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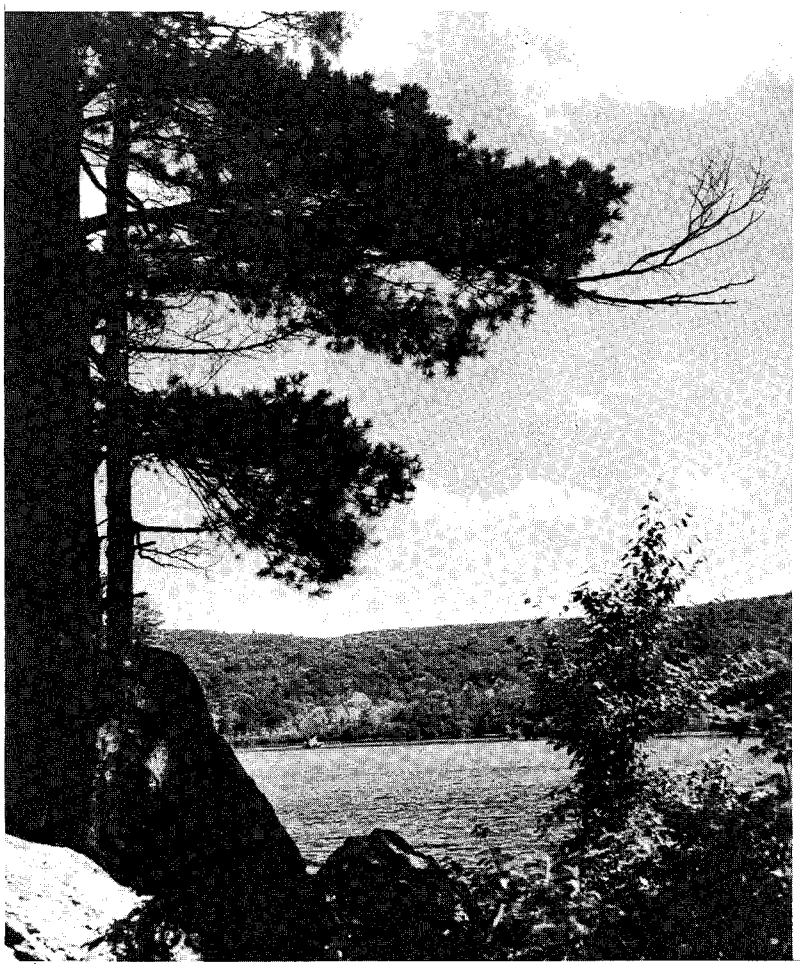
The TIMBER RESOURCES OF SOUTHERN NEW ENGLAND



USDA FOREST SERVICE RESOURCE BULLETIN NE-36
1974

NORTHEASTERN FOREST EXPERIMENT STATION
FOREST SERVICE, U.S. DEPARTMENT OF AGRICULTURE
6816 MARKET STREET, UPPER DARBY, PA. 19082
F. BRYAN CLARK, STATION 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.

A resurvey of the forest resources of the three southern New England States—Connecticut, Massachusetts, and Rhode Island—was undertaken in 1971 by the Northeastern Forest Experiment Station some 19 years after the initial forest survey. The Experiment Station staff had the cooperation of the Connecticut Commission of Parks and Forests, the Massachusetts Department of Natural Resources, and the Rhode Island Department of Natural Resources.

Carl E. Mayer, project leader, directed the resurvey. Joseph E. Barnard was in charge of computing and tabulating all inventory data. He was assisted in this task by David R. Dickson. James T. Bones, with assistance from state personnel in these three states, collected and compiled the data on timber removals and timber-products output. Teresa M. Bowers assisted with the compilations and checked the statistical data. Carmela M. Hyland assisted with administrative services for the field personnel during the survey.

This report summarizes the forest-resource situation and the changes that have taken place since the initial survey. More detailed data for individual states and counties may be obtained in other publications resulting from this resurvey. Users having a need for such data should contact the Forest Survey Project, Northeastern Forest Experiment Station, 6816 Market Street, Upper Darby, Pa. 19082. Users of these data are strongly advised to read carefully the definitions of forest-survey terms and the section on the reliability of the estimates in the appendix of this report.

COVER PHOTO CREDIT

MASSACHUSETTS DEPARTMENT OF NATURAL RESOURCES PHOTO

MANUSCRIPT RECEIVED FOR PUBLICATION 1 MAY 1974

The TIMBER RESOURCES OF SOUTHERN NEW ENGLAND

by Neal P. Kingsley

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THE AUTHOR

NEAL P. KINGSLEY, research forester, received his bachelor's degree in forestry from the University of New Hampshire in 1961 and his master's degree in forest economics from the same university in 1963. He joined the Northeastern Forest Experiment Station in August 1962 and is resource analyst in the Experiment Station's Forest Survey unit at Upper Darby, Pa.

Highlights

- The area of commercial forest land declined more than 11 percent from 1953 to 1972, due mainly to increasing urbanization.
- Nearly 90 percent of the commercial forest land is privately owned.
- Farmers own only 8 percent of the commercial forest land compared to 24 percent in 1953.
- Area of oak types declined, but oaks are still the major type.
- Volume of timber was up despite decrease in area; growing stock up 60 percent; sawtimber up 87 percent.
- Average net annual growth exceeds removals 4 to 1.
- More than 85 percent of all timber removals are due to land-use changes; 56 percent is not utilized.
- Forests exert a profound influence on the region's environment.
- Lack of active timber harvesting may adversely affect forests in the future.
- Southern New England presents foresters with a unique opportunity for multiple-use forest management.

Introduction

NO ONE KNOWS for certain when the first white man set foot on the shores of Southern New England. It has been said that Vikings may have landed in Rhode Island 500 or more years before the Pilgrims stepped ashore at Plymouth in 1620. The first permanent settlement of English-speaking people in the new world was Plimouth Plantation.

From this fragile beginning, the settlement of Southern New England spread rapidly. Boston soon became the largest and most cosmopolitan city in North America. Land was cleared for farms and towns. Southern New England became a hotbed of revolutionary fervor. After the Revolution it became the commercial and intellectual center of our new nation.

Today Southern New England is one of the most densely populated regions of the country. Nearly 10 million people live in this region —about 703 people per square mile. Of all the states, Rhode Island, Massachusetts, and Connecticut rank second, third, and fourth in density of population. And yet the forests of Southern New England are still as much an integral part of the landscape as are the cities.

Since the coming of the white man, the forests of Southern New England have undergone extensive changes. The Indians of the region were in the habit of burning the forest to facilitate hunting and travel. Because of this, the forest cover was open and parklike; the only large trees were found in the swamps, along stream banks, and in other areas too wet for burning. It has been estimated that such burning was carried on for more than 1,000 years before settlement. Frequent burning, in both spring and fall, eliminated the dense tangle of underbrush and provided conditions conducive to game species.

Much of Southern New England's present forest land was once cleared and used for agriculture. This old chestnut fence marks the boundary of what once may have been a pasture.

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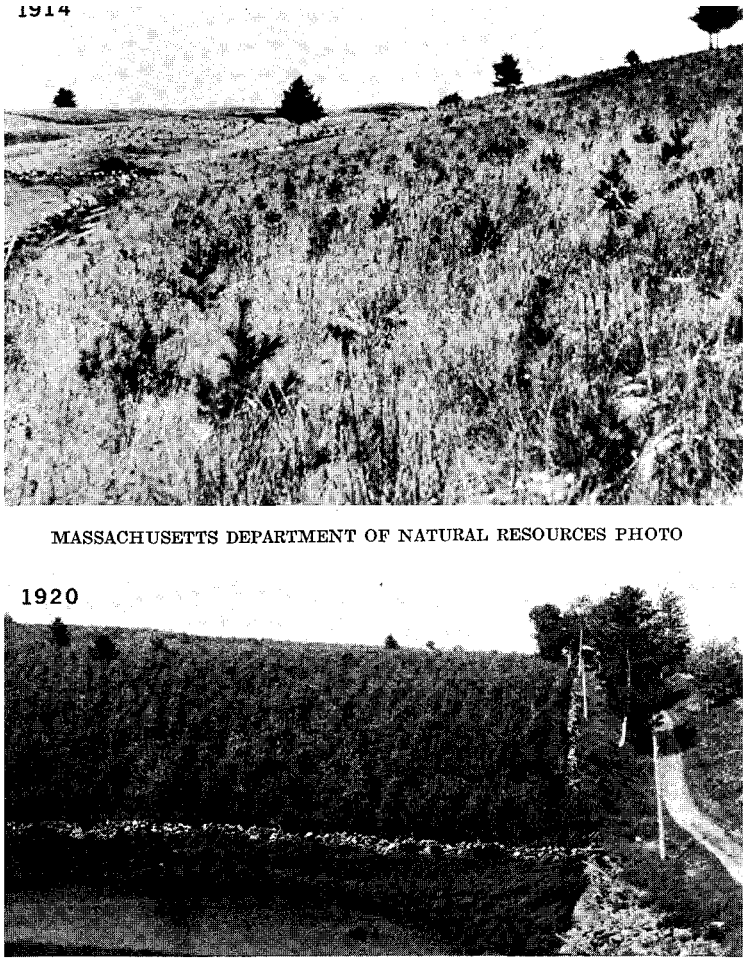


The results of reforestation can be dramatic. The same area in the H. O. Cook State Forest, Massachusetts, in 1914, 3 years after planting, in 1920, and in 1973.

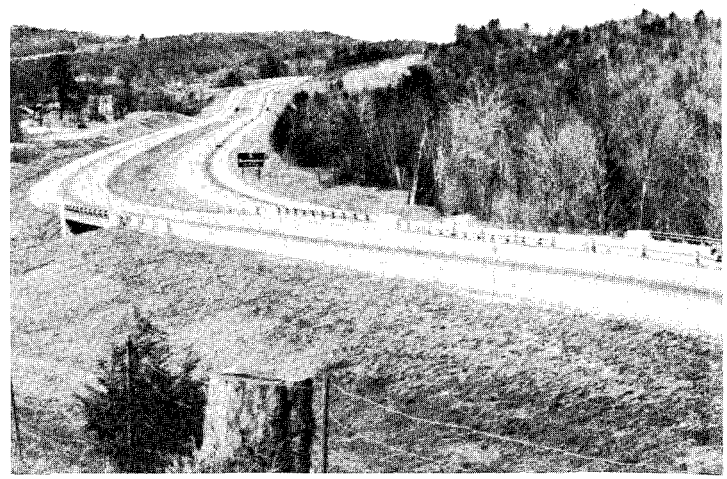
As the white man moved onto the land, he cleared it for farming. By 1820 only 25 percent of Connecticut was still forested. Massachusetts probably had a slightly higher percentage of its land in forest, while Rhode Island probably had about as much as Connecticut. Farming flourished in Southern New England, but in 1830, with the opening of the Erie Canal, its fate was sealed. By 1850 it was becoming evident that the small stony farms of New England could not compete with the large mechanized farms of western New York, Ohio, and Indiana. People in Boston, Providence, and Hartford were eating bread made from wheat that had traveled hundreds of miles.

As land went out of farming, it reverted to to forest. In many areas this new forest was mostly white pines, a species that was found scattered through the original Southern New England forest but was not a predominant species. In the early years of the present century, until about 1920, an extensive white pine logging industry flourished. This industry produced boxes, pails, and barrels primarily for shipping fish products inland and overseas.

The advent of the portable sawmill permitted the purchaser to move onto the land, cut off the pine, and move out, leaving behind the hardwoods, slash, slab piles, and sawdust. Frequently, operators purchased the land and the timber in one lump sum and high-graded it; they took the best and left the worst standing. This practice hastened the development of poor-quality hardwood stands to take the place of the white pine. After 1920 this industry began to decline both because of the advent of other packaging materials and because the accessible pine had been cut over.

After World War II, Southern New England, like many other areas, embarked on a massive building boom. Towns mushroomed overnight, and once again the forest was being pushed back as it had been 300 years earlier.

Today the forests do not represent the same source of material goods as they did in colonial times. But they do represent a means to provide a more habitable environment. Today Southern New England is at a crossroads. Will it become a massive unbroken urban sprawl? Or will it become an urbanized environment interlaced and in harmony with natural areas—including forest land?



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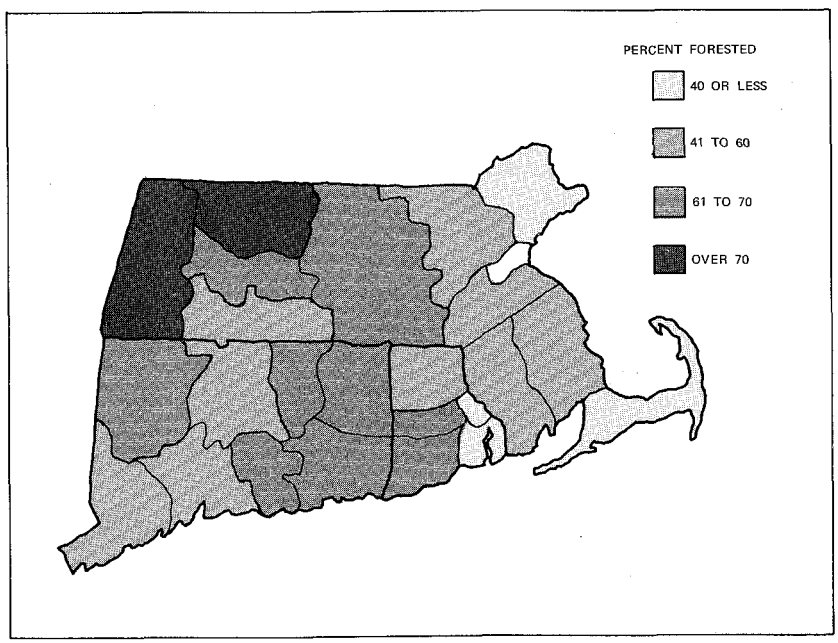
Construction of modern highways has contributed to the decrease in commercial forest land.

Area

Nearly 60 percent of the land area of Southern New England is covered by forests. Of the remaining 40 percent, only 6 percent is in cropland; and the great proportion of the remaining 34 percent is in urban and industrial areas, highways, and the like. Of the 5.2 million acres of forest land in the three-state area, nearly 5 million or 57 percent of the region's total land area is classed as commercial forest land. This is forest land that is producing or capable of producing crops of wood and is not withdrawn from timber utilization by statute or administrative order.

The area of commercial forest land in Southern New England declined from 5.7 million acres in 1953 to 5.0 million in 1972 or from 64 percent to 57 percent of the land area of these states. This decline was due entirely to the increased proportion of land in urban and other land uses such as airports and highways. In fact, the area devoted to urban and other uses rose from 18 percent of the total land area of Southern New England to nearly 34 percent by 1972. The decline of agricultural land was even more pronounced than the de-

Figure 1.—Percentage of land area in commercial forest land in Southern New England, by counties, 1972.



cline in forest land. In 1953, nearly 18 percent of Southern New England was in agriculture, but by 1972 the proportion had dropped to 7 percent. Thus the urban expansion of Southern New England over the last two decades has been mostly at the expense of agricultural land. This land-use change was not concentrated in any one state.

OWNERSHIP

More than 89 percent—4.5 million acres—of Southern New England's commercial forest land is privately owned. Governments—federal, state, and local—own slightly more than 500,000 acres. Corporations own 527,000 acres or 12 percent of the private commercial forest land. Some of these corporations are incorporated farms that produce such products as cranberries or tobacco. Others are forest-based industries and public utilities such as power companies and water companies, but a surprisingly large proportion are land-investment or real-estate development firms. This seems to indicate that the urban development observed over the past two decades may be only a preview of things to come. All other owners, most of whom are individuals, own 3.9 million acres—88 percent of the privately owned commercial forest land.

Farmers, including incorporated farmers, own 406,500 acres of commercial forest land. The share owned by farmers declined substantially during the period between surveys. In 1953 farmers owned 24 percent of the region's commercial forest land, but by 1972 their share had dropped to only 8 percent. In 1972 forest industries owned only 30,100 acres of commercial forest land.

Results of a mail canvass of forest landowners in the three Southern New England states conducted in conjunction with this second forest survey show that there are 184,100 owners of the 4.5 million acres of privately owned commercial forest land in the region. Thus the average owner owns 24.2 acres. The study also indicated that 58 percent of the owners owned forest land simply because it was part of their residence. Only 2 percent replied that their primary reason for owning forest land was for timber production. However, an additional 8 percent indicated timber production as an important secondary reason for owning forest land.

