The TIMBER RESOURCES Of DELAWARE

USDA FOREST SERVICE RESOURCE BULLETIN NE-32
1974

NORTHEASTERN FOREST EXPERIMENT STATION
FOREST SERVICE, U.S. DEPARTMENT OF AGRICULTURE
6816 MARKET STREET, UPPER DARBY, PA. 19082
WARREN T. DOOLITTLE, DIRECTOR

FOREWORD

UNDER THE AUTHORITY of the McSweeney-McNary Forest Research Act of May 22, 1928, and subsequent amendments, the Forest Service, U.S. Department of Agriculture, conducts a series of continuing forest surveys of all states to provide up-to-date information about the forest resources of the Nation.

The first forest survey of Delaware was made in 1956 by the Northeastern Forest Experiment Station. A resurvey was made in 1971 with excellent help and cooperation of the Delaware Department of Natural Resources and Environmental Control. Aerial photographs used for this survey were also supplied by the Department.

The resurvey of the State was directed by Carl E. Mayer, leader of the Forest Survey Project. He was assisted by John R. Peters, who supervised the field crews; Joseph E. Barnard and David R. Dickson, who applied the general sampling procedures used by the Forest Survey to meet the specific requirements for the Delaware inventory; James T. Bones, who, with the cooperation of the Department of Natural Resources and Environmental Control, collected and compiled data on timber products output and plant residues; Teresa M. Bowers, who assisted in computing and compiling data for the sampling design and the tables in this report; and Carmela M. Hyland, who assisted with administrative services for the field crews and typed the manuscript and tables.

The authors and Joseph E. Barnard checked the consistency of the previous inventory with the new inventory. They made frequent use of the TRAS model in this phase of the data analysis and in the 30-year projections of timber volumes.

Cover Photo

A typical stand of loblolly pine in southern Delaware.

THE AUTHORS

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CARL E. MAYER is the forest survey project leader at the Northeastern Forest Experiment Station. He received his bachelor's degree in forestry from Iowa State University in 1943. After military service as an officer in the U. S. Marine Corps, he spent 12 years in Forest Survey at the Pacific Northwest Experiment Station in Portland, Oregon. He transferred to the Northeastern Station in 1958 and since that time has directed the Forest Survey of the 14-state Northeastern area.

MANUSCRIPT RECEIVED FOR PUBLICATION 25 JUNE 1973

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The Resurvey

THE FIRST forest survey of the timber resources in Delaware was made in 1956. Now the second forest survey of the State, 15 years later, shows that a number of significant changes have taken place.

This report summarizes the present timber-resource situation and the changes that have taken place since the initial survey. It presents the inventory, annual net growth, and timber removals in more detail than was possible for the initial survey. Also included are discussions of trends in the timber supply, timber availability, and projections of future timber supply.

Comparisons of volume estimates given in this report were made after putting the initial survey estimates on the same basis as the resurvey. Growing-stock volume in 1957, after such revision, was 4 percent greater than reported in *The Timber Resources of Delaware*(*3*).

In the resurvey, all of the initial field plots were remeasured to provide estimates of average annual net timber growth, average annual timber removals, and land-use change, and to update the initial forest-inventory volume estimates. To develop an independent second estimate, new field plots were established and measured. These two samples yielded independent estimates, which were weighted and combined to give the current estimates of forest area and timber volume reported in this publication. A more detailed discussion of the design and sampling procedure can be found in the appendix.

Sampling errors, which indicate the reliability of the estimates, are shown for most of the totals and subtotals of the new estimates. Definitions of forest-survey terms and a discussion about reliability of the estimates are presented in the appendix. Users of these timber-resource data are strongly advised to read these definitions and explanations carefully.

Highlights of the Findings

In the 15 years between the initial forest survey and the resurvey, many significant changes have taken place. Here briefly are some of the more important findings of this second forest survey of the First State:

- The area of commercial forest land declined since 1957 and now totals 384,400 acres.
- Eighty percent of the commercial forest land is fully stocked with growing-stock trees; almost 40 percent of the commercial forest land is overstocked if all live trees are considered.
- Delaware has the highest average volume per acre of any state east of the Mississippi River. The average volumes are 1,530 cubic feet and 3,340 board feet per acre.
- Growing-stock volume increased 17 percent to 588 million cubic feet. Softwood volume decreased 20 percent, and hardwood volume increased 48 percent.
- Hardwoods make up 70 percent of the growing-stock volume. Oaks alone make up about one-fourth of the volume.
- Sawtimber trees make up 64 percent (373 million cubic feet) of the total growing-stock volume.
- Total sawtimber volume increased 28 percent to 1,284 million board feet; however, softwood sawtimber volume decreased 4 percent.
- The select white oak species and sweetgum had the largest increases in sawtimber volume (more than 50 percent).
- Annual net growth for 1971 was 19 million cubic feet of growing stock, including 44 million board feet of sawtimber.
- Timber removals for 1971 were 13 million cubic feet of growing stock, including 24 million board feet of sawtimber.
- Volume of loblolly pine that was cut between surveys was 87 percent greater than net growth. Acreage of this forest type decreased 50 percent, and the growing-stock volume inventory of loblolly pine decreased 20 percent.
- Projections of future timber supply show that, if present removal trends continue, total inventory volume would increase 55 percent; however, the volume of softwoods would decrease 44 percent.

Timber-Resource Trends

Thirty percent of Delaware's land area is made up of commercial forest land. Another 1 percent of the land area is classified as noncommercial forest land. Although the acreage of commercial forest land is relatively very small in Delaware when compared with most other states, the average growing-stock volume per acre of commercial forest land is greater than that for any other state east of the Mississippi River. And the timber volume, though small in quantity, is important locally.

Since the first forest survey of Delaware, many definitions, procedures, and methods have been changed as a result of improved forest-inventory and data-processing techniques. This means that, to analyze actual trends between surveys, the initial survey estimates must be put on a basis comparable to the resurvey estimates. The 1957 estimates are valid for the procedures and definitions used at that time, and should not therefore be discounted. The trends in commercial forest-land area, growing-stock volume, and sawtimber volume (after adjustment of these 1957 data to the resurvey standards) are presented:

Area and Volume	*1957*	*1972*	*Change*
Commercial forest land:	(thousand acres)		
	385.4	384.4	−1.0
Growing-stock volume:	(million cubic feet)		
Softwoods	230.0	184.3	−45.7
Hardwoods	273.1	403.3	+130.2
Total	503.1	587.6	+84.5
Sawtimber volume:	(million board feet)		
Softwoods	435.0	418.0	−17.0
Hardwoods	568.0	865.7	+297.7
Total	1,003.0	1,238.7	+280.7

SOME CHANGES IN FOREST AREA

Land-use changes between surveys resulted in a negligible change in commercial forest land for the State as a whole. Commercial forest land in 1972 totaled 384,400 acres. Clearing of forest land for urban development during the period between surveys totaled 37,000 acres (*2*). However, this loss of forest land was nearly offset by the reversion of abandoned farmland to forest land (*6*) (fig. 1).

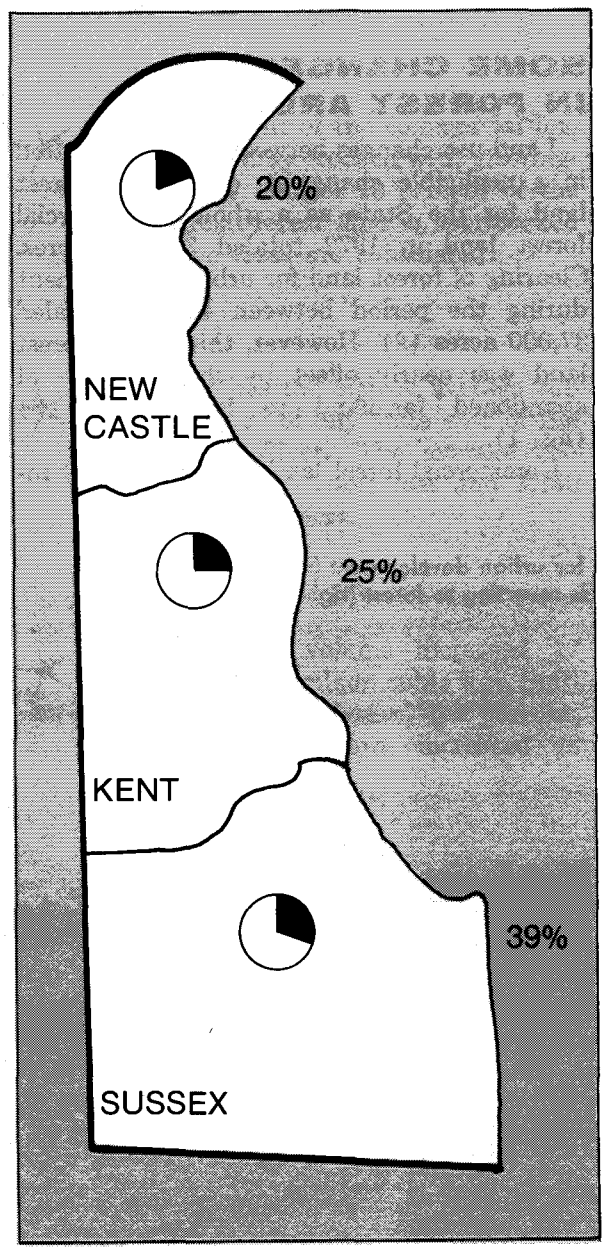
Commercial forest land in Kent County in-

Figure 1. — Clearing of forest land for urban development (left) was offset by abandoned farmland that is reverting to forest (right).

creased 21 percent (16,000 acres) to 93,000 acres. The other two counties had a total decrease of 17,000 acres. New Castle County's commercial forest area, the smallest in the State, decreased 7 percent (4,000 acres) to 56,000 acres. Commercial forest land in Sussex County decreased 5 percent (13,000 acres) to 236,000 acres (fig. 2).

Noncommercial forest land in the State—7,400 acres—was located mainly in Sussex County—4,800 acres of the total. Most of the noncommercial forest land acreage was classified as unproductive (5,600 acres). The remaining 1,800 acres consisted of productive forest land that was administratively reserved from timber cutting. Some productive forest land occurs in private estates that probably will never be put under management for timber products. Such land is included in the estimate of commercial forest land.

Figure 2. — Commercial forest land in Delaware, by counties, 1972.



Public ownership of commercial forest land (almost all in state forests) makes up almost 4 percent of the total—14,000 acres (fig. 3). Forest-industry holdings total about 30,000 acres and make up almost 8 percent. Farmer-owned commercial forest land, including incorporated farms, totaled 178,100 acres. The present farmer-owned acreage accounts for 48 percent of the private commercial forest land in contrast to 55 percent in 1957. Commercial forest land in the miscellaneous private category increased to 162,600 acres and makes up 44 percent of the total.

The above estimates of privately owned forest land are based upon a canvass of forest landowners in Delaware that was conducted concurrently with the survey of the State. Further breakdowns of these ownerships show that 19 percent (68,800 acres) of Delaware's privately owned commercial forest land is owned by corporations. These include incorporated farms, forest industries, public utilities, and real estate development firms. Of the individually owned commercial forest land (275,400 acres), farmers own 57 percent, retired persons own 21 percent, and a varied assortment of other people—including housewives, business people, laborers, and white-collar workers—own 22 percent.

The stocking of commercial forest land in Delaware is better than that in most states. About 80 percent of the commercial forest land is fully stocked with growing-stock trees. However, when the stocking of rough and rotten trees is included with the stocking of growing-stock trees, about 40 percent of the commercial forest land is overstocked for optimum growing conditions. The acreage of nonstocked commercial forest land (less than 10 percent stocked) was negligible.

Figure 3. — State forests make up 4 percent of the commercial forest land. Top, an oak-hickory stand on a state forest. Middle, entrance to Blackbird State Forest. Bottom, a pine plantation on a state forest.

Sawtimber stands in Delaware continued to make up the same proportion (54 percent) of the total commercial forest land, even though the classification was made differently from that for the initial survey. Sawtimber stands totaled 207,000 acres in 1972 and averaged about 5,400 board feet per acre, or 17 percent more than the average volume per acre for 1957. Poletimber stands (83,000 acres) averaged 1,300 cubic feet per acre, and sapling-seedling stands (94,000 acres) averaged 500 cubic feet.

The four major forest types that follow are made up of many local forest types in Delaware. The local forest types were classified on the basis of plurality of stocking of the key indicator species. Change in area, causes for the change, and current acreage are given for each major type.

Loblolly-shortleaf pine.—This forest type is made up of all the pine species in Delaware (however, most of the trees are loblolly pine). In the timber resource report for the initial survey, it was pointed out that the removals of softwood (pine) growing stock were 35 percent greater than the annual net growth. During the period betweeen surveys, softwood timber removals were even greater (fig. 4).

Figure 4. — Natural stands of loblolly pine often do not reach maturity because of the high rate of cutting for pulpwood.

They were about double the average annual net growth of growing stock.

As a consequence, the pine component of many timber stands became less than 50 percent of the stocking, and the classification changed from loblolly-shortleaf pine to *oak-hickory, oak-pine,* or some other forest type. The acreage of loblolly-shortleaf pine type in 1972—99,000 acres—is one-half of what it was in 1957 (fig. 5). It makes up one-fourth of the commercial forest area in the State. More than 80 percent (82,000 acres) of this type is in Sussex County.

Oak-pine.—The acreage in this type increased 2½ times between surveys to 57,000 acres. Some of the increase was due to the reduction of the pine stocking to less than 50 percent in stands previously classified as loblolly-shortleaf pine forest type. Also, some of the increase was due to abandoned farmland that reverted to forest land and had sufficient stocking of pine trees. The oak-pine forest

Figure 5. — Changes in commercial forest area, by forest types, 1957-72.

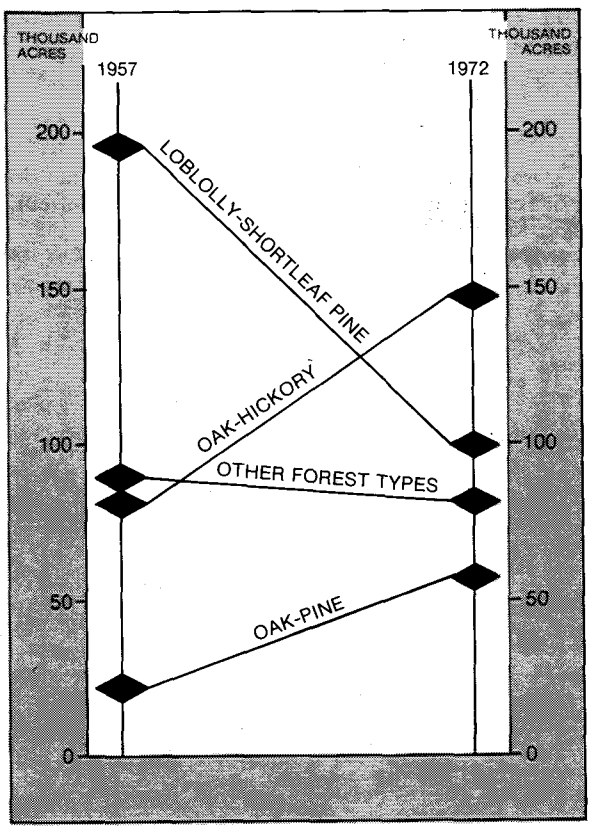
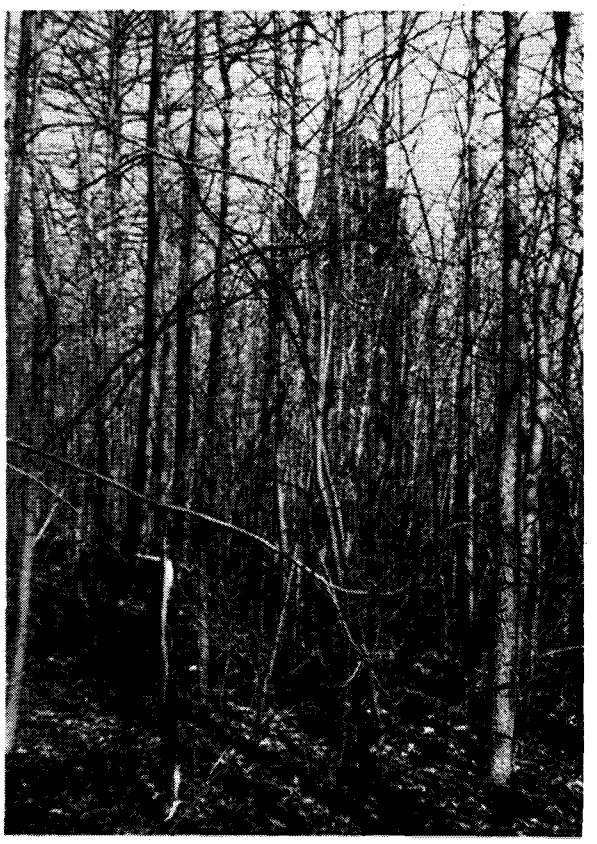


Figure 6. — A natural hardwood stand on an abandoned field. This local type (sweetgum — yellow-poplar) makes up more than one-third of the oak-hickory major forest type.



type makes up 15 percent of the commercial forest land in the State.

