	600,171	440,631	781,487	143,303
Other white oaks	262,364	—	67,571	80,218	33,818	14,109	25,744	31,856	9,048
Other red oaks	5,838,186	—	1,187,991	1,349,257	1,122,627	805,214	520,866	709,597	142,634
Hickory	2,700,331	—	585,987	643,089	533,638	411,465	204,449	281,544	40,159
Yellow birch	19,621	—	3,335	3,768	5,795	—	—	6,723	—
Hard maple	347,889	—	64,026	57,352	63,160	47,832	46,041	56,052	13,426
Soft maple	1,554,547	—	361,162	300,419	295,223	203,008	133,821	220,376	40,538
Beech	1,043,407	—	157,619	166,596	170,383	170,690	139,449	205,307	33,363
Sweetgum	1,832,656	—	457,176	444,723	322,417	235,547	155,895	195,135	21,763
Tupelo and blackgum	814,777	—	175,247	194,184	164,991	92,559	60,230	99,114	28,452
Ash	490,038	—	111,039	113,448	103,071	64,808	29,836	50,542	17,294
Cottonwood	12,056	—	995	—	4,248	—	—	6,813	—
Basswood	358,401	—	73,900	71,624	73,054	46,672	23,643	62,625	6,883
Yellow-poplar	6,812,275	—	1,330,795	1,484,046	1,319,226	1,009,190	612,592	904,732	151,694
Bay and magnolia	143,553	—	28,741	28,290	11,012	11,190	30,589	29,666	4,065
Black cherry	74,371	—	18,609	23,812	9,127	9,847	5,105	7,871	—
Black walnut	177,837	—	47,095	45,414	29,326	25,531	18,499	5,266	6,706
Sycamore	475,877	—	79,200	66,312	79,398	56,282	50,169	103,999	40,317
Black locust	293,757	—	114,274	81,852	47,683	24,317	10,467	15,164	—
Elm	217,786	—	44,861	41,119	43,590	19,412	23,410	35,276	10,118
Other eastern hardwoods	683,893	—	155,491	147,142	107,543	82,543	47,680	123,054	20,440
Total hardwoods	37,636,550	—	7,350,314	7,927,327	6,943,207	5,200,926	3,524,597	5,565,198	1,124,981
All species	53,770,635	3,977,471	11,327,336	11,096,958	9,073,296	6,509,229	4,220,547	6,324,087	1,241,711

<sup>1</sup>Includes white, swamp white, swamp chestnut and chinkapin oaks.<sup>2</sup>Includes cherrybark and northern red oaks.

Table 15. — Volume of sawtimber on commercial forest land, by species and quality classes, Virginia, 1977

Species	All grades	Log grade			
		1	2	3	4
. . . . . Thousand board feet . . . . .					
Softwood:					
Yellow pines <sup>1</sup>	13,938,738	446,001	2,679,632	10,813,105	( <sup>2</sup> )
Eastern white pine <sup>3</sup>	1,365,031	110,758	68,252	637,529	548,492
Cypress <sup>3</sup>	236,511	54,560	59,955	121,996	—
Spruce and fir <sup>3</sup>	12,432	401	622	6,128	5,281
Other eastern softwoods <sup>3</sup>	581,373	58,404	25,267	260,728	236,974
Total	16,134,085	670,124	2,833,728	11,839,486	790,747
Hardwood: <sup>4</sup>					
Select white and red oaks	9,238,807	1,103,261	1,867,868	3,460,590	2,807,088
Other white and red oaks	10,344,671	899,719	1,476,003	4,123,736	3,845,213
Hickory	2,700,331	132,413	316,411	999,122	1,252,385
Yellow birch	19,621	1,140	3,457	7,175	7,849
Hard maple	347,889	49,832	103,555	137,463	57,039
Sweetgum	1,832,656	139,614	239,111	703,986	749,945
Ash, walnut, and black cherry	742,246	106,490	139,773	411,210	84,773
Yellow-poplar	6,812,275	439,718	556,808	2,083,656	3,732,093
Other hardwoods	5,598,054	231,632	799,147	2,328,054	2,239,221
Total	37,636,550	3,103,819	5,502,133	14,254,992	14,775,606
All species	53,770,635	3,773,943	8,335,861	26,094,478	15,566,353

<sup>1</sup>Based on Southern Pine Log Grades for Yard and Structural Lumber, Research Paper SE-39, published by the Southeastern Forest Experiment Station in 1968.

<sup>2</sup>Not applicable.

<sup>3</sup>Based on Trial Log Grades for Eastern White Pine prepared by the Northeastern Forest Experiment Station in 1960.

<sup>4</sup>Graded according to Hardwood Log Grades for Standard Lumber published by the U. S. Forest Products Laboratory in 1953. Specifications for the grade 4 tie and timber logs are based chiefly on knot size and log soundness.

