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Forest Resources of Southern New England

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Abstract

An analytical report that summarizes and discusses information collected by and reported on the third survey of Southern New England forests. Additional information is drawn from the previous forest surveys to identify trends in forest resources. Topics include forest area, species composition, volume, growth, wildlife habitat, and ownership.

Foreword

The third inventory of Southern New England was under the overall direction of John R. Peters, Project Leader of the Forest Inventory and Analysis Unit. Eric H. Wharton assisted in the development and administration of the operating plan. Charles T. Scott was responsible for the design of the inventory and sample selection. David J. Alerich supervised the interpretation of aerial photos and collection of data. He was assisted by Joseph G. Reddan. Numerous individuals served as field staff. David R. Dickson and Carol L. Alerich applied FINSYS (Forest INventory SYStem), a generalized data processing system, to the specific needs of the inventory and produced summary tables for this publication. Thomas W. Birch and Carol L. Alerich were instrumental in assuring that the area estimates were consistent with the two previous inventories. Marie Pennestri was responsible for administrative and secretarial services.

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Highlights

Forest Land Area

Southern New England, with an estimated 5.5 million acres of forest land, is 62 percent forested.

Forest area has changed little in the 30 years since the first extensive forest survey.

Timberland Area

Timberland, previously termed commercial forest land, accounts for 93 percent of all forest land.

Hardwood forest-type groups predominate in Southern New England; two-fifths of the timberland acreage is classified as oak/hickory.

Nearly 60 percent of the Southern New England timberland area is classified as sawtimber-size stands.

Number of Trees

There are more than 500 live trees 1.0 inches d.b.h. and larger on the average acre of timberland.

Red maple is by far the predominant tree species in the Southern New England forest, accounting for one of every four trees.

Timber Volume, Biomass, and Value

Red maple has become the predominant species in regional growing-stock volume, pushing eastern white pine, the previous number one species, to second place.

While net change in growing-stock volume is similar to that of the previous survey, the principal component of change has become accretion on existing trees versus ingrowth of new trees.

Board-foot volume increased by 50 percent from the 1972 survey to 20 billion board feet.

Eastern white pine remains the number one species of board-foot volume, but red maple eclipsed northern red oak for second place.

There are nearly 500 million green tons of tree biomass in Southern New England forests, more than 40 percent in nongrowing-stock timber.

Across all of New England, timber stands appreciated in value by an average of 4.2 percent between the last two forest surveys; the average rate of value change of all trees appreciated by 3.2 percent.

Forest Wildlife Habitat

There are more than 12,000 seedlings, saplings, and shrubs on the average acre of Southern New England timberland.

More than 116 species of trees, shrubs, and vines were tallied on Southern New England timberland; blueberry is the most important species based on density and frequency.

Oaks account for nearly 75 percent of all mast-producing trees in Southern New England.

There are nearly 95 million standing-dead trees in Southern New England, 25 percent of which have an observed cavity; only 7 percent of live trees have an observable cavity.

Introduction

The three Southern New England states (Massachusetts, Rhode Island, and Connecticut), are commonly perceived as constituting the highly urbanized northern terminus of the Boston to Washington corridor. While densely populated, averaging some 712 individuals per square mile in 1980, the region has significant acreage of rural lands, much of which is forested. In 1985, the third forest survey of the region estimated that there are 5.5 million acres of forest land in Southern New England, representing 62 percent of the total land area (Table 1). This is a slight but nonsignificant increase in forest area since the previous forest survey in 1972.

This rural land base provides considerable resources to the people and economy of the region, including wood products, recreational opportunities, wildlife habitat, water, visual amenities, and employment (Millar 1984; More 1985). The landscape matrix of forest land interspersed with agricultural and residential lands gives New England its unique character.

The forest lands of Southern New England have been surveyed three times by the USDA Forest Service's Forest Inventory and Analysis (FIA) until, initially in 1953, again in 1972, and most recently in 1984. The survey is extensive and sample-based. Samples include both remeasurements of ground plots established in previous surveys, and the establishment of new ground plots. Estimates of resource information are made at the county level of resolution and higher. Information at this resolution is most appropriately used for assessing of conditions and trends of dominant resources at broad scales. The survey cannot adequately answer forest resource questions at scales smaller than counties or for lesser common resources or resource conditions.

Each survey has expanded on the previous one. At the most recent occasion, survey data were collected and reported on timber and wildlife habitat resources, forest ownership patterns, forest biomass, and the region's forest industry. Information is organized differently in this report than in the state reports. A table is provided that cross references resource tables in this and the state reports. This publication draws from these reports and from previous survey reports to describe the forest resources of Southern New England and to discuss issues concerning the management and use of the forest. The three Southern New England states are similar both in forest resources and the issues and opportunities regarding their use.

Questions not answered by this report or by the material referenced by this work, or questions concerning survey procedures, should be directed to the Forest Inventory and Analysis unit, USDA Forest Service, 5 Radnor Corporate Center, Suite 200, 100 Matsonford Road, P.O. Box 6775, Radnor, PA 19087-4585; phone (215) 975-4075.