Oak-hickory.—This is now the predominant forest type in the State. The acreage in this type about doubled between surveys—now 147,000 acres. Much of the increase was due to decreases in pine stocking of stands previously classified as loblolly-shortleaf pine or oak-pine forest types. When the pine stocking became less than 25 percent of the total, the stand classification became oak-hickory. This oak-hickory type also includes 62,000 acres of the local forest type, sweetgum—yellow-poplar, that consisted of only 14,000 acres in 1957. Part of the increase in the oak-hickory type consists of abandoned farmland that reverted to forest land—often to sweetgum or yellow-poplar (fig. 6).

The 147,000 acres in the oak-hickory forest

type make up 38 percent of the commercial forest land in the State. In Sussex County, this forest type makes up 32 percent of that county's commercial forest-land area, and in Kent and New Castle counties, it makes up more than 45 percent.

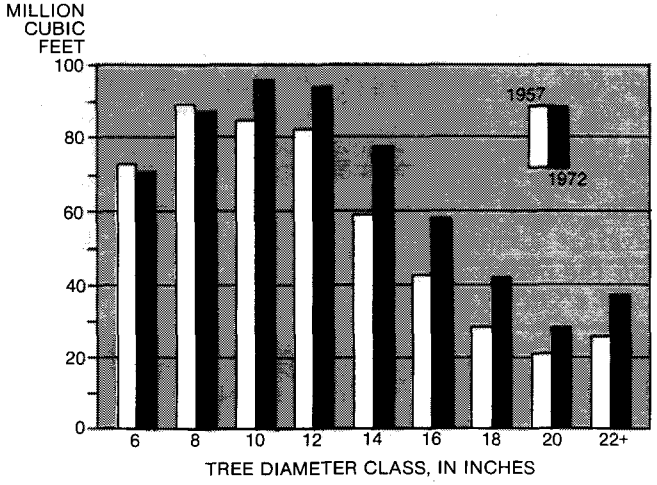
Oak-gum-red maple. — This type consists of moist-site hardwood species. The area totals 82,000 acres and makes up 21 percent of the commercial forest land total. (In 1957 this was called the oak-gum-cypress forest type, but because the stocking of baldcypress was negligible and the stocking of red maple was considerable, the type name was changed accordingly.) The acreage in this type decreased about 8 percent between surveys.

VOLUME INCREASES VARIED CONSIDERABLY

Growing-stock volume increased 85 million cubic feet between surveys to 588 million in 1972. This was an average increase for all species of about 17 percent and was due to the much larger volume of growth than removals for hardwood species. More volume of softwoods was cut than was replaced by growth during the period. Consequently, the initial softwood inventory decreased 20 percent.

Softwood species volume totaled 184 million cubic feet in 1972 and made up 31 percent of total growing-stock volume. In 1957 softwood species made up 46 percent of the total. Hardwood species volume totaled 403 million cubic feet in 1972 and made up 69 percent of the total volume.

Figure 7. — Growing-stock volume, by diameter classes, 1957 and 1972.



Distribution of total growing-stock volume by diameter classes reveals a decrease in the 6- and 8-inch tree-diameter classes, an average decrease of almost 3.0 percent (fig. 7). Volume in the 10- and 12-inch classes combined increased an average of 13 percent. The combined volumes in the larger diameter classes increased an average of 38 percent. The decreases in the smaller diameter classes were due to the heavy cutting of softwoods. Softwood volume in the 6- to 12-inch diameter classes decreased 33 percent between surveys.

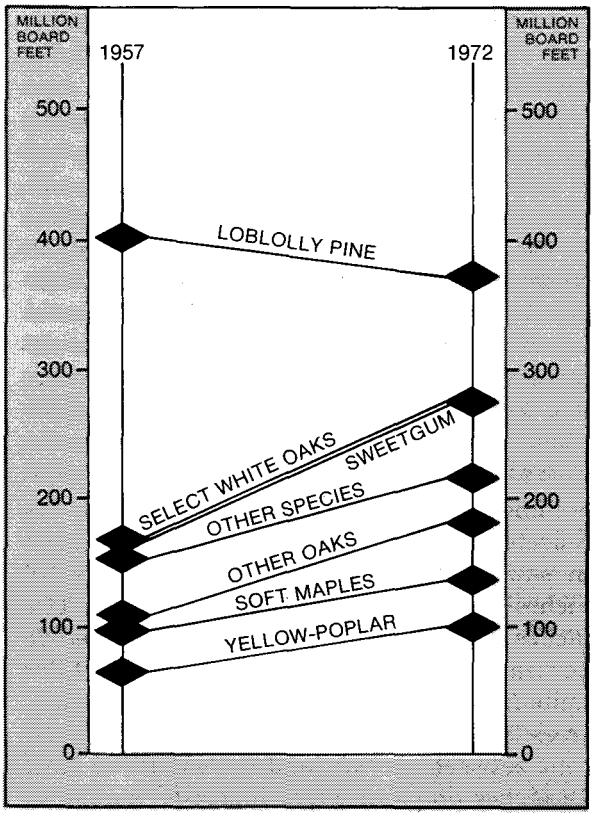
Similar changes in board-foot volume are reflected in the sawtimber trend. The volume in sawtimber trees (growing-stock trees 9.0 inches dbh and larger for softwoods and 11.0 inches and larger for hardwoods) increased 28 percent between surveys — from 1,003 to 1,284 million board feet. The board-foot volume of trees less than 16 inches dbh increased 15 percent between surveys, and the volume in trees 16 inches dbh and larger increased almost 45 percent. However, sawtimber volume for the softwood species decreased about 4.0 percent to 418 million board feet in 1972, whereas the hardwood volume increased more than 50 percent to 866 million board feet.

Loblolly pine, which made up 40 percent of the total board-foot volume in 1957, was the only major species that decreased in volume (fig. 8). This decrease was due to the heavy demand for this valuable species for piling, veneer, and lumber. The volume of loblolly pine dropped to 371 million board feet and made up less than 30 percent of the total in 1972. Sawtimber volume for the other softwood species increased to 47 million board feet, even though growing-stock volume for these same species decreased about 15 percent.

Oaks, as a group, now make up one-fourth of the total sawtimber volume. This group increased more than 60 percent between surveys to 319 million board feet in 1972. All other hardwood species increased an average of 47 percent.

Quality of loblolly pine sawtimber is poor.

Figure 8. — Changes in board-foot volume, by species, 1957-71.



Only 7 percent of the volume was in standard-lumber log grade 1. And for most hardwood species, log quality is also poor. Eight percent of the hardwood sawtimber volume was classified as log grade 1 quality. A few species — yellow-poplar, blackgum (black tupelo), and northern red oak — had 14 to 19 percent of their volume in log grade 1. More than one-third (37 percent) of the hardwood sawtimber volume was classified as construction-log quality.

TOTAL NET GROWTH EXCEEDS TIMBER REMOVALS

Growing-stock volume increased 84 million cubic feet during the 15-year period between surveys to 588 million cubic feet in 1972. This increase resulted from less timber removal than net growth during the period — an average annual net change of 5.7 million cubic feet. Hardwood growing-stock volume increased 130 million cubic feet. The large increase in hardwood volume more than offset the heavy removal of softwood volume. Softwood growing-stock volume decreased 46 million cubic feet.

Sawtimber volume increased 281 million board feet during the same period to 1,284 million board feet. Total sawtimber removal was less than net growth, and the average annual net change was 18.7 million board feet. The hardwood sawtimber inventory increased 52 percent, for removals were only 30 percent of the net growth. Softwood sawtimber volume decreased 4 percent as a result of removals exceeding growth by 15 percent.

Volume of Ingrowth Is Large

The average annual change in growing-stock volume and sawtimber volume is the composite of several components: growth on initial volume (accretion), ingrowth, change from a merchantable tree to a rough or rotten tree (cull-tree increment), mortality, and timber removal. An unusual change in one or more of these components could account for an unusual difference in the average annual change. For example, one species may have had unusually high mortality, while another may have had unusually high cull-tree increment.

For most species in Delaware, ingrowth is one of the most important components. It is almost as large as the growth on the initial volume. The volume of ingrowth trees (growing-stock trees that were less than 5.0 inches dbh on the initial survey and that grew to 5.0 inches dbh and larger) made up about 40 percent of the average gross growth of growing stock. Mortality of growing-stock trees and cull-tree increment together reduced the average gross growth by more than 20 percent. The volume for each of the components of average annual net change in growing stock for the period 1957-71 is shown below.

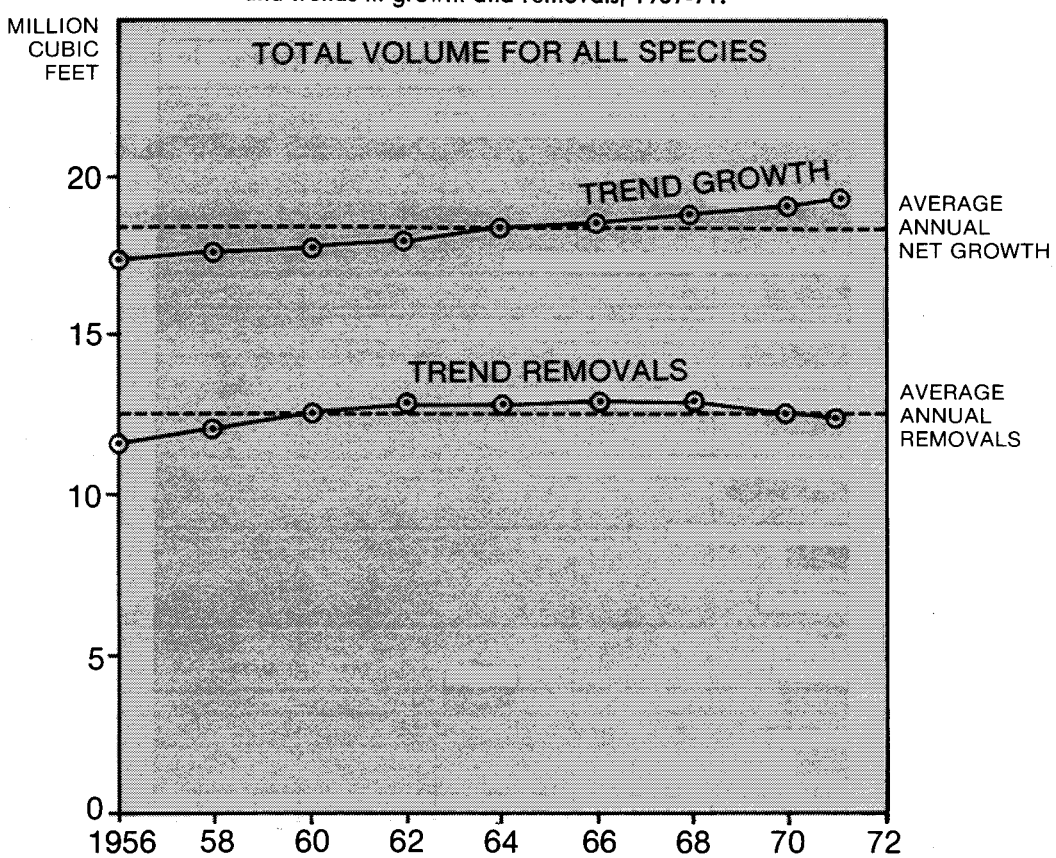
	Thousand cubic feet	*Percent of gross growth*
Survivor growth of growing stock	13,645	59
Volume and growth of trees that became poletimber	+9,473	+41
Average annual gross growth	23,118	100
Cull-tree increment	−1,226	−5
Growing-stock tree mortality	−3,592	−16
Average annual net growth	18,300	79
Average annual removals	−12,600	−54
Average annual net change	5,700	25

Ingrowth volume of growing-stock trees that grew into the sawtimber-size class was equal to the volume of accretion. Each of these components made up 50 percent of the gross growth of 48.5 million board feet. The volume of trees that died and the volume of trees that became nongrowing stock reduced the volume of the average annual gross growth of sawtimber almost 15 percent. The average annual net growth of 41.5 million board feet exceeded the average annual removal of 22.8 million board feet and resulted in an average annual change of 18.7 million board feet.

Growth Increased Faster Than Removals

Annual net growth of growing-stock volume has increased at a faster rate than annual timber removals. Annual net growth for 1956 was 17.3 million cubic feet, and for 1971 it was 19.2 million — an increase of about 10 percent. Timber removals for 1956 were 11.6 million cubic feet and for 1971 were 12.5 million — an increase of 8 percent. Timber removal of growing stock as a percent of annual net growth in 1971 was 65 percent, as compared to 67 percent in 1956 (fig. 9).

Figure 9. — Average annual growth and removals and trends in growth and removals, 1957-71.

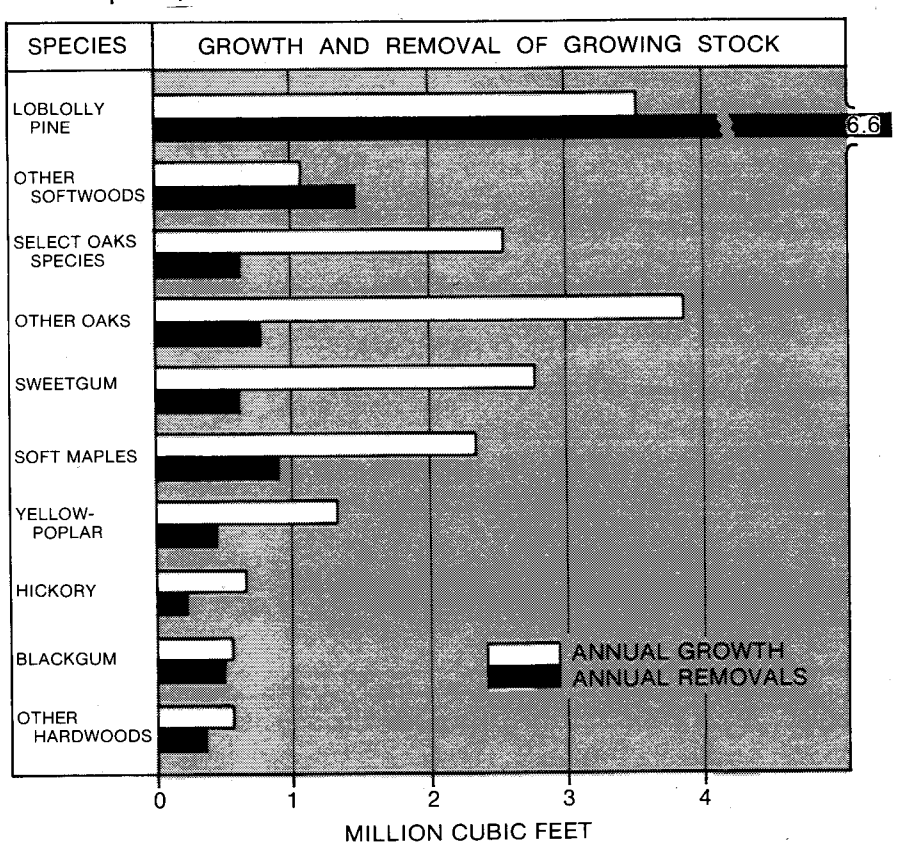


The growth-removal relationship for softwood growing stock is quite different than that for hardwoods. The annual net growth for softwoods in 1971 was 4.6 million cubic feet, or expressed as an annual rate based on the inventory, it was 2.5 percent. Softwood removals in 1971 (8.1 million cubic feet) exceeded growth by 76 percent. In contrast, the annual net growth for hardwood growing stock in 1971 was 14.6 million cubic feet. The hardwoods had a growth rate of 3.6 percent. Hardwood removals in 1971 (4.4 million cubic feet) were only 30 percent of the net growth.