Who are these forest landowners? Among individual owners, 54 percent are over the age of 50, and 58 percent have incomes in excess of $10,000; 19 percent over $30,000. Their occupations run the gamut. Professional persons, business executives, and retired persons account for 50 percent of the owners, and they own 1.9 million acres—56 percent of the commercial forest land owned by all individuals. Farmers formerly a prominent group of forest landowners, account for only 4 percent of the individual owners, and they own only 345,000 acres or 10 percent of the individually owned acreage.

Another item uncovered by this ownership survey is that 18 percent of all owners, owning 14 percent of the private commercial forest land, have owned it for less than 5 years. Only 5 percent of the private commercial forest land has been in the same ownership for more than 50 years. This too points up the active land-use changes occurring in Southern New England.

FOREST TYPES

Forest-type classifications used in the initial survey are fairly comparable to the forest-type classifications used in the resurvey. Differences in acreage between surveys can be attributed to actual trends.

In this resurvey of Southern New England, 24 local forest types were recognized. These local types were combined into eight major types. For example, the major type—white pine—red pine—hemlock—is composed of four local or minor types: red pine, white pine, white pine—hemlock, and hemlock. Of the total 841,000 acres in the type, white pine accounts for 484,000, white pine—hemlock 170,000, hemlock 128,000, and red pine (mostly in plantations) 59,000.

Softwood types.—Despite the total decrease in the area of commercial forest land in Southern New England, the area of softwood types increased about 17 percent. Two types accounted for most of the increase. The white pine—red pine—hemlock type gained 26 percent and the spruce—fir type rose 60 percent in area. The pitch pine type, however, de-

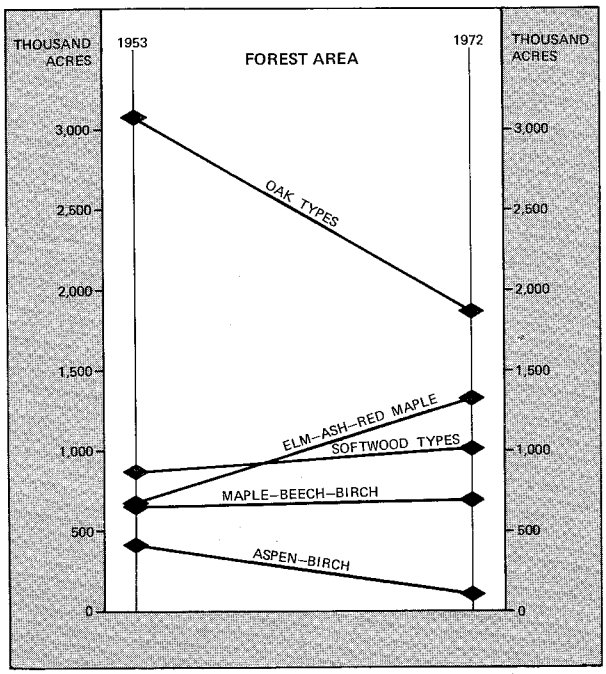


Figure 2.—Changes in forest area, by forest types, 1953-72.

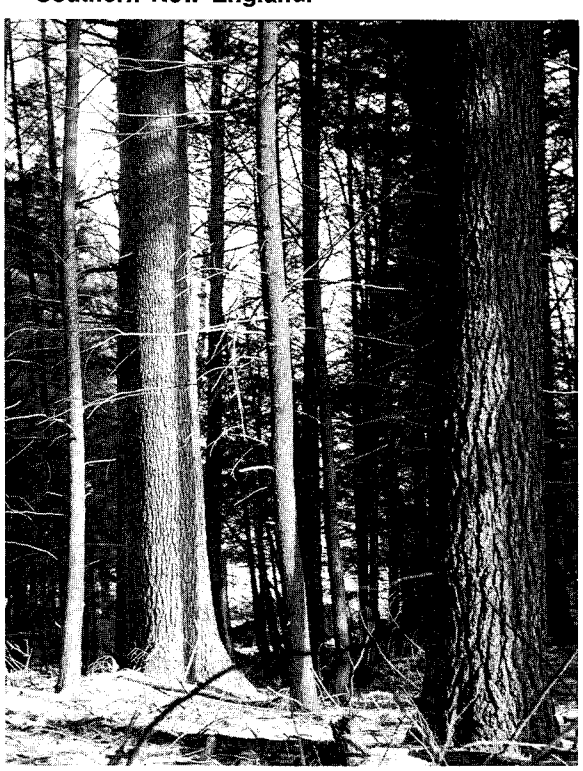
creased in area by 26 percent. This type is found primarily in the eastern and coastal portions of the region. These are also the areas that have been subjected to the most intense urbanization, and this has undoubtedly accounted for the decline in the pitch pine type.

This increase in the white pine type is apparently the result of less cutting of white pine. Before the age of the corrugated box and the plastic container, the white pine resource of Southern New England was extensively cut over for box lumber. In 1948 there were 61 wooden box plants in operation in Massachusetts alone. By 1967 the number had dropped to only 37.

Another factor is the loss of white pine from the 1938 hurricane. This natural disaster proved most devasting to white pine because the species tends to be shallow-rooted and susceptible to windthrow. The damage was so extensive that the Forest Service instituted an emergency program to salvage usable white pine and reduce the fire hazard from accumulated blown-down trees. Usable pine logs were removed from the woods and stored in ponds to be sawed the following year. Today, white pine seems to be staging a comeback after this two-pronged devastation both man-caused and natural.

Oak types.—The oak types consist of the

Hemlock is an important forest type in Southern New England.



The oak-hickory or central hardwood type is the most extensive forest type in Southern New England.

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oak-hickory type—1.5 million acres—and the oak-pine type—358,000 acres. Both of these types showed declines since 1953. The oak-pine type dropped 8 percent from 391,000 acres, while the oak-hickory fell 44 percent from 2.7 million acres.

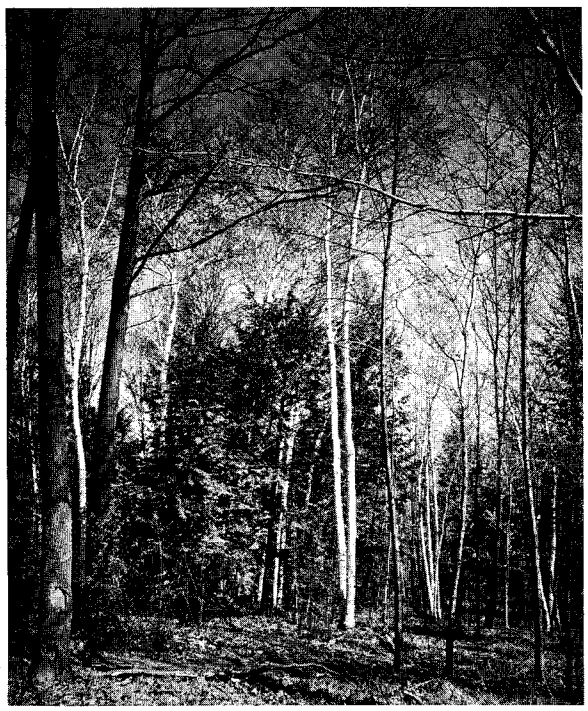
Most of the oak types are found in Connecticut and eastern Massachusetts as well as in Rhode Island. Since these are also the areas of greatest urban expansion, it is the oak type that has been most affected.

Elm—ash—red maple.—This type has increased substantially since 1953, from 653,000 acres to more than 1.3 million acres in 1972.

The explanation for this increase is the abandonment of many of the better farms of Southern New England. Red maple, as well as elm and ash, have their best development in this region on moist sites, particularly in bottomland areas. These sites were also once prime agricultural sites. Also, red maple tends to be the pioneer, or first type, to become established on such sites.

Maple—beech—birch.—The maple—beech—birch or northern hardwood type is commercially the most valuable and one of the aesthetically most attractive forest types in Southern New England. Most of this type is found in the Berkshire Mountains of Massachusetts and northwestern Connecticut. This type now covers 693,000 acres, up from 673,000 in 1953.

The maple—beech—birch or northern hardwood forest type is one of the esthetically most attractive types in Southern New England.



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Aspen—birch.—The aspen—birch type occupies 105,000 acres down from 406,000 in 1953. Aspen and its associates—white birch, gray birch, and red maple—frequently establish themselves on burned-over land, disturbed land, and recently abandoned cropland. Because aspen—birch is often the first association to become established on such areas, it is considered a pioneer forest type in Southern New England. The type is often short-lived and gives way to one of the other types. Because of the decrease in farm abandonment, large fires, and limited disturbance of forest land in the region, the area of aspen—birch has declined.

STAND-SIZE CLASSES

Stand-size categories for 1953 and 1972 are not on the same basis, so differences do not necessarily represent actual trends.

The stand-size classes in Southern New England are nearly evenly distributed. That is, about one-third of the area is in each of three categories—sawtimber stands, poletimber stands, and seedling-sapling stands and nonstocked areas. This is a nearly optimum situation for sustained-yield forestry. However, because Southern New England is not an active timber-producing region, we anticipate that the third forest survey of the region will find a disproportionate area in sawtimber-size stands.

STOCKING AND AREA CONDITION

Stocking and area condition can be analyzed from two viewpoints. The first is to consider all the trees in the stand. This gives a measure of the utilization of the area by trees compared to its potential or optimum utilization. Second is to consider only the growing-stock trees. This gives a measure of the utili-

zation of the area by presently or potentially usable trees.

Eighty percent of the commercial forest land in Southern New England is fully stocked or overstocked. This means that on 80 percent of the commerical forest land in the region, 100 percent or more of the optimum growth potential of the site is being utilized. When we consider only growing-stock trees—all trees except those that are classified as rough or rotten—the percentage of commercial forest land that would be considered to be fully stocked drops to only 46 percent. This means that poor-quality trees are a large enough component in 34 percent of all stands to cause them to be excluded from full stocking. A look at the average number of trees per acre in Southern New England bears out this conclusion. When all kinds of trees are included, Southern New England stands average 605 trees per acre. But when rough and rotten trees are excluded, the number drops to 400. Thus one tree in three is of such poor quality that it cannot be considered as growing stock.

The volume per acre of commercial forest land has nearly doubled since 1953. In 1953 all stands averaged 673 cubic feet per acre and in 1972 they averaged 1,219. This is the result of the even distribution of stand-size classes mentioned earlier and a better level of tree stocking.

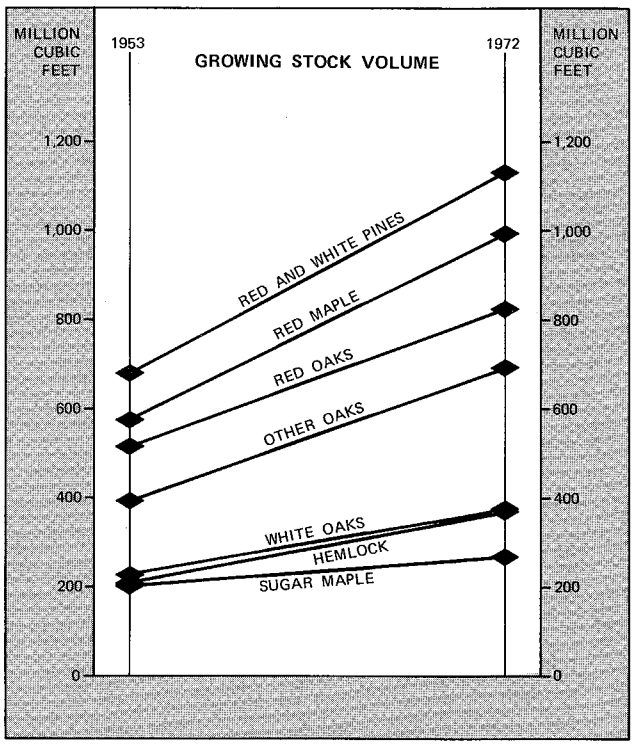


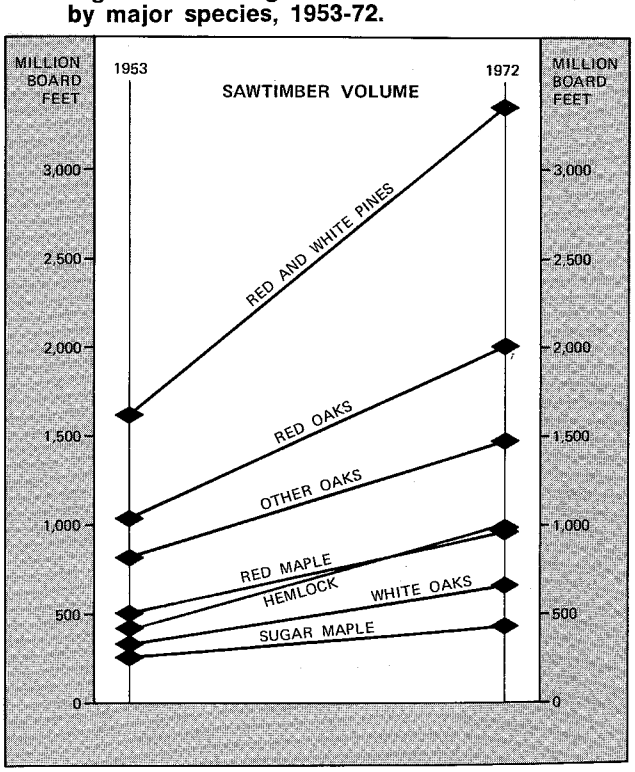
Figure 3.—Changes in growing-stock volume, by major species, 1953-72.

Volume

Although the area of commercial forest land in Southern New England declined 12 percent, the volume of growing stock increased nearly 60 percent. This large increase was primarily the result of the increasing average size of trees, the declining demand for timber, and the recovery of the forest from previous timber-harvesting and storm damage.

The present volume of growing stock in Southern New England is 6.1 billion cubic feet. In 1953 the volume was 3.8 billion. Softwoods account for 1.7 billion cubic feet, up nearly 69 percent from 1.0 billion cubic feet in 1953. Hardwoods account for 4.4 billion cubic feet, compared to 2.8 billion in 1953, up 57 percent. Thus the greatest percentage increase was in the softwood species.

Figure 4.—Changes in sawtimber volume, by major species, 1953-72.



Sawtimber volume—the volume in board feet of softwoods 9 inches dbh and larger and of hardwoods 11 inches dbh and larger—increased 87 percent. In 1953 sawtimber volume stood at 6.4 billion board feet, but by 1972 it had risen to 12.1 billion. The greatest percentage gain was in the softwood species, which more than doubled, going from 2.3 billion board feet in 1953 to 4.8 billion in 1972. Hardwoods rose from 4.1 in 1953 to 7.3 in 1972. These increases reflect the increasing tree size in Southern New England.

SAWLOG QUALITY

Though the total sawtimber volume in Southern New England has increased substantially since 1953, the quality of this material is generally poor. Sawlogs of standard-lumber log grade 1 and 2 are the most sought-after because they yield more volume of the better lumber grades. Only 18 percent of the softwood sawtimber graded fell in these two grades. Only 5 percent was in grade 1. Of the hardwood sawtimber, only 29 percent fell in the two top grades—10 percent in grade 1 and 19 percent in grade 2. By comparison Vermont, also a state with a high proportion of low-quality material, had 41 percent of its hardwood volume in these two grades.

Poor-quality trees such as these white pines account for too large a part of the volume.

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SPECIES

Red and white pines.—The volume of red and white pines rose 67 percent, from 677 million cubic feet in 1953 to 1.1 billion in 1972. Sawtimber volume jumped 106 percent, from 1.6 billion board feet in 1953 to 3.3 billion board feet in 1972. Much of this increase can be attributed to a slackening in demand for pine following earlier heavy cutting and the extensive damage done by the 1938 hurricane. Trees that succeeded those cut or blown down are now moving into the small sawtimber category.

Hemlock.—The volume of hemlock in Southern New England now stands at 379 million cubic feet, up 86 percent from 204 million in 1953. Hemlock sawtimber jumped 135 percent between the surveys. In 1953 hemlock sawtimber stood at 424 million board feet, but by 1972 it totaled 995 million. The most likely reason for this increase is the diminished demand for hemlock. Hemlock bark was used as a tanning agent during the heyday of the leather industry in New England and as framing lumber. Today both of these uses have all but disappeared. Synthetic tanning agents have replaced hemlock bark, and the ready abundance and superior nail-holding ability of West Coast framing lumber has forced hemlock out of local lumber yards.