Table 16. — Net annual growth and removals of growing stock on commercial forest land, by species, Virginia, 1976

Species	Net annual growth	Annual timber removals
<i>Thousand cubic feet</i>		
<b>Softwood:</b>		
Yellow pines	220,877	196,222
Eastern white pine	18,164	5,683
Spruce and fir	136	—
Cypress	1,564	1,087
Other eastern softwoods	6,464	2,233
<b>Total softwoods</b>	<b>247,205</b>	<b>205,225</b>
<b>Hardwood:</b>		
Select white and red oaks	127,670	79,748
Other white and red oaks	144,331	78,792
Hickory	34,282	22,376
Yellow birch	92	—
Hard maple	4,267	1,239
Sweetgum	28,312	17,984
Ash, walnut, and black cherry	12,650	3,138
Yellow-poplar	129,869	48,752
Tupelo and blackgum	8,839	9,897
Other eastern hardwoods	85,651	28,847
<b>Total hardwoods</b>	<b>575,963</b>	<b>290,773</b>
<b>All species</b>	<b>823,168</b>	<b>495,998</b>

Table 17. — Net annual growth and removals of growing stock on commercial forest land, by ownership classes and by softwood and hardwood, Virginia, 1976

Ownership class	Net annual growth			Annual timber removals		
	All species	Soft-wood	Hard-wood	All species	Soft-wood	Hard-wood
<i>Thousand cubic feet</i>						
National Forest	55,405	6,717	48,688	21,752	5,074	16,678
Other public	31,452	10,771	20,681	22,298	10,311	11,987
Forest industry	95,156	52,288	42,868	80,976	46,303	34,673
Farmer and misc. private	641,155	177,429	463,726	370,972	143,537	227,435
<b>All ownerships</b>	<b>823,168</b>	<b>247,205</b>	<b>575,963</b>	<b>495,998</b>	<b>205,225</b>	<b>290,773</b>

Table 18. — Net annual growth and removals of sawtimber on commercial forest land, by species, Virginia, 1976

Species	Net annual growth	Annual timber removals
<i>Thousand board feet</i>		
Softwood:		
Yellow pines	712,885	676,340
Eastern white pine	80,536	23,704
Spruce and fir	918	—
Cypress	10,185	6,176
Other eastern softwoods	21,895	8,288
Total softwoods	826,419	714,508
Hardwood:		
Select white and red oaks	446,215	251,717
Other white and red oaks	515,024	256,230
Hickory	112,812	82,349
Yellow birch	279	—
Hard maple	12,710	2,893
Sweetgum	76,297	61,516
Ash, walnut, and black cherry	34,479	4,980
Yellow-poplar	518,849	186,431
Tupelo and blackgum	23,219	32,229
Other eastern hardwoods	222,503	87,629
Total hardwoods	1,962,387	965,974
All species	2,788,806	1,680,482

Table 20. — Mortality of growing stock and sawtimber on commercial forest land, by species, Virginia, 1976

Species	Growing stock	Saw-timber
	<i>M cubic feet</i>	<i>M board feet</i>
Softwood:		
Yellow pines	60,492	134,056
Eastern white pine	992	1,718
Spruce and fir	—	—
Cypress	—	—
Other eastern softwoods	725	408
Total softwoods	62,209	136,182
Hardwood:		
Select white and red oaks	10,015	28,279
Other white and red oaks	19,548	48,915
Hickory	4,409	15,732
Yellow birch	—	—
Hard maple	253	—
Sweetgum	3,345	6,483
Ash, walnut, and black cherry	1,633	3,277
Yellow-poplar	4,502	7,176
Tupelo and blackgum	1,340	2,842
Other eastern hardwoods	12,290	21,165
Total hardwoods	57,335	133,869
All species	119,544	270,051

Table 19. — Net annual growth and removals of sawtimber on commercial forest land, by ownership classes, and by softwood and hardwood, Virginia, 1977

Ownership class	Net annual growth			Annual timber removals		
	All species	Soft-wood	Hard-wood	All species	Soft-wood	Hard-wood
<i>Thousand board feet</i>						
National Forest	197,627	27,943	169,684	62,134	17,447	44,687
Other public	115,063	44,557	70,506	84,772	39,410	45,362
Forest industry	256,791	127,628	129,163	269,191	167,221	101,970
Farmer and misc. private	2,219,325	626,291	1,593,034	1,264,385	490,430	773,955
All ownerships	2,788,806	826,419	1,962,387	1,680,482	714,508	965,974

Table 21. — Mortality of growing stock and sawtimber on commercial forest land, by ownership classes, and by softwood and hardwood, Virginia, 1976

Ownership class	Growing stock			Sawtimber		
	All species	Soft-wood	Hard-wood	All species	Soft-wood	Hard-wood
<i>Thousand cubic feet</i> <i>Thousand board feet</i>						
National Forest	8,171	2,235	5,936	13,238	4,909	8,329
Other public	8,512	4,490	4,022	24,652	12,497	12,155
Forest industry	12,287	7,784	4,503	31,833	21,254	10,579
Farmer and misc. private	90,574	47,700	42,874	200,328	97,522	102,806
All ownerships	119,544	62,209	57,335	270,051	136,182	133,869

Table 22. — Mortality of growing stock and sawtimber on commercial forest land, by causes and by softwood and hardwood, Virginia, 1976