Discussion

Forest Land Area

Southern New England has been predominantly forested throughout most of its history. Prior to the arrival of European colonists, Southern New England was principally forested land, interspersed with wetlands and small-scale agriculture (Atwood 1970; Cronon 1983). The colonial period was one of conversion of forest land to agricultural use, with the change occurring later in the north and west of Southern New England. The period between the

Table 1. Land area by land class and state, Southern New England, 1985[1], and published forest land area, Southern New England, 1953[2] and 1972[3]

(In thousands of acres)

Land	Massachusetts	Connecticut	Rhode Island	All states 1985	All states 1972	All states 1953
Timberland	2,929.4	1,777.3	371.7	5,078.4	4,998.6	5,662
Noncommercial forest:						
Productive reserved	101.4	20.9	8.4	130.7	128.8	33
Unproductive	142.5	17.2	20.5	180.2	74.8	17
Urban	52.0	10.3	4.2	66.5	n/a[4]	n/a
Christmas tree plantation	n/a	n/a	n/a	n/a	15.1	n/a
Total noncommercial	295.9	48.4	33.1	404.8	218.7	50
Total forest land	3,225.2	1,825.7	404.8	5,455.7	5,217.3	5,712
Nonforest:						
Cropland	214.2	182.2	23.5	419.9		
Pasture	51.7	42.8	4.6	99.1		
Other	1,516.5	1,067.2	242.2	2,825.9		
Total nonforest land	1,782.4	1,292.2	270.3	3,344.9		
Total land area	5,007.6	3,117.8	675.1	8,800.5		

[1]From Dickson and McAfee (1988a, 1988b, 1988c)

[2]From Ferguson and Howard (1956), Ferguson and McGuire (1957), and Griswold and Ferguson (1957)

[3]From Dickson and Bowers (1976) and Peters and Bowers (1977a, 1977b)

[4]n/a (not available) statistic not published

Revolutionary and Civil Wars found the region's forest lands to be at an ebb in area, accounting for as little as 25 percent of the total land area (Cronon 1983). Following the Civil War and the opening of the public lands of the west, the abandonment of farm land and its reversion to forest was common. This was to continue through World War II and the surge in urbanization of the Northeast.

In 1953, the initial forest survey of Southern New England reported 5.7 million acres of forest land (Table 1). Forest land is specifically defined by FIA (see Definition of Terms) for application of the forest survey. In general terms, forest land is all land, one acre and larger in size, that supports a specified minimum number of trees or more and functions as a natural system or is maintained as a forestry plantation.

In the 30 years since the initial survey, forest land area has changed relatively little, declining to 5.2 million acres in 1972 from 5.7 million acres and then increasing slightly to the current 5.5 million acres (Table 1). One part of the increase in forest land area from the 1972 survey is due to a change in survey procedures. In 1972, Dukes and Nantucket Counties in Massachusetts were administratively defined as being entirely nonforest land, in the 1985 survey, these counties were surveyed the same as all other land. If one also considers the sampling errors on each estimate, it is likely there has been no significant change in forest land area between the last two surveys. The major conclusion to be drawn from these numbers is that forest land area has been relatively stable over the last three decades, and that major changes in forest resources have been those of change within the forest (e.g, maturation, fragmentation of ownerships) rather than change between forest land and alternate land uses.

It is of interest that over this period, cropland resources have declined dramatically, from a high of 1.2 million acres in 1950 to the current 519,000 acres (Table 2). Both harvested croplands and pastured lands have experienced this decline. It is likely that a large amount of this previously farmed acreage currently is in residential or other developed land uses. Since 1950, the population of Southern New England has increased some 38 percent to estimated 10.3 million people in 1990 (Table 3). The rural population has been increasing at a similar rate, but since lands classified as rural have declined in acreage, rural population density has increased some 51 percent since 1950 to 183 individuals per square mile in 1980 (US. Dep. Commer. Bureau of Census 1987). Some of the most densely populated states in the country are in Southern New England, yet the region remains heavily forested. The impact of this increase in rural populations on forest resources is discussed in detail in the section on forest ownership patterns.

As part of the most recent forest survey, landscape patterns were characterized by sampling the interspersion of different land cover types (Brooks and Sykes 1984). As the interspersion of land uses increases, the landscape becomes more complex. Depending on the land uses involved, increasing complexity in a landscape dominated by forests can be associated with increasing fragmentation of forest land. Landscape pattern data are reported as "edge hits" per 1,000 acres. An "edge" is defined as the juxtaposition of two visually different land cover types or the occurrence of a linear land use (for example, hedgerow, or right-of-way). An edge hit occurs when an edge is detected on an aerial photograph with a sampling template.

Table 2. Cropland area by cropland type, Census year, and state, Southern New England[1]

(In thousands of acres)

Census year	Massachusetts	Connecticut	Rhode Island	All states
Harvested cropland				
1950	376.0	308.5	39.8	724.3
1964	234.4	205.9	28.9	469.2
1974	188.0	159.2	21.4	368.6
1982	197.8	171.2	21.3	390.3
Pastured cropland				
1950	151.0	128.5	25.5	305.5
1964	79.9	56.3	12.1	148.3
1974	55.5	56.0	5.3	116.8
1982	51.7	42.8	4.6	99.1
Total cropland[2]				
1950	624.4	498.0	80.3	1,202.7
1964	347.8	288.0	45.2	681.0
1974	257.0	227.0	29.1	513.1
1982	265.9	225.0	28.2	519.1

[1]Data from the Census of Agriculture, U. S. Department of Commerce, Bureau of Census
[2]Includes Other cropland area