Oaks.—The oaks are the most abundant species in Southern New England. In this resurvey of Southern New England, nine species of oak were tallied. However, these nine can be aggregated into three major groups—the select white oaks, select red oaks, and all other oaks.

In Southern New England the select white oak group consists almost entirely of white oak (*Quercus alba*). This group totaled 378 million cubic feet of growing stock and 661 million board feet of sawtimber. The select red oak group, the largest of the three groups, consists almost entirely of northern red oak (*Q. rubra*). This group totaled 875 million cubic feet of growing stock and 2.0 billion board feet of sawtimber in 1972.

The other oaks group consists of all the

other oak species, but in Southern New England this is principally black oak (*Q. velutina*). This group totaled 698 million cubic feet of growing stock and 1.5 billion board feet of sawtimber. The oaks increased in growing-stock volume 72 percent and in sawtimber volume 89 percent. While the increase in sawtimber volume was only 2 percent greater than the general increase in all species, the increase in growing stock was 12 percent greater than that for all species combined. This may be explained by the high rate of farm abandonment, particulary in the Connecticut Valley, the principal range of the oaks.

Sugar maple.—Sugar maple is probably the most prized species in Southern New England, both for its wood and for its beauty. Sugar maple growing-stock volume rose only 33 percent from 203 million cubic feet in 1953 to 271 million in 1972. Sawtimber volume rose 69 percent—from 262 million board feet in 1953 to 443 million in 1972.

This comparatively low increase may be explained by a combination of factors. Most of the sugar maple volume in Southern New England is found in western Massachusetts and northwestern Connecticut; and this is the region with a demand for timber, particularly quality hardwoods. Thus hardwoods—and particularly sugar maple—are being harvested in this region. Also, common harvesting practices, dictated largely by lumber demand, preclude the harvesting of such lower valued species as red maple and beech. Given more room to grow, these species quickly dominate the stands and crowd out younger sugar maples.

Red maple.—The volume of red maple growing stock rose from 572 million cubic feet in 1953 to 988 million in 1972—an increase of 73 percent. Red maple sawtimber volume jumped 92 percent over the period, from 510 million to 978 million board feet. This increase in red maple volume is a result of farmland abandonment where red maple stands become established on fertile, moist sites and as a result of cutting practices that remove the more valuable species and leave the less valued red maple free to grow.

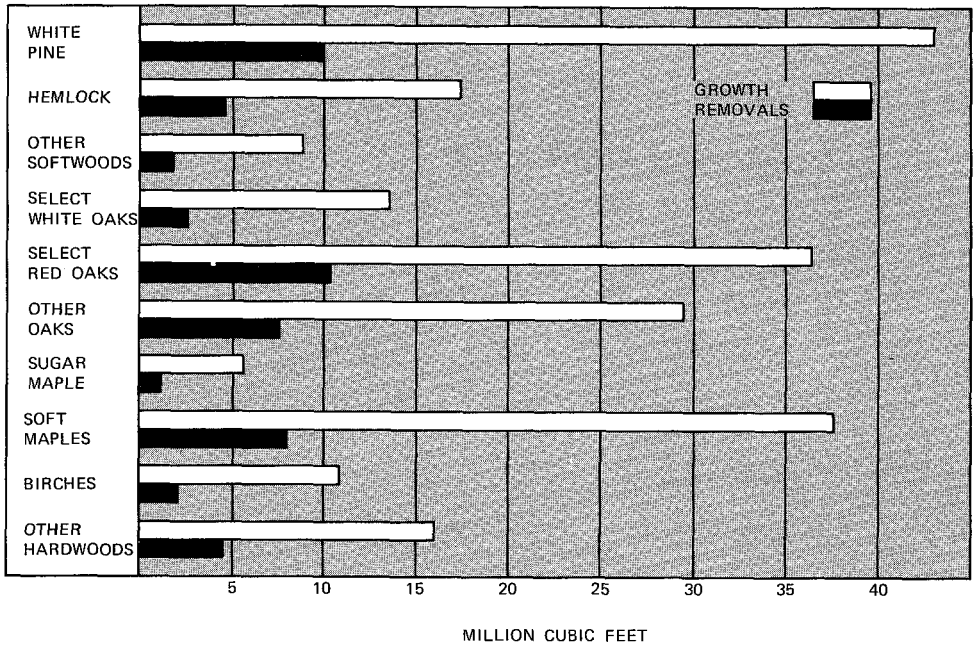
Growth and Removals

In 1971 annual net growth of growing stock totaled 218.8 million cubic feet and timber removals totaled only 52.0 million. Thus growth was more than four times removals. The situation for sawtimber was similar: annual net growth of 542.3 million board feet and 120.7 million board feet of removals.

A common method of analyzing timber growth is to look at it as a percentage of the timber inventory. The annual net growth of growing stock in Southern New England in 1971 was 3.6 percent of the inventory, and for sawtimber 4.5 percent. Softwood growing stock did somewhat better than hardwood—4.1 percent compared to 3.4 percent. The reverse was the case for sawtimber. Hardwood sawtimber growth was 4.6 percent of the inventory while softwood growth was 4.4 percent. By multiplying the acreage in each potential productivity class (table 8) by the lowest point of each range, except for the "less-than-50-cubic-foot class," in which case 25 cubic feet per acre is used, we find that a conservative estimate of the potential productivity of commercial forest land in Southern New England would be approximately 3.9 percent of the inventory. This means that the current growth rate of 3.6 is approaching the potential of the area. This can be explained by the fact that most timber stands in Southern New England are relatively young and have reached the point of near optimum stocking.

A continuation of the current low rate of timber harvesting will eventually result in stand stocking levels above the optimum for net growth. When timber stands become overstocked, the growth rate declines as mortality increases. Also, only shade-tolerant species are able to grow under the dense shade of such stands. This means that species like hemlock, beech, and red maple would become more prominent components of northern hardwood stands at the expense of ash and the birches. Similarly, we would also expect beech, red maple, dogwood, and redbud to become more prominent components in the oak-hickory type at the expense of yellow-poplar, the gums, and ash.

Figure 5.—Annual net growth and removals of growing stock in Southern New England, by species groups, 1952-71.



TIMBER REMOVALS AND TIMBER-PRODUCTS OUTPUT

The average annual timber removals (table 23) and the annual removals for 1971 (tables 24 and 25) should not be confused with the output of timber products (tables 28 through 30). The data in tables 23 through 25 were developed from the remeasurement of permanent sample plots. Average timber removals (table 23), give a more reliable description of the growth-and-removals trend and more accurately assess the changes in the timber inventory since 1952. The timber-removals estimates for a particular year are more useful when they are related to the output of timber products in the same year. The output of timber products (tables 28 through 30) relates only to that portion of total removals that was utilized for products.

With few local exceptions, the production of timber products is not a major industry in Southern New England. However, an average 42.5 million cubic feet of growing stock was removed annually from the region's commercial forest land during the period between surveys. Significantly though, only 6.2 million cubic feet of this volume was removed intentionally for timber products. The other 36.3 million cubic feet was removed from forested areas that were being converted to other land uses—forest land being cleared for highways, shopping centers, housing developments, and the like.

About 24 million cubic feet of timber removed from such areas was not utilized in any way. This material was either piled and burned or buried. About 5.7 million cubic feet was utilized for industrial products—sawlogs, pulpwood, and similar products. An additional 1.2 million cubic feet, 3 percent of the volume, was utilized for fuelwood—mainly fireplace wood.

It is estimated that 90 percent of the growing stock used for fuelwood in Southern New England comes from land-clearing operations. Another 5.4 million cubic feet is material that was removed from the growing-stock inventory although it was not severed from the stump. This is the growing-stock volume of trees that remain on areas where land-use changes have occurred. Examples would be trees remaining on wooded house lots, trees

Figure 6.—Distribution of total removals in Southern New England, by reason for removal and final disposition of timber removed.

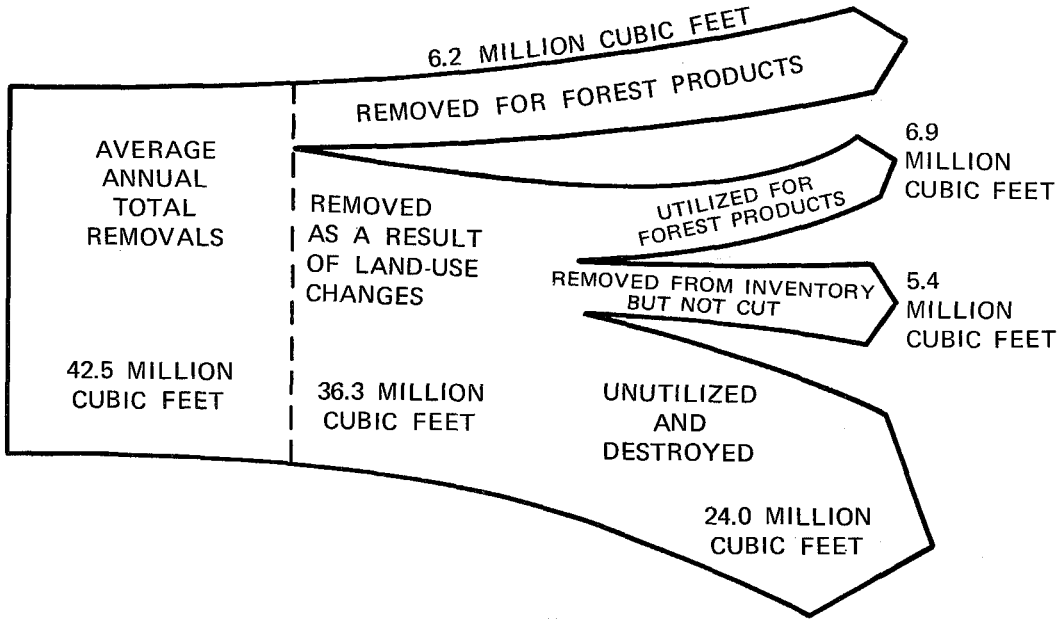
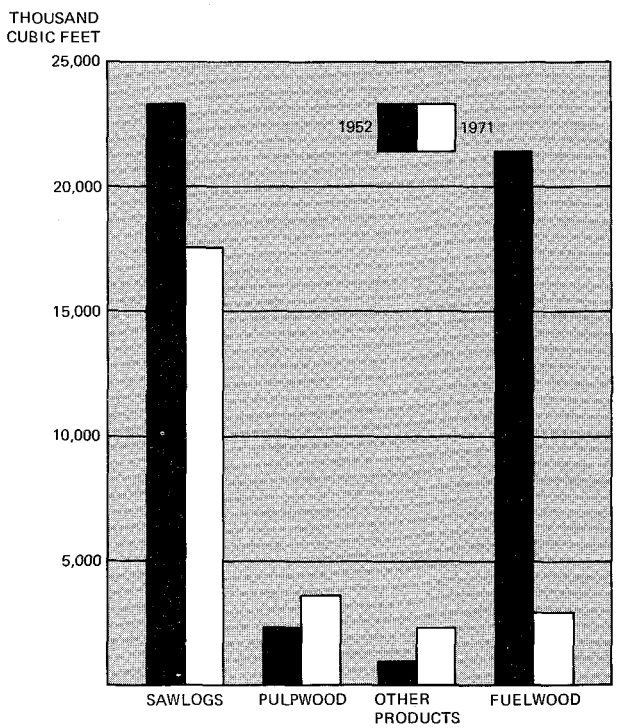


Figure 7.—Timber products output in Southern New England, by product, 1952-71.

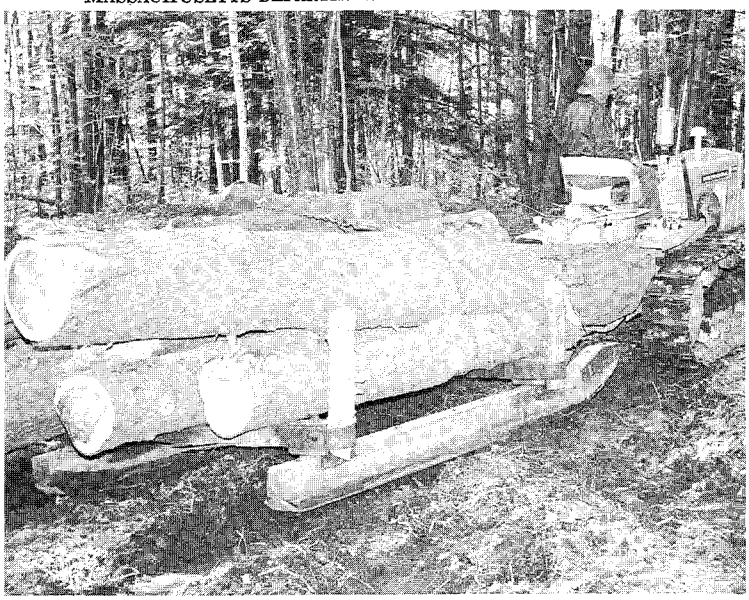


within highway rights-of-way, or in public parks, golf courses, and other recreation areas.

Was all of the 24 million cubic feet of growing stock removed but not utilized actually wasted? In all probability much of this material occurred in tracts too small to provide marketable volumes, or it occurred in areas where no market for timber existed. However, it is undoubtedly true that in many instances no attempt was made to find a use for this material. Taking all this into consideration we think it is reasonable to conclude that half, or 12 million cubic feet, could have been recovered and utilized if sufficient effort had been put into finding uses and markets for it. Wood-processing plants in Southern New England import substantial volumes of wood fiber from outside the region. Also plants outside the region, but adjacent to it, consume similar material and could conceivably utilize this kind of material.

DESPITE INCREASING URBANIZATION, SOUTHERN NEW ENGLAND STILL HAS AN ACTIVE AND DIVERSIFIED FOREST INDUSTRY.

MASSACHUSETTS DEPARTMENT OF NATURAL RESOURCES PHOTO



Logging with a scoot.

UNIVERSITY OF MASSACHUSETTS PHOTO

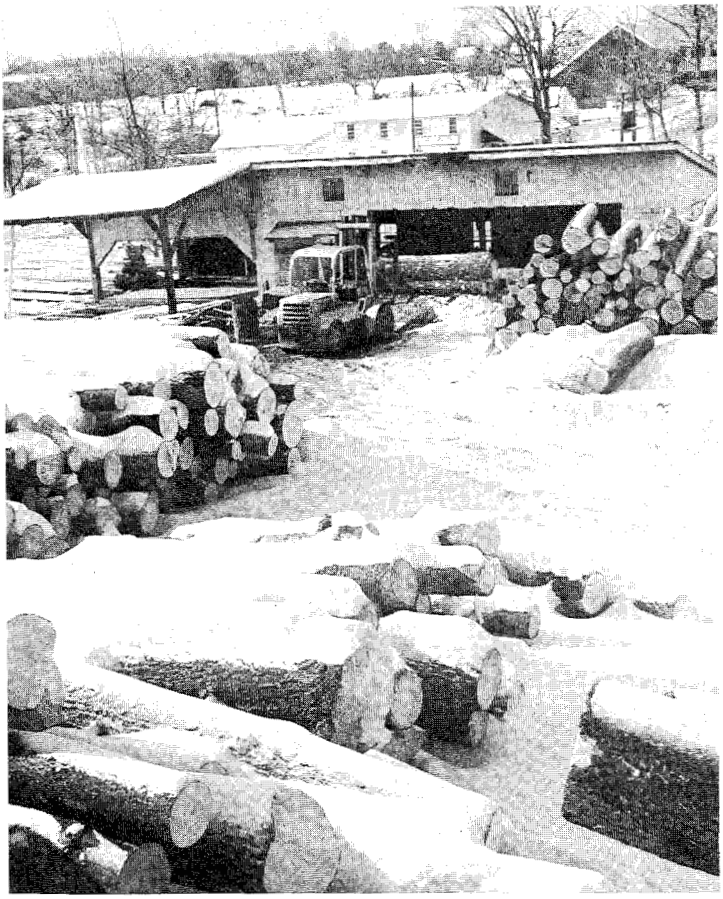
Shipping pallets—a good use for low-quality wood.

Machining furniture parts.

MASSACHUSETTS DEPARTMENT OF NATURAL RESOURCES PHOTO

Finishing furniture.