Cause of death	Growing stock			Sawtimber		
	All species	Soft-wood	Hard-wood	All species	Soft-wood	Hard-wood
<i>Thousand cubic feet</i> <i>Thousand board feet</i>						
Fire	1,987	407	1,580	4,478	463	4,015
Insects	27,235	26,897	338	81,042	80,470	572
Disease	2,511	981	1,530	10,164	4,411	5,753
Weather	13,666	6,260	7,406	44,808	20,484	24,324
Suppression	22,339	14,573	7,766	6,563	4,557	2,006
Animals	745	—	745	1,628	—	1,628
Undetermined	51,061	13,091	37,970	121,368	25,797	95,571
All causes	119,544	62,209	57,335	270,051	136,182	133,869

**Table 23. — Output of timber products, by product, by source of material, and by softwood and hardwood, Virginia, 1976**

Product and species group	Standard units	Total output		Roundwood products		Plant byproducts	
		Number of units	Thousand cu. ft.	Number of units	Thousand cu. ft.	Number of units	Thousand cu. ft.
Saw logs:							
Softwood	M fbm <sup>1</sup>	450,351	84,629	426,564	80,157	23,787	4,472
Hardwood	M fbm <sup>1</sup>	586,966	109,135	586,934	109,129	32	6
Total	M fbm <sup>1</sup>	1,037,317	193,764	1,013,498	189,286	23,819	4,478
Veneer logs and bolts:							
Softwood	M fbm <sup>1</sup>	50,836	8,273	50,836	8,273	—	—
Hardwood	M fbm <sup>1</sup>	18,316	2,693	18,316	2,693	—	—
Total	M fbm <sup>1</sup>	69,152	10,966	69,152	10,966	—	—
Pulpwood: <sup>2</sup>							
Softwood	Stand. cords <sup>3</sup>	1,366,086	99,827	1,011,057	73,875	355,029	25,952
Hardwood	Stand. cords <sup>3</sup>	1,295,660	98,944	983,065	75,062	312,595	23,882
Total	Stand. cords <sup>3</sup>	2,661,746	198,771	1,994,122	148,937	667,624	49,834
Cooperage logs and bolts:							
Softwood	M fbm <sup>1</sup>	—	—	—	—	—	—
Hardwood	M fbm <sup>1</sup>	1,779	281	1,779	281	—	—
Total	M fbm <sup>1</sup>	1,779	281	1,779	281	—	—
Poles and piling:							
Softwood	M pieces	58	1,633	58	1,633	—	—
Hardwood	M pieces	—	—	—	—	—	—
Total	M pieces	58	1,633	58	1,633	—	—
Posts (round and split):							
Softwood	M pieces	440	396	440	396	—	—
Hardwood	M pieces	4	4	4	4	—	—
Total	M pieces	444	400	444	400	—	—
Other: <sup>4</sup>							
Softwood	M ft <sup>3</sup>	4,842	4,842	1,889	1,889	2,953	2,953
Hardwood	M ft <sup>3</sup>	4,574	4,574	2,664	2,664	1,910	1,910
Total	M ft <sup>3</sup>	9,416	9,416	4,553	4,553	4,863	4,863
Total industrial products:							
Softwood		—	199,600	—	166,223	—	33,377
Hardwood		—	215,631	—	189,833	—	25,798
Total		—	415,231	—	356,056	—	59,175
Fuelwood: <sup>5</sup>							
Softwood	Stand. cords	547,746	40,040	534,583	39,078	13,163	962
Hardwood	Stand. cords	948,977	72,502	895,668	68,429	53,309	4,073
Total	Stand. cords	1,496,723	112,542	1,430,251	107,507	66,472	5,035
All products: <sup>6</sup>							
Softwood		—	239,640	—	205,301	—	34,339
Hardwood		—	288,133	—	258,262	—	29,871
Total		—	527,773	—	463,563	—	64,210

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

<sup>2</sup> Roundwood figures include 19,056 thousand cubic feet of roundwood chipped at other primary wood-using plants.

<sup>3</sup> Rough-wood basis (includes chips converted to equivalent standard cords).

<sup>4</sup> Includes particleboard, excelsior bolts, and various specialty products.

<sup>5</sup> Excludes 7,249 thousand cubic feet of plant byproducts used for industrial fuel.

<sup>6</sup> Excludes 1,981 thousand cubic feet of plant byproducts used for litter and mulch.