Loblolly pine and other softwoods were the only species that showed greater removals of growing-stock volume in 1971 than growth (fig. 10). Removals of loblolly pine growing stock totaled about 6.6 million cubic feet, and annual net growth was 3.5 million. Loblolly pine accounted for 53 percent of the total removals for all species in 1971. Oaks, as a group, had the greatest volume of net growth — 6.4 million cubic feet. The corresponding volume of removals for the oaks was 1.4 million cubic feet, and this was about one-fifth (21 percent) of the growth. All other hardwoods had 8.2 million cubic feet of growth and 3.0 million cubic feet of removals; the removals were 37 percent of growth.

Net growth of sawtimber in 1971 was 44 million board feet, and sawtimber removals totaled 24 million. Sawtimber removals as a percent of annual net growth (55 percent) were slightly more than in 1956 when they made up 46 percent. Like growing stock, the sawtimber removals and annual net growth differed according to softwood and hardwood species groups. In 1971 softwood sawtimber removals (15 million board feet) were 15 percent more than the net growth of 13 million board feet; hardwood sawtimber removals (9 million board feet) were 71 percent below the net growth of 31 million board feet.

Figure 10. — Net growth and removals of growing stock, by species, 1971.



Timber-Products Output

The timber-products output estimates for 1970 (tables 25 and 26) should not be confused with the estimates of annual timber removals for 1971 (tables 20 and 21). More than just the year is different. Timber-products output is that portion of total timber removals that was used for products. In addition to timber removed for products, timber removals include logging residues and "other removals," such as land clearing.

In this section, data obtained from a field canvass of all known primary wood manufacturers that operated in Delaware in 1970, and data from utilization studies conducted during logging operations, were used to analyze the 1970 timber harvest and output of timber products.

The production of timber products in Delaware from all sources totaled 10.0 million cubic feet in 1970, a decrease of 26 percent from the total output of 13.6 million cubic feet in 1956. The source of the 1970 output consisted of 9.7 million cubic feet of roundwood and 0.3 million cubic feet of plant by-products. Output of roundwood came from growing-stock trees (8.1 million cubic feet) and from other sources, such as rough and rotten trees and trees from noncommercial forest land (1.6 million cubic feet).

Softwood made up two-thirds of the total output from all sources in 1970. Softwood output had decreased 30 percent to 6.8 million cubic feet, and the hardwood output had decreased 18 percent to 3.3 million cubic feet.

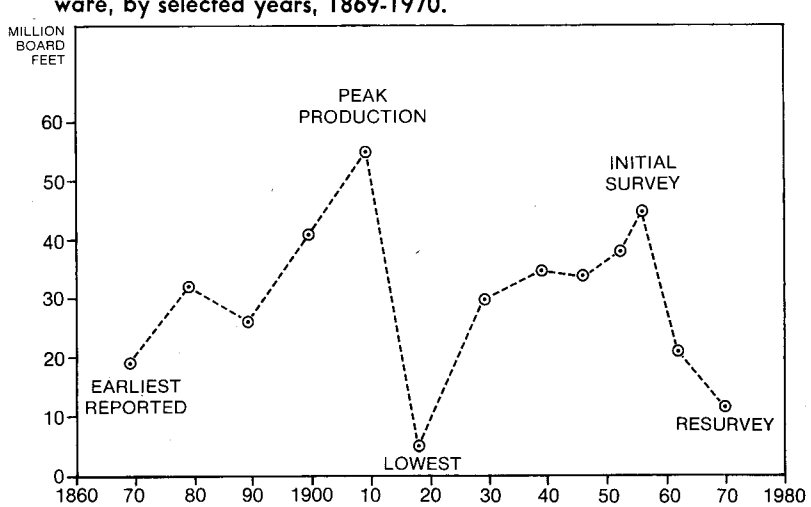
Changes in roundwood production between 1956 and 1970 by products and species groups were very pronounced. Sawlog production decreased greatly, and pulpwood bolt production almost tripled. The changes in industrial roundwood production are shown in greater detail in the report *The Timber Industries of New Jersey and Delaware(1)*. Roundwood production in Delaware, by products, is shown below for 1970:

	Million cubic feet	*Percent*
Sawlogs	1.9	20
Veneer logs	.9	9
Pulpwood bolts	5.0	51
Piling	.7	7
Fuelwood and other	1.2	13
Total	9.7	100

LUMBER AND SAWLOGS

Lumber production in Delaware reached a record high of 55 million board feet in 1909, declined sharply in the next few years, and dropped to an all-time low of 5.2 million board feet in 1918. In the 30-year period between 1930 and 1960, lumber production averaged

Figure 11. — One hundred years of lumber production in Delaware, by selected years, 1869-1970.



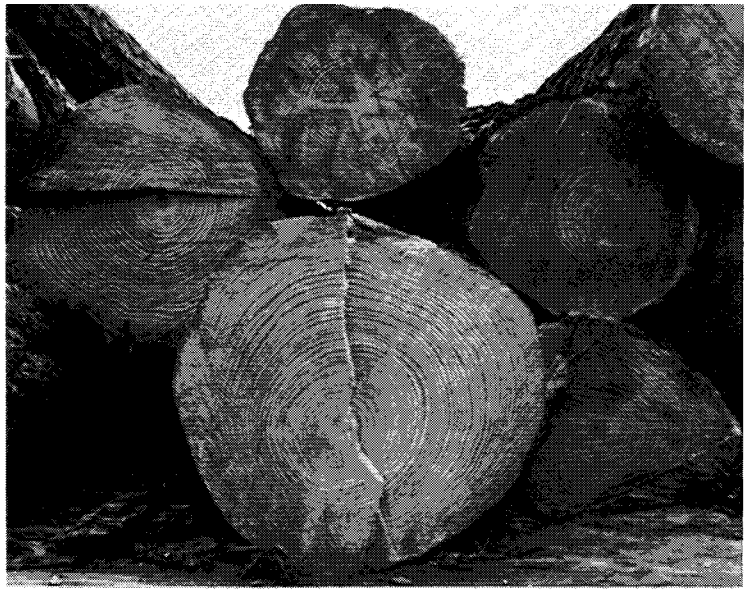


Figure 12. — Loblolly pine sawlogs at a southern Delaware sawmill.

Figure 13.—All pulpwood cut in Delaware is shipped to out-of-state mills by rail and by truck.

more than 30 million board feet a year. After 1960, lumber production again declined sharply to 13.1 million board feet in 1970 (fig. 11).

More than one-half (6.8 million board feet) of the lumber production in 1970 was from the hardwood species group (fig. 12). At the time of the initial survey, less than one-fourth (9.4 out of 44.5 million board feet) of the lumber production was from hardwoods.

PULPWOOD

Although there are no woodpulp mills in Delaware, the harvest of pulpwood bolts increased almost three-fold — from 22,500 cords in 1956 to 62,200 cords in 1970. Pulpwood bolts made up more than one-half of the total products output in 1970 from all sources. No hardwood pulpwood bolts were cut in 1956, but in 1970 about 5 percent of the pulpwood production was made up of hardwood species.

Timber-products output for pulpwood from all sources totaled 63,700 cords. Of this, 50,200 cords came from growing-stock trees, 12,000 cords came from non-growing stock, and 1,500 cords came from plant byproducts that were converted into chips. Most of the pulpwood and wood chips were shipped to mills in tidewater Virginia and western Maryland, but some reached mills in Pennsylvania and New Jersey (fig. 13).

OTHER PRODUCTS

Veneer logs and bolts, cooperage, piling, poles, posts, and fuelwood (a total of 2.8 million cubic feet) accounted for the remainder of the timber-products output for 1970 from all sources. The combined volumes made up 29 percent of the total output. Of these other products, veneer logs and piling are the most important; they totaled 1.6 million cubic feet.

The output of veneer logs and bolts was greater for softwoods than for hardwoods in 1970—3.0 million board feet for softwoods and 2.3 million for hardwoods—in sharp contrast to the output in 1956 when there was no softwood veneer-log production. Most of the softwood veneer logs and bolts (loblolly pine) were used for the manufacture of yellow pine plywood, and some were used for basket

Figure 14. — Top, piling cut from timber stand in southern Delaware. Bottom, piling in use at the only ferry operating in Delaware.

veneer. Three basket-veneer mills were operating in Delaware in 1956, but there was none in 1970. The hardwood veneer logs and bolts (mostly sweetgum and yellow-poplar) harvested in Delaware are shipped to mills in Pennsylvania and southern New Jersey.

Piling is more valuable than sawlogs, and a few operators cut piling exclusively for specific orders (fig. 14). Trees suitable for piling are usually harvested at the same time as sawlogs and are sorted out at the roadside or at a concentration yard. Softwood piling (loblolly pine) made up 420 thousand cubic feet of the output, and hardwood piling (mostly oak) made up about 280 thousand cubic feet. Total output of piling in 1970 (1.2 million linear feet) was 37 percent less than it was in 1956.

Fuelwood—the only nonindustrial product —accounted for almost 1.2 million cubic feet of output from all sources. One-half of this came from growing-stock volume. Ninety percent of the fuelwood volume was from the hardwood species.

ECONOMIC IMPORTANCE OF THE TIMBER RESOURCE

Because Delaware is a small state that has a low percentage of forest land, timber makes a relatively small contribution to the State's economy. According to the latest U.S. Bureau of the Census data, the manufacturing industry in Delaware in the first quarter of 1969 accounted for 42 percent of the State's employment of 176,452 employees and 54 percent of the State's payrolls of $308 million (*8*).

Timber-based industries made up a very small part in the overall manufacturing industry. Of the 528 manufacturing establishments in Delaware that had an average of 70,700 employees in 1967, only 61 establishments with about 2,200 employees (3.1 percent of the total) were in the timber-based industries. The lumber and wood products industry, SIC-24, (Standard Industrial Classification by the U.S. Bureau of the Census)

employed about 500; the furniture and fixtures industry, SIC-25, employed about 200; and the paper and allied products, SIC-26, employed about 1,500 (*7*).

Value added by manufacturing is indicative of the relative economic importance of a manufacturing industry. *Value added* is the difference been the cost of goods and services purchased by a manufacturer and the value of the products sold. The U.S. Bureau of the Census reported that in Delaware the value added by manufacturing in 1967 totaled $958 million. The value added by the timber-based industries probably would not exceed $20 million, 2 percent of that total. The lumber and wood products industry created a $4.1 million value added, and the furniture and fixtures industry created a $1.7 million value added. However, the Bureau of the Census did not disclose how much value added resulted from the paper and allied product industry.

Even though the timber industry contributes much less than the rest of the manufacturing industry to the economy of the State as a whole, timber is a valuable resource to rural Sussex County. This county has 51 percent of the cropland and 61 percent of the forest land in the State.

How Much Timber Could Be Harvested?

Softwood timber is being overcut, and in each succeeding year less softwood is harvested than in the preceding year. Normal species succession in this region tends towards the more tolerant hardwoods. In the absence of disturbances, including special efforts to favor the pine, stands will naturally revert to hardwoods in time. This may not be all bad, especially on sites that can support high-quality hardwoods. Many years will pass before the softwood timber removals can be increased and yet not exceed the annual net growth.

In 1971 the total annual net growth of hardwoods was 14.6 million cubic feet. The volume of hardwood growing-stock removals was 4.4 million cubic feet. The difference between net growth and removals is often thought of as the volume of additional timber that could be harvested without reducing the growing-stock inventory volume. However, the actual volume of hardwood that could be harvested is much less than this difference, for a variety of reasons. No attempt has been made to determine the volume of softwood or hardwood timber that can be bought or sold on the open market.

Most of the timber in Delaware is owned by farmers and miscellaneous private owners. Some of these owners may be unwilling to sell timber under any circumstances. Others may be unwilling to sell at current market prices. In a recent study of the marketing of forest products in Delaware was a statement that ". . . two of the larger operators indicated a difficulty in buying a sufficient supply of timber" (*5*).

In the ownership study conducted by the Northeastern Station, it was revealed that 63 percent of the non-corporate forest landowners in Delaware have owned their forest land for 10 years or more and account for 69 percent of the non-corporate commercial forest land. Over one-half of the forest landowners in Delaware have harvested timber.

Nearly 55 percent of the owners in Delaware indicated that they owned forest land because it was "part of their residence." The next most common reason (from 24 percent of the owners) was land investment. Only a small percentage of the owners stated that they owned forest land primarily for timber production.

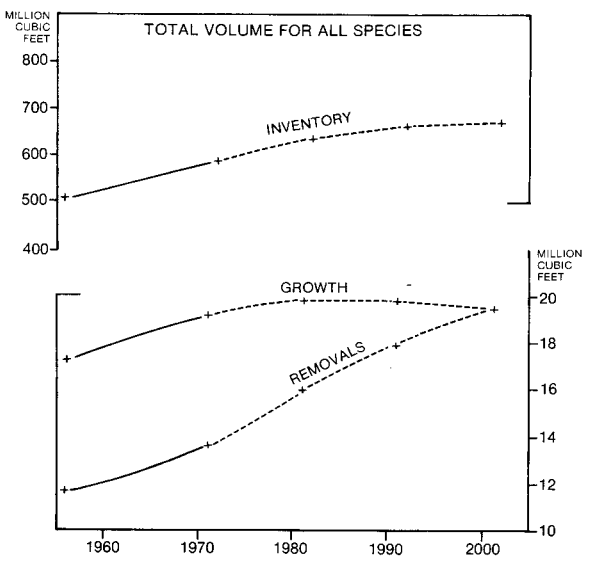
About 95 percent of the commercial forest land is owned by those people who have had timber harvests in the past. Owners of 77 percent of the commercial forest land (273,000 acres) plan to harvest timber within the next 10 years, and owners of 15 percent of the commercial forest land (57,000 acres) may or may not harvest timber. And the owners of 8 percent of the commercial forest land (29,000 acres) plan never to harvest any timber; therefore, the maximum acreage of commercial forest land available for timber harvesting is less than 341,000 acres.

Timber-Supply Outlook

Preceding sections of this report have pointed out that timber removals of softwood species were much greater than annual net growth and that timber removals for hardwood species were much less than growth. This section presents the results of several projections for the two major species groups —softwoods and hardwoods. The main question is: What might be the future timber supply in Delaware?

In answer to this question, two separate projections based upon different basic assumptions are presented. Both projections, however, have three assumptions in common: (1) the total area of commercial forest land in Delaware will remain fairly constant; (2) diameter-growth rates by species groups, based upon the average annual net growth between surveys, will hold for the next 30 years: and (3) trends in forestry programs will continue at the same rate as in the past.

Figure 15. — First projection: growth equals removals in 2002.



FIRST PROJECTION: GROWTH EQUALS REMOVALS IN 2001

This first projection is based on the objective that the annual net growth and removal of growing stock will be brought into balance in 30 years (table 29). Also, timber available for cutting can be assumed to be that amount that will bring annual net growth and timber removals into balance at the end of 30 years (fig. 15). From the trend curves of timber removals and corresponding annual net growth for softwoods and for hardwoods, the following tabulation shows for specified years the annual growth and available cut, in millions of cubic feet:

	ALL SPECIES		*SOFTWOODS ONLY*	
Year	*Annual growth*	*Available cut*	*Annual growth*	*Available cut*
1971	19.2	12.5	4.6	8.1
1981	19.8	16.0	3.5	5.5
1991	19.8	17.9	2.6	3.7
2001	19.6	19.5	2.3	2.3

Under this projection, the inventory of growing stock would increase from 588 million cubic feet in 1972 to 670 million cubic feet in 2002. However, this increase would take place entirely in the hardwood species group. The hardwood inventory volume would increase 31 percent to 530 million cubic feet, but the softwood inventory volume would decrease 24 percent to 140 million cubic feet. Unless timber cutting of hardwoods is greatly accelerated, annual net growth and annual removals will not come into balance at the end of the 30-year period.