MASSACHUSETTS DEPARTMENT OF NATURAL RESOURCES PHOTO



MASSACHUSETTS DEPARTMENT OF NATURAL RESOURCES PHOTO

A typical Southern New England sawmill.

RHODE ISLAND DEPARTMENT OF FORESTS & PARKS PHOTO

Hauling out a load of hemlock logs.

Loading logs with a modern mechanical loader.

RHODE ISLAND DEPARTMENT OF FORESTS & PARKS PHOTO

SAWLOG PRODUCTION

Lumber production in Southern New England began almost with the first settlement. It is known that a sawmill was in operation in Farmington, Connecticut, in 1645. Others were probably in operation by this time, and perhaps some earlier. At Plimouth Plantation there were pit saws from the beginning, but these cannot accurately be called sawmills in the modern sense. The earliest mills utilized the push-pull or up-and-down principle of the pit saw with power supplied by a water wheel as opposed to human muscle power.

From 1869, the year of the first authenticated records, lumber production rose almost steadily from 266.6 million feet to a peak of 555.0 million in 1909. After 1909 the decline was quite rapid until 1933, when the low point of 66 million feet was reached. Lumber production then made a short-lived recovery to 146.3 million in 1946 and then began a slow, steady decline.

The 1971 sawlog production in Southern New England totaled 104.8 million board feet —34 million board feet below the 1952 total. Though the total production of sawlogs dropped 25 percent from 1952 to 1971, the production of hardwood sawlogs actually increased 19 percent. In 1952 hardwood sawlog output stood at 47 million board feet while in 1971 it had reached 55.9 million. This gain in hardwood production is a reflection of the development of the wooden pallet industry. Pallets are frames on which warehoused goods or goods in production are stacked so that they can be easily moved by a fork lift. This industry is able to utilize low-quality hardwoods.

Softwood sawlog production, however, took a nose dive. In 1952 softwood sawlogs accounted for 91.9 million board feet. By 1971 production had dropped to just under 49 million feet—a decline of 47 percent. This decline is probably tied to the decline of the wooden box industry during the same period.

PULPWOOD

A total of 43,900 standard cords of pulpwood were produced in Southern New England in 1971. In 1952 pulpwood production stood at 29,600 cords. The output of pulpwood from other wood-using plant byproducts, such as chipped sawmill slabs and edgings, accounted for 14,000 cords. When we exclude the material from plant byproducts we find that roundwood production rose only 500 cords. In 1952 only an inconsequential volume of plant byproducts was used for pulpwood.

In 1971 about 58 percent of the round pulpwood and 60 percent of the chipped byproducts produced in Southern New England were shipped to pulpmills outside the region, principally to New York State. Southern New England has only two operating woodpulp mills, both of which produce roofing felt and other building-board products. Because the requirements of these mills are comparatively small, the region usually produces more pulpwood than it consumes.

Despite having only two woodpulp mills, the region has about 100 paper mills, 75 in Massachusetts alone. These mills utilize pulp purchased from other manufacturers and specialize in manufacturing what are known as specialty grade papers. These are typically produced in low volume, but have a high value per unit. They include such products as ledger stock, fine writing papers, glassine, carbon papers, and bank-note papers. Southern New England is the center of the fine-paper industry in the United States.

MISCELLANEOUS INDUSTRIAL PRODUCTS

Included under "miscellaneous industrial products" are all products except sawlogs, pulpwood, and fuelwood, such as veneer logs and bolts, cooperage logs and bolts, piling, poles, posts, charcoal wood, horticultural mulches, fence pickets, and similar minor products.

In 1971 a total of 2.3 million cubic feet of miscellaneous industrial products were produced in Southern New England. Hardwoods accounted for 1.6 million cubic feet, softwoods for 0.7 million. Of the 2.3 million cubic feet of miscellaneous industrial products, only 549,000 or 24 percent came from roundwood. The remainder came from other timber-industry byproducts. Much of this was mulches and charcoal wood.

In 1952 miscellaneous industrial products from roundwood stood at 436,000 cubic feet.

Hardwood production rose from 263,000 to 475,000 cubic feet while softwood declined from 173,000 cubic feet of roundwood to only 74,000 in 1972. This decline is attributed to the almost total decline of the softwood cooperage industry. In 1952 a market existed for such softwood cooperage products as fish pails and butter firkins. Since then, however, other forms of packaging have almost totally displaced these products.

Byproducts from other timber industries accounted for 1.7 million cubic feet in 1971. This total is nearly three times the volume produced in 1952. In 1952 large volumes of the byproducts that are now being chipped and utilized were either burned or piled and left to rot.

FUELWOOD

In Southern New England fuelwood is an important timber product. It rivals pulpwood in total production almost 3.2 million cubic feet of it compared to 3.7 for pulpwood.

The production of fuelwood declined drastically from 1952 to 1974 in Southern New England, as it did in most other regions; and the nature of its end use changed. But during the winter of 1973-74, fuelwood production shot up as homeowners turned to wood as a source of fuel in the energy crisis. It is too early at this writing to estimate the volume of fuelwood consumed in the winter of 1973-74 as a result of the fuel-oil shortage or to determine if this increased level of consumption is a short-term event or whether it will continue in years to come.

Until the winter of 1973-74, very little wood was burned for heat in Southern New England, and the term "fuelwood" could almost have been considered a misnomer. Most fuelwood was burned for the pleasant effect of a fire in the living-room fireplace.

In 1952 about 50 percent of the roundwood produced for fuelwood came from growing-stock sources while in 1971 about 64 percent came from growing stock. The most apparent explanation for this increase in the use of growing stock is the large proportion of material removed in land-clearing operations that is utilized for fuelwood. Since most areas that are cleared are adjacent to suburban areas, fuelwood is the most accessible market and use for this material.

Nontimber Benefits

While the production of timber products may be of major importance in many forested regions, in Southern New England they must be considered as a secondary benefit derived from the forest. The major benefits of Southern New England's forests are their influence on water quality, climate and the environment, and their amenity and esthetic values.

WATER

With an average annual precipitation range of 40 to 48 inches, distributed evenly throughout the year, water quantity is not a problem in the region. However, the quality of water in such a highly industrialized and highly populated region is of critical importance.

While forests may actually reduce total water yields by transpiration, they minimize peak flows by promoting water infiltration into the soil by means of their extensive root systems. This infiltration reduces overland flow and thereby reduces erosion and stream sedimentation. It also helps to increase ground-water supplies. In a study of one stream valley in Maryland it was found that forest land produced about 50 tons of stream sediment per square mile per year, established urban and suburban land 50 to 100 tons, farmland 1,000 to 5,000 tons, and land stripped for construction 25,000 to 50,000 tons (*Lull 1971*). Thus in forested areas, stream sedimentation is substantially lower while water infiltration is greater than for other land uses.

CLIMATE AND ENVIRONMENT

Thousands of people each summer come to Southern New England for their vacations. Still other thousands leave Southern New England's cities to escape into the countryside. One of the reasons they do this is because it is cooler there than in the cities. Since

Southern New England is no further north than Chicago and other mid-continent locations that are known for their hot, sultry summers, and because the prevailing wind, as in all of North America, is westerly and is therefore a land breeze, the relative coolness of the region cannot be ascribed to geography alone.

The fact is that the abundance of forested land, coupled with an adequate rainfall, plays a key role in providing the region with a much desired summer climate. Since heat is required to evaporate moisture, trees act like living air conditioners. It has been estimated that a single isolated tree can transpire 100 gallons of water per day. Since it requires 230,000 K cal. of energy in the form of heat to evaporate this much water, a tree can be equated to five 2,500 K cal/hr. air conditioners running for 20 hours per day (*Federer 1971*).

Another effect that trees have on climate is the absorption and scattering of solar radiation—the shading effect. In forested areas night temperatures tend to be warmer, and the frost-free period is longer than it would otherwise be. Conversely, daytime temperatures are cooler because of the effects of evapotranspiration. Thus trees limit the daily temperature variations.

The vacationer is often heard to remark that the air "seems fresher" or "cleaner" in a forest environment. Though some of this feeling can undoubtedly be ascribed to a psychological sense of well-being, there is evidence that trees do often act as air purifiers. Urban areas emit or produce large quantities of gaseous pollutants.

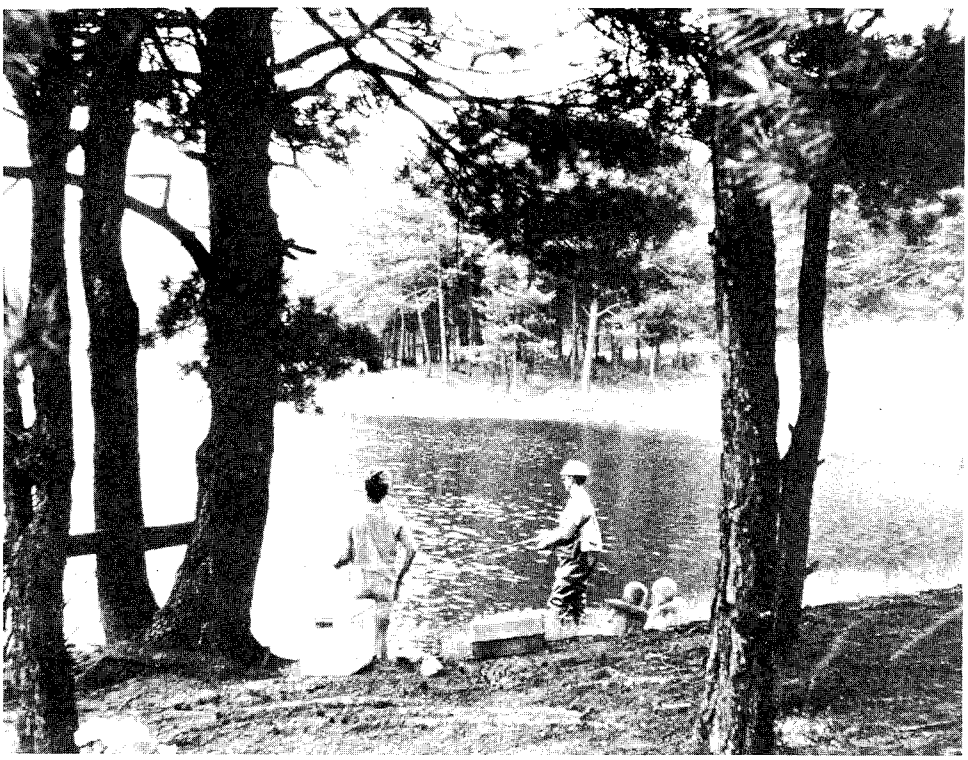
One important pollutant is ozone, which occurs naturally in the atmosphere in small amounts, but is very unstable. The effect of sunlight on automobile exhaust, however, often causes an inversion layer of ozone to form over urban areas. It has been shown that evapotranspiration is directly related to the uptake of ozone and thus its removal from the atmosphere (*Rich 1971*). However, high concentrations of ozone cause damage to foliage, particularly in conifers.

Another natural component of air that can become a pollutant is carbon dioxide. This gas is produced by oxidation and respiration in animals. In urban areas the combustion of fossil fuels and the absence of green plants permits a buildup of carbon dioxide. All green plants use carbon dioxide in photosynthesis and return free oxygen to the atmosphere. Therefore a healthy, vigorous stand of trees acts like a giant air purifier. It should be pointed out that because decay gives off carbon dioxide it is important that the stand be kept in a healthy condition. Also, because they do not lose their needles every year and because they carry on a slow rate of photosynthesis in winter, conifers are more effective at removing carbon dioxide from the air than are hardwoods.

Another air pollutant that is a byproduct of urbanization is sulfur dioxide. Much of this gas also gets into the atmosphere by the combustion of fossil fuels. Since not all sources of coal and oil contain high percentages of sulfur, many cities have prohibited the use of high sulfur content fuels in an attempt to limit emission of sulfur dioxide. Trees remove sulfur dioxide from the atmosphere. However, unlike carbon dioxide, sulfur dioxide is not beneficial to the plants, and in fact too much sulfur dioxide can be extremely harmful to the trees.

The urban-industrial complex generates considerable noise. Some writers have labled the problem "noise pollution." Because of the increasing use of automobiles, trucks, and jet aircraft, the noise problem is growing constantly. Cook and Van Haverbeke estimated that the noise level in the average community has increased fourfold in the past 20 years (*Cook and Van Haverbeke 1971*). It has been shown that trees and shrubs can act as buffers and absorbers of sound. A forest stand can absorb from 6 to 8 decibels per 100 feet (*Federer 1971*). Thus a strip of dense forest interposed between a highway, railroad line, or industrial complex and a residential area can greatly improve the habitability of the residential community and probably increase property values.

In addition to providing a sound buffer, trees also provide a visual screen and a relaxant to the eyes. Then too, if the source of noise is visually screened from view, it often seems less bothersome. In addition to reducing glare, the green foliage of a forest stand has a relaxing and less tiring effect. Note the extensive use of green chalkboards in schools and green tones in offices and similar work areas.



The forest environment provides a valuable recreation resource.

OUTDOOR RECREATION

According to the U. S. Bureau of Sport Fisheries and Wildlife, there were an estimated 222,704 paid hunting license holders and 436,053 paid fishing license holders in Southern New England in 1972. In 1970 the U.S. Bureau of Sport Fisheries and Wildlife estimated that nationally each hunter spent approximately 9 days afield and spent $81 during the hunting season or $9 per day in the field. If we apply these national estimates, it means that these hunters spent more than 2 million days hunting and spent more than $18 million dollars for licenses, equipment, supplies, travel, and lodging.

Since licenses are not required for salt-water fishing, all of the more than 400,000 fishermen fished in fresh-water streams and ponds. These sportsmen spent an average of $6.30 per day or a total of $127 per season. Since they spent an average of 21 days each fishing during the year, this means they spent more than $55 million dollars for more than 9 million recreation-days of fishing. A recreation-day is defined as a day or any part of a day that was spent hunting or fishing.

Hunting and fresh-water fishing recreation depend on forest land both for adequate wildlife habitat and for clean fishable streams and ponds. With such a high density of population, pressure on the fish and wildlife resource in Southern New England is intense. This pressure calls for imaginative planning and action by the state fish and game agencies to provide the fish and game resources and to keep lands available for this form of recreation.

Hiking, camping, and picnicking are increasingly popular forms of forest recreation. In 1967 there were a total of 183 campgrounds in Southern New England, 122 of them privately owned. The growth of the private campground business in Southern New England has been phenomenal in recent years. In 1961 there were only 13 commercial campgrounds in the region.

State parks account for 39,600 acres of for-

est land in the three-state region. This land is not considered as commercial forest land because it is withdrawn by law from timber harvesting. In addition to the state park lands, there are over 440,000 acres of forest land owned by various public agencies that are available for some form of forest recreation although the land may not be specifically held for recreation. State forests account for 296,000 acres of this total. Other lands include town forests, public reservations, the Metropolitan District Commission lands in Massachusetts, wildlife refuges, National Park Service lands, state fish and game lands, and reservoir watersheds.

Timber Supply Outlook

It has been pointed out earlier that the demand for timber for products in Southern New England has declined to only 19.7 million cubic feet and that 85 percent of all the timber removed is removed in land-clearing operations. In fact, during the period between surveys, Southern New England lost an average of 35,000 acres of commercial forest land per year. The question then becomes not what will the future supply of timber be, but what will commercial forest land in Southern New England be like? Can we expect this rate of land-clearing to continue, and will timber removals for products continue to decline? In this section of the report we attempt to answer these questions.

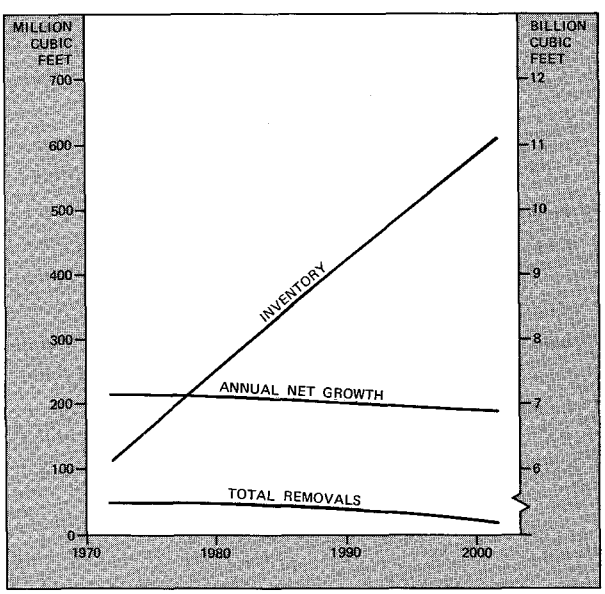
All long-range projections are subject to many uncertainties. Therefore, the result of such projections can be considered only in the light of the basic assumptions that must precede the projections.