**Table 24. — Output of roundwood products, by product, by source, and by softwood and hardwood, Virginia, 1976**

Product and species group	All sources	Growing-stock trees <sup>1</sup>			Cull trees <sup>1</sup>	Salvable dead trees <sup>1</sup>	Other sources <sup>2</sup>
		Total	Sawtimber	Pole/timber			
..... Thousand cubic feet .....							
Saw logs:							
Softwood	80,157	77,746	73,761	3,985	531	—	1,880
Hardwood	109,129	100,030	90,116	9,914	7,787	—	1,312
Total	189,286	177,776	163,877	13,899	8,318	—	3,192
Veneer logs and bolts:							
Softwood	8,273	8,118	8,118	—	—	—	155
Hardwood	2,693	2,429	2,429	—	190	—	74
Total	10,966	10,547	10,547	—	190	—	229
Pulpwood:							
Softwood	73,875	62,291	26,936	35,355	3,531	1,027	7,026
Hardwood	75,062	58,213	24,137	34,076	12,489	—	4,360
Total	148,937	120,504	51,073	69,431	16,020	1,027	11,386
Cooperage logs and bolts:							
Softwood	—	—	—	—	—	—	—
Hardwood	281	281	281	—	—	—	—
Total	281	281	281	—	—	—	—
Poles and piling:							
Softwood	1,633	1,586	1,586	—	—	—	47
Hardwood	—	—	—	—	—	—	—
Total	1,633	1,586	1,586	—	—	—	47
Posts (round and split):							
Softwood	396	279	72	207	50	—	67
Hardwood	4	3	1	2	—	—	1
Total	400	282	73	209	50	—	68
Other:							
Softwood	1,889	1,010	1,010	—	—	691	188
Hardwood	2,664	2,488	1,915	573	92	—	84
Total	4,553	3,498	2,925	573	92	691	272
Total industrial products:							
Softwood	166,223	151,030	111,483	39,547	4,112	1,718	9,363
Hardwood	189,833	163,444	118,879	44,565	20,558	—	5,831
Total	356,056	314,474	230,362	84,112	24,670	1,718	15,194
Fuelwood:							
Softwood	39,078	22,419	9,014	13,405	—	9,415	7,244
Hardwood	68,429	43,983	17,823	26,160	12,660	2,224	9,562
Total	107,507	66,402	26,837	39,565	12,660	11,639	16,806
All products:							
Softwood	205,301	173,449	120,497	52,952	4,112	11,133	16,607
Hardwood	258,262	207,427	136,702	70,725	33,218	2,224	15,393
Total	463,563	380,876	257,199	123,677	37,330	13,357	32,000

<sup>1</sup> On commercial forest land.

<sup>2</sup> Includes trees less than 5.0 inches in diameter, tree tops and limbs from commercial forest areas, or material from noncommercial forest land or nonforest land such as fence rows or suburban areas.

Table 25. — Annual timber removals from growing stock on commercial forest land, by items, and by softwood and hardwood, Virginia, 1976

Item	All species	Softwood	Hardwood
. . . . Thousand cubic feet . . . .			
Roundwood products:			
Saw logs	177,776	77,746	100,030
Veneer logs and bolts	10,547	8,118	2,429
Pulpwood	120,504	62,291	58,213
Cooperage logs and bolts	281	—	281
Poles and piling	1,586	1,586	—
Posts	282	279	3
Other	3,498	1,010	2,488
Fuelwood	66,402	22,419	43,983
All products	380,876	173,449	207,427
Logging residues	46,764	11,850	34,914
Other removals	68,358	19,926	48,432
Total removals	495,998	205,225	290,773

Table 27. — Volume of unused residues at primary manufacturing plants, by industry and type of residue, and by softwood and hardwood, Virginia, 1976

Species group and type of residues	All industries	Lumber	Veneer and plywood	Other
. . . . . Thousand cubic feet . . . . .				
Softwoods:				
Coarse <sup>1</sup>	1,516	1,490	—	26
Fine <sup>2</sup>	4,025	4,025	—	—
Total	5,541	5,515	—	26
Hardwoods:				
Coarse <sup>1</sup>	3,305	3,236	8	61
Fine <sup>2</sup>	10,056	9,968	43	45
Total	13,361	13,204	51	106
All species:				
Coarse <sup>1</sup>	4,821	4,726	8	87
Fine <sup>2</sup>	14,081	13,993	43	45
Total	18,902	18,719	51	132

<sup>1</sup> Material such as slabs, edgings, and veneer cores.

<sup>2</sup> Material such as sawdust, shavings, and veneer clippings.

Table 26. — Annual timber removals from live sawtimber on commercial forest land, by items, and by softwood and hardwood, Virginia, 1976

Item	All species	Softwood	Hardwood
. . . . Thousand board feet . . . .			
Roundwood products:			
Saw logs	1,010,895	432,045	578,850
Veneer logs and bolts	73,088	53,772	19,316
Pulpwood	179,932	106,155	73,777
Cooperage logs and bolts	2,235	—	2,235
Poles and piling	8,556	8,556	—
Posts	61	60	1
Other	15,466	3,971	11,495
Fuelwood	167,282	52,798	114,484
All products	1,457,515	657,357	800,158
Logging residues	49,294	15,788	33,506
Other removals	173,673	41,363	132,310
Total removals	1,680,482	714,508	965,974

Table 28. — Projection of net annual growth, available cut, and inventory of sawtimber and growing stock on commercial forest land, by softwood and hardwood, Virginia, 1976 to 2006<sup>1</sup>