Table 3. Total and rural human population by Census year and state, Southern New England[1]

(In thousands of individuals)

Census year	Massachusetts	Connecticut	Rhode Island	All states
Total population				
1950	4,690.5	2,007.3	791.9	7,489.7
1960	5,148.6	2,535.2	859.5	8,543.3
1970	5,689.2	3,032.2	949.7	9,671.1
1980	5,737.0	3,107.6	947.2	9,791.8
1990	6,016.4	3,287.1	1,003.5	10,307.0
Rural population[2,3]				
1950	731.3	448.6	124.7	1,304.6
1960	846.0	549.7	116.6	1,512.3
1970	878.7	655.6	121.8	1,656.1
1980	928.7	657.8	123.2	1,709.7

[1]Data from Census of Population, U. S. Department of Commerce, Bureau of Census
[2]Rural population is defined for the 1980 Census as all persons living outside urbanized areas and outside places of 2500 or more inhabitants outside urbanized areas
[3]Rural population data for 1990 not available at this time

The results of this survey show forest land to be highly interspersed with cultural lands (that is, lands with human development as the major land cover) (Table 4). Forest-cultural juxtaposition is the major edge type in Southern New England after transportation right-of-ways. As expected, the juxtaposition of forest and cultural land covers increases in the more urbanized counties (Dickson and McAfee 1988a, 1988b, 1988c). In northern New England, land use patterns are less complex, total "edge hits" accounting for less than half of the values for Southern New England (for example, Brooks et al. 1986).

It will be interesting to follow this statistic in future surveys as a measure of single family-residential development in historically rural counties. While the construction of a house on a 10-acre forested lot may remove little forest land, it does influence the use of the remaining adjacent forest land for commercial forest, for wildlife habitat, and for wildland recreation.

Timberland Area

Timberland is a subset of all forest land, defined as being capable of growing at least 20 cubic feet of wood per acre per year and not being administratively withdrawn from timber utilization. The third Southern New England forest survey classed 93 percent of the region's forest land as timberland, some 5.1 million acres (Table 1). This is an insignificant increase in absolute timberland area from the previous survey and a slight decrease in the percentage of timberland as a component of total forest land. This change in status from timberland to noncommercial forest land is due to a slight increase in reserved timberland (forest land set aside or withdrawn from timber utilization by statute or designation) and a larger increase in unproductive forest land.

While these changes in timberland and noncommercial forest land area since 1972 are interesting, we are unable to identify any significant change in area over this period. The sampling error associated with each estimate precludes identification of significant differences unless the difference exceeds the combined error of the two estimates. Sampling errors are calculated for each estimated statistic. It is impractical to report all of these numbers. Sampling errors for a few estimates are given (see Sampling Errors for Selected Estimates) and the balance is available upon request from the FIA unit, Radnor, Pennsylvania.

As an example of how a change is determined to be insignificant when considering sampling error, we can look at the change in timberland area in Southern New England between surveys. In 1972, timberland area was estimated to be 4,998,600 acres, $\pm$ 1.3 percent (see Table 1 and Sampling Errors for Selected Estimates), or 65,000 acres. In 1985, timberland area was estimated to have increased to 5,078,400 acres, $\pm$ 0.9 percent, or 45,700 acres. This means that if there are no errors in the procedure and we repeated these surveys in the same way, the odds are 19 to 1 (significant at the 95-percent probability level) that the 1972 estimate of timberland area would be between 4,933,600 and 5,063,600 acres, and the 1985 estimate would be between 5,032,700 and 5,124,100 acres. The 95-percent confidence intervals on the two estimates overlap and we are unable to say there has in fact been a significant increase in Southern New England timberland area from 1972 to 1985.

Table 4. Index to land-use interspersion by type of land use or land cover and state, Southern New England, 1985

(In edge hits[1] per thousand acres)

Land use/cover	Massachusetts	Connecticut	Rhode Island	All states[2]
Forest -				
forest	9.6	10.6	8.6	9.9
shrub	4.4	4.3	2.2	4.2
agricultural/ herbaceous	8.8	10.6	4.1	9.1
cultural	12.3	13.5	10.1	12.6
Shrub -				
agricultural/ herbaceous	0.9	1.7	0.6	1.2
cultural	0.7	1.1	0.6	0.8
Agricultural/ herbaceous -				
cultural	1.5	3.1	1.3	2.1
Hedgerow	2.3	3.0	1.6	2.5
Transportation right-of-way	15.3	17.0	13.8	15.8
Utility right-of-way	3.3	2.1	1.6	2.7
Aquatic	6.1	10.6	11.2	8.1
All edge classes	65.2	77.5	55.6	68.8

[1]Brooks and Sykes (1980)

[2]Averaged state values weighted by total state area

While timberland area at the regional level appears to have increased slightly, this trend is not consistent across the states. Both Connecticut and Rhode Island have shown a nonsignificant decrease in timberland area from 1972 to 1985 (Dickson and McAfee 1988a, 1988b). Rhode Island timberland area decreased in every county, but the total timberland area in the state is less than 400,000 acres, and statements about county-level change are unreliable due to excessive sampling error. In Connecticut, timberland area increased slightly in the less urbanized three eastern counties and decreased consistently in the more urbanized five western counties. While these changes are statistically nonsignificant, their consistency lends them credence.