SECOND PROJECTION: REMOVALS FOLLOW 1956-71 TREND

The softwood and hardwood projections are based on the assumption that the trend of removals for 1956-71 will continue through the next 30 years. The timber removal rates, however, are considerably different for softwoods than for hardwoods. During the 15-year period between surveys, softwood removals decreased an average of 0.6 percent per year and hardwood removals increased 4.2 percent per year.

Current timber removals of all species combined are about 65 percent of annual net growth, but softwood timber removals were much greater than annual growth. Under this projection (1971 to 2001), total removals of growing stock would increase from 12.5 million to 13.2 million cubic feet in the year 2001. Annual net growth would increase from 19.2 million to 28.5 million cubic feet. At the same time, the total growing-stock inventory volume would increase from 588 million to 910 million cubic feet in 2002 (fig. 16).

The inventory volume for all species combined would increase 55 percent in the 30-year period. Softwoods made up 31 percent of the inventory volume in 1972, but would make up only 11 percent of the inventory volume in 2002 if present trends continue.

Annual cut of all species would increase slightly during the period—only 6 percent—and annual net growth would increase 48 percent. Softwoods in Delaware are being greatly overcut. They made up 65 percent of the timber removals in 1971, and by 2001 they will make up less than 30 percent. These projections based on present trends show that softwood timber removals in 2001 will be less than half of what they were in 1971 and that hardwood timber removals will be more than double.

Figure 16. — Second projection: removals continue present trend.

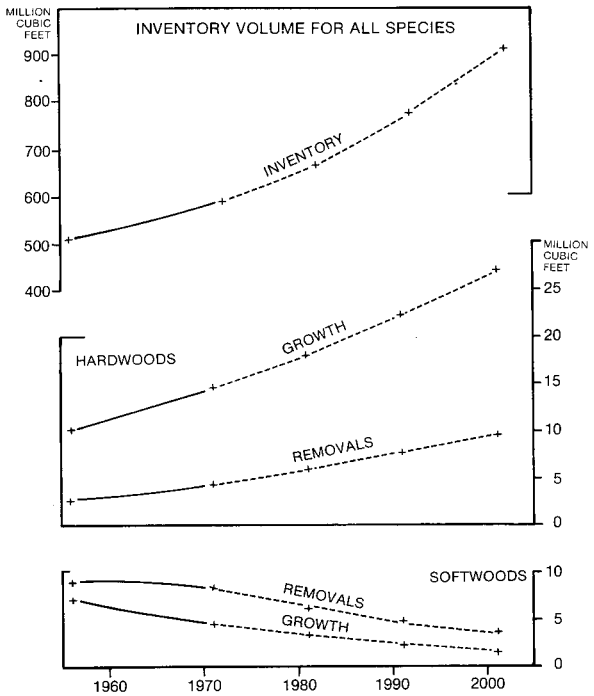


Figure 17. — Service for woodland owners is available through the Forestry Section of the Delaware Department of Agriculture. Headquarters are in Dover.

Management Opportunities

At the time of the initial survey, the total volume of timber growth was 49 percent greater than the volume of timber cut, and softwood growth was less than softwood cut. However, the timber-volume inventory increased greatly between surveys. In 1957 the growing-stock volume per acre was 1,300 cubic feet, and in 1972 the volume per acre had increased to 1,500 cubic feet. And, along with the increases in timber volume, about 40 percent of the present timber stands are overstocked, including rough and rotten trees.

Delaware has a much higher volume-per-acre annual net growth than most eastern states. In 1956 the commercial forest land in Delaware was producing 45 cubic feet of net growth per acre, and in 1971 the rate had increased to 50 cubic feet per acre. And yet, the potential is even greater. Only one-third of the commercial forest land has a potential site productivity of less than 50 cubic feet of growth per acre (table 8). Thirty-six percent of the commercial forest land has the potential of 50 to 85 cubic feet per acre, and 31 percent has the potential of more than 85 cubic feet per acre.

The highly productive forest soils throughout most of the State favor improvement of the timber resource. Forests in the State would become more valuable if a greater proportion of the timber were in softwood species, in larger-size trees, and in trees of higher quality.

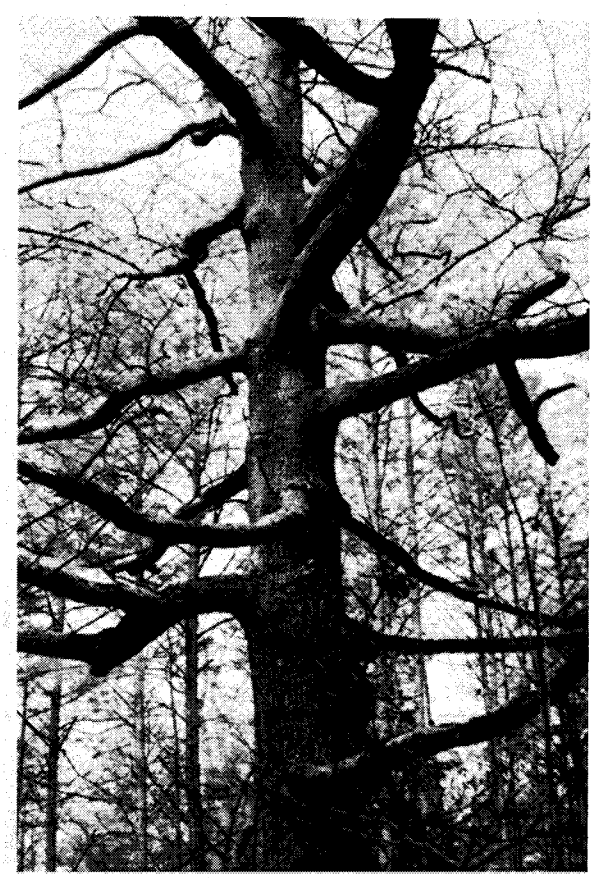
Loblolly pine is the species in greatest demand, and it is being greatly overcut. Before- and after-harvest treatment of stands that contain loblolly pine is needed to insure continuation of the pine stocking and to reduce hardwood competition. Planting of pine is not enough; a follow-through is urgently needed to keep the low-quality hardwoods in check. Cutting practices that discourage low-quality hardwoods are needed.

Increased forest management would help make the forests a more valuable resource. Woodland management service is available upon request. This is a free service of the Delaware State Department of Agriculture, Division of Production and Promotion, Forestry Section, headquartered in Dover (fig. 17). The objectives of this service are: (1) to encourage woodland owners to produce more and better forest crops and (2) to establish new forest crops on idle land.

To accomplish the first objective, timber stand improvement (TSI) needs to be done to increase the proportion of pine and high-quality hardwoods. Many of the rough and rotten trees that occupy valuable growing space should be cut or girdled (fig. 18). Many of the pine plantations that have been established over the years are in urgent need of thinning and pruning.

The timber in the 6- to 12-inch dbh classes has been cut more heavily than in the larger

Figure 18. — Old rough and rotten trees that remain after timber harvesting often hinder valuable natural growth.



diameter classes, especially poletimber-size loblolly pine. The result shows up quite clearly in figure 7 (growing-stock volume by diameter classes); growing-stock volume in the 6- and 8-inch dbh classes is actually less now than in 1957. Many more of the smaller-diameter trees need to be left uncut to grow into larger size and better quality sawtimber.

Loblolly pine stands are the most profitable of all the forest types in Delaware. Many of the best loblolly pine stands originated on old-field sites. Unfortunately, hardwoods also invaded these areas. Conditioning treatments applied in advance of the main harvest cutting to increase the proportion of pine in the next stand are recommended (*4*). Loblolly pine grows well in Sussex County; however, it is being overcut heavily. In 1971 the annual net growth was 3.5 million cubic feet, and timber removals were 6.6 million cubic feet. Therefore it is very important to apply conditioning treatments to help build back the supply of this valuable species.

To accomplish the second objective — to establish new forest crops on idle land—Delaware has supplied forest trees for many years to farmers and other woodland owners to plant on their cut-over forest land or idle cropland (fig. 19). The State constructed a new forest-tree nursery at Ellendale in 1970 to replace a former one. The present nursery produced almost one million seedlings for distribution in 1972. The output consisted of loblolly pine, white pine, Norway spruce, Douglas-fir, Japanese black pine, baldcypress, and yellow-poplar.

Seedlings ready for transplanting can be purchased from the State nursery for about $7 per thousand. Much of the field planting is done in the spring, but fall planting has become more favored by landowners in recent years. The recommended spacing is approximately 600 to 800 seedlings per acre. The 1972 production at the Ellendale nursery was large enough for planting more than 1,000 acres.

Figure 19. — Seedlings that are grown and bundled at Delaware's tree nursery often become part of a Tree Farm.

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Appendix

DEFINITION OF TERMS

Land-Area Classes

Land area. — (a) Bureau of the Census. The area of dry land and land that is temporarily or partly covered by water, such as marshes, swamps, and river flood plains; streams, sloughs, estuaries, and canals that are less than 1/8 statute mile in width; and lakes, reservoirs, and ponds that are less than 40 acres in area. (b) Forest Survey. The same as the Bureau of the Census, except that the minimum width of streams, etc., is 120 feet, and the minimum size of lakes, etc., is 1 acre.

Forest land. — Land that is at least 16.7 percent stocked (contains at least 7.5 square feet of basal area) by forest trees of any size, or that formerly had such tree cover and is not currently developed for nonforest use. (Forest trees are woody plants that have a well-developed stem and usually are more than 12 feet in height at maturity.) The minimum area for classification of forest land is 1 acre.

Commercial forest land. — Forest land that is producing or capable of producing crops of industrial wood (more than 20 cubic feet per acre per year) and is not withdrawn from timber utilization. (Industrial wood: all roundwood products except fuelwood.)

Noncommercial forest land. — Forest land that is incapable of yielding timber crops because of adverse site conditions (unproductive forest land), and productive forest land that is withdrawn from commercial timber use (productive-reserved forest land).

Productive-reserved forest land. — Forest land that is sufficiently productive to qualify as commercial forest land, but is withdrawn from timber utilization through statute, administrative designation, or exclusive use for Christmas-tree production.

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

Nonforest land. — Land that has never supported forests, and land formerly forested but now in nonforest use such as for crops, improved pasture, residential areas, and the like.

Ownership Classes

Federal. — Lands (other than National Forests) that are administered by Federal agencies.

State. — Lands that are owned by the State of Delaware or leased to the State for 50 years or more.

County and municipal. — Lands that are owned by counties and local public agencies or municipalities or leased to them for 50 years or more.

Forest industry. — Lands that are owned by companies or individuals operating wood-using plants.

Farmer-owned. — Lands that are owned by farm operators, whether part of the farmstead or not. Excludes land leased by farm operators from nonfarm owners.

Miscellaneous private. — Privately owned lands other than forest-industry and farmer-owned lands.

Stand-Size Classes

Stand. — A growth of trees (see definitions under "Tree Classess") on a minimum of 1 acre of forest land that is at least 16.7 percent stocked by forest trees of any size.

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

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

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

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

Stocking Classes

Stocking. — The degree of occupancy of land by trees, measured in terms of basal area of trees in a stand compared to the basal area of trees required to utilize fully the growth potential of the land. The actual stocking at a point was evaluated against a standard of 75 square feet of basal area per acre (see definition of basal area under "Tree Measurement and Volume"). The stocking percentage for a sample plot is derived from the stocking for each of 10 points. Three categories of stocking are used:

All live trees. — These are used in the classification of forest land and forest types.
Growing-stock trees. — These are used in the classification of stand-size classes.
Desirable trees. — These are used in the classification of area-condition classes.

The degree of plot stocking is viewed as a range of values rather than single points. A fully stocked stand lies within the range of 100 to 133 percent of the basal-area standard. An overstocked stand contains more than 133 percent. The range for medium stocking is 60 to 100 percent and for poor stocking is 16.7 to 60 percent of the basal-area standard. Forest land with less than 16.7 percent of the basal-area standard is classed as nonstocked.

Tree Classes

Forest trees. — Woody plants that have a well-developed stem and usually are more than 12 feet in height at maturity.
Commercial species. — Tree species that are presently or prospectively suitable for industrial wood products. Excludes species of typically small size, poor form, or inferior quality, such as hawthorn and sumac.
Growing-stock trees. — Live trees of commercial species that are classified as sawtimber, poletimber, saplings, and seedlings; that is, all live trees of commercial species except rough and rotten trees. (See definitions under "Class of timber.")
Acceptable trees. — Growing-stock trees of commercial species that meet specified standards of size and quality, but do not qualify as desirable trees.
Desirable trees. — Growing-stock trees of commercial species; (a) that have no serious quality defects that limit present or prospective use for timber products, (b) that are of relatively high vigor, and (c) that contain no pathogens that may result in death or serious deterioration before rotation age.
Rotten trees. — Live trees of commercial species that do not contain at least one 12-foot sawlog or two noncontiguous sawlogs, each 8 feet or longer, now or prospectively, and do not meet regional specifications for freedom from defect primarily because of rot; that is, when more than 50 percent of the cull volume in a tree is rotten.
Rough trees. — (a) The same as above, except that rough trees do not meet regional specifications for freedom from defect primarily because of roughness or poor form, and (b) all live trees that are of noncommercial species.

Site - Quality Classes

Site class. — A classification of forest land in terms of inherent capacity to grow crops of industrial wood. Classifications are based upon the mean annual growth of growing stock attainable in fully stocked natural stands at culmination of mean annual growth.

Forest Types

Forest type. — A classification of forest land based upon the species forming a plurality of live-tree stocking. The many local forest types in Delaware were combined into the following major forest types:
Loblolly-shortleaf pine. — Forests in which loblolly pine, shortleaf pine, or other southern yellow pines, singly or in combination, make up a plurality of the stocking. Includes a small acreage of the eastern redcedar type. (Common associates include sweetgum, black tupelo, and southern red oak.)
Oak-pine. — Forests in which oaks or hickory, singly or in combination make up a plurality of the stocking, but in which southern pines make up 25 to 50 percent of the stocking.
Oak-hickory. — Forests in which oaks or hickory, singly or in combination, make up a pluraliy of the stocking, except where southern pines make up 25 to 50 percent, in which case the stand would be classified oak-pine. (Common associates include yellow-poplar, sweetgum, and red maple.)
Oak-gum-red maple. — Forests in which oak, gum, or red maple, singly or in combination, make up a plurality of the stocking. Although there is some baldcypress in Delaware, none was tallied on the sample plots. (Common associates include beech and sweetbay.)

Class of Timber

Softwoods. — Coniferous trees that are usually evergreen, having needles or scalelike leaves.
Hardwoods. — Dicotyledonous trees that are usually broad-leaved and deciduous.
Sawtimber trees. — Live trees of commercial species: (a) that are of the following minimum diameters at breast height — softwoods 9.0 inches and hardwoods 11.0 inches, and (b) that contain at least one 12-foot merchantable sawlog and meet regional specifications for freedom from defect.
Poletimber trees. — Live trees of commercial species that meet regional specifications of soundness and form, and are at least 5.0 inches dbh but are smaller than sawtimber size.
Saplings. — Live trees of commercial species that are 1.0 to 5.0 inches dbh and of good form and vigor.
Seedlings. — Live trees of commercial species that are less than 1.0 inches dbh and are expected to survive.
Rough and rotten trees. — See definitions under "Tree Classes."

Timber Measurement and Volume

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.
Board foot. — A unit of lumber measurement 1 foot long, 1 foot wide, and 1 inch thick, or its equivlent. By forest-survey convention, softwoods less than 9.0 inches dbh and hardwoods less than 11.0 inches dbh do not contain board-foot volume.
Diameter at breast height (dbh). — The diameter outside bark of a standing tree measured at 4½ feet above the ground.
Growing-stock volume. — Net volume, in cubic feet, of live growing-stock trees that are 5.0 inches dbh 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 equals gross volume less deduction for rot.