Species group	1976	Projected to:		
		1986	1996	2006
<i>GROWING STOCK (In thousand cubic feet)</i>				
Softwood:				
Cut	205,225	226,800	238,100	233,700
Growth	247,205	255,600	250,800	233,700
Inventory <sup>2</sup>	5,512,096	5,854,000	6,019,800	5,891,700
Hardwood:				
Cut	290,773	458,400	601,700	695,000
Growth	575,963	648,500	695,300	695,000
Inventory <sup>2</sup>	14,144,364	16,474,300	17,743,500	17,598,200
Total:				
Cut	495,998	685,200	839,800	928,700
Growth	823,168	904,100	946,100	928,700
Inventory <sup>2</sup>	19,656,460	22,328,300	23,763,300	23,489,900
<i>SAWTIMBER (In thousand board feet)</i>				
Softwood:				
Cut	714,508	805,000	881,100	942,500
Growth	826,419	995,100	1,011,200	942,500
Inventory <sup>2</sup>	16,134,085	18,397,500	19,843,800	20,233,500
Hardwood:				
Cut	965,974	1,511,000	2,022,500	2,321,600
Growth	1,962,387	2,183,500	2,336,800	2,321,600
Inventory <sup>2</sup>	37,636,550	45,840,300	50,323,800	49,861,100
Total:				
Cut	1,680,482	2,316,000	2,903,600	3,264,100
Growth	2,788,806	3,178,600	3,348,000	3,264,100
Inventory <sup>2</sup>	53,770,635	64,237,800	70,167,600	70,094,600

<sup>1</sup> Assumptions:

1. There will be no substantial reduction in area of commercial forest land within the next decade. Between 1986 and 2006, area of commercial forest land will decline by 600,000 acres.

2. Forestry progress will continue at the rate indicated by recent trends.

3. Cut starting at the 1976 level will gradually increase and come into balance with growth by 2006.

<sup>2</sup> Inventory as of January 1 of the following year.

Table 29. — Basal area per acre of growing stock and rough and rotten trees 5.0 inches d.b.h. and larger, by forest type and Survey Unit, Virginia, 1977

Forest type	State	Survey Unit				
		Coastal Plain	Southern Piedmont	Northern Piedmont	Northern Mountain	Southern Mountain
..... Square feet .....						
White pine-hemlock:						
Growing stock	61.1	—	51.9	39.4	58.8	66.4
Rough and rotten trees	13.7	—	16.3	—	17.1	13.1
All trees	74.8	—	68.2	39.4	75.9	79.5
Loblolly-shortleaf pine:						
Growing stock	60.8	67.6	54.8	56.4	50.4	52.0
Rough and rotten trees	5.3	4.7	4.0	4.7	15.2	12.2
All trees	66.1	72.3	58.8	61.1	65.6	64.2
Oak-pine:						
Growing stock	52.5	56.1	50.0	47.7	48.9	52.9
Rough and rotten trees	10.5	8.5	8.6	8.7	18.8	16.7
All trees	63.0	64.6	58.6	56.4	67.7	69.6
Oak-hickory:						
Growing stock	55.3	53.9	52.5	60.9	55.1	54.7
Rough and rotten trees	16.5	12.2	12.9	13.4	24.7	20.7
All trees	71.8	66.1	65.4	74.3	79.8	75.4
Oak-gum-cypress:						
Growing stock	67.4	67.6	61.3	63.8	—	—
Rough and rotten trees	30.7	31.3	5.0	33.8	—	—
All trees	98.1	98.9	66.3	97.6	—	—
Elm-ash-cottonwood:						
Growing stock	46.9	49.3	49.3	38.0	41.7	50.0
Rough and rotten trees	19.7	21.0	16.3	22.4	23.8	28.8
All trees	66.6	70.3	65.6	60.4	65.5	78.8
Maple-beech-birch:						
Growing stock	61.2	—	—	—	55.4	62.2
Rough and rotten trees	23.4	—	—	—	38.5	20.7
All trees	84.6	—	—	—	93.9	82.9
All types:						
Growing stock	56.4	59.9	52.8	58.0	53.8	55.1
Rough and rotten trees	13.8	11.0	10.1	11.3	23.2	19.8
All trees	70.2	70.9	62.9	69.3	77.0	74.9

Table 30. — Number of growing-stock and rough and rotten trees 1.0–4.9 inches d.b.h. per acre, by forest type and Survey Unit, Virginia, 1977

Forest type	State	Survey Unit				
		Coastal Plain	Southern Piedmont	Northern Piedmont	Northern Mountain	Southern Mountain
..... Number of trees .....						
White pine-hemlock						
Growing stock	265	—	333	851	267	182
Rough and rotten trees	203	—	200	—	356	147
All trees	468	—	533	851	623	329
Loblolly-shortleaf pine:						
Growing stock	466	478	496	499	198	279
Rough and rotten trees	317	374	257	234	373	318
All trees	783	852	753	733	571	597
Oak-pine:						
Growing stock	323	329	415	340	206	195
Rough and rotten trees	437	474	465	320	398	410
All trees	760	803	880	660	604	605
Oak-hickory:						
Growing stock	190	222	216	213	127	162
Rough and rotten trees	407	430	456	310	448	378
All trees	597	652	672	523	575	540
Oak-gum-cypress:						
Growing stock	152	152	167	100	—	—
Rough and rotten trees	477	487	167	300	—	—
All trees	629	639	334	400	—	—
Elm-ash-cottonwood:						
Growing stock	106	123	90	179	33	67
Rough and rotten trees	286	427	263	157	222	167
All trees	392	550	353	336	255	234
Maple-beech-birch:						
Growing stock	133	—	—	—	75	144
Rough and rotten trees	233	—	—	—	325	217
All trees	366	—	—	—	400	361
All types:						
Growing stock	266	315	312	288	142	170
Rough and rotten trees	387	425	391	291	430	363
All trees	653	740	703	579	572	533