In this projection we have assumed that land-clearing will decrease at the rate of 1,000 acres per year over the projection period. That is, the area of commercial forest land lost annually because of land-use changes will drop steadily from 35,000 acres to 5,000 acres in 2002. This area loss is translated into a volume loss dependent upon the average volume per acre for the particular year. Total product removals other than from sources involving land-use changes are assumed to hold constant at 6.0 million cubic feet per year. The reason for not assuming a further decline in product removals is that this volume appears to be the practical minimum.

The annual net growth minus the product removals is added back into the inventory for those acres remaining. Thus the average volume of growing stock per acre in Southern New England will increase from about 1,200 cubic feet in 1971 to nearly 2,500 cubic feet in 2002. Since growth per acre is a function of stand density, increases in volume per acre influence annual net growth per acre. Because of this effect, average annual net growth per acre will increase from nearly 44 cubic feet per acre to nearly 45 in 1986, when volume per acre will be over 1,800 cubic feet. Then, however, it will begin to decline as this optimum stand density is past. At 2,400 cubic feet per acre, which would theoretically be reached in 2000, growth will have declined to 43 cubic feet per acre per year and will be held at this level to the end of the projection period.

Under these assumptions, the area of commercial forest land in Southern New England is projected to decline from 5 million acres in 1972 to 4.4 million in 2002. Total removals

Figure 8.—Projected growth, removals, and inventory in Southern New England, 1972-2002.



will decline from 52 million cubic feet in 1971 to 18 million in 2020. The inventory will nearly double, going from 6.1 billion cubic feet in 1971 to 11.1 billion in 2002. Total annual net growth will decline from 219 million cubic feet to 190 million.

If this projection holds, we can expect the forests of Southern New England to become typically dense sawtimber stands. The projection implicitly assumes that there will not be a major fire, disease, or insect outbreak. With modern fire-suppression techniques, plus the fact that the forests of Southern New England generally are less flammable than most other types, the assumption about fire is probably a very safe one. Such is not the case for insects and disease. As stands become overstocked, they become more susceptible to insect or disease attack. Thus we might expect continuing outbreaks of certain forest pests and disease.

Management Opportunities

The forests of Southern New England present the forester with an interesting array of opportunities for practicing multiple-use forest management. Probably in no other region of the country is the management of forests for the production of timber products of such a minor consideration and the management of forests for their amenity values of such major consideration as in this three-state area. Yet when properly managed for watershed protection, esthetics, wildlife production, and recreation, timber products will be a byproduct.

One might be tempted to ask, because the production of timber products is not a major forest-management consideration in Southern New England, why have forest management at all? Why not just let nature take care of the region's forest land? Some people have proposed large "wilderness areas" in the East, in which man's influence would be kept to a minimum.

Since we can no longer tolerate uncontrolled wildfire or uncontrolled insect and disease epidemics, what would such a forest eventually be like? In a humid region like Southern New England the northern hardwood forest would eventually reach a climax of almost pure beech and hemlock because these are the only species in this forest type that can reproduce and tolerate the kind of dense shade that would develop. Most of the birches, red maple, white ash, pines, and practically all of the shrubs would disappear. Only a few sugar maples would remain, but these would be generally spindly, weak individuals because sugar maple can just about exist under dense shade. It should be noted that those species that would be eliminated are species that provide the vibrant autumn foliage and varied textures of bark and foliage during the remainder of the year. Many shrubs such as shadbush and many of the viburnums would be unable to survive under such conditions.

What about wildlife? It is a popular misconception that the early settlers found dense, mature forests teaming with game. Since the forest floor in mature, dense stands is nearly devoid of brush and herbaceous vegetation, these dense stands are zoological deserts. To flourish, wildlife species need a mixture of habitat types. Some provide food; others, nesting and mating areas; others, areas suitable for rearing the young; and still others, areas for shelter from natural enemies.

Naturally, not all species require the same mixture of cover types. So to provide for a mixture of wildlife species, a highly varied mixture of cover types must be provided. The mature, dense forest provides only one—and not a very good one at that. The American Indian understood this well, for he frequently set large forest fires both to drive the game toward hunting parties and to create conditions favorable to wildlife as the burned-over areas once again began the slow progression back to mature forest.

Because of this practice the Southern New England of early colonial times has been described as an open park-like area with trees scattered here and there, with few large trees except in areas too wet to burn, and scattered sweet pastures that attracted deer.

It was pointed out earlier in this report that trees take in carbon dioxide from the atmosphere and release free oxygen. However, in an overstocked, stagnated stand or an unhealthy one with many decaying dead or dying trees,

the oxygen demanded by decaying material may equal that produced by photosynthesis. Therefore, for a forest stand to achieve the maximum practical oxygenation effect, it must be maintained in a healthy and vigorous condition.

We have posed a highly theoretical situation. Namely, that all or nearly all of Southern New England's forest land be left untouched except to be protected from fire, insects, and disease. But something close to this could happen in many sections of the region if a hands-off preservationist approach were taken.

This second survey of Southern New England's forest resource has provided some insights that bear on this problem. Stand-size classes are about evenly distributed now, but the first inventory revealed a high proportion of small-size stands. More than 56 percent of all of the timber removed from the timber inventory in Southern New England is unused. Land clearing operations and other nontimber production removals amount to more than 85 percent of all the timber removed. The results of the landowner survey conducted concurrently with this survey show that only 2 percent of the owners of forest land in Southern New England own their land for timber production. Many own land for investment, while a large number own forest land simply for the enjoyment of it.

To be successful, a forest-management program for Southern New England must be aimed at providing nontimber benefits from forest land. Foresters have considerable knowledge and expertise that they can impart in assisting landowners whose objectives are not the production of timber products. Foresters can assist landowners in developing a mixture of land uses and vegetation that is consistent with their interests. At the same time, timber will be produced in the course of keeping stands healthy and in the condition desired by the owner.

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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 states of Southern New England or leased to a 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 Classes") 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 minimum 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 the aggregate of the stocking for each of the 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 basal area of live trees. The many local forest types in Southern New England were combined into the following major forest types:

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

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

Pitch pine—eastern redcedar.—Forests in which pitch pine or eastern redcedar, singly or in combination, make up a plurality of the stocking. (Common associates include oak and hickory.)

Oak—pine.—Forests in which oaks or hickory, singly or in combination, make up a plurality of the stocking, but in which pitch pine and/or eastern redcedar make up 25 to 50 percent of the stocking.

Oak—hickory.—Forests in which oaks or hickory, singly or in combination, make up a plurality of the stocking, except where pitch pine and/or eastern redcedar make up 25 to 50 percent, in which case the stand would be classified oak-pine. (Common associates include yellow-poplar, elm, and red maple.)

Elm—ash—red maple.—Forests in which elm, ash, or red maple, singly or in combination, make up a plurality of the stocking. (Common associates include beech and sugar maple.)

Maple—beech—birch.—Forests in which sugar maple, beech, or yellow birch, singly or in combination, make up a plurality of the stocking. (Common associates include sweet birch, black cherry, hemlock, and white pine.)

Aspen—birch.—Forests in which aspen, paper birch, or gray birch, singly or in combination, comprise a plurality of stocking. (Common associates include maple and balsam fir.)

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 or two noncontiguous 8-foot merchantable sawlogs and that meet regional specifications for freedom from defect.

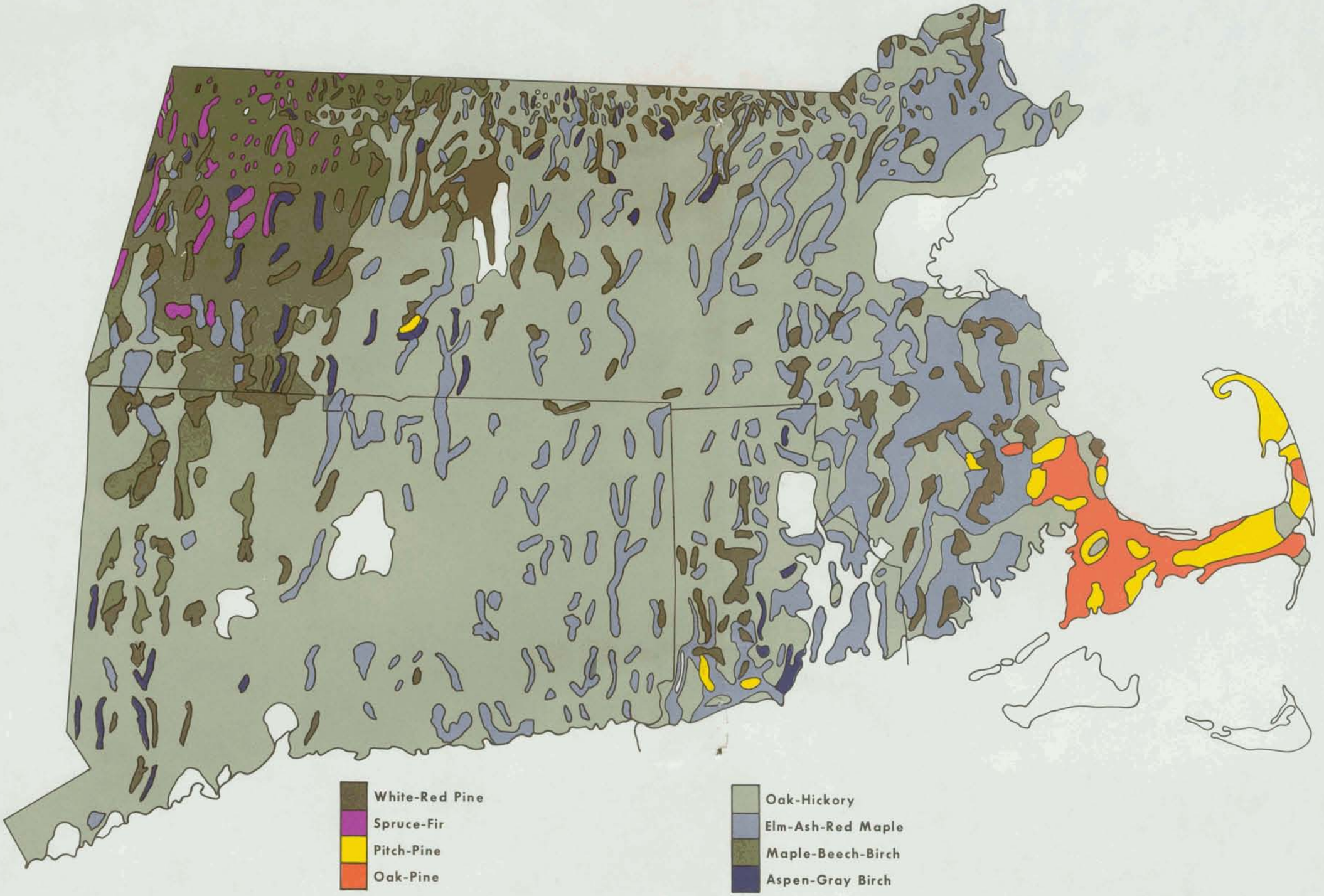
Poletimber trees.—Live trees of commercial species that meet regional specifications of soundness and form, and are at least 5.0 inches dbh but are smaller than sawtimber size.

Saplings.—Live trees of commercial species that are 1.0 to 5.0 inches in diameter at breast height and of good form and vigor.

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

Rough and rotten trees.—See definitions under "Tree Classes."

MAJOR FOREST TYPES OF SOUTHERN NEW ENGLAND



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 equivalent. 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 and/or sweep and crook.

International ¼-inch rule.—A log rule, or formula, for estimating the board-foot volume of logs. Stated mathematically, the formula is $[\{D^2 \times 0.22\} - 0.71\ D] \times 0.904762$ 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 a 1-foot stump and the sawlog top.

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.

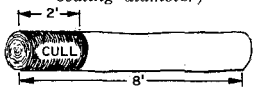
Upper-stem portion.—That part of the main stem or fork of a sawtimber tree above the sawlog top to a diameter of 4.0 inches outside bark or to the point where the main stem or fork breaks into limbs.

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 Southern New England are shown in the following specifications:

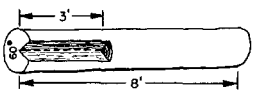
METHODS USED TO DETERMINE SCALING DEDUCTION

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



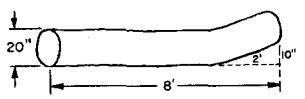
If *section* of bole is affected, deduct percent of log length affected.

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



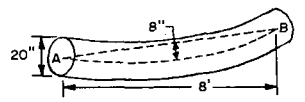
If *sector* is affected, multiply percent of circle times percent of length.

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



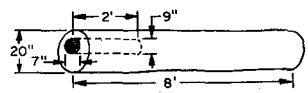
For a *crook*, multiply proportion of diameter displaced times proportion of log length affected by crook.*

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: $\frac{8 \times 10}{20-1} \times \frac{2}{8}$ = 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

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.

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 $\overline{=}$ < [3] D/6 and no larger than 3″. Black knots: Butt logs $\overline{=}$ < D/12 and no larger than 1½″. Upper logs $\overline{=}$ < 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 $\overline{=}$ < D/3 and no larger than 5″.
					10′+ logs: 2 weevils	Black knots $\overline{=}$ < 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 2× (sum of the diameters of dead or black knots) in inches is $\overline{=}$ < ½ the diameter of the log (in inches).
[3] $\overline{=}$ < 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	⅔	¾	⅔	⅔	½
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 basswod 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 had be-

come rough or rotten trees by the time of 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 (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 nongrowing 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.

FOREST-SURVEY METHODS

The Northeastern Forest Experiment Station's Forest Survey project used the sampling-with-partial replacement (SPR) design in the reinventory of Southern New England's timber resource. With this design, estimates of forest area and timber volume were made by combining a subsample of remeasured plots, a regression updating of the initial inventory, and 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 surveys (1953). This required the remeasurement of 482 initial inventory ground plots (Rhode Island 86, Connecticut 146, and Massachusetts 250). With these area-change and current-volume estimates obtained from the remeasured sample plots, regression techniques were used to update all the initial ground and 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 Southern New England 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 (784) was measured on the ground (Rhode Island 106, Connecticut 349, and Massachusetts 329). This subsample of ground plots was selected to be proportional to the area in each photo strata. 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 (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 Southern New England was designed to obtain an estimate of the components of average annual change during the period between the initial and 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.

Remeasured-Plot Phase

The initial forest inventory of Southern New England consisted of a large photo-plot sample plus a ground measurement of a subsample of these photo plots. (At the initial survey, 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 872 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, 482 initial ground plots (including 127 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 Southern New England consisted of about 26,253 photo points on the latest available aerial photography. A subset of 784 of these photo plots, including 265 nonforest plots, was located on the ground. Land use was verified and tree-measurement data were recorded for the 519 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.

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.

Comparisons Between Inventories

After inventories have been completed for several points in time, it is desirable to evaluate the trends between the several imventories and to make comparisons. A comparison of the 1972 and the 1953 forest-survey estimates of volume, growth, removals, and mortality was made for Southern New England. A computer program, TRAS (Timber Resource Analysis System), was used.

RELIABILITY 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 Southern New England. However, since neither every acre nor every tree in the region 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 Southern New England—6,091.9 million cubic feet—has an associated sampling error of 1.8 percent (109.7 million cubic feet). This means that our best estimate of the total growing-stock volume in Southern New England in 1972 is 6,091.9 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 estimates of growing-stock volume would be between 5,982.2 million and 6,201.6 million cubic feet (6,091.9 ± 109.7). Similarly, the odds are 19 to 1 that it would be within ± 219.4 million cubic feet and 300 to 1 that it would be within ± 329.1 million cubic feet.