International ¼-inch rule. — A log rule, or formula, for estimating the board-foot volume of logs. Stated mathematically, the formula is [{D^2 x 0.22} — 0.71 D] x 0.904762 for 4-foot sections, where D = the diameter inside bark at the small end of the 4-foot section. The International ¼-inch rule is used as the USDA Forest Service standard log rule in the northeastern United States.

Standard cord. — A unit of measure for stacked bolts of wood, encompassing 128 cubic feet of wood, bark, and air space. Cord estimates can be derived from cubic-foot estimates of growing stock by applying an average factor of 80 cubic feet of wood (inside bark) per rough cord.

Sawtimber volume. — Net volume in board feet, International ¼-inch rule, of merchantable sawlogs in live sawtimber trees. Net volume equals gross volume less deductions for rot, sweep, and other defects that affect use for lumber.

Sawlog. — A log that meets minimum standards of diameter, length, and defect, including logs at least 8 feet long, and with a minimum diameter inside bark of 6 inches for softwoods and 8 inches for hardwoods. (See specifications under "Log Grade Classification.")

Sawlog portion. — That part of the bole of a sawtimber tree between the stump and the sawlog top (merchantable height).

Sawlog top. — The point on the bole of a sawtimber tree above which a sawlog cannot be produced. The minimum sawlog top is 7.0 inches dob (diameter outside bark) for softwoods and 9.0 inches dob for hardwoods.

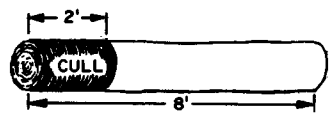
Upper-stem portion. — That part of the main stem or fork of a sawtimber tree above the sawlog top to a diameter of 4.0 inches outside bark or to the point where the main stem or fork breaks into limbs.

Log-Grade Classification

Log grades are a classification of logs based on external characteristics as indicators of quality or value. The log-grade standards and grading systems for softwood and hardwood species used in this forest survey of Delaware are shown in the following specifications:

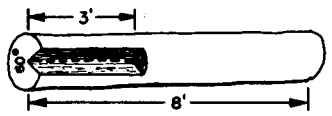
METHODS USED TO DETERMINE SCALING DEDUCTION

(Examples based on an 8-foot log with 20-inch scaling diameter)



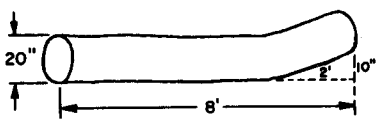
If section of bole is affected, deduct percent of log length affected.

Example $\frac{2}{8}$ = 25 percent cull



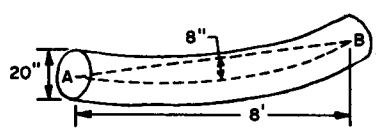
If sector is affected, multiply percent of circle times percent of length.

Example: $\frac{60°}{360°} \times \frac{3}{8}$ = 6 percent cull



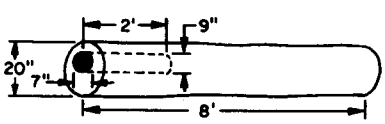
For a crook, multiply proportion of diameter displaced times proportion of log length affected by crook.*

Example: $\frac{10}{20} \times \frac{2}{8}$ = 12 percent board-foot cull



For a sweep, determine sweep departure and subtract 1 inch for 8-foot logs or 2 inches for 16-foot logs. Divide by log diameter.

Example: $\frac{8 - 1}{20}$ = 35 percent board-foot cull**



For interior cull, square out interior cull as a percent of total volume of the section. For board-foot cull, add 1 inch to width and to thickness; for cubic-foot cull, use actual dimensions of rot. For board-foot cull divide width and thickness by the scaling diameter (average d.i.b., small end) minus 1; for cubic-foot cull, divide by scaling diameter. Multiply fractions by percent of log affected.

Example: $\frac{8 \times 10}{20\text{-}1} \times \frac{2}{8}$ = 6 percent cubic-foot cull

* No reduction of cubic-foot volume will be made.

** If a straight line between A and B falls outside the bark, the affected section is over 50 percent cull in board feet.

SOUTHERN PINE LOG GRADES

Grade factor	Grade			
	1	*2*	*3*	*4*
Minimum diameter	17″	10″	6″	6″
Maximum K value	1/5D	1/2D	None	None
Minimum specification on bad knots			Any bad knots present are localized in section not exceeding ¼″ circumference and length.	No limit

Exceptions

a. Lower one grade any log, not grade 4, having 3 inches or more of sweep if such sweep is ⅓ or more of log diameter.

b. Lower one grade any log, not grade 4, if heart-rot fruiting has occurred or is imminent, as indicated by conk or visible, massed, heart-rot hyphae.

K = number of overgrown knots plus sum of diameters of sound knots plus twice sum of diameters of unsound knots.

Bad knot: A knot with diameter > D/6, or an unsound knot (advance decay or a hole > ¼″ and 2″ or more deep).

Source: Forest Service Log Grades for Southern Pine. SE. Forest Exp. Sta., U.S. Forest Serv. Res. Paper SE-11, 1964.
Note: These log grades were applied to pitch pine in New York.

WHITE PINE LOG GRADES

(Unpublished trial specifications, revised 1963)

Log grade	*Minimum size*		*Defect allowance*		*Maximum weevil injury*	*Allowable knot size (inches) on 3 best faces or minimum clearness on 4 faces*
	Diameter	*Length*[1]	*Sweep or crook*	*Total cull including sweep*		
	Inches	*Feet*	*Percent*	*Percent*	*Number*	*Inches*
No. 1	12 & 13	8–16	20	50	0	4 faces free of knots ½″ or larger full length of log.
	14+	10–16	20	50	0	2 faces free of knots ½″ or larger full length of log, or 4 faces free of knots ½″ or larger 50 percent length of log (6′ minimum length)[2].
No. 2	6+	8–16	30	50	0	Sound red knots ≦[3] D/6 and no larger than 3″. Black knots: Butt logs ≦ D/12 and no larger than 1½″. Upper logs ≦ D/10 and no larger than 1½″. or 4 faces free of knots ½″ or larger 50 percent length of log.
No. 3	6+	8–16	40	50	8′ logs: 1 weevil	Sound red knots ≦ D/3 and no larger than 5″.
					10′+ logs: 2 weevils	Black knots ≦ D/6 and no larger than 2½″.
No. 4	6+	8–16	50	50	No limit	No limit.

[1] Plus trim.

[2] If the sum of the diameters of sound red knots plus 2X (sum of the diameters of dead or black knots) in inches is ≦ ½ the diameter of the log (in inches).

[3] ≦ means equal to or less than.

SPRUCE, FIR, HEMLOCK, TAMARACK, AND CEDAR LOG GRADE

(Minimum merchantability specifications)

Log grade	Minimum size		Defect allowance		Other requirements
	Diameter[1]	Length[2]	Sweep or crook	Total deduction	
	Inches	*Feet*	*Percent*	*Percent*	
1	10–12	8–16 in 2-foot multiples	25	50	Sound knots not over 2 inches in diameter permitted. Shake permitted up to 20 percent of gross scale if not combined with other serious defects.
	13+	8–16 in 2-foot multiples	25	50	Sound knots not over 3 inches in diameter permitted. Shake permitted up to 20 percent of gross scale if not combined with other serious defects.

[1] At small end of log.
[2] Without trim.

HARDWOOD FACTORY LUMBER LOG-GRADE SPECIFICATIONS

(From U.S. Forest Products Laboratory Report D 1737)

GRADE FACTORS*		SPECIFICATIONS							
		Log Grade 1			Log Grade 2				Log Grade 3
Position in tree		Butts only	Butts & uppers		Butts & uppers				Butts & uppers
Minimum diameter (inches)		13–15[1]	16–19	20+	11[2]		12+		8+
Minimum length (feet)		10+	10+	10+	10+	8–9	10–11	12+	8+
Clear cuttings** on each of the 3 best faces	Min. length (ft.)	7	5	3	3	3	3	3	2
	Max. number	2	2	2	2	2	2	3	—
	Min. yield in face length	5/6	5/6	5/6	2/3	3/4	2/3	2/3	1/2
Max. sweep and crook allowance (percent of gross volume)		15			30				50
Max. cull and sweep allowance (percent of gross volume)		40[3]			50[4]				50

* End defects, although not visible in standing trees, are important in grading cut logs. Instructions for dealing with this factor are contained in Forest Prod. Lab. Rpt. D 1737.

** A clear cutting is a portion of a face free of defects, extending the width of the face. A face is one-fourth the surface of the log as divided lengthwise.

[1] Ash and basswood butts can be 12 inches if otherwise meeting requirements for small No. 1's.

[2] 10-inch logs of all species can be No. 2 if otherwise meeting requirements for small No. 1's.

[3] Otherwise No. 1 logs with 41-50 percent cull can be No. 2.

[4] Otherwise No. 2 logs with 51-60 percent cull can be No. 3.

Source: A Guide to Hardwood Log Grading (pg 11), NE. Forest Exp. Sta., Upper Darby, Pa. 1965.

HARDWOOD CONSTRUCTION LOG SPECIFICATIONS

GRADE FACTORS		SPECIFICATIONS
Position in tree		Butts and uppers
Scaling diameter (inches)		8+
Length, without trim (feet)		8+
Clear cuttings		No requirements: not graded on cutting basis.
Max. sweep allowance		One-fourth d.i.b. of small end for half logs, and one-half d.i.b. for logs 16 feet long.
Sound surface defects permitted	Single knots	Any number, if none has an average collar* diameter that is more than one-third of log diameter at point of occurrence.
	Whorled knots	Any number, provided the sum of the collar diameters does not exceed one-third the log diameter at point of occurrence.
	Holes	Any number not exceeding knot specifications if they do not extend more than 3 inches into the contained tie or timber.
Unsound surface defects permitted**		Any number and size if they do not extend into contained tie or timber. If they extend into contained tie or timber, they shall not exceed size, number, and depth of limits for sound defects.

* *Knot collar is the* average of the vertical and horizontal diameters of the limb or knot swelling as measured flush with the surface of the log.

** *Interior defects are not* visible in standing trees. They are considered in grading cut logs. No interior defects are permitted except one shake not more than one-third the width of the contained tie or timber, and one split not more than 5 inches long.

Source: A Guide to Hardwood Log Grading, (pg. 28), NE. Forest Exp. Sta., Upper Darby, Pa. 1965.

Annual Net Growth and Timber Removals

Average annual net growth of growing stock. — The change (resulting from natural causes) in volume of sound wood in sawtimber and poletimber trees during the period between surveys, divided by the length of the period. (Components of annual net growth of growing stock include the increment in net volume of trees present at the beginning of the period and surviving to its end, plus net volume of trees reaching poletimber size during the period, minus the net volume of trees that died during the period, minus the net volume of trees that became rough or rotten trees during the period, cull increment.)

Average annual ingrowth of growing stock. — The net cubic-foot volume of trees now classed as growing stock that were less than 5.0 inches dbh on the initial survey, divided by the length of the period between surveys.

Average annual mortality of growing stock. — The net cubic-foot volume removed from the growing stock because of death from natural causes during the period between surveys, divided by the length of the period between surveys.

Average annual growing-stock removals. — The net cubic-foot volume of growing-stock trees harvested or killed in logging, cultural operations such as timber-stand improvement, land-clearing, or changes in land use during the period between surveys, converted to an annual basis.

Average annual net growth of sawtimber. — The change (resulting from natural causes) in net board-foot volume of sawtimber during the period between surveys, divided by the length of the period. (Components of annual net growth of sawtimber include the increment in net volume of sawtimber trees present at the beginning of the period and surviving to its end, plus the net volume of trees reaching sawtimber size during the period, minus the net volume of sawtimber trees that died during the period, minus the net volume of sawtimber trees that became rough or rotten trees during the period between surveys, cull increment.)

Average annual ingrowth of sawtimber. — The net board-foot volume of trees now classed as sawtimber that were not tallied as such on the initial survey, divided by the length of the period between surveys.

Average annual mortality of sawtimber. — The net board-foot volume removed from live sawtimber by death from natural causes during the period between surveys, divided by the length of the period between surveys.

Average annual sawtimber removals. — The net board-foot volume of sawtimber trees harvested or killed in logging, cultural operations such as timber-stand improvement, land-clearing, or changes in land use during the period between surveys, converted to an annual basis.

Cull increment. — The net volume of growing-stock trees on the initial inventory that became rough or rotten trees in the second inventory.

Logging residues. — The unused growing-stock volume of trees cut for products and the total growing-stock volume of trees destroyed in the course of logging but not removed for products.

Other removals. — The growing-stock volume of trees that were removed from the inventory and not used for products, by cultural operations (i.e., weeding, thinning, etc.), land-clearing, and reclassification of some commercial forest land as noncommercial forest land.

Plant byproducts. — Wood products, such as slabs, edgings, and veneer cores, that are obtained incidental to the production of timber products and are utilized in the manufacture of other timber products. (Bark is not included.)

Plant residues. — Wood material produced incidental to the production of timber products but not utilized.

Roundwood products. — Logs, bolts, or other round sections cut from growing stock or non-growing stock for industrial or nonindustrial uses.

Timber products. — Roundwood products and plant byproducts from all sources.

Timber removals. — The growing-stock volume of trees removed from the inventory for roundwood products, plus logging residues and other removals.

Annual net growth trend-level. — The estimated growth of growing stock or sawtimber for a specific year that is consistent with the average annual growth during the period between surveys and with the current inventory. (1971 for Delaware.)

Annual removals trend-level. — The estimated removals of growing stock or sawtimber for a specific year that is consistent with the trend of removals during the period between surveys and with the current inventory. (1971 for Delaware.)

FOREST-SURVEY METHODS

The Northeastern Forest Experiment Station's Forest Survey project used the sampling-with-partial replacement (SPR) design in the re-inventory of Delaware's timber resource. With this design, estimates of forest area and timber volume were made by combining an inventory estimate based on a remeasured sample with a new independent photo and ground-plot inventory. Thus the SPR design, by combining two independent estimates of the inventory, yields a better estimate of the timber resource at a given cost.

One estimate is based on the updating of the initial survey (1957). This required the remeasurement of all the initial inventory ground plots. The area-change and current-volume estimates obtained from the remeasured sample plots were used to update the initial photo plots to obtain an independent estimate of current timber volume and forest area.

The second estimate is also based on a large photo-plot sample with a subsample of ground plots. For the second estimate the most recent aerial photography coverage of Delaware was used. Photo plots were pinpointed on each photograph to provide a uniformly distributed sample of the area. Each photo plot was examined stereoscopically and classified as either forest or nonforest land. Those classified as forest land were further stratified into cubic-foot-volume-per-acre classes. A subsample of these photo plots, which was selected to be proportional to the area in a photo class, was measured on the ground. From this ground measurement, estimates of the mean and variance of each photo class were obtained. These means were expanded by the photo-strata areas to yield a second independent estimate of forest area and timber volume.

The final estimates of current forest area and timber volume were developed by combining these two independent estimates. The combination process consisted of weighting each estimate by the reciprocal of its variance and then adding them. The associated sampling error for this new estimate was also obtained. These combined totals were partitioned into the various categories of area and volume (e.g., volume by species and dbh class) using the data obtained from the new ground-plot sample.

In addition to estimating current timber volume and forest area, the forest survey of Delaware was designed to obtain an estimate of the components of average annual change during the period between the initial and the current inventories. The parameters of interest include area change from forest to nonforest and vice versa, timber growth, timber removals, and timber mortality. All this information was obtained from the remeasured plots. The timber-change parameters were obtained by a tree-by-tree reconciliation of each remeasured plot. The reconciliation code for each remeasured tree was used to make estimates of the parameters of change, by species. The estimates of change were expressed as average annual figures by dividing the totals for the period by the number of years between measurements. These estimates were then used in the computations of annual net growth, mortality, and removals for 1971.

Although ownership was determined for each forest ground plot, the data were superseded by a more recent ownership study in Delaware and other states. The area in farmer-owned commercial forest land, based on the ownership study, was found to be greater than the estimate based on the sample plots.

Remeasured-plot Phase

The initial forest inventory of Delaware consisted of a large photo-plot sample plus a ground measurement of a subsample of these photo plots. (At the initial survey occasion, the ground plots were selected according to optimum allocation for volume estimation.) The photo plots were stratified according to land use as forest or nonforest. The forest plots were further classified into volume classes. A total of 103 ground plots were measured by field crews during this first inventory. These ground samples were 1/5-acre circular plots.