Table 31. — Area of commercial forest land, by stand volume (board feet) and ownership classes, by physiographic classes, Virginia, 1977

Ownership class and stand volume per acre <sup>1</sup> (board feet)	All classes	Physiographic class								
		Deep swamps	Broad stream margins	Narrow stream margins	Mountain tops and slopes	Flatwoods and dry pocosins	Bays and wet pocosins	Rolling uplands	Sand-hills	Other misc. classes
..... <i>Acres.</i> .....										
National Forest:										
Less than 1,500	475,415	—	—	7,515	413,166	—	—	50,247	—	4,487
1,500 to 5,000	608,024	—	—	7,806	515,959	—	—	64,938	—	19,321
More than 5,000	374,550	—	—	—	343,156	—	—	20,789	—	10,605
All classes	1,457,989	—	—	15,321	1,272,281	—	—	135,974	—	34,413
Other public:										
Less than 1,500	201,476	542	4,444	3,191	70,199	23,492	—	96,467	—	3,141
1,500 to 5,000	116,880	—	175	3,867	45,610	9,590	—	54,703	—	2,935
More than 5,000	179,585	—	1,627	20,628	14,241	25,655	—	117,434	—	—
All classes	497,941	542	6,246	27,686	130,050	58,737	—	268,604	—	6,076
Forest industry:										
Less than 1,500	891,780	—	6,041	10,504	54,703	276,540	—	529,157	—	14,835
1,500 to 5,000	396,418	—	2,975	24,533	51,260	89,818	2,590	222,596	—	2,646
More than 5,000	381,420	—	5,281	25,105	30,034	163,182	—	157,173	—	645
All classes	1,669,618	—	14,297	60,142	135,997	529,540	2,590	908,926	—	18,126
Farmer and misc. private:										
Less than 1,500	4,387,182	11,989	17,998	184,473	906,881	552,891	18,736	2,643,632	—	50,582
1,500 to 5,000	4,966,291	17,744	53,680	198,129	1,380,231	474,946	3,106	2,760,153	—	78,302
More than 5,000	2,993,772	8,987	46,328	156,937	734,117	611,642	3,106	1,367,419	—	65,236
All classes	12,347,245	38,720	118,006	539,539	3,021,229	1,639,479	24,948	6,771,204	—	194,120
All ownerships:										
Less than 1,500	5,955,853	12,531	28,483	205,683	1,444,949	852,923	18,736	3,319,503	—	73,045
1,500 to 5,000	6,087,613	17,744	56,830	234,335	1,993,060	574,354	5,696	3,102,390	—	103,204
More than 5,000	3,929,327	8,987	53,236	202,670	1,121,548	800,479	3,106	1,662,815	—	76,486
All classes	15,972,793	39,262	138,549	642,688	4,559,557	2,227,756	27,538	8,084,708	—	252,735

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

Table 32. — Area of commercial forest land, by stand volume (cubic feet) and ownership classes, by physiographic classes, Virginia, 1977

Ownership class and stand volume per acre <sup>1</sup> (cubic feet)	All classes	Physiographic class								
		Deep swamps	Broad stream margins	Narrow stream margins	Mountain tops and slopes	Flatwoods and dry pocosins	Bays and wet pocosins	Rolling uplands	Sand-hills	Other misc. classes
..... <i>Acres.</i> .....										
National Forest:										
Less than 500	229,774	—	—	7,515	190,675	—	—	31,584	—	—
500 to 1,000	367,439	—	—	5,364	336,744	—	—	25,331	—	—
More than 1,000	860,776	—	—	2,442	744,862	—	—	79,059	—	34,413
All classes	1,457,989	—	—	15,321	1,272,281	—	—	135,974	—	34,413
Other public:										
Less than 500	141,676	542	4,444	3,226	50,734	21,082	—	61,307	—	341
500 to 1,000	81,389	—	—	—	41,625	875	—	35,708	—	3,181
More than 1,000	274,876	—	1,802	24,460	37,691	36,780	—	171,589	—	2,554
All classes	497,941	542	6,246	27,686	130,050	58,737	—	268,604	—	6,076
Forest industry:										
Less than 500	641,373	—	6,041	2,305	33,585	206,358	—	385,686	—	7,398
500 to 1,000	268,309	—	—	5,815	46,689	67,476	2,590	138,302	—	7,437
More than 1,000	759,936	—	8,256	52,022	55,723	255,706	—	384,938	—	3,291
All classes	1,669,618	—	14,297	60,142	135,997	529,540	2,590	908,926	—	18,126
Farmer and misc. private:										
Less than 500	2,422,792	6,016	16,825	124,726	408,544	367,625	18,736	1,455,523	—	24,797
500 to 1,000	2,753,588	9,044	22,891	109,040	808,836	268,112	3,106	1,494,460	—	38,099
More than 1,000	7,170,865	23,660	78,290	305,773	1,803,849	1,003,742	3,106	3,821,221	—	131,224
All classes	12,347,245	38,720	118,006	539,539	3,021,229	1,639,479	24,948	6,771,204	—	194,120
All ownerships:										
Less than 500	3,435,615	6,558	27,310	137,772	683,538	595,065	18,736	1,934,100	—	32,536
500 to 1,000	3,470,725	9,044	22,891	120,219	1,233,894	336,463	5,696	1,693,801	—	48,717
More than 1,000	9,066,453	23,660	88,348	384,697	2,642,125	1,296,228	3,106	4,456,807	—	171,482
All classes	15,972,793	39,262	138,549	642,688	4,559,557	2,227,756	27,538	8,084,708	—	252,735

<sup>1</sup> Growing-stock volume.