COMMERCIAL TREE SPECIES OF SOUTHERN NEW ENGLAND

OCCURRENCE[1]	*COMMON NAME*	*SCIENTIFIC NAME*[2]
	SOFTWOODS	
r	Balsam fir	*Abies balsamea*
vr	Atlantic white-cedar	*Chamaecyparis thyoides*
c	Eastern redcedar (savin)[3]	*Juniperus virginiana*
r	Tamarack	*Larix laricina*
r	Norway spruce[4]	*Picea abies*
r	White spruce	*P. glauca*
c	Red spruce	*P. rubens*

CONTINUED

vr	Jack pine	*Pinus banksiana*
c	Red pine (Norway)	*P. resinosa*
c	Pitch pine	*P. rigida*
vc	Eastern white pine	*P. strobus*
r	Scotch pine[4]	*P. sylvestris*
vr	Douglas fir[4]	*Pseudotsuga menziesii*
r	Northern white-cedar	*Thuja occidentalis*
vc	Eastern hemlock	*Tsuga canadensis*

HARDWOODS

vc	Red maple	*Acer rubrum*
r	Silver maple	*A. saccharinum*
vc	Sugar maple	*A. saccharum*
vc	Yellow birch	*Betula alleghaniensis*
vc	Sweet birch (black)	*B. lenta*
vr	River birch (red)	*B. nigra*
c	Paper birch (white)	*B. papyrifera*
c	American hornbeam (blue beech)	*Carpinus caroliniana*
vc	Hickory	*Carya* spp.
r	American chestnut	*Castanea dentata*
c	Flowering dogwood	*Cornus florida*
vc	American beech	*Fagus grandifolia*
vc	White ash	*Fraxinus americana*
vr	Black ash (brown)	*F. nigra*
r	Green ash (red)	*F. pennsylvanica*
vr	Honeylocust	*Gleditsia triacanthos*
vr	American holly	*Ilex opaca*
vr	Black walnut	*Juglans nigra*
r	Butternut	*J. cinerea*
vr	Sweetgum	*Liquidambar styraciflua*
c	Yellow-poplar (tuliptree)	*Liriodendron tulipifera*
r	Black tupelo (blackgum)	*Nyssa sylvatica*
r	Eastern hophornbeam (ironwood)	*Ostrya virginiana*
vr	American sycamore (buttonwood)	*Platanus occidentalis*
vr	Balsam poplar (Balm-of-Gilead)	*Populus balsamifera*
vr	Eastern cottonwood	*P. deltoides*
c	Bigtooth aspen (popple)	*P. grandidentata*
c	Quaking aspen (popple)	*P. tremuloides*
vc	Black cherry	*Prunus serotina*
vc	White oak	*Quercus alba*
r	Swamp white oak	*Q. bicolor*
vc	Scarlet oak	*Q. coccinea*
vr	Swamp chestnut oak	*Q. michauxii*
vr	Pin oak	*Q. palustris*
vr	Willow oak	*Q. phellos*
c	Chestnut oak	*Q. prinus*
vc	Northern red oak	*Q. rubra*
vc	Black oak	*Q. velutina*
r	Black locust	*Robinia pseudoacacia*
r	Black willow	*Salix nigra*
r	American basswood	*Tilia americana*
c	American elm (white)	*Ulmus americana*
vr	Slippery elm (red)	*U. rubra*

[1] Occurrence is based on the frequency at which the species was encountered on forest-survey field plots: vr—very rare, r—rare, c—common, and vc—very common.

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

[3] Names in parenthesis are other frequently used common names.

[4] Species introduced in Southern New England.

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Table 1.—Area by land classes and states, Southern New England, 1972

Land class	Connecticut		Massachusetts		Rhode Island		Total	
	Thousand acres	*Percent*	*Thousand acres*	*Percent*	*Thousand acres*	*Percent*	*Thousand acres*	*Percent*
Forest land:								
Commercial	1,805.6	58	2,797.7	56	395.3	59	4,998.6	57
Productive-reserved	15.4	1	104.5	2	8.9	1	128.8	1
Christmastree plantation	15.1	(1)	—	—	—	—	15.1	(1)
Unproductive	24.7	1	50.1	1	—	—	74.8	1
Total forest land	1,860.8	60	2,952.3	59	404.2	60	5,217.3	59
Nonforest:								
Cropland[2]	232.4	7	247.5	5	27.3	4	507.2	6
Pasture	71.8	2	53.1	1	4.7	1	129.6	1
Water[3]	24.2	1	43.7	1	4.6	1	72.5	1
Other[4]	927.6	30	1,716.5	34	230.6	34	2,874.7	33
Total nonforest land	1,256.0	40	2,060.8	41	267.2	40	3,584.0	41
Total land area[5]	3,116.8	100	5,013.1	100	671.4	100	8,801.3	100

[1] Less than 0.5 percent.

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

[3] Classed as water by Forest Survey standards, but defined by the Bureau of the Census as land.

[4] Includes swampland, industrial and urban areas, and other nonforest land.

[5] Source: United States Bureau of the Census, 1960.

Table 2.—Area of commercial forest land, by ownership classes and states, Southern New England, 1972

Ownership	Connecticut		Massachusetts		Rhode Island		Total	
	Thousand acres	*Percent*	*Thousand acres*	*Percent*	*Thousand acres*	*Percent*	*Thousand acres*	*Percent*
Other Federal	2.4	(1)	9.6	(1)	—	—	12.0	(1)
State	119.8	7	240.1	9	20.1	5	380.0	8
County and municipal	24.4	1	115.7	4	12.0	3	152.1	3
Total public	146.6	8	365.4	13	32.1	8	544.1	11
Forest industry	—	—	30.1	1	—	—	30.1	1
Farmer-owned:								
Corporate	10.4	1	51.2	2	—	—	61.6	1
Individual	117.9	6	202.4	7	24.6	6	344.9	7
Total farmer-owned	128.3	7	253.6	9	24.6	6	406.5	8
Miscellaneous private:								
Corporate	162.3	9	230.3	8	42.7	11	435.3	8
Other	1,368.4	76	1,918.3	69	295.9	75	3,582.6	72
Total miscellaneous private	1,530.7	85	2,148.6	77	338.6	86	4,017.9	80
All ownerships	1,805.6	100	2,797.7	100	395.3	100	4,998.6	100

[1] Less than 0.5 percent.

Table 3.—Area of commercial forest land, by stand-size and ownership classes and states, Southern New England, 1972

[In thousands of acres]

Stand-size class	All ownership	Other public	Forest industry	Farmer and other
		CONNECTICUT		
Sawtimber stands	631.0	64.8	—	566.2
Poletimber stands	600.1	55.4	—	544.7
Sapling-seedling stands	574.5	26.4	—	548.1
Nonstocked areas	—	—	—	—
All classes	1,805.6	146.6	—	1,659.0
		MASSACHUSETTS		
Sawtimber stands	934.1	138.1	—	796.0
Poletimber stands	947.2	113.0	30.1	804.1
Sapling-seedling stands	857.5	102.5	—	755.0
Nonstocked areas	58.9	11.8	—	47.1
All classes	2,797.7	365.4	30.1	2,402.2
		RHODE ISLAND		
Sawtimber stands	87.9	5.3	—	82.6
Poletimber stands	133.0	5.4	—	127.6
Sapling-seedling stands	168.3	21.4	—	146.9
Nonstocked areas	6.1	—	—	6.1
All classes	395.3	32.1	—	363.2
		TOTAL		
Sawtimber stands	1,653.0	208.2	—	1,444.8
Poletimber stands	1,680.3	173.8	30.1	1,476.4
Sapling-seedling stands	1,600.3	150.3	—	1,450.0
Nonstocked areas	65.0	11.8	—	53.2
All classes	4,998.6	544.1	30.1	4,424.4

Table 4.—Area of commercial forest land, by stand-volume and ownership classes, and states, Southern New England, 1972

[In thousands of acres]

Stand-volume per acre (board feet)[1]	All ownership	Other public	Forest industry	Farmer and other
		CONNECTICUT		
Less than 1,500	564.4	40.1	—	524.3
1,500 to 5,000	953.3	79.9	—	873.4
More than 5,000	287.9	26.6	—	261.3
All classes	1,805.6	146.6	—	1,659.0
		MASSACHUSETTS		
Less than 1,500	1,132.6	148.5	—	984.1
1,500 to 5,000	1,274.7	146.9	30.1	1,097.7
More than 5,000	390.4	70.0	—	320.4
All classes	2,797.7	365.4	30.1	2,402.2
		RHODE ISLAND		
Less than 1,500	266.2	21.4	—	244.8
1,500 to 5,000	104.0	10.7	—	93.3
More than 5,000	25.1	—	—	25.1
All classes	395.3	32.1	—	363.2
		TOTAL		
Less than 1,500	1,963.2	210.0	—	1,753.2
1,500 to 5,000	2,332.0	237.5	30.1	2,064.4
More than 5,000	703.4	96.6	—	606.8
All classes	4,998.6	544.1	30.1	4,424.4

Table 5.—Area of commercial forest land, by stocking classes based on selected stand components, Southern New England, 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	20.2	—	—	—	—
150 to 160	221.5	58.0	—	28.2	—
140 to 150	317.5	103.4	—	59.8	—
130 to 140	905.8	191.5	—	205.0	15.2
120 to 130	976.8	581.1	—	337.9	—
110 to 120	860.6	567.4	—	473.5	—
100 to 110	712.7	820.2	—	732.1	—
90 to 100	448.5	746.3	—	909.1	.8
80 to 90	226.6	773.7	—	754.8	29.1
70 to 80	124.5	336.2	0.8	583.3	56.3
60 to 70	49.2	247.4	—	304.1	84.6
50 to 60	62.1	169.3	16.8	147.7	127.5
40 to 50	14.3	129.2	45.0	188.2	417.2
30 to 40	13.1	94.4	81.1	94.5	507.3
20 to 30	30.3	71.1	141.7	71.0	1,070.4
10 to 20	14.9	103.4	794.8	103.4	1,349.3
Less than 10	—	6.0	3,918.4	6.0	1,340.9
Total	4,998.6	4,998.6	4,998.6	4,998.6	4,998.6

Table 6.—Percent of commercial forest land, by stocking classes, based on selected stand components, Southern New England, 1972

Level of stocking	Stocking in terms of selected stand components expressed as a percentage of all stands			
	Acceptable trees	Desirable trees	Growing-stock trees	All trees
Overstocked	6	—	7	29
Fully stocked	31	—	39	51
Medium stocking	51	—	42	17
Poorly stocked and nonstocked	12	100	12	3
All levels	100	100	100	100

Table 7.—Area of commercial forest land, by area condition and ownership classes, Southern New England, 1972

[In thousands of acres]

Area-condition class[1]	All ownerships	Other public	Forest industry	Farmer and other
Class *10-50*	1,815.6	233.2	30.1	1,552.3
Class *60*	2,555.9	216.7	—	2,339.2
Class *70*	627.1	94.2	—	532.9
All classes	4,998.6	544.1	30.1	4,424.4

[1] Class *10*.—Areas fully stocked with desirable trees and not overstocked.
Class *20*.—Areas fully stocked with desirable trees, but overstocked with all live trees.
Class *30*.—Areas medium to fully stocked with desirable trees, and with less than 30 percent of the area controlled by other trees and/or inhibiting vegetation or surface conditions that will prevent occupancy by desirable trees.
Class *40*.—Areas medium to fully stocked with desirable trees and with 30 percent or more of the area controlled by other trees and/or conditions that ordinarily prevent occupancy by 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, Southern New England, 1972

[In thousands of acres]

Growth-per-acre class (cubic feet)	All ownerships	Other public	Forest industry	Farmer and other
120 to 165	236.9	39.9	—	197.0
85 to 120	818.6	95.0	—	723.6
50 to 85	1,599.6	151.1	—	1,448.5
Less than 50	2,343.5	258.1	30.1	2,055.3
All classes	4,998.6	544.1	30.1	4,424.4

Table 9.—Area of commercial forest land, by forest types and ownership classes, Southern New England, 1972

[In thousands of acres]

Forest type	All ownerships	Other public	Forest industry	Farmer and other
White pine—red pine—hemlock	841.2	98.2	—	743.0
Spruce–fir	44.5	12.1	—	32.4
Pitch pine—eastern redcedar	128.3	25.7	—	102.6
Oak—pine	357.8	33.3	30.1	294.4
Oak—hickory	1,505.3	148.5	—	1,356.8
Elm—ash—red maple	1,323.3	163.6	—	1,159.7
Maple—beech—birch	693.0	40.0	—	653.0
Aspen—birch	105.2	22.7	—	82.5
All types	4,998.6	544.1	30.1	4,424.4

Table 10.—Area of commercial forest land, by forest types and states, Southern New England, 1972

[In thousands of acres]

Forest type	Connecticut	Massachusetts	Rhode Island	Total
White pine—red pine—hemlock	180.2	632.2	28.8	841.2
Spruce—fir	15.9	28.6	—	44.5
Pitch pine—eastern redcedar	29.2	73.9	25.2	128.3
Oak—pine	103.1	217.6	37.1	357.8
Oak—hickory	730.1	602.3	172.9	1,505.3
Elm—ash—red maple	415.4	795.3	112.6	1,323.3
Maple—beech—birch	304.4	376.0	12.6	693.0
Aspen—birch	27.3	71.8	6.1	105.2
All types	1,805.6	2,797.7	395.3	4,998.6

Table 11.—Area of noncommercial forest land, by forest types, Southern New England, 1972

[In thousands of acres]

Forest type	All areas	Productive-reserved areas	Unproductive areas
White pine—red pine—hemlock	39.1	24.6	14.5
Spruce—fir	20.2	18.4	1.8
Pitch pine—eastern redcedar	7.0	7.0	—
Oak—pine	8.6	8.6	—
Oak—hickory	34.5	28.7	5.8
Elm—ash—red maple	94.7	42.0	52.7
Maple—beech—birch	8.2	8.2	—
Aspen—birch	6.4	6.4	—
All types	218.7	143.9	74.8

Table 12.—Number of trees on commercial forest land by species groups, tree classes, and diameter classes, Southern New England, 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	165,687	55,406	221,093	644,760	670,703	1,315,463
3.0 to 4.9	84,423	23,755	108,178	361,642	166,748	528,390
Total saplings	250,110	79,161	329,271	1,006,402	837,451	1,843,853
5.0 to 6.9	64,474	8,864	73,338	248,646	49,444	298,090
7.0 to 8.9	41,476	4,509	45,985	152,217	19,315	171,532
9.0 to 10.9	—	—	—	86,288	9,368	95,656
Total poletimber	105,950	13,373	119,323	487,151	78,127	565,278
9.0 to 10.9	28,369	3,035	31,404	—	—	—
11.0 to 12.9	17,076	1,481	18,557	42,609	6,742	49,351
13.0 to 14.9	9,450	621	10,071	21,303	2,352	23,655
Total small sawtimber	54,895	5,137	60,032	63,912	9,094	73,006
15.0 to 16.9	5,354	432	5,786	9,971	1,201	11,172
17.0 to 18.9	3,119	66	3,185	5,193	1,207	6,400
19.0 to 20.9	1,365	173	1,538	2,420	332	2,752
21.0 to 28.9	1,164	205	1,369	2,072	735	2,807
29.0 and larger	106	138	244	179	115	294
Total large sawtimber	11,108	1,014	12,122	19,835	3,590	23,425
All classes	422,063	98,685	520,748	1,577,300	928,262	2,505,562

Table 13.—Number of growing-stock trees on commercial forest land, by species and diameter classes, Southern New England, 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	21.0-28.9	29.0+
White pine	86,645	27,501	21,173	14,421	9,303	5,802	3,834	2,507	1,144	874	86
Red pine	9,090	2,112	2,908	2,491	741	635	174	29	—	—	—
Pitch pine	15,718	7,227	4,190	2,345	1,175	520	186	75	—	—	—
Hemlock	46,951	21,318	10,093	6,837	4,931	1,683	1,084	474	221	290	20
Spruce[1]	9,576	3,776	2,701	1,807	612	570	76	34	—	—	—
Other softwoods	3,973	2,540	411	468	314	240	—	—	—	—	—
Total softwoods	171,953	64,474	41,476	28,369	17,076	9,450	5,354	3,119	1,365	1,164	106
Select white oaks	53,195	21,813	15,311	7,819	4,042	2,514	626	638	226	195	11
Select red oaks	82,151	23,785	20,666	17,373	8,951	4,807	3,264	1,698	917	606	84
Other white oaks	8,328	4,791	1,651	1,057	282	375	104	41	27	—	—
Other red oaks	65,811	21,325	16,372	11,936	8,315	4,060	1,947	1,088	473	271	24
Hickory	20,374	7,670	6,325	3,115	1,910	666	270	160	140	108	10
Sugar maple	30,146	11,780	9,104	4,774	1,844	1,286	656	320	124	247	11
Soft maples	165,174	86,955	45,228	19,734	7,745	3,064	1,508	402	291	216	31
Sweet birch	32,851	14,652	10,214	4,744	1,941	766	316	95	81	42	—
Yellow birch	16,519	8,766	4,679	1,571	690	570	23	157	25	38	—
Paper birch	17,981	10,094	3,529	2,968	947	335	77	4	27	—	—
Beech	12,224	4,592	3,020	2,179	1,278	663	325	111	—	56	—
White ash	22,633	9,661	5,294	3,571	2,189	1,147	378	202	59	132	—
Black cherry	19,798	11,216	4,384	2,561	1,006	431	82	99	—	19	—
Aspen	9,963	4,751	3,382	1,051	497	113	139	30	—	—	—
Elms	4,522	2,183	1,036	890	214	136	41	—	—	22	—
Other hardwoods	9,228	4,612	2,022	945	758	370	215	148	30	120	8
Total hardwoods	570,898	248,646	152,217	86,288	42,609	21,303	9,971	5,193	2,420	2,072	179
All species	742,851	313,120	193,693	114,657	59,685	30,753	15,325	8,312	3,785	3,236	285

[1] Includes 1,479,000 balsam fir trees.