At this second measurement occasion, all the initial ground plots (including 11 nonforest plots) were revisited. The plot center was relocated for each remeasured plot. On those plots that were forested, all the trees on the 1/5-acre were tallied. The new tally was reconciled with the initial tally to account for every tree at both occasions.

New Ground-plot Phase

The source of the new independent estimates of volume and forest area was a new photo stratification with a subsample of ground measurements. The photo sample of Delaware consisted of about 4,100 photo points on the latest available aerial photography. A subset of 146 of these photo plots, including 53 nonforest plots, was located on the ground. Land use was verified and tree-measurement data were recorded for the 93 forest plots. Unlike the initial inventory, in which fixed-radius 1/5-acre plots were tallied, the new ground plots consisted of a cluster of 10 prism points systematically covering approximately 1 acre. At each point, trees were selected for tally by using a prism with a basal area-factor of 37.5. Area-attribute data were also tallied at each of the 10 points.

Data Processing

Field-tally data consisting of plot and individual-tree information were processed and compiled into various tables, using FINSYS — Forest Inventory System — on modern, large-capacity, high-speed computers.

FINSYS is a data-processing system consisting primarily of a series of computer programs that was developed by the Northeastern Forest Experiment Station to process and compile a large volume of

forest-inventory data. The system consists of an editing subsystem that edits field-tally data for errors; a table-compiling subsystem that compiles tables from edited field data; and, finally, an output subsystem that expands the plot data to geographic-unit or statewide estimates and prints the final tables.

FINSYS was described in a series of research papers by R. W. Wilson and R. C. Peters in 1967: *The Northeastern Forest Inventory Data Processing System,* USDA Forest Service Research Papers NE-61 and NE-70 to 80.

Before modern computers came into use, the compiling of forest-inventory data was a major bottleneck in forest inventory work. Using FINSYS, it is possible, as it was in the resurvey of Delaware, to have preliminary estimates available within 6 months after the last plot is taken. To process and compile data for a state the size of Delaware, from key-punching to the output of tables, requires about 2½ months of elapsed time and about 2½ hours of computer time.

FINSYS has several features that make it unique. One of these is the ability not only to calculate inventory estimates but also to calculate the variance and sampling error for each estimate. This feature provides the user with a measure of the reliability of each statistic and the ability to determine the reliability of a new estimate based upon a data combination he may make.

Another feature of FINSYS is its flexibility. The system is not restricted to the Northeastern forest survey but can be used for any large-scale forest inventory. Also, the system does not produce a standard set of tables. The individual user specifies the tables to be developed according to his particular need. Thus, at any stage in the data-processing phase or even at a later date, a specific table can be developed with minimum effort.

County Data

Many users of forest-survey data have shown a need for county information. To provide such information within the framework of the survey design, tables for counties where more than one county makes up a geographic stratum (the entire state in the case of Delaware) have been developed, based on a survey-unit partitioning technique.

First, the State means and variances for the various photo-plot strata were applied to the photo-plot data for each county. This yielded an estimate of total volume or total commercial forest-land area for each county. Next, the data from all the new ground plots in the State were used to partition the county totals into their various components. For example, if a table of cubic-foot volume by softwoods and hardwoods is to be made for a county, the estimate of total cubic-foot volume for that county is partitioned into softwood and hardwood totals according to the proportion of softwoods and hardwoods for all new forest-survey ground plots within the State.

Comparisons Between Inventories

After inventories have been completed for several points in time, it is desirable to evaluate the trends between the several inventories and to make comparisons. A comparison of the 1971-72 and the 1956-57 forest-survey estimates of volume, growth, removals, and mortality was made for Delaware. A computer program, TRAS (Timber Resource Analysis System), was used.

Because of changes in procedures and in definitions, it was necessary to adjust the 1957 inventory-volume estimate to what it would have been had the 1971-72 procedures and definitions been used in 1957. This process involves several calculations and adjustments in the 1957 inventory to make it comparable with the 1972 inventory. One important step in this process is to recalculate the 1957 inventory volume, using the average net volume per tree from the resurvey. To do this, the average net volume per tree (for softwoods and for hardwoods) developed from the resurvey for each 2-inch diameter class was multiplied by the number of trees in each 2-inch diameter class from the 1957 inventory. These calculations resulted in an inventory estimate for 1957 adjusted to 1971-72 standards. The adjusted 1957 volume estimates for Delaware are as follows:

- For softwood growing stock, both the adjusted and reported volume estimates are the same.
- For hardwood growing stock, the volume is 8 percent greater than reported.
- For softwood sawtimber, the volume is 14 percent lower than reported.
- For hardwood sawtimber, the volume is 10 percent lower than reported.

The adjusted 1957 volume estimates, not the volume estimates published in the report for the initial survey, are the basis for comparisons between surveys shown in this report.

RELIABILTY OF THE ESTIMATES

The forest-area and timber-volume data presented in this report were based upon a carefully designed sample of forest conditions throughout Delaware. However, since neither every acre nor every tree in the State was measured, the data presented in this report are estimates. A measure of the reliability of these estimates is given by a sampling error. An associated sampling error was calculated for each estimate in this report. Many of these appear in the data tables.

Briefly, this is how the sampling error indicates the reliability of an estimate. Our estimate of the total growing-stock volume in Delaware — 588 million cubic feet — has an associated sampling error of 5 percent (29 million cubic feet). This means that our best estimate of the total growing-stock volume in Delaware in 1972 is 588 million cubic feet. If there are no errors in procedure, the odds are 2 to 1 that, if we repeated the survey in the same way, the resulting estimate of growing-stock volume would be between 559 million and 617 million cubic feet (588 ±29). Similarly, the odds are 19 to 1 that it would be within ±58 million cubic feet and 300 to 1 that it would be within ±87 million cubic feet.

The computed sampling error is not a complete measure of reliability. There are other sources of error that this term does not include. There could be imperfections in volume tables and equations, and errors in field measurement. Procedural errors were kept to a minimum by careful training of all personnel, frequent inspection of field work, and application of the most reliable survey methods.

Computed sampling errors for the totals shown in the statistical tables are:

	Sampling error (percent)
Commercial forest area: 384 thousand acres	3.0
Growing-stock volume: 588 million cubic feet	4.6
Sawtimber volume: 1,284 million board feet	6.0
Annual net growth: 19.2 thousand cubic feet	11.2
Annual removals: 12.5 thousand cubic feet	16.3

COMMERCIAL TREE SPECIES OF DELAWARE

Names are according to Elbert L. Little, Jr.: *Checklist of Native and Naturalized Trees of the United States (including Alaska)*. U.S. Dep. Agr. Handbook 41, 472 p., 1953.

Softwoods

Atlantic white-cedar	*Chamaecyparis thyoides*
Eastern redcedar	*Juniperus virginiana*
Shortleaf pine	*Pinus echinata*
Pitch pine	*P. rigida*
Pond pine	*P. serotina*
Eastern white pine	*P. strobus*
*Scotch pine	*P. sylvestris*
Loblolly pine	*P. taeda*
Virginia pine	*P. virginiana*
Baldcypress	*Taxodium distichum*

Hardwoods

Red maple	*Acer rubrum*
*Sugar maple	*A. saccharum*
River birch	*Betula nigra*
Hickory	*Carya* species
*Northern catalpa	*Catalpa speciosa*
*Flowering dogwood	*Cornus florida*
*Common persimmon	*Diospyros virginiana*
American beech	*Fagus grandifolia*
White ash	*Fraxinus americana*
Green ash	*F. pennsylvanica*
*American holly	*Ilex opaca*
*Butternut	*Juglans cinerea*
Black walnut	*J. nigra*
Sweetgum	*Liquidambar styraciflua*
Yellow-poplar	*Liriodendron tulipifera*
*Sweetbay	*Liriodendron tulipifera*
Black tupelo (blackgum)	*Nyssa sylvatica*
*Bigtooth aspen	*Populus grandidentata*
Black cherry	*Prunus serotina*
White oak	*Quercus alba*
Swamp white oak	*Q. bicolor*
Scarlet oak	*Q. coccinea*
Southern red oak	*Q. falcata*
Swamp chestnut oak	*Q. michauxii*
Water oak	*Q. nigra*
Pin oak	*Q. palustris*
Willow oak	*Q. phellos*
Chestnut oak	*Q. prinus*
Northern red oak	*Q. rubra*
Post oak	*Q. stellata*
Black oak	*Q. velutina*
Black locust	*Robinia pseudoacacia*
*Black willow	*Salix nigra*
*American elm	*Ulmus americana*

* These species are very scarce in Delaware.

INDEX TO TABLES

Table 1.—*Area by land classes and counties, Delaware, 1972*

[In thousands of acres]

Land class	County			State total
	Kent	New Castle	Sussex	
Forest land:				
Commercial	93.1	55.7	235.6	384.4
Productive-reserved	.6	.2	1.0	1.8
Unproductive	.9	.9	3.8	5.6
Total forest land	94.6	56.8	240.4	391.8
Nonforest:				
Cropland[1]	163.1	84.9	255.5	503.5
Pasture[1]	3.0	3.8	2.8	9.6
Other[2]	119.5	134.8	109.3	363.6
Total nonforest land	285.6	223.5	367.6	876.7
Total land area[3]	380.2	280.3	608.0	1,268.5

[1]Source: 1969 and 1964 Census of Agriculture. Total cropland includes cropland used for pasture. Pasture totals based upon ratios developed from the 1964 census report. Data extrapolated to 1972.

[2]Includes swampland, industrial and urban areas, other nonforest land, and 10,146 acres classed as water by Forest Survey Standards but defined by the Bureau of the Census as land.

[3]Source: United States Bureau of the Census, Areas of Delaware, 1960 (Feb. 1967).

Table 2.—*Area of commercial forest land, by ownership classes and counties, Delaware, 1972*

[In thousands of acres]

Ownership	County			State total
	Kent	New Castle	Sussex	
Federal	0.6	—	—	0.6
State	4.7	1.4	7.3	13.4
County and municipal	—	—	—	—
Total public	5.3	1.4	7.3	14.0
Forest industry[1]	—	—	—	29.7
Farmer-owned[2]	55.6	16.6	105.9	178.1
Miscellaneous private:[1]				
Individual[3]	—	—	—	143.2
Corporate	—	—	—	19.4
Total private[4]	87.8	54.3	228.3	370.4
All ownerships	93.1	55.7	235.6	384.4

[1]Includes acreage owned in each county but withheld to avoid disclosure of individual ownerships.

[2]Includes incorporated farms.

[3]Includes acreage owned by business partnerships and organizations such as churches and associations.

[4]Estimates of privately owned commercial forest land are based upon an ownership study in 1972 by the Northeastern Forest Experiment Station.

Table 3.—*Area of commercial forest land, by stand-size classes and counties, Delaware, 1972*

[In thousands of acres]

Stand-size class	County			State total
	Kent	New Castle	Sussex	
Sawtimber stands	55.5	29.3	122.3	207.1
Poletimber stands	17.6	9.8	55.9	83.3
Sapling-seedling stands	20.0	16.6	57.4	94.0
Nonstocked areas	—	—	—	—
All classes	93.1	55.7	235.6	384.4

Table 4.—*Area of commercial forest land, by stand-size and ownership classes, Delaware, 1972*

[In thousands of acres]

Stand-size class	All ownerships	Public	Forest industry	Farmer and other
Sawtimber stands	207.1	10.6	13.2	183.3
Poletimber stands	83.3	1.6	6.6	75.1
Sapling-seedling stands	94.0	1.8	9.9	82.3
Nonstocked areas	—	—	—	—
All classes	384.4	14.0	29.7	340.7

Table 5.—*Area of commercial forest land, by stand-volume and ownership classes, Delaware, 1972*

[In thousands of acres]

Stand-volume per acre (board feet)[1]	All ownerships	Public	Forest industry	Farmer and other
Less than 1,500	129.2	1.8	9.8	117.6
1,500 to 5,000	114.0	5.0	13.0	96.0
More than 5,000	141.2	7.2	6.9	127.1
All classes	384.4	14.0	29.7	340.7

[1]International ¼-inch rule.

Table 6.—*Area of commercial forest land, by stocking classes based on selected stand components, Delaware, 1972*

[In thousands of acres]

Stocking class (percent)	Stocking classified in terms of—				
	All trees	Growing-stock trees			Rough and rotten trees
		Total	Desirable	Acceptable	
160	0.6	—	—	—	—
150 to 160	16.3	9.0	—	9.0	—
140 to 150	40.3	10.8	—	6.5	—
130 to 140	92.3	45.3	—	19.0	—
Overstocked	149.5	65.1	—	34.5	—
120 to 130	79.9	78.0	—	34.4	—
110 to 120	61.3	45.1	—	74.9	—
100 to 110	50.9	71.9	—	66.9	—
90 to 100	21.1	55.7	—	83.1	—
80 to 90	13.1	30.0	—	34.3	—
70 to 80	4.3	25.9	—	34.7	—
Fully stocked	230.6	306.6	—	328.3	—
60 to 70	4.3	4.3	—	13.2	—
50 to 60	—	4.1	4.5	4.1	4.7
40 to 50	—	—	—	—	12.8
Medium stocked	4.3	8.4	4.5	17.3	17.5
30 to 40	—	4.3	4.3	4.3	21.8
20 to 30	—	—	30.8	—	54.4
10 to 20	—	—	92.2	—	138.5
Less than 10	—	—	252.6	—	152.2
Poorly stocked	—	4.3	379.9	4.3	366.9
All classes	384.4	384.4	384.4	384.4	384.4

Table 7.—*Area of commercial forest land, by area-condition and ownership classes, Delaware 1972*

[In thousands of acres]

Area-condition class[1]	All ownerships	Public	Forest industry	Farmer and other
Class *10-40*	—	—	—	—
Class *50*	210.8	10.4	9.7	190.7
Class *60*	165.2	3.6	20.0	141.6
Class *70*	8.4	—	—	8.4
All classes	384.4	14.0	29.7	340.7

[1]Class *10-40*.—Areas medium to fully stocked with desirable trees.

Class *50*.—Areas poorly stocked with desirable trees, but fully stocked with growing-stock trees.

Class *60*.—Areas poorly stocked with desirable trees, but with medium to full stocking of growing-stock trees.

Class *70*.—Areas poorly stocked with desirable trees, and poorly stocked with growing-stock trees.