Table 33. — Average net volume and growth per acre on commercial forest land, by physiographic class, tree class, and species group, Virginia, 1977

Physiographic class and tree class	Net volume per acre						Net growth per acre					
	Softwood		Hardwood		Total		Softwood		Hardwood		Total	
	Cubic feet	Board feet	Cubic feet	Board feet	Cubic feet	Board feet	Cubic feet	Board feet	Cubic feet	Board feet	Cubic feet	Board feet
Deep swamps:												
Growing stock	170.7	757	1,217.4	2,700	1,388.1	3,457	5.0	32	65.3	111	70.3	143
Rough and rotten trees	—	—	657.8	—	657.8	—	—	—	17.9	—	17.9	—
Total	170.7	757	1,875.2	2,700	2,045.9	3,457	5.0	32	83.2	111	88.2	143
Broad stream margins:												
Growing stock	283.1	1,368	1,265.9	3,863	1,549.0	5,231	7.8	51	44.6	152	52.4	203
Rough and rotten trees	14.6	—	420.5	—	435.1	—	0.1	—	9.1	—	9.2	—
Total	297.7	1,368	1,686.4	3,863	1,984.1	5,231	7.9	51	53.7	152	61.6	203
Narrow stream margins:												
Growing stock	98.9	414	1,233.5	3,737	1,332.4	4,151	2.7	15	42.6	162	45.3	177
Rough and rotten trees	2.6	—	315.0	—	317.6	—	—	—	7.7	—	7.7	—
Total	101.5	414	1,548.5	3,737	1,650.0	4,151	2.7	15	50.3	162	53.0	177
Mountain tops and slopes:												
Growing stock	131.2	429	1,069.0	2,873	1,200.2	3,302	4.0	15	37.9	131	41.9	146
Rough and rotten trees	11.2	—	349.0	—	360.2	—	0.1	—	6.7	—	6.8	—
Total	142.4	429	1,418.0	2,873	1,560.4	3,302	4.1	15	44.6	131	48.7	146
Flatwoods & dry pocosins:												
Growing stock	721.2	2,659	691.7	1,890	1,412.9	4,549	29.3	126	30.9	102	60.2	228
Rough and rotten trees	6.2	—	117.7	—	123.9	—	0.1	—	3.3	—	3.4	—
Total	727.4	2,659	809.4	1,890	1,536.8	4,549	29.4	126	34.2	102	63.6	228
Bays and wet pocosins:												
Growing stock	401.9	1,739	64.0	98	465.9	1,837	10.1	48	5.5	5	15.6	53
Rough and rotten trees	6.1	—	145.7	—	151.8	—	—	—	6.9	—	6.9	—
Total	408.0	1,739	209.7	98	617.7	1,837	10.1	48	12.4	5	22.5	53
Rolling uplands:												
Growing stock	389.5	937	794.6	2,041	1,184.1	2,978	19.8	56	35.6	120	55.4	176
Rough and rotten trees	14.2	—	133.7	—	147.9	—	0.5	—	4.0	—	4.5	—
Total	403.7	937	928.3	2,041	1,332.0	2,978	20.3	56	39.6	120	59.9	176
Sandhills:												
Growing stock	—	—	—	—	—	—	—	—	—	—	—	—
Rough and rotten trees	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—
Other misc. classes:												
Growing stock	227.1	793	1,051.9	2,827	1,279.0	3,620	7.3	35	38.9	136	46.2	171
Rough and rotten trees	15.2	—	252.4	—	267.6	—	0.6	—	6.9	—	7.5	—
Total	242.3	793	1,304.3	2,827	1,546.6	3,620	7.9	35	45.8	136	53.7	171
All classes:												
Growing stock	345.1	1,010	885.5	2,356	1,230.6	3,366	15.5	52	36.1	123	51.6	175
Rough and rotten trees	11.7	—	206.7	—	218.4	—	0.3	—	5.0	—	5.3	—
Total	356.8	1,010	1,092.2	2,356	1,449.0	3,366	15.8	52	41.1	123	56.9	175

Table 34. — Land area, by class, major forest type, and survey completion date, 1957, 1966, and 1977

Land use class	Survey completion date			Change 1966-1977
	1957	1966 <sup>1</sup>	1977	
..... Acres .....				
Forest land:				
Commercial forest land:				
Pine and oak-pine types	5,909,400	5,523,492	5,369,114	-154,378
Hardwood types	9,540,500	10,300,856	10,603,679	+302,823
Total	15,449,900	15,824,348	15,972,793	+148,445
Noncommercial forest land:				
Productive-reserved	259,400	313,427	374,561	+ 61,134
Unproductive	404,200	216,292	70,025	-146,267
Total	663,600	529,719	444,586	- 85,133
Nonforest land:				
Cropland	4,650,000	3,607,794	3,098,623	-509,171
Pasture and range	3,506,200	3,593,906	3,641,844	+ 47,938
Other	1,137,200	1,831,039	2,138,656	+307,617
Total	9,293,400	9,032,739	8,879,123	-153,616
All land <sup>2</sup>	25,406,900	25,386,806	25,296,502	- 90,304

<sup>1</sup>These figures differ slightly from reported figures because of revisions in the estimates of land area.