Massachusetts' timberland area, on the other hand, is estimated to have increased some 179,000 acres between 1972 and 1985 (Dickson and McAfee 1988c). When considering the sampling error on both estimates, this change is nonsignificant. Berkshire and the Pioneer Valley counties in the west all show an increase in timberland area while Worcester and the eastern counties are mixed, with changes of only several thousand acres each.

The only general conclusion one can draw from these statistics is that, both regionally and locally, timberland area has remained stable between 1972 and 1985. In the years since the last forest survey, it is possible that timberland area may have declined. The number of housing starts has increased from 41,000 in 1983 to 75,000 in 1986 in Southern New England (U.S. Dep. Commer. Bur. Census 1987). In Connecticut, the population density of the 10 towns with the largest increase in housing units between 1980 and 1989 (10-town average increase of 39.6 percent versus a 14.1-percent increase statewide) averaged only 271 people per square mile, much less than the statewide average of 664 (Connecticut Dep. of Econ. Dev. 1990). Massachusetts Audubon reports, based on a town-by-town survey of building permits, that between 1981 and 1986, 112,000 acres of Massachusetts "open space" were affected by development (Greenbaum and O'Donnell 1987). In 1986 alone, more than 30,000 acres in Massachusetts were developed. While it is not reported how much of this open space was forest land, these figures serve as an important index of the degree of development in Southern New England.

This development has occurred in traditionally rural, extensively forested counties as well as in predominantly urbanized counties. In Connecticut, over the decade of the 1980's, housing units increased by 14.1 percent (Connecticut Dep. of Econ. Dev. 1990). For the 10 Connecticut towns with the lowest population density, that is, rural towns, the median increase in housing units was 21 percent for the decade and 8.2 percent for the 10 towns with the highest population density (urban towns). While each home in a rural, forested setting may remove only a small area of forest, cumulatively this development activity will reduce forest area. More important, the subdivision of forest land alters management and utilization options and the general character of forest land and landscapes.

Classification of timberland by type and stand size is made by considering of the stocking of either species (forest type) or diameter classes (stand size). Forest-type groups and stand-size classes are described by the species or diameter classes that constitute the plurality of stocking. Accurate changes in type and stand size from previous surveys can be made only between 1972 and 1985 due to changes in classification standards and algorithms.

At the time of the prior forest survey (1972), the predominant forest-type groups in Southern New England were the oak/hickory, northern hardwoods, and white/red pine groups (Table 5). These forest-type groups were again predominant in the 1985 forest survey (Table 6). These types account for 4.2 million timberland acres or 83 percent of the total. No significant change in the distribution of timberland area by forest type has been detected for 1972 to 1985 in Southern New England.

While there is not necessarily a perfect correlation between tree age and diameter, stand-size class generally is indicative of stand-age class. This is especially likely in Southern New England where much of today's forest reverted following agricultural abandonment, resulting in the establishment of an even-aged forest. In 1985, sawtimber-size stands account for a majority of Southern New England timberland (Fig. 1). Sawtimber-size stands increased by 1.1 million acres between 1972 and 1985, a significant increase between surveys. Over the same period, both poletimber- and sapling and seedling-size stands decreased significantly by 325,000 and 588,000 acres respectively. The 1985 forest survey reported that sapling and seedling-size stands account for only 8 percent of forest land or slightly more than 400,000 acres of a total forest area of 5 million acres.

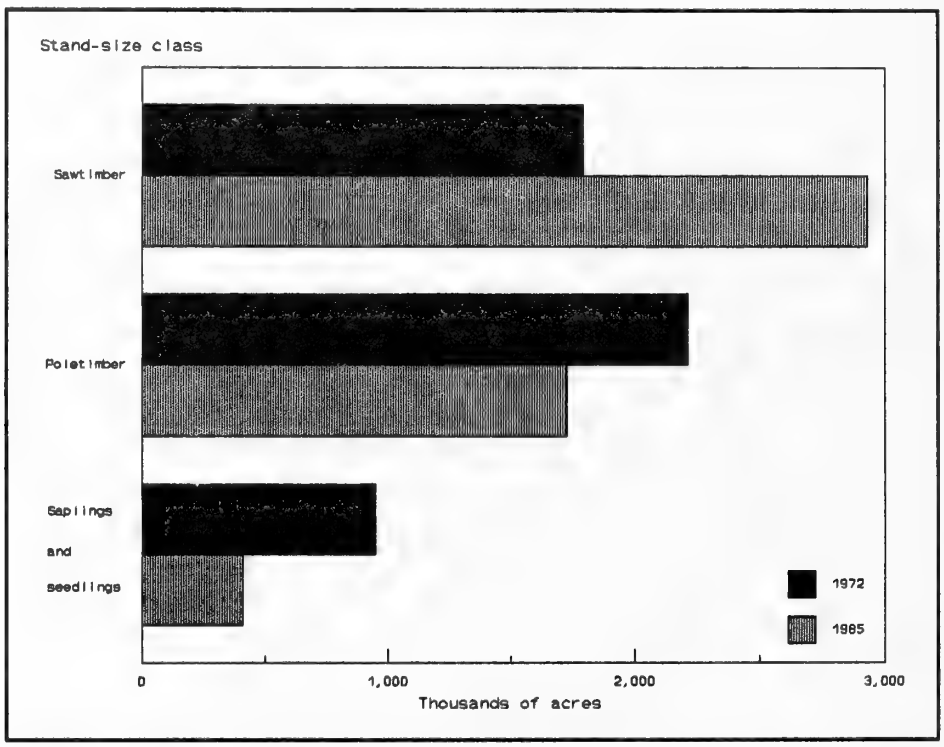

Figure 1.--Area of timberland by stand-size class, Southern New England, 1972 and 1985.