Table 8.—*Area of commercial forest land, by potential site productivity and ownership classes, Delaware 1972*

[In thousands of acres]

Growth-per-acre class (cubic feet)	All ownerships	Public	Forest industry	Farmer and other
120 to 165	35.0	1.6	—	33.4
85 to 120	82.1	3.5	6.5	72.1
50 to 85	138.6	5.5	20.1	113.0
Less than 50	128.7	3.4	3.1	122.2
All classes	384.4	14.0	29.7	340.7

Table 9.—*Area of commercial forest land, by forest types and counties, Delaware, 1972*

[In thousands of acres]

Forest type	County			State total
	Kent	New Castle	Sussex	
Loblolly-shortleaf pine	12.1	5.1	82.0	99.2
Oak-pine	12.7	6.3	37.6	56.6
Oak-hickory	42.2	28.5	76.5	147.2
Oak-gum-red maple	26.1	15.8	39.5	81.4
All types	93.1	55.7	235.6	384.4

Table 10.—*Area of forest land, commercial and noncommercial, by forest types and ownership classes, Delaware 1972*

[In thousands of acres]

Forest type	All ownerships	Public	Forest industry	Farmer and other
	COMMERCIAL FOREST LAND			
Loblolly-shortleaf pine	99.2	3.4	19.9	75.9
Oak-pine	56.6	5.3	—	51.3
Oak-hickory	147.2	3.5	3.2	140.5
Oak-gum-red maple	81.4	1.8	6.6	73.0
All types	384.4	14.0	29.7	340.7
	NONCOMMERCIAL FOREST LAND			
Oak hickory:				
Productive-reserved	1.8	1.8	—	—
Unproductive	5.6	.2	—	5.4
Total	7.4	2.0	—	5.4

Table 11.—*Number of trees on commercial forest land by species groups, tree classes, and diameter classes, Delaware, 1972*

[In thousands of trees]

Dbh class (inches)	Softwoods			Hardwoods		
	Growing-stock trees	Rough and rotten trees	Total	Growing-stock trees	Rough and rotten trees	Total
1.0 to 2.9	13,263	3,634	16,897	72,851	63,717	136,568
3.0 to 4.9	8,448	1,969	10,417	30,730	14,463	45,193
Total saplings	21,711	5,603	27,314	103,581	78,180	181,761
5.0 to 6.9	5,951	61	6,012	17,470	3,410	20,880
7.0 to 8.9	4,472	266	4,738	9,748	941	10,689
9.0 to 10.9	—	—	—	5,479	613	6,092
Total poletimber	10,423	327	10,750	32,697	4,964	37,661
9.0 to 10.9	3,103	59	3,162	—	—	—
11.0 to 12.9	1,564	—	1,564	3,828	322	4,150
13.0 to 14.9	1,181	—	1,181	1,795	204	1,999
Total small sawtimber	5,848	59	5,907	5,623	526	6,149
15.0 to 16.9	456	—	456	1,187	107	1,294
17.0 to 18.9	193	—	193	706	34	740
19.0 to 20.9	81	8	89	420	20	440
21.0 and larger	51	—	51	444	65	509
Total large sawtimber	781	8	789	2,757	226	2,983
All classes	38,763	5,997	44,760	144,658	83,896	228,554

Table 12.—*Number of growing-stock trees on commercial forest land, by species and diameter classes, Delaware, 1972*

[In thousands of trees]

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+
Loblolly pine	13,729	4,310	3,602	2,682	1,343	1,095	418	162	73	44
Other softwoods	3,323	1,641	870	421	221	86	38	31	8	7
Total softwoods	17,052	5,951	4,472	3,103	1,564	1,181	456	193	81	51
Select white oaks	6,189	2,078	1,570	1,187	685	376	101	98	41	53
Other oaks[1]	6,874	2,740	1,747	841	689	261	267	122	111	96
Hickory	1,899	711	445	300	171	136	66	49	9	12
Soft maples	9,412	5,596	1,576	883	571	306	222	107	85	66
Beech	847	248	172	115	62	90	12	39	55	54
Blackgum	1,623	808	222	176	142	155	87	11	17	5
Sweetgum	9,338	3,796	2,670	1,516	666	238	211	170	39	32
Yellow-poplar	1,708	75	566	302	227	181	122	70	55	110
Other hardwoods	2,634	1,418	780	159	62	52	99	40	8	16
Total hardwoods	40,524	17,470	9,748	5,479	3,275	1,795	1,187	706	420	444
All species	57,576	23,421	14,220	8,582	4,839	2,976	1,643	899	501	495

[1]Includes 6,812,000 red oak trees and 62,000 white oak trees.

Table 13.—*Net volume of timber on commercial forest land, by class of timber, softwoods and hardwoods, Delaware, 1972*

[In millions of cubic feet]

Class of timber	All species	Softwoods	Hardwoods
Sawtimber trees:			
Sawlog portion	312.2	123.9	188.3
Upper-stem portion	61.0	16.6	44.4
All sawtimber trees	373.2	140.5	232.7
Poletimber trees	214.4	43.8	170.6
All growing-stock trees	587.6	184.3	403.3
Rough trees	26.8	2.3	24.5
Rotten trees	7.0	.2	6.8
Total, all timber	621.4	186.8	434.6

Table 14.—*Net volume of growing stock and sawtimber on commercial forest land, by ownership classes, stand-size classes, softwoods and hardwoods, Delaware, 1972*

Ownership or stand-size class	Growing stock (million cubic feet)			Sawtimber (million board feet)[1]		
	All species	Softwoods	Hardwoods	All Species	Softwoods	Hardwoods
BY OWNERSHIP CLASSES						
Public	25.1	9.6	15.5	57.6	21.8	35.8
Forest industry	39.6	30.9	8.7	90.1	78.6	11.5
Farmer and other	522.9	143.8	379.1	1,136.0	317.6	818.4
All ownerships	587.6	184.3	403.3	1,283.7	418.0	865.7
BY STAND-SIZE CLASSES						
Sawtimber stands	431.4	141.5	289.9	1,108.2	372.0	736.2
Poletimber stands	109.2	33.2	76.0	123.9	39.8	84.1
Sapling-seedling stands	47.0	9.6	37.4	51.6	6.2	45.4
All classes	587.6	184.3	403.3	1,283.7	418.0	865.7

[1]International ¼-inch rule.

Table 15.—*Net volume of growing stock and sawtimber on commercial forest land, by forest types, stand-size classes, and counties, Delaware, 1972*

Forest type or stand-size class	Growing stock (million cubic feet)				Sawtimber (million board feet)[1]			
	Kent	New Castle	Sussex	All counties	Kent	New Castle	Sussex	All counties
BY FOREST TYPES								
Loblolly-shortleaf pine	20.4	6.1	155.0	181.5	42.2	12.9	334.6	389.7
Oak-pine	21.7	7.4	67.0	96.1	47.0	14.8	153.8	215.6
Oak-hickory	67.7	40.8	107.0	215.5	160.9	95.1	217.3	473.3
Oak-gum-red maple	31.6	18.4	44.5	94.5	77.7	46.7	80.7	205.1
All types	141.4	72.7	373.5	587.6	327.8	169.5	786.4	1,283.7
BY STAND-SIZE CLASSES								
Sawtimber stands	109.2	55.3	266.9	431.4	293.6	150.7	663.9	1,108.2
Poletimber stands	21.4	10.5	77.3	109.2	21.5	10.9	91.5	123.9
Sapling-seedling stands	10.8	6.9	29.3	47.0	12.7	7.9	31.0	51.6
All classes	141.4	72.7	373.5	587.6	327.8	169.5	786.4	1,283.7

[1]International ¼-inch rule.

Table 16.—*Net volume of growing stock and sawtimber on commercial forest land, by species and counties, Delaware, 1972*

Species	Growing stock (million cubic feet)				Sawtimber (million board feet)[1]			
	Kent	New Castle	Sussex	All counties	Kent	New Castle	Sussex	All counties
Loblolly pine	9.9	—	148.0	157.9	33.9	—	336.7	370.6
Other softwoods	16.1	9.3	1.0	26.4	25.2	20.4	1.8	47.4
Total softwoods	26.0	9.3	149.0	184.3	59.1	20.4	338.5	418.0
Select white oaks	20.0	10.7	34.1	64.8	44.0	23.5	70.2	137.7
Other oaks	19.6	10.1	47.7	77.4	46.0	24.0	111.0	181.0
Hickory	8.2	5.5	8.3	22.0	18.8	12.9	16.3	48.0
Soft maples	22.1	12.1	38.7	72.9	48.8	27.9	62.1	138.8
Beech	6.7	4.5	4.6	15.8	21.0	13.5	14.4	48.9
Blackgum	3.9	1.9	11.4	17.2	10.7	5.7	25.6	42.0
Sweetgum	19.8	10.1	53.3	83.2	36.8	18.9	82.0	137.7
Yellow-poplar	10.4	6.0	15.9	32.3	33.3	18.2	48.7	100.2
Other hardwoods	4.7	2.5	10.5	17.7	9.3	4.5	17.6	31.4
Total hardwoods	115.4	63.4	224.5	403.3	268.7	149.1	447.9	865.7
All species	141.4	72.7	373.5	587.6	327.8	169.5	786.4	1,283.7

[1]International ¼-inch rule.

Table 17.—*Net volume of growing stock on commercial forest land, by species and diameter classes, Delaware, 1972*

[In millions of cubic feet]

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+
Loblolly pine	157.9	11.3	22.2	32.9	25.5	31.1	17.1	8.7	4.9	4.2
Other softwoods	26.4	4.3	6.0	5.4	4.0	2.4	1.5	1.7	.6	.5
Total softwoods	184.3	15.6	28.2	38.3	29.5	33.5	18.6	10.4	5.5	4.7
Select white oaks	64.8	6.2	9.1	11.7	13.0	9.4	3.4	4.7	2.4	4.9
Other oaks[1]	77.4	9.2	10.5	9.2	14.3	6.6	8.9	5.6	6.2	6.9
Hickory	22.0	2.6	3.1	3.2	3.5	3.4	2.4	2.4	.5	.9
Soft maples	72.9	17.2	9.3	8.7	11.0	7.1	6.8	4.2	4.2	4.4
Beech	15.8	.9	1.2	1.3	1.4	2.3	.4	1.7	2.8	3.8
Blackgum	17.2	2.6	1.3	1.8	2.7	4.1	3.0	.4	.9	.4
Sweetgum	83.2	12.1	16.6	16.8	13.1	5.7	7.4	7.5	2.1	1.9
Yellow-poplar	32.3	.3	3.2	2.9	4.3	4.2	3.9	2.8	2.8	7.9
Other hardwoods	17.7	3.9	4.1	1.6	1.0	1.1	2.9	1.5	.5	1.1
Total hardwoods	403.3	55.0	58.4	57.2	64.3	43.9	39.1	30.8	22.4	32.2
All species	587.6	70.6	86.6	95.5	93.8	77.4	57.7	41.2	27.9	36.9

[1]Includes 76.6 million cubic feet of red oaks and 0.8 million of white oaks.

Table 18.—*Net volume of sawtimber on commercial forest land, by species and diameter classes, Delaware, 1972*

[In millions of board feet, International ¼-inch rule]

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+
Loblolly pine	370.6	84.4	74.4	98.6	55.7	28.3	16.1	13.1
Other softwoods	47.4	13.8	11.8	7.6	5.1	5.4	1.9	1.8
Total softwoods	418.0	98.2	86.2	106.2	60.8	33.7	18.0	14.9
Select white oaks	137.7	—	41.6	33.5	12.9	19.1	9.9	20.7
Other oaks[1]	181.0	—	45.9	23.5	33.6	22.3	25.6	30.1
Hickory	48.0	—	11.1	12.1	9.2	9.6	2.1	3.9
Soft maples	138.8	—	35.4	25.1	25.9	16.6	17.2	18.6
Beech	48.9	—	4.4	8.1	1.6	6.9	11.7	16.2
Blackgum	42.0	—	8.7	14.6	11.6	1.9	3.5	1.7
Sweetgum	137.7	—	42.1	20.3	28.3	29.9	8.8	8.3
Yellow-poplar	100.2	—	13.8	15.3	14.8	11.4	11.4	33.5
Other hardwoods	31.4	—	3.3	3.8	11.7	5.9	2.1	4.6
Total hardwoods	865.7	—	206.3	156.3	149.6	123.6	92.3	137.6
All species	1,283.7	98.2	292.5	262.5	210.4	157.3	110.3	152.5

[1]Includes 178.7 million board feet of red oaks and 2.3 million of white oaks.

Table 19.—*Net volume of sawtimber on commercial forest land, by species and log-quality classes, Delaware, 1972*

[In millions of board feet][1]

Species	All classes	Standard-lumber logs			Construction logs
		Grade 1	Grade 2	Grade 3	
Softwoods:					
Loblolly pine	370.6	26.1	46.8	297.7	—
Other pines	47.4	—	2.8	44.6	—
Total softwoods	418.0	26.1	49.6	342.3	—
Hardwoods:					
Select white oaks	137.7	10.0	25.2	58.2	44.3
Other oaks	181.0	14.9	26.0	75.0	65.1
Hickory	48.0	3.3	2.7	16.2	25.8
Soft maples	138.8	2.3	16.3	55.4	64.8
Beech	48.9	.1	1.2	16.3	31.3
Blackgum	42.0	8.1	6.8	21.9	5.2
Sweetgum	137.7	11.4	18.7	73.2	34.4
Yellow-poplar	100.2	14.3	19.9	29.1	36.9
Other hardwoods	31.4	5.9	7.7	10.8	7.0
Total hardwoods	865.7	70.3	124.5	356.1	314.8
Hardwood quality (in percent)	100	8	14	41	37

[1]International ¼-inch rule.

Table 20.—*Net growth, removals, and mortality of growing stock and sawtimber on commercial forest land, by ownership classes and species, Delaware, 1971*

Species	Growing stock			Sawtimber		
	Net growth	Timber removals	Mortality	Net growth	Timber removals	Mortality
	Thousand cubic feet			*Thousand board feet*[1]		
Softwoods:						
Loblolly pine	3,537	6,627	632	11,227	14,124	1,159
Virginia pine	1,035	1,400	298	1,707	702	386
Other softwoods	28	73	6	66	174	8
Total softwoods	4,600	8,100	936	13,000	15,000	1,553
Hardwoods:						
Select white oaks	2,345	499	304	5,979	2,558	605
Other oaks	4,074	871	940	8,360	2,434	1,319
Hickory	641	213	22	1,359	235	89
Soft maples	2,324	890	426	3,360	349	952
Beech	192	131	124	941	78	305
Blackgum	538	495	99	1,323	373	149
Sweetgum	2,774	605	624	4,984	1,183	448
Yellow-poplar	1,342	453	127	3,783	1,618	360
Other hardwoods	370	243	266	911	172	191
Total hardwoods	14,600	4,400	2,932	31,000	9,000	4,418
Total, all species	19,200	12,500	3,868	44,000	24,000	5,971

[1]International ¼-inch rule.

Table 21.—*Net growth and removals of growing stock and sawtimber on commercial forest land, by ownership classes, softwoods and hardwoods, Delaware, 1971*

Ownership	Net growth			Timber removals		
	All species	Softwoods	Hardwoods	All species	Softwoods	Hardwoods
	GROWING STOCK					
	Thousand cubic feet					
Public	802	251	551	495	288	207
Forest industry	743	536	207	700	406	294
Farmer and misc. private	17,655	3,813	13,842	11,305	7,406	3,899
All ownerships	19,200	4,600	14,600	12,500	8,100	4,400
	SAWTIMBER					
	Thousand board feet[1]					
Public	2,001	678	1,323	949	511	438
Forest industry	1,915	1,632	283	1,337	720	617
Farmer and misc. private	40,084	10,690	29,394	21,714	13,769	7,945
All ownerships	44,000	13,000	31,000	24,000	15,000	9,000

[1]International ¼-inch rule.

Table 22.—*Mortality of growing stock and sawtimber on commercial forest land, by ownership classes, causes, softwoods and hardwoods, Delaware, 1971*

Ownership and cause	Growing stock (thousand cubic feet)			Sawtimber (thousand board feet)[1]		
	All species	Softwoods	Hardwoods	All species	Softwoods	Hardwoods
			BY OWNERSHIP CLASS			
Public	161	49	112	264	81	183
Forest industry	147	104	43	234	195	39
Farmer and other	3,560	783	2,777	5,473	1,277	4,196
All ownerships	3,868	936	2,932	5,971	1,553	4,418
			BY CAUSE			
Weather	861	72	789	2,390	222	2,168
Suppression	109	23	86	—	—	—
Disease	2,628	811	1,817	3,581	1,331	2,250
Unknown	270	30	240	—	—	—
All causes	3,868	936	2,932	5,971	1,553	4,418

[1]International ¼-inch rule.

Table 23.—*Components of average annual net growth of growing stock and sawtimber on commercial forest land, softwoods and hardwoods, Delaware, 1956-71*

Components	All species	Softwoods	Hardwoods
	GROWING STOCK *Thousand cubic feet*		
Growth on initial growing-stock inventory[1]	13,645	3,743	9,902
Ingrowth—saplings that became poletimber	9,473	3,291	6,182
Gross growth	23,118	7,034	16,084
Cull increment	1,226	22	1,204
Annual mortality	3,592	1,112	2,480
Average annual net growth	18,300	5,900	12,400
	SAWTIMBER *Thousand board feet*[2]		
Growth on initial sawtimber inventory[1]	24,418	8,694	15,724
Ingrowth—poletimber trees that became sawtimber	24,055	7,700	16,355
Gross growth	48,473	16,394	32,079
Cull increment	1,433	50	1,383
Annual mortality	5,540	1,844	3,696
Average annual net growth	41,500	14,500	27,000

[1]Including growth on trees that were cut.

[2]International ¼-inch rule.