<sup>2</sup>Excludes all water areas.

Table 35. — Volume<sup>1</sup> of sawtimber, growing stock, and all live timber on commercial forest land, by species group, diameter class, and survey completion date

Species group	Year	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 and larger
SAWTIMBER (In thousand board feet)											
Softwood	1957	13,797,941	-	-	3,621,608	3,601,330	1,624,848	1,625,019	958,065	630,883	736,188
	1966	13,930,530	-	-	3,551,533	3,349,256	2,690,420	1,804,908	1,174,143	678,496	681,774
	1977	16,134,085	-	-	3,977,471	3,977,022	3,169,631	2,130,089	1,308,303	695,950	875,619
Hardwood	1957	26,557,643	-	-	-	5,324,704	5,705,776	4,550,157	3,621,421	2,405,595	4,949,990
	1966	29,073,386	-	-	-	5,818,694	6,135,760	5,081,083	3,835,109	2,620,214	5,582,526
	1977	37,636,550	-	-	-	7,350,314	7,927,327	6,943,207	5,200,926	3,524,597	6,690,179
GROWING STOCK (In thousand cubic feet)											
Softwood	1957	5,038,377	823,515	1,147,980	1,025,844	830,012	528,064	298,495	164,462	104,231	115,774
	1966	4,838,852	706,729	1,060,204	1,005,983	772,287	541,392	331,670	201,989	111,684	106,914
	1977	5,512,096	791,755	1,162,673	1,126,535	919,437	640,416	392,379	225,996	115,062	137,843
Hardwood	1957	10,260,211	1,005,188	1,399,532	1,613,006	1,594,038	1,446,448	1,036,690	767,113	483,972	914,224
	1966	11,318,573	1,214,068	1,550,268	1,723,582	1,742,190	1,556,412	1,158,940	812,005	527,692	1,032,416
	1977	14,144,364	1,288,857	1,827,309	2,176,969	2,202,011	2,011,847	1,586,130	1,102,065	710,131	1,239,045
ALL LIVE TIMBER (In thousand cubic feet)											
Softwood	1957	5,196,046	876,815	1,194,342	1,055,753	845,846	533,049	301,299	165,961	104,575	118,406
	1966	4,998,173	759,144	1,106,016	1,037,306	788,097	546,969	334,877	203,940	112,101	109,723
	1977	5,699,650	847,959	1,215,524	1,165,270	940,195	648,256	396,979	228,458	115,587	141,422
Hardwood	1957	12,640,786	1,461,214	1,845,796	1,992,167	1,879,516	1,652,031	1,176,221	887,096	573,673	1,173,072
	1966	14,010,778	1,773,230	2,049,307	2,132,625	2,059,508	1,781,818	1,319,294	937,814	627,538	1,329,644
	1977	17,445,647	1,880,668	2,415,752	2,701,244	2,609,214	2,307,473	1,811,697	1,273,081	844,304	1,602,214

<sup>1</sup>To provide a basis for valid comparisons, adjustments have been made to allow for differences in volume tables and sawtimber specifications used in previous surveys.

Table 36. — Volume of all live timber, by species group and Survey Unit, Virginia, 1957, 1966, and 1977

Species group and Survey Unit	1957	1966	Change 1957-1966	1977	Change 1966-1977
	<i>Thousand cu. ft.</i>	<i>Thousand cu. ft.</i>	<i>Percent</i>	<i>Thousand cu. ft.</i>	<i>Percent</i>
<b>Softwood:</b>					
Coastal Plain	2,674,960	2,452,968	- 8.3	2,415,647	- 1.5
Southern Piedmont	1,281,926	1,191,258	- 7.1	1,449,889	+21.7
Northern Piedmont	561,529	573,034	+ 2.0	756,986	+32.1
Northern Mountain	406,378	453,990	+11.7	590,082	+30.0
Southern Mountain	271,253	326,923	+20.5	487,046	+49.0
All units	5,196,046	4,998,173	- 3.8	5,699,650	+14.0
<b>Hardwood:</b>					
Coastal Plain	3,403,081	3,525,488	+ 3.6	3,808,100	+ 8.0
Southern Piedmont	2,403,287	2,576,027	+ 7.2	3,284,391	+27.5
Northern Piedmont	2,113,692	2,293,885	+ 8.5	2,959,566	+29.0
Northern Mountain	2,224,898	2,607,881	+17.2	3,325,700	+27.5
Southern Mountain	2,495,828	3,007,497	+20.5	4,067,890	+35.3
All units	12,640,786	14,010,778	+10.8	17,445,647	+24.5





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**Keywords:** Commercial forest area, ownership class, timber volume, timber growth, timber removals.

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