The skewed distribution of timberland by stand-size class affects to some extent the future potential flow of wood products. As is shown in the discussion of numbers of trees and tree volume by diameter, the skewed distribution of forest area by stand size is a result of the skewed distribution of trees by diameter. Without a more balanced distribution of size classes for stands or trees, harvest yields will follow a boom and bust cycle rather than a sustained, even flow.

Table 5. Area of timberland by forest-type group and stand-size class, Southern New England, 1972

(In thousands of acres)

Forest-type group	Stand-size class				All classes
	Sawtimber	Poletimber	Sapling and seedling	Nonstocked	
White/red pine	616.9	208.8	119.5	.0	945.1
Spruce/fir	28.2	.0	15.8	.0	43.9
Hard pine	28.6	56.0	49.8	.0	134.4
Oak/pine	94.8	171.3	78.5	.0	344.6
Oak/hickory	767.6	1,071.5	352.0	.0	2,191.2
Elm/ash/red maple	6.1	77.5	101.2	.0	184.8
Northern hardwoods	361.4	453.2	260.3	.0	1,074.9
Aspen/birch	.0	13.8	21.0	.0	34.8
All groups	1,903.6	2,052.1	998.1	.0	4,953.8

Table 6. Area of timberland by forest-type group and stand-size class, Southern New England, 1985

(In thousands of acres)

Forest-type group	Stand-size class				All classes
	Sawtimber	Poletimber	Sapling and seedling	Nonstocked	
White/red pine	800.6	115.3	42.4	.0	958.3
Spruce/fir	6.7	35.7	9.1	.0	51.5
Hard pine	43.4	67.9	32.2	.0	143.5
Oak/pine	204.0	124.3	6.2	.0	334.6
Oak/hickory	1,050.9	911.3	177.4	.0	2,139.6
Elm/ash/red maple	132.2	81.4	63.9	.0	277.6
Northern hardwoods	687.2	363.1	72.5	9.9	1,132.6
Aspen/birch	6.5	28.0	6.2	.0	40.7
All groups	2,931.4	1,727.0	410.1	9.9	5,078.4

The predominance of a single size class, in this case sawtimber, determines in part the wildlife community in Southern New England forests. DeGraaf and Rudis (1986) classified New England wildlife by habitat use and identified the many species of herptofauna, birds, and mammals that use or prefer the younger sapling and seedling-sized forest stands. As these stands mature into poletimber size and are inadequately replaced by regeneration harvests of mature stands, wildlife species that are obligate residents of early successional stands become increasingly rare, e. g., American woodcock (Scolopax minor), rufous-sided towhee (Pipilo erythrophthalmus), eastern cottontail (Sylvilagus floridanus) and New England cottontail (S. transitionalis).

Stocking is a means of evaluating stand density by comparing the sample stand to a standard of "normal" or "full" stocking (Smith 1986). Stocking is a matter of concern as it directly influences many other forest environment processes including timber growth and yield. As calculated by FIA, stocking is the degree of occupancy of land by trees, measured either in basal area and/or in the number of trees in a stand. These measurements are compared to a standard of 75 square feet of basal area per acre for trees 5.0 inches or larger in diameter at breast height (d.b.h.), or its equivalent in number of trees per acre for seedlings and saplings (that is, trees less than 5.0 inches d.b.h.).

Southern New England forests have become increasingly overstocked (Fig. 2). In 1985, it is estimated that 46 percent of timberland is overstocked, and 79 percent of timberland is either fully stocked or overstocked (Table 7). This is a significant change from the 1972 survey, with a decrease in fully stocked stands and a comparable increase in overstocked stands.

Trees in fully stocked to overstocked forest stands are growing at less than their potential due to competition between trees for growing space (light, nutrients, and moisture). The vigor of individual trees is lessened due to the stress of competition and the trees are more susceptible to insect and disease infestations, resulting in mortality. Overstory mast production is reduced in overstocked stands due to reduced individual tree-crown size. Understory growth and shrub fruiting, important components of wildlife habitat, are suppressed due to a fully closed crown canopy.

Number of Trees

The total number of live trees in Southern New England forests declined some 13 percent between 1972 and 1985 (Tables 8-9). The decline was in the smaller diameter classes: the seedlings, saplings, and smallest poletimber size trees (Fig. 3). The change in the diameter distribution of Southern New England trees reflects the maturation of the forest. Sapling-size trees are only 80 percent as numerous in 1985 as in 1972. This decline in numbers continues through the 6-inch diameter class, the smallest poletimber-size class. Trees 7 inches d.b.h. and larger are more numerous currently than a decade ago. The greatest increase, 30 percent from the prior survey, is in small sawlog-size (11.0 to 14.9 inches) trees. The principal effect of this increase is discussed in the section on changes in board-foot volume.