Table 14.—Net volume of timber on commercial forest land, by class of timber, softwoods and hardwoods, Southern New England, 1972

[In millions of cubic feet]

Class of timber	All species	Softwoods	Hardwoods
Sawtimber trees:			
Sawlog portion	2,527.1	1,053.1	1,474.0
Upper-stem portion	504.6	134.8	369.8
All sawtimber trees	3,031.7	1,187.9	1,843.8
Poletimber trees	3,060.2	511.6	2,548.6
All growing-stock trees	6,091.9	1,699.5	4,392.4
Rough trees	591.0	166.9	424.1
Rotten trees	143.0	10.9	132.1
Total, all trees	6,825.9	1,877.3	4,948.6

Table 15.—Net volume of timber on commercial forest land, by class of timber and states, Southern New England, 1972

[In millions of cubic feet]

Class of timber	Connecticut	Massachusetts	Rhode Island	Total
Sawtimber trees:				
Sawlog portion	1,003.0	1,402.0	122.1	2,527.1
Upper-stem portion	217.0	261.7	25.9	504.6
All sawtimber trees	1,220.0	1,663.7	148.0	3,031.7
Poletimber trees	1,131.8	1,729.2	199.2	3,060.2
All growing-stock trees	2,351.8	3,392.9	347.2	6,091.9
Rough trees	117.3	421.5	52.2	591.0
Rotten trees	47.3	88.4	7.3	143.0
Total, all trees	2,516.4	3,902.8	406.7	6,825.9

Table 16.—Net volume of growing stock and sawtimber on commercial forest land, by ownership classes and states, softwoods and hardwoods, Southern New England, 1972

Ownership class	Growing stock (million cubic feet)			Sawtimber (million board feet)[1]		
	All species	Softwoods	Hardwoods	All species	Softwoods	Hardwoods
			CONNECTICUT			
Other public	211.8	42.2	169.6	414.4	112.0	302.4
Forest industry	—	—	—	—	—	—
Farmer and other	2,140.0	315.0	1,825.0	4,513.3	965.8	3,547.5
All ownership	2,351.8	357.2	1,994.6	4,927.7	1,077.8	3,849.9
			MASSACHUSETTS			
Other public	514.3	231.6	282.7	1,012.4	661.0	351.4
Forest industry	58.5	21.1	37.4	96.4	71.7	24.7
Farmer and other	2,820.1	1,014.6	1,805.5	5,483.2	2,802.5	2,680.7
All ownership	3,392.9	1,267.3	2,125.6	6,592.0	3,535.2	3,056.8
			RHODE ISLAND			
Other public	17.9	3.0	14.9	27.8	4.3	23.5
Forest industry	—	—	—	—	—	—
Farmer and other	329.3	72.0	257.3	520.5	191.9	328.6
All ownership	347.2	75.0	272.2	548.3	196.2	352.1
			TOTAL			
Other public	744.0	276.8	467.2	1,454.6	777.3	677.3
Forest industry	58.5	21.1	37.4	96.4	71.7	24.7
Farmer and other	5,289.4	1,401.6	3,887.8	10,517.0	3,960.2	6,556.8
All ownership	6,091.9	1,699.5	4,392.4	12,068.0	4,809.2	7,258.8

[1] International ¼-inch rule.

Table 17.—Net volume of growing stock and sawtimber on commercial forest land, by stand-size classes and states, softwoods and hardwoods, Southern New England, 1972

Stand-size class	Growing stock (million cubic feet)			Sawtimber (million board feet)[1]		
	All species	Softwoods	Hardwoods	All species	Softwoods	Hardwoods
			CONNECTICUT			
Sawtimber stands	1,141.9	275.1	866.8	3,129.4	903.9	2,225.5
Poletimber stands	834.2	44.9	789.3	1,106.9	113.2	993.7
Sapling-seedling stands	375.7	37.2	338.5	691.4	60.7	630.7
Nonstocked areas	—	—	—	—	—	—
All classes	2,351.8	357.2	1,994.6	4,927.7	1,077.8	3,849.9
			MASSACHUSETTS			
Sawtimber stands	1,635.8	827.7	808.1	4,243.9	2,528.0	1,715.9
Poletimber stands	1,334.4	289.4	1,045.0	1,660.2	608.5	1,051.7
Sapling-seedling stands	417.6	149.1	268.5	678.7	398.7	280.0
Nonstocked areas	5.1	1.1	4.0	9.2	—	9.2
All classes	3,392.9	1,267.3	2,125.6	6,592.0	3,535.2	3,056.8
			RHODE ISLAND			
Sawtimber stands	128.3	36.8	91.5	300.0	100.7	199.3
Poletimber stands	148.4	11.4	137.0	141.3	27.6	113.7
Sapling-seedling stands	70.1	26.8	43.3	105.6	67.9	37.7
Nonstocked areas	.4	—	.4	1.4	—	1.4
All classes	347.2	75.0	272.2	548.3	196.2	352.1
			TOTAL			
Sawtimber stands	2,906.0	1,139.6	1,766.4	7,673.3	3,532.6	4,140.7
Poletimber stands	2,317.0	345.7	1,971.3	2,908.4	749.3	2,159.1
Sapling-seedling stands	863.4	213.1	650.3	1,475.7	527.3	948.4
Nonstocked areas	5.5	1.1	4.4	10.6	—	10.6
All classes	6,091.9	1,699.5	4,392.4	12,068.0	4,809.2	7,258.8

[1] International ¼-inch rule.

Table 18.—Net volume of growing stock on commercial forest land, by species and diameter classes, Southern New England, 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	21.0-28.9	29.0+
White pine	1,040.5	132.6	146.0	152.9	144.6	129.2	114.4	96.5	56.7	57.2	10.4
Red pine	93.8	11.5	21.9	27.7	12.4	13.8	5.2	1.3	—	—	—
Pitch pine	93.3	12.1	20.2	20.7	17.1	13.5	6.3	3.4	—	—	—
Hemlock	378.9	77.3	56.8	60.6	65.6	33.8	31.0	18.7	11.5	20.6	3.0
Spruce[1]	68.4	10.4	12.9	17.1	10.1	13.7	2.8	1.4	—	—	—
Other softwoods	24.6	8.1	1.8	4.6	4.4	5.7	—	—	—	—	—
Total softwoods	1,699.5	252.0	259.6	283.6	254.2	209.7	159.7	121.3	68.2	77.8	13.4
Select white oaks	377.6	60.5	79.0	68.5	55.3	49.9	17.1	23.8	11.5	11.0	1.0
Select red oaks	875.2	83.6	122.3	166.6	137.9	106.7	97.1	67.3	45.3	39.9	8.5
Other white oaks	54.9	15.4	9.3	10.6	4.9	8.7	2.9	1.8	1.3	—	—
Other red oaks	642.9	69.3	98.6	113.9	125.4	90.5	58.8	42.3	24.0	17.6	2.5
Hickory	179.0	32.7	42.8	33.0	27.7	14.6	7.9	4.9	7.8	7.6	—
Sugar maple	270.8	48.3	60.9	50.9	30.5	27.9	19.1	12.1	5.4	14.5	1.2
Soft maples	987.8	290.8	260.9	182.8	107.1	61.7	41.6	14.0	12.5	12.6	3.8
Sweet birch	212.3	50.9	57.6	44.5	27.3	14.6	8.6	3.2	3.4	2.2	—
Yellow birch	96.4	27.6	25.1	14.0	9.7	11.1	.5	5.3	.9	2.2	—
Paper birch	99.9	30.5	18.9	27.4	13.5	6.3	2.2	.1	1.0	—	—
Beech	115.3	16.4	19.0	24.6	21.6	15.1	10.2	4.6	—	3.8	—
White ash	197.5	34.2	34.8	36.9	34.6	25.6	11.4	7.6	3.0	9.4	—
Black cherry	115.8	36.9	25.4	24.0	14.4	8.5	2.2	3.3	—	1.1	—
Aspen	61.7	15.9	20.8	9.7	8.1	2.3	3.8	1.1	—	—	—
Elms	26.8	6.2	4.8	7.3	3.0	2.5	1.2	—	—	1.8	—
Other hardwoods	78.5	14.1	11.2	9.2	12.0	8.3	6.4	6.5	1.4	8.2	1.2
Total hardwoods	4,392.4	833.3	891.4	823.9	633.0	454.3	291.0	197.9	117.5	131.9	18.2
All species	6,091.9	1,085.3	1,151.0	1,107.5	887.2	664.0	450.7	319.2	185.7	209.7	31.6

[1] Includes 5.5 million cubic feet of balsam fir.

Table 19.—Net volume of sawtimber on commercial forest land, by species and diameter classes, Southern New England, 1972

[In millions of board feet][1]

Species	All classes	Diameter class (inches at breast height)							
		9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9	29.0+
White pine	3,126.6	478.6	564.2	541.3	497.5	444.1	263.7	284.1	53.1
Red pine	227.9	88.9	49.2	60.2	23.9	5.7	—	—	—
Pitch pine	231.4	64.8	65.0	57.9	27.9	15.8	—	—	—
Hemlock	995.0	193.0	260.8	143.8	141.8	87.2	54.4	99.3	14.7
Spruce[2]	171.9	54.6	40.4	58.6	12.1	6.2	—	—	—
Other softwoods	56.4	14.8	17.4	24.2	—				
Total softwoods	4,809.2	894.7	997.0	886.0	703.2	559.0	318.1	383.4	67.8
Select white oaks	660.7	—	193.5	192.6	69.1	100.1	51.2	50.1	4.1
Select red oaks	2,016.4	—	487.5	415.9	404.1	286.9	198.7	184.4	38.9
Other white oaks	75.3	—	16.6	33.6	11.6	7.5	6.0	—	—
Other red oaks	1,415.6	—	441.2	353.7	244.5	178.8	106.9	80.4	10.1
Hickory	279.4	—	98.2	56.9	33.3	20.7	35.5	34.8	—
Sugar maple	443.3	—	108.3	108.5	79.0	51.2	24.1	66.5	5.7
Soft maples	978.3	—	376.2	239.4	173.0	57.7	56.7	57.3	18.0
Sweet birch	228.3	—	97.3	56.8	35.6	13.4	15.3	9.9	—
Yellow birch	116.0	—	34.4	43.4	1.9	22.2	4.5	9.6	—
Paper birch	86.9	—	47.7	24.6	9.3	.5	4.8	—	—
Beech	217.7	—	77.6	59.3	42.7	19.9	—	18.2	—
White ash	359.5	—	124.3	99.9	48.2	31.9	12.8	42.4	—
Black cherry	111.7	—	50.7	33.1	9.1	14.2	—	4.6	—
Aspen	58.5	—	29.2	9.1	15.4	4.8	—	—	—
Elms	32.5	—	10.7	9.4	5.0	—	—	7.4	—
Other hardwoods	178.7	—	43.0	32.1	26.5	28.2	6.2	37.0	5.7
Total hardwoods	7,258.8	—	2,236.4	1,768.3	1,208.3	838.0	522.7	602.6	82.5
All species	12,068.0	894.7	3,233.4	2,654.3	1,911.5	1,397.0	840.8	986.0	150.3

[1] International ¼-inch rule.
[2] Includes 6.2 million board feet of balsam fir.

Table 20.—Net volume of sawtimber on commercial forest land, by species and quality classes, Southern New England, 1972

[In millions of board feet][1]

Species	All classes	Standard-lumber logs			
		Grade 1	Grade 2	Grade 3	Grade 4[2]
Softwoods:					
White pine	3,126.6	104.8	403.4	1,558.5	1,059.9
Red pine	227.9	74.0	35.0	97.0	21.9
Pitch pine	231.4	15.1	28.0	188.3	—
Other softwoods[3]	1,223.3	—	—	—	—
Total softwoods	4,809.2	193.9	466.4	1,843.8	1,081.8
Hardwoods:					
Select white oaks	660.7	38.0	126.0	372.7	124.0
Select red oaks	2,016.4	313.7	486.9	1,007.9	207.9
Other white oaks	75.3	16.1	13.3	31.0	14.9
Other red oaks	1,415.6	136.5	250.0	830.9	198.2
Hickory	279.4	35.1	36.1	122.6	85.6
Sugar maple	443.3	25.7	67.9	258.9	90.8
Soft maples	978.3	23.5	115.1	624.9	214.8
Sweet birch	228.3	14.9	33.9	144.0	35.5
Yellow birch	116.0	5.4	15.7	64.6	30.3
Paper birch	86.9	5.6	24.2	49.2	7.9
Beech	217.7	2.0	8.3	185.4	22.0
White ash	359.5	54.6	96.3	152.1	56.5
Black cherry	111.7	—	13.3	77.8	20.6
Aspen	58.5	5.5	11.1	33.1	8.8
Elms	32.5	—	4.9	24.7	2.9
Other softwoods	178.7	33.1	55.0	60.4	30.2
Total hardwoods	7,258.8	709.7	1,358.0	4,040.2	1,150.9
Hardwood quality (in percent)	100	10	19	55	16

[1] International ¼-inch rule.
[2] Grade 4 applies only to the pines. For hardwoods the volumes in this column are for construction logs.
[3] Species other than pine are not graded into standard-lumber grades.

Table 21.—Net volume of growing stock and sawtimber on commercial forest land, by forest types, and softwoods and hardwoods, Southern New England, 1972

Forest type	Growing stock			Sawtimber		
	All species	Softwoods	Hardwoods	All species	Softwoods	Hardwoods
	Million cubic feet			*Million board feet*[1]		
White pine—red pine—hemlock	1,522.3	1,058.5	463.8	3,869.1	3,058.9	810.2
Spruce—fir	59.5	47.1	12.4	117.0	99.2	17.8
Pitch pine—eastern redcedar	85.5	73.2	12.3	213.9	195.2	18.7
Oak—pine	363.5	126.6	236.9	734.9	312.6	422.3
Oak—hickory	1,829.7	98.1	1,731.6	3,267.9	296.8	2,971.1
Elm—ash—red maple	1,307.9	199.5	1,108.4	2,173.5	557.2	1,616.3
Maple—beech—birch	861.2	87.7	773.5	1,611.1	263.2	1,347.9
Aspen—birch	62.3	8.8	53.5	80.6	26.1	54.5
All types	6,091.9	1,699.5	4,392.4	12,068.0	4,809.2	7,258.8

[1] International ¼-inch rule.

Table 22.—Net volume of growing stock and sawtimber on commercial forest land, by forest types, and states, Southern New England, 1972

Forest type	Growing stock			Sawtimber		
	Connecticut	Massachusetts	Rhode Island	Connecticut	Massachusetts	Rhode Island
	Million cubic feet			*Million board feet*[1]		
White pine—red pine—hemlock	405.8	1,064.2	52.3	1,158.3	2,572.9	137.9
Spruce—fir	10.5	49.0	—	6.7	110.3	—
Pitch pine—eastern redcedar	16.5	59.4	9.6	30.8	172.3	10.8
Oak—pine	75.5	264.2	23.8	154.8	531.8	48.3
Oak—hickory	995.3	677.3	157.1	1,976.4	1,091.4	200.1
Elm—ash—red maple	467.0	748.8	92.1	831.3	1,203.6	138.6
Maple—beech—birch	374.5	476.4	10.3	751.8	852.2	7.1
Aspen—birch	6.7	53.6	2.0	17.6	57.5	5.5
All types	2,351.8	3,392.9	347.2	4,927.7	6,592.0	548.3

[1] International ¼-inch rule.