Table 24.—*Sampling errors for major forest area and timber-volume classes in Delaware, 1972*

Table No.	Item classification	Sampling error
	FOREST AREA	*Percent*
1	Forest-land area:	
	Commercial	3.0
	Unproductive	81.0
	Total	3.2
	Commercial forest land:	
	Kent County	7
	New Castle County	9
	Sussex County	4
2	Ownership:[1]	
	Forest industry	45
	Farmer-owned	15
	Misc. private	11
	Farmer and misc. private	5
3	Stand-size class:	
	Sawtimber	9
	Poletimber	21
	Sapling-seedling	18
5	Stand-volume per acre (board feet):	
	Less than 1,500	13
	1,500 to 5,000	17
	More than 5,000	13
7	Area-condition class:	
	50	10
	60	13
	70	(*)
8	Growth-per-acre class (cubic feet):	
	120 to 165	35
	85 to 120	22
	50 to 85	14
	Less than 50	16
9	Forest type:	
	Loblolly-shortleaf pine	15
	Oak-pine	26
	Oak-hickory	13
	Oak-gum-red maple	22

Table No.	Item classification	Sampling error: *Cubic feet*	Sampling error: *Board feet*
	TIMBER VOLUME	*Percent*	
13	Class of timber:		
	Sawtimber trees	6	—
	Poletimber trees	7	—
	All growing stock	5	—
	Rough trees	18	—
	Rotten trees	19	—
	All live trees	4	—
14	Ownership and stand-size:		
	Public	34	37
	Forest industry	(*)	(*)
	Farmer and other	7	8

Table No.	Item classification	Sampling error: *Cubic feet*	Sampling error: *Board feet*
	TIMBER VOLUME	*Percent*	
	Sawtimber stands	7	7
	Poletimber stands	23	27
	Sapling-seedling	28	38
	Softwoods	13	15
	Hardwoods	7	9
	All species	5	6
15	Counties:		
	Kent	10	13
	New Castle	14	18
	Sussex	7	9
17-18	Diameter classes (inches):		
	5.0- 6.9	10	—
	7.0- 8.9	9	—
	[2]9.0-10.9	9	20
	11.0-12.9	9	11
	13.0-14.9	9	9
	15.0-16.9	12	12
	17.0-18.9	12	11
	19.0-20.9	17	16
	21.0 and larger	20	19
17-18	Species:		
	Loblolly pine	15	17
	Other softwoods	25	33
	Select white oaks	18	21
	Other oaks	15	19
	Hickory	24	27
	Soft maples	17	24
	Beech	47	(*)
	Blackgum	35	36
	Sweetgum	20	25
	Yellow-poplar	24	28
	Other hardwoods	32	49

Table No.	Item classification	Sampling error: *Cubic feet*	Sampling error: *Board feet*
	GROWTH-REMOVAL-MORTALITY	*Percent*	
20	Growth by:		
	Softwoods	23	23
	Hardwoods	13	15
	All species	11	11
	Removals by:		
	Softwoods	24	28
	Hardwoods	22	25
	All species	19	21
	Mortality by:		
	Softwoods	28	31
	Hardwoods	17	29
	All species	14	21
22	Mortality by cause:		
	Weather	35	44
	Suppression	(*)	—
	Disease	17	25
	Unknown	44	—

[1] Some classifications have no sampling errors and some less important classifications have been omitted.

[2]Board-foot sampling error for this diameter class is for softwoods only.

*Sampling errors of 50 to 99 percent.

Table 25.—*Output of timber products, by source of material, softwoods and hardwoods, Delaware, 1970*

Product and species group	Standard units	Total output		Output from roundwood		Output from plant byproducts	
		Number of units	Thousand cubic feet	Number of units	Thousand cubic feet	Number of units	Thousand cubic feet
Sawlogs:							
Softwoods	M bd. ft.[1]	6,326	952	6,326	952	—	—
Hardwoods	M bd. ft.[1]	6,787	979	6,787	979	—	—
Total	M bd. ft.[1]	13,113	1,931	13,113	1,931	—	—
Veneer logs and bolts:							
Softwoods	M bd. ft.[1]	2,988	468	2,988	468	—	—
Hardwoods	M bd. ft.[1]	2,328	407	2,328	407	—	—
Total	M bd. ft.[1]	5,316	875	5,316	875	—	—
Pulpwood:							
Softwoods	Std. cords[2]	59,062	4,725	59,062	4,725	—	—
Hardwoods	Std. cords[2]	4,676	374	3,181	254	1,495	120
Total	Std. cords[2]	63,738	5,099	62,243	4,979	1,495	120
Cooperage logs and bolts:							
Softwoods	M bd. ft.[1]	—	—	—	—	—	—
Hardwoods	M bd. ft.[1]	38	6	38	6	—	—
Total	M bd. ft.[1]	38	6	38	6	—	—
Piling:							
Softwoods	M linear ft.	700	420	700	420	—	—
Hardwoods	M linear ft.	472	283	472	283	—	—
Total	M linear ft.	1,172	703	1,172	703	—	—
Poles:							
Softwoods	M pieces	2	48	2	48	—	—
Hardwoods	M pieces	—	—	—	—	—	—
Total	M pieces	2	48	2	48	—	—
Posts (round & split):							
Softwoods	M pieces	—	—	—	—	—	—
Hardwoods	M pieces	200	132	200	132	—	—
Total	M pieces	200	132	200	132	—	—
Other:[3]							
Softwoods	M cu. ft.	18	18	—	—	18	18
Hardwoods	M cu. ft.	48	48	—	—	48	48
Total	M cu. ft.	66	66	—	—	66	66
Total industrial products:[4]							
Softwoods	—	—	6,631	—	6,613	—	18
Hardwoods	—	—	2,229	—	2,061	—	168
Total	—	—	8,860	—	8,674	—	186
Fuelwood:							
Softwoods	Std. cords	1,550	124	362	29	1,188	95
Hardwoods	Std. cords	12,988	1,039	12,638	1,011	350	28
Total	Std. cords	14,538	1,163	13,000	1,040	1,538	123
All products:[5]							
Softwoods	—	—	6,755	—	6,642	—	113
Hardwoods	—	—	3,268	—	3,072	—	196
Total	—	—	10,023	—	9,714	—	309

[1]International ¼-inch rule.

[2]Rough wood basis (for example, chips converted to equivalent standards cords).

[3]Used for miscellaneous fiber products.

[4]No mine timbers are produced in Delaware.

[5]Does not include 269,900 cubic feet of softwood and 136,600 cubic feet of hardwood residues used mainly for chicken litter and livestock bedding.

Table 26.—*Output of roundwood products, by source, softwoods and hardwoods, Delaware, 1970*

[In thousands of cubic feet]

Product and species group	All sources	Growing-stock trees[1]			Rough and rotten trees[1]	Salvable dead trees[1]	Other sources[2]
		Total	Sawtimber	Poletimber			
PRINCIPAL INDUSTRIAL PRODUCTS							
Sawlogs:							
Softwoods	952	862	859	3	—	60	30
Hardwoods	979	945	931	14	—	—	34
Total	1,931	1,807	1,790	17	—	60	64
Veneer logs and bolts:							
Softwoods	468	455	455	—	—	—	13
Hardwoods	407	402	402	—	—	—	5
Total	875	857	857	—	—	—	18
Pulpwood:							
Softwoods	4,725	3,810	3,235	575	—	137	778
Hardwoods	254	209	93	116	3	1	41
Total	4,979	4,019	3,328	691	3	138	819
MISCELLANEOUS INDUSTRIAL PRODUCTS							
Cooperage logs and bolts:							
Softwoods	—	—	—	—	—	—	—
Hardwoods	6	6	6	—	—	—	—
Total	6	6	6	—	—	—	—
Piling:							
Softwoods	420	380	365	15	25	—	15
Hardwoods	283	280	245	35	—	—	3
Total	703	660	610	50	25	—	18
Poles:							
Softwoods	48	48	46	2	—	—	—
Hardwoods	—	—	—	—	—	—	—
Total	48	48	46	2	—	—	—
Posts (round and split):							
Softwoods	—	—	—	—	—	—	—
Hardwoods	132	131	131	—	—	—	1
Total	132	131	131	—	—	—	1
All misc. industrial products:							
Softwoods	468	428	411	17	25	—	15
Hardwoods	421	417	382	35	—	—	4
Total	889	845	793	52	25	—	19
TOTAL INDUSTRIAL PRODUCTS							
Softwoods	6,613	5,555	4,960	595	25	197	836
Hardwoods	2,061	1,973	1,808	165	3	1	84
Total	8,674	7,528	6,768	760	28	198	920
NONINDUSTRIAL PRODUCTS (FUELWOOD)							
Softwoods	29	16	1	15	7	3	3
Hardwoods	1,011	592	228	364	213	113	93
Total	1,040	608	229	379	220	116	96
TOTAL ALL PRODUCTS							
Softwoods	6,642	5,571	4,961	610	32	200	839
Hardwoods	3,072	2,565	2,036	529	216	114	177
Total	9,714	8,136	6,997	1,139	248	314	1,016

[1]On commercial forest land.

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

Table 27.—*Timber removals from growing stock and live sawtimber on commercial forest land, by items, softwoods and hardwoods, Delaware, 1970*

Item	Growing stock (thousand cubic feet)			Sawtimber (thousand board feet)[1]		
	All species	Softwoods	Hardwoods	All species	Softwoods	Hardwoods
Roundwood products:						
Sawlogs	1,807	862	945	8,107	3,392	4,715
Veneer logs and bolts	857	455	402	3,756	1,806	1,950
Pulpwood	4,019	3,810	209	9,547	9,026	521
Cooperage logs and bolts	6	—	6	34	—	34
Piling	660	380	280	2,385	1,018	1,367
Poles	48	48	—	128	128	—
Posts	131	—	131	731	—	731
Fuelwood	608	16	592	1,275	3	1,272
All products	8,136	5,571	2,565	25,963	15,373	10,590
Logging residues	2,341	1,221	1,120	3,135	2,153	982
Other removals	2,400	469	1,931	3,880	960	2,920
Total removals	12,877	7,261	5,616	32,978	18,486	14,492

[1]International ¼-inch rule.

Table 28.—*Volume of unused residues at primary manufacturing plants, by industry and type of residue, softwoods and hardwoods, Delaware, 1970*

[In thousands of cubic feet]

Species group and type of residues	All industries	Lumber	Veneer and plywood	Other
Softwoods:				
Coarse[1]	1.0	1.0	—	—
Fine[2]	33.2	33.2	—	—
Total	34.2	34.2	—	—
Hardwoods:				
Coarse[1]	32.0	32.0	—	—
Fine[2]	.5	.5	—	—
Total	32.5	32.5	—	—
All species:				
Coarse[1]	33.0	33.0	—	—
Fine[2]	33.7	33.7	—	—
Total	66.7	66.7	—	—

[1]Material such as slabs, edgings, and veneer cores.

[2]Material such as sawdust and shavings.

Note: The volume of used residues is shown under "Output from plant byproducts" of table 25.

Table 29.—*Projections of net annual growth, available cut, and inventory of growing stock and sawtimber on commercial forest land, Delaware, 1972-2002*[1]

Species group	1972 (inventory year)	1982	1992	2002
		GROWING STOCK		
		Million cubic feet		
Softwoods:				
Cut	8.1	5.5	3.7	2.3
Growth	4.6	3.5	2.6	2.3
Inventory	184.3	159.5	144.8	140.1
Hardwoods:				
Cut	4.4	10.5	14.2	17.2
Growth	14.6	16.3	17.2	17.3
Inventory	403.3	474.2	516.5	530.0
Total:				
Cut	12.5	16.0	17.9	19.5
Growth	19.2	19.8	19.8	19.6
Inventory	587.6	633.7	661.3	670.1
		SAWTIMBER		
		Million board feet[2]		
Softwoods:				
Cut	15	12	9	6
Growth	13	11	9	8
Inventory	418	397	390	401
Hardwoods:				
Cut	9	21	30	39
Growth	31	38	42	43
Inventory	866	1,050	1,191	1,272
Total:				
Cut	24	33	39	45
Growth	44	49	51	51
Inventory	1,284	1,447	1,581	1,673

[1]Based upon the following assumptions: Farmland abandonment and reversion to forest will be offset by forest land lost by land clearing, growth rates will continue to be the same for the next 30 years, and trends in forestry programs will continue at the same rate as in the past. Timber available for cutting in this projection is assumed to be that amount that will bring growth and cut into balance by the end of 30 years.

[2]International ¼-inch rule.

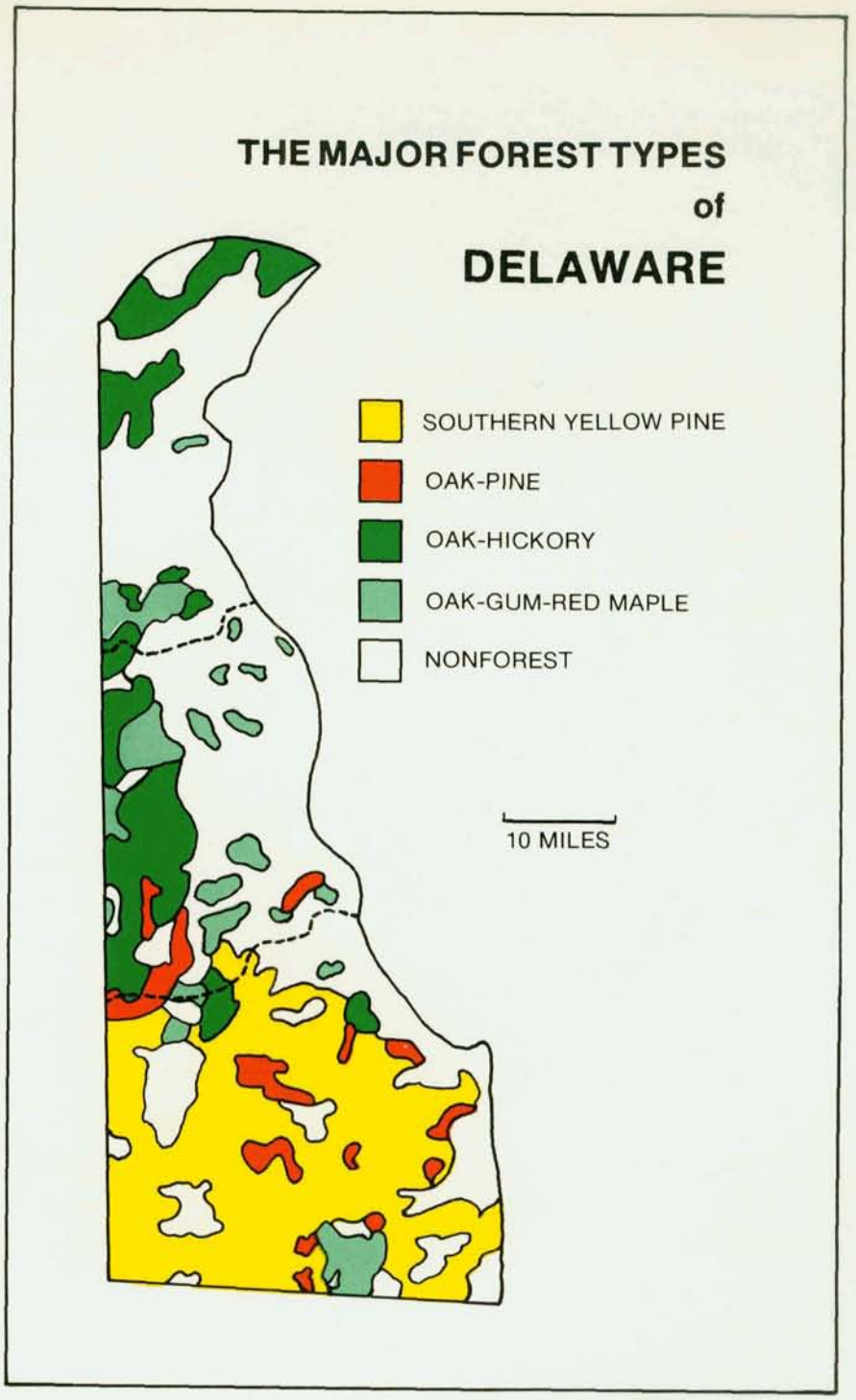


Figure 20. — The major forest types of Delaware.

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