The ubiquitous red maple was the most common tree species in Southern New England in 1985 (Table 9). Its estimated 692 million stems 1.0-inch d.b.h. and

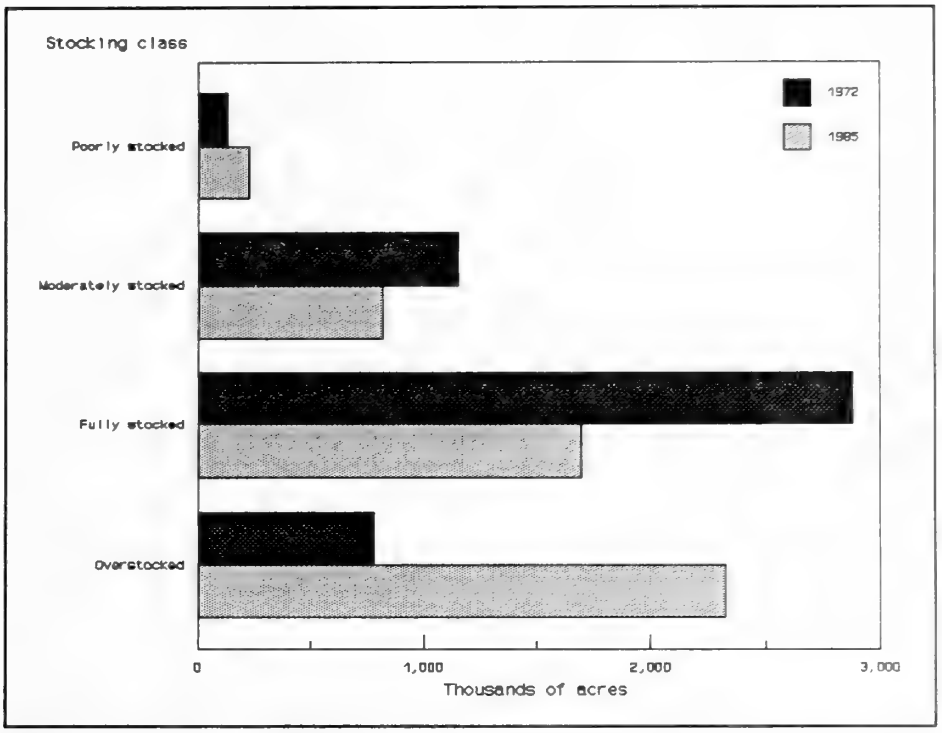

Figure 2.--Area of timberland by all-live stocking class, Southern New England, 1972 and 1985.

larger account for every fourth tree in the region. White pine and eastern hemlock are the second and third most common species, due mostly to their wide distribution in Massachusetts (Dickson and McAfee 1988c). As a group, the oaks and hickories are common; this is reflected in the predominance of the oak/hickory forest-type group (Table 6). These same species and species groups were equally common at the prior survey (Fig. 4). Changes in species numbers probably are non-significant.

Growing-stock trees accounted for 79 percent of all trees and 87 percent of all-live trees in Southern New England in 1985 (Fig. 5). As with all-live trees, red maple is the predominant species of growing-stock trees, followed by northern red oak and white pine.

Rough- and rotten-cull trees make up 12 percent of all trees and red maple is again the most common tree in this class (Fig. 6). Noncommercial hardwoods (for example, boxelder, gray birch, and hawthorn) as a group are a major component of these trees as they are by definition considered rough cull. Generally, the proportion of cull trees by species follows the distribution of the species in the general population. An exception is American beech, for which a higher proportion was classified as cull than would be expected. Beech bark disease, a disease complex caused by beech scale (Cryptococcus fagisuga) infestation followed by a Nectria fungus invasion, was epidemic in Southern New England prior to the last survey. This disease causes significant beech defect and mortality (Burns and Houston 1987).

Table 7. Area of timberland by all-live tree stocking class and state, Southern New England, 1972 and 1985

(In thousands of acres)

Stocking class	Massachusetts		Connecticut		Rhode Island		All states	
	1972	1985	1972	1985	1972	1985	1972	1985
Nonstocked	0.0	0.0	0.0	9.9	0.0	0.0	0.0	9.9
Poorly stocked	58.2	120.1	57.3	95.3	18.3	12.7	133.8	228.1
Moderately stocked	431.9	475.7	350.3	261.8	60.3	81.7	842.5	819.2
Fully stocked	1,335.5	837.6	1,036.0	689.2	231.5	170.5	2,603.0	1,697.3
Overstocked	925.1	1,496.0	361.9	721.1	87.5	106.8	1,374.5	2,323.9
All classes	2,750.7	2,929.3	1,805.5	1,777.3	397.6	371.7	4,953.8	5,078.4