Table 23.—Components of average annual net growth and removals of growing stock and sawtimber on commercial forest land, softwoods and hardwoods, Southern New England, 1952-71

Components	All species	Softwoods	Hardwoods
	GROWING STOCK		
	Thousand cubic feet		
Growth on initial growing-stock inventory[1]	107,660	27,892	79,768
Ingrowth—saplings that became poletimber	117,922	34,486	83,436
Gross growth	225,582	62,378	163,204
Cull increment	13,902	1,410	12,492
Annual mortality	27,780	5,568	22,212
Average annual net growth	183,900	55,400	128,500
Average annual removals	42,520	11,444	31,076
	SAWTIMBER		
	Thousand board feet[2]		
Growth on initial sawtimber inventory[1]	180,588	79,724	100,864
Ingrowth—poletimber trees that became sawtimber	296,499	106,427	190,072
Gross growth	477,087	186,151	290,936
Cull increment	16,687	3,651	13,036
Annual mortality	25,500	11,600	13,900
Average annual net growth	434,900	170,900	264,000
Average annual removals	85,620	36,741	48,879

[1] Including growth on trees that were cut.
[2] International ¼-inch rule.

Table 24.—Annual net growth, removals, and mortality of growing stock and sawtimber on commercial forest land, by species, Southern New England, 1971

Species	Growing stock			Sawtimber		
	Annual net growth	Annual timber removals	Annual mortality	Annual net growth	Annual timber removals	Annual mortality
	Thousand cubic feet			*Thousand board feet*[1]		
Softwoods:						
White pine	42,091	9,821	3,185	139,045	24,311	8,445
Red pine	4,428	981	231	9,234	1,254	314
Pitch pine	1,860	200	434	5,587	201	411
Hemlock	17,710	4,462	1,680	47,997	10,330	4,546
Spruce	2,132	366	549	5,114	594	594
Other softwoods	1,279	170	688	3,023	510	185
Total softwoods	69,500	16,000	6,767	210,000	37,200	14,495
Hardwoods:						
Select white oaks	13,478	2,507	2,289	30,938	6,596	2,243
Select red oaks	36,405	10,322	3,561	95,852	20,279	1,611
Other white oaks	2,914	171	1,849	7,932	1,633	687
Other red oaks	26,592	7,359	2,094	66,392	19,137	2,480
Hickory	4,839	1,253	625	9,665	2,335	479
Sugar maple	5,644	1,140	922	18,087	4,049	1,643
Soft maples	37,593	7,978	4,596	54,452	15,853	2,044
Sweet birch	5,263	847	594	6,454	1,372	229
Yellow birch	3,567	1,056	871	5,422	1,827	223
Paper birch	2,033	157	1,016	4,118	536	300
Beech	3,642	633	778	9,756	2,127	1,623
White ash	4,933	941	1,047	13,261	3,396	631
Black cherry	2,207	240	535	5,843	1,080	109
Aspen	1,925	426	895	3,994	866	78
Elms	−1,627	96	1,947	−2,016	18	1,816
Other hardwoods	− 108	874	2,914	2,150	2,396	2,309
Total hardwoods	149,300	36,000	26,533	332,300	83,500	18,505
Total, all species	218,800	52,000	33,300	542,300	120,700	33,000

[1] International ¼-inch rule.

Table 25.—Annual net growth and removals of growing stock and sawtimber on commercial forest land by ownership classes, softwoods and hardwoods, Southern New England, 1971

Ownership	Annual net growth			Annual timber removals		
	All species	Softwoods	Hardwoods	All species	Softwoods	Hardwoods
	GROWING STOCK *Thousand cubic feet*					
Other public	33,901	11,190	22,711	4,550	1,179	3,371
Forest industry	2,242	818	1,424	—	—	—
Farmer and other	182,657	57,492	125,165	47,450	14,821	32,629
All ownerships	218,800	69,500	149,300	52,000	16,000	36,000
	SAWTIMBER *Thousand board feet*[1]					
Other public	79,899	35,634	44,265	7,505	2,936	4,569
Forest industry	4,282	3,022	1,260	—	—	—
Farmer and other	458,119	171,344	286,775	113,195	34,264	78,931
All ownerships	542,300	210,000	332,300	120,700	37,200	83,500

[1] International ¼-inch rule.

Table 26.—Annual mortality of growing stock and sawtimber on commercial forest land, softwoods and hardwoods, Southern New England, 1971

Ownership and cause	Growing stock (thousand cubic feet)			Sawtimber (thousand board feet)[1]		
	All species	Softwoods	Hardwoods	All species	Softwoods	Hardwoods
			BY OWNERSHIP			
Other public	3,450	971	2,479	2,993	577	2,416
Forest industry	200	—	200	—	—	—
Farmer and other	29,650	5,796	23,854	30,007	13,918	16,089
All ownerships	33,300	6,767	26,533	33,000	14,495	18,505
			BY CAUSE			
Disease	26,240	4,883	21,357	25,369	9,927	15,442
Weather	2,089	1,137	952	5,306	4,338	968
Suppression	406	—	406	352	—	352
Fire	381	220	161	230	230	—
Other	309	—	309	671	—	671
Insects	32	32	—	—	—	—
Unknown	3,843	495	3,348	1,072	—	1,072
All causes	33,300	6,767	26,533	33,000	14,495	18,505

[1] International ¼-inch rule.

Table 27.—Sampling errors for major forest area and timber-volume classes, Southern New England, 1972

Table No.	Item classification	Sampling error
	FOREST AREA	*Percent*
1	Forest-land area:	
	Commercial	1.4
	Unproductive	41
	Total	2
2	Ownership:[1]	
	Forest industry	(*)
	Farmer-owned	21
	Misc. private	3
	Farmer and other	3
3	Stand-size class:	
	Sawtimber	7
	Poletimber	7
	Sapling-seedling	7
	Nonstocked areas	43
4	Stand-volume per acre (board feet):	
	Less than 1,500	6
	1,500 to 5,000	5
	More than 5,000	11
7	Area-condition class:	
	10-50	7
	60	5
	70	13
8	Growth-per-acre class (cubic feet):	
	120 to 165	23
	85 to 120	12
	50 to 85	8
	Less than 50	6
9	Forest type:	
	White pine—red pine—hemlock	10
	Spruce—fir	(*)
	Pitch pine	31
	Oak—pine	19
	Oak—hickory	8
	Elm—ash—red maple	9
	Maple—beech—birch	13
	Aspen—birch	36

Table No.	Item classification	Sampling error	
	TIMBER VOLUME	*Cubic feet*	*Board feet*
		Percent	
15	Class of timber:		
	Sawtimber trees	3	—
	Poletimber trees	3	—
	All growing stock	1.8	—
	Rough trees	6	—
	Rotten trees	7	—
	All live trees	2	—
16	Ownership class:		
	Other public	20	25
	Forest industry	(*)	(*)
	Farmer and other	3	4
17	Stand-size class:		
	Sawtimber stands	6	5
	Poletimber stands	8	10
	Sapling-seedling	10	13
	Nonstocked areas	(*)	(*)
	Softwoods	7	6
	Hardwoods	3	5
	All classes	1.8	2.6
18-19	Diameter class (inches):		
	5.0- 6.9	5	—
	7.0- 8.9	4	—
	9.0-10.9[2]	4	10
	11.0-12.9	4	5
	13.0-14.9	6	5
	15.0-16.9	6	5
	17.0-18.9	7	7
	19.0-20.9	9	8
	21.0-28.9	10	9
	29.0 and larger	21	21
18-19	Species:		
	White pine	9	10
	Red pine	42	49
	Pitch pine	27	33
	Hemlock	16	17
	Spruce	(*)	(*)
	Fir	(*)	(*)
	Other softwoods	(*)	(*)
	Sel. white oaks	9	11
	Sel. red oaks	8	9
	Other white oaks	30	40
	Other red oaks	10	12
	Hickory	16	28
	Sugar maple	15	20
	Soft maples	8	13
	Sweet birch	14	20
	Yellow birch	18	25
	Paper birch	17	29
	Beech	19	25
	White ash	15	21
	Black cherry	21	26
	Aspen	23	38
	Elm	22	38
	Other hardwoods	18	26
	GROWTH REMOVALS		
25	Growth by:		
	Other public	16	17
	Forest industry	(*)	(*)
	Farmer and other	6	6
	Softwoods	11	10
	Hardwoods	6	6
	All species	5	5
25	Removals by:		
	Other public	40	44
	Forest industry	—	—
	Farmer and other	16	23
	Softwoods	30	38
	Hardwoods	16	22
	All species	15	21
	MORTALITY		
26	By ownership:		
	Other public	32	(*)
	Forest industry	(**)	—
	Farmer and other	11	22
	Softwoods	22	34
	Hardwoods	11	21
	All species	10	20
26	By cause:		
	Fire	(*)	(**)
	Insect	(**)	—
	Disease	12	24
	Weather	38	(*)
	Suppression	43	(*)
	Other	(*)	(**)
	Unknown	29	43

* Sampling errors of 50 to 99 percent.
** Sampling errors of 100 percent or more.
[1] Some classifications have no sampling errors and some less important classifications have been omitted.
[2] Board-foot sampling error for this class is for softwoods only.

Table 28.—Output of timber products, by source of material, softwoods and hardwoods, Southern New England, 1971

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:							
Softwood	M bd. ft.[1]	48,976	8,207	48,976	8,207	—	—
Hardwood	M bd. ft.[1]	55,866	9,372	55,866	9,372	—	—
Total	M bd. ft.[1]	104,842	17,579	104,842	17,579	—	—
Veneer logs and bolts:							
Softwood	M bd. ft.[1]	—	—	—	—	—	—
Hardwood	M bd. ft.[1]	289	52	289	52	—	—
Total	M bd. ft.[1]	289	52	289	52	—	—
Pulpwood:							
Softwood	Std. cords[2]	19,898	1,691	14,876	1,264	5,022	427
Hardwood	Std. cords[2]	23,984	2,039	14,974	1,273	9,010	766
Total	Std. cords[2]	43,882	3,730	29,850	2,537	14,032	1,193
Cooperage logs and bolts:							
Softwoods	M bd. ft.[1]	—	—	—	—	—	—
Hardwood	M bd. ft.[1]	125	17	125	17	—	—
Total	M bd. ft.[1]	125	17	125	17	—	—
Piling:							
Softwood	M linear ft.	2	1	2	1	—	—
Hardwood	M linear ft.	241	88	241	88	—	—
Total	M linear ft.	243	89	243	89	—	—
Poles:							
Softwood	M pieces	1	13	1	13	—	—
Hardwood	M pieces	2	1	2	1	—	—
Total	M pieces	3	14	3	14	—	—
Posts (round and split):							
Softwood	M pieces	61	43	61	43	—	—
Hardwood	M pieces	—	—	—	—	—	—
Total	M pieces	61	43	61	43	—	—
Other:[3]							
Softwood	M cu. ft.	653	653	17	17	636	636
Hardwood	M cu. ft.	1,427	1,427	317	317	1,110	1,110
Total	M cu. ft.	2,080	2,080	334	334	1,746	1,746
Total industrial products:[4]							
Softwood	M cu. ft.		10,608		9,545		1,063
Hardwood	M cu. ft.		12,996		11,120		1,876
Total	M cu. ft.		23,604		20,665		2,939
Fuelwood:							
Softwood	Std. cords	5,638	452	1,693	136	3,945	316
Hardwood	Std. cords	33,752	2,700	24,616	1,969	9,136	731
Total	Std. cords	39,390	3,152	26,309	2,105	13,081	1,047
All products:[5]							
Softwood	M cu. ft.		11,060		9,681		1,379
Hardwood	M cu. ft.		15,696		13,089		2,607
Total	M cu. ft.		26,756		22,770		3,986[6]

[1] International ¼-inch rule.
[2] Rough wood basis, includes chips converted to equivalent standard cords.
[3] Includes handle, roller and dimension bolts, shingle bolts, pickets and stakes, charcoal wood, horticultural mulch, and wood novelty items.
[4] No mine timbers are produced in Southern New England.
[5] Does not include 1,233,500 cubic feet of softwood and 1,339,800 cubic feet of hardwood residues used for agricultural bedding.
[6] Hardwood pulpwood from plant residues does not agree with table 22 in Resource Bulletin NE-30, Primary Wood-Product Industries of Southern New England, 1971, because of different data sources.

Table 29.—Output of roundwood products, by source, softwoods and hardwoods, Southern New England, 1971

[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:							
Softwood	8,207	7,118	6,889	229	—	54	1,035
Hardwood	9,372	8,998	8,563	435	41	—	333
Total	17,579	16,116	15,452	664	41	54	1,368
Veneer logs and bolts:							
Softwood	—	—	—	—	—	—	—
Hardwood	52	50	50	—	—	—	2
Total	52	50	50	—	—	—	2
Pulpwood:							
Softwood	1,264	1,085	451	634	5	6	168
Hardwood	1,273	723	—	723	—	—	550
Total	2,537	1,808	451	1,357	5	6	718
MISCELLANEOUS INDUSTRIAL PRODUCTS							
Cooperage logs and bolts:							
Softwood	—	—	—	—	—	—	—
Hardwood	17	16	16	—	—	—	1
Total	17	16	16	—	—	—	1
Piling:							
Softwood	1	1	1	—	—	—	—
Hardwood	88	85	81	4	—	—	3
Total	89	86	82	4	—	—	3
Poles:							
Softwood	13	13	11	2	—	—	—
Hardwood	1	1	—	1	—	—	—
Total	14	14	11	3	—	—	—
Posts (round and split):							
Softwood	43	15	—	15	—	25	3
Hardwood	—	—	—	—	—	—	—
Total	43	15	—	15	—	25	3
Other:							
Softwood	17	6	—	6	—	9	2
Hardwood	317	208	136	72	54	11	44
Total	334	214	136	78	54	20	46
TOTAL INDUSTRIAL PRODUCTS							
Softwood	9,545	8,238	7,352	886	5	94	1,208
Hardwood	11,120	10,081	8,846	1,235	95	11	933
Total	20,665	18,319	16,198	2,121	100	105	2,141
NONINDUSTRIAL PRODUCTS							
Fuelwood:							
Softwood	136	49	—	49	—	77	10
Hardwood	1,969	1,292	843	449	338	68	271
Total	2,105	1,341	843	498	338	145	281
ALL PRODUCTS							
Softwood	9,681	8,287	7,352	935	5	171	1,218
Hardwood	13,089	11,373	9,689	1,684	433	79	1,204
Total	22,770	19,660	17,041	2,619	438	250	2,422

[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 30.—Timber removals from growing stock and sawtimber on commercial forest land, by items, softwoods and hardwoods, Southern New England, 1971

Item	Growing stock			Sawtimber		
	All species	Soft-woods	Hard-woods	All species	Soft-woods	Hard-woods
	Thousand cubic feet			*Thousand board feet*[1]		
Roundwood products:						
Sawlogs	16,116	7,118	8,998	69,911	31,293	38,618
Veneer logs and bolts	50	—	50	226	—	226
Pulpwood	1,808	1,085	723	1,644	1,644	—
Cooperage logs and bolts	16	—	16	72	—	72
Piling	86	1	85	371	5	366
Poles	14	13	1	50	50	—
Posts	15	15	—	—	—	—
Other	214	6	208	611	—	611
Fuelwood	1,341	49	1,292	3,797	—	3,797
All products	19,660	8,287	11,373	76,682	32,992	43,690
Logging residues	2,997	693	2,304	1,959	767	1,192
Other removals	30,507	6,972	23,535	32,290	12,460	19,830
Total removals	53,164	15,952	37,212	110,931	46,219	64,712

[1] International ¼-inch rule.

Table 31.—Volume of unused residues at sawmills,[1] by type of residue for softwoods and hardwoods, Southern New England, 1971

[In thousands of cubic feet]

Type of residue	Softwoods	Hardwoods	All species
Coarse[2]	920.5	556.7	1,477.2
Fine[3]	101.3	78.5	179.8
Total	1,021.8	635.2	1,657.0

[1] The sawmill industry was the only industry in Southern New England with unused residues.
[2] Material such as slabs and edgings.
[3] Material such as sawdust and shavings.

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