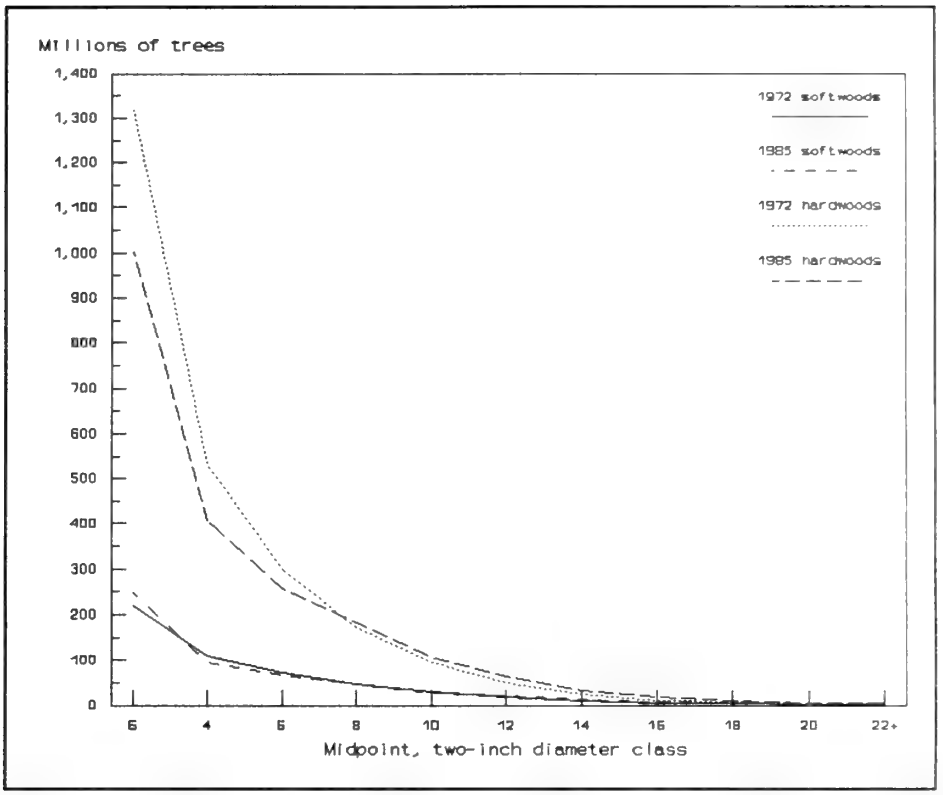

Figure 3.--Number of all-live trees on timberland by diameter class and species group, Southern New England, 1972 and 1985.

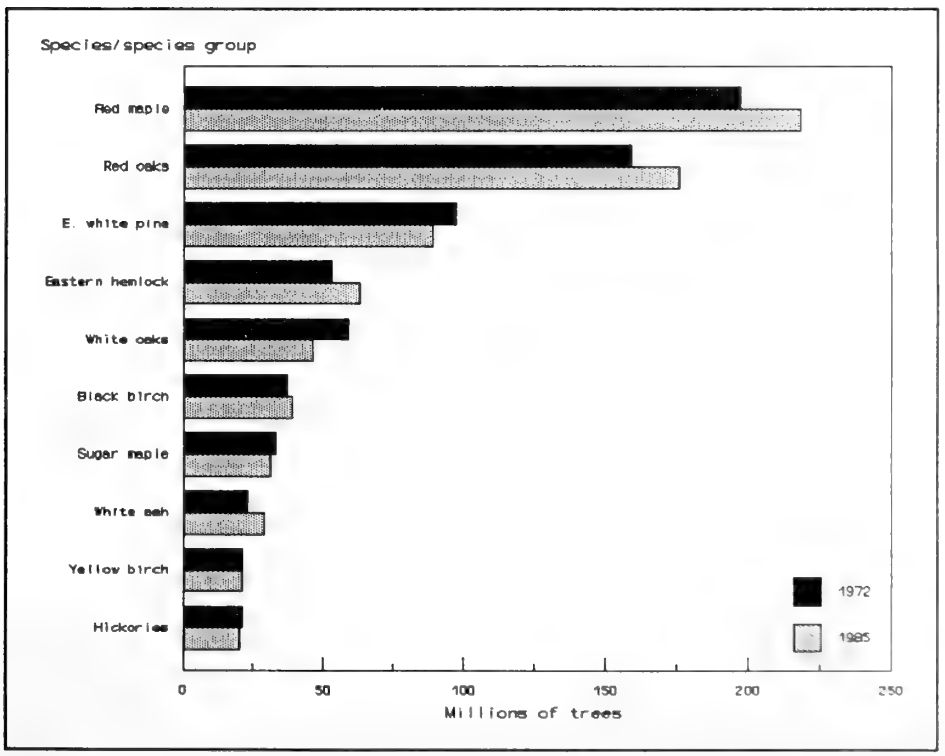

Figure 4.--Number of all-live trees on timberland by principal species or species group, Southern New England, 1972 and 1985.

Table 8. Number of live trees on timberland by species and diameter class, Southern New England, 1972

(In thousands of trees)

Species	Diameter class (inches at breast height)						
	1.0-2.9	3.0-4.9	5.0-6.9	7.0-8.9	9.0-10.9	11.0-12.9	13.0-14.9
Spruce/fir	7,608	6,088	3,771	2,841	1,922	611	570
Red pine	2,611	1,549	2,220	3,076	2,554	765	637
Pitch pine	19,989	6,718	9,171	5,112	2,843	1,174	579
White pine	114,367	50,557	32,025	23,768	15,940	9,816	6,076
Hemlock	63,063	35,387	23,722	10,893	7,710	5,904	1,978
Other softwoods	12,906	8,072	2,555	411	518	314	240
All softwoods	220,544	108,372	73,465	46,101	31,487	18,584	10,081
Red maple	406,317	182,826	102,339	53,462	23,271	10,165	3,871
Sugar maple	81,353	26,889	13,056	9,815	5,153	2,147	1,510
Yellow birch	33,813	13,559	10,461	5,781	2,455	1,056	622
Sweet birch	45,020	24,180	16,226	11,252	5,116	2,452	859
Paper birch	22,599	14,614	10,495	3,690	2,973	1,018	339
Hickory	37,122	13,370	7,734	6,594	3,232	1,910	723
Beech	32,201	10,719	4,939	3,799	2,571	1,504	824
White ash	40,725	13,357	9,353	5,326	3,808	2,727	1,217
Aspen	20,175	8,464	5,157	3,394	1,056	497	113
Black cherry	53,114	26,126	15,098	5,839	2,966	1,389	708
White oak	83,962	47,927	25,244	16,344	8,337	4,254	2,567
Northern red oak	51,992	30,299	26,930	21,649	17,844	9,455	4,928
Other red oaks	49,350	30,582	23,633	17,493	12,629	8,908	4,396
Elm	10,076	4,842	2,783	1,243	1,000	359	230
Other commercial hardwoods	34,251	17,232	11,610	3,925	2,040	1,164	781
Noncommercial hardwoods	315,953	65,519	13,762	2,294	1,292	234	4
All hardwoods	1,318,023	530,508	298,822	171,900	95,744	49,240	23,692
All species	1,538,568	638,880	372,288	218,001	127,231	67,824	33,773

Table 8. continued

(In thousands of trees)

Species	Diameter class (inches at breast height)					
	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9	29.0+	All classes
Spruce/fir	76	34	0	0	0	23,522
Red pine	176	29	0	0	0	13,617
Pitch pine	185	74	0	0	0	45,846
White pine	4,076	2,574	1,242	1,047	217	261,705
Hemlock	1,281	476	298	324	27	151,065
Other softwoods	0	0	0	0	0	25,017
All softwoods	5,793	3,188	1,540	1,372	244	520,772
Red maple	2,146	1,001	428	461	64	786,353
Sugar maple	737	418	175	428	53	141,735
Yellow birch	121	159	25	68	11	68,132
Sweet birch	381	195	84	43	0	105,809
Paper birch	79	38	27	0	0	55,873
Hickory	273	201	141	123	0	71,424
Beech	414	145	82	91	0	57,291
White ash	418	202	59	173	0	77,365
Aspen	139	57	0	0	0	39,051
Black cherry	121	99	0	19	0	105,481
White oak	594	770	255	230	17	190,503
Northern red oak	3,341	1,742	952	694	84	169,910
Other red oaks	2,013	1,156	476	327	32	150,996
Elm	44	0	0	21	0	20,600
Other commercial hardwoods	406	191	59	121	30	71,809
Noncommercial hardwoods	0	13	0	0	0	399,071
All hardwoods	11,227	6,390	2,763	2,802	291	2,511,403
All species	17,021	9,577	4,303	4,174	535	3,032,176

Table 9. Number of live trees on timberland by species and diameter class, Southern New England, 1985

(In thousands of trees)

Species	Diameter class (inches at breast height)						
	1.0-2.9	3.0-4.9	5.0-6.9	7.0-8.9	9.0-10.9	11.0-12.9	13.0-14.9
Spruce/fir	14,955	8,670	3,785	3,005	1,074	1,036	398
Red pine	0	1,553	322	317	865	839	387
Pitch pine	15,002	4,405	6,232	5,421	2,753	1,241	471
White pine	112,601	39,130	27,197	19,038	12,839	9,946	6,567
Hemlock	87,853	37,203	23,387	15,022	9,114	6,719	4,202
Other softwoods	17,137	4,035	5,684	3,764	1,225	635	51
All softwoods	247,547	94,996	66,607	46,568	27,871	20,415	12,076
Red maple	331,913	142,598	86,542	61,752	31,746	19,753	8,713
Sugar maple	99,547	29,507	10,972	8,630	3,998	2,841	1,721
Yellow birch	46,526	21,755	8,010	6,398	3,174	1,766	890
Sweet birch	46,674	31,646	16,659	11,444	5,314	3,299	1,399
Paper birch	9,340	7,660	7,189	5,543	2,476	962	465
Hickory	36,636	9,129	7,451	5,512	3,517	1,855	1,179
Beech	84,942	13,849	9,132	4,592	1,901	1,917	1,172
White ash	40,441	13,321	10,181	7,063	4,707	2,668	1,985
Aspen	11,074	5,961	2,424	3,350	1,911	1,225	448
Black cherry	15,373	11,213	7,875	4,855	3,732	1,782	862
White oak	29,925	30,768	19,963	11,071	7,137	3,871	2,075
Northern red oak	36,582	12,651	21,385	19,938	17,056	12,341	7,030
Other red oaks	43,155	27,905	30,922	24,495	15,589	8,417	4,980
Elm	12,387	0	1,218	748	370	254	47
Other commercial hardwoods	21,591	10,430	6,266	4,140	4,159	1,732	979
Noncommercial hardwoods	135,298	39,832	11,750	2,553	1,003	370	160
All hardwoods	1,001,403	408,225	257,939	182,085	107,791	65,054	34,106
All species	1,248,950	503,221	324,546	228,653	135,663	85,469	46,182

Table 9. continued

(In thousands of trees)

Species	Diameter class (inches at breast height)					
	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9	29.0+	All classes
Spruce/fir	147	27	27	0	0	33,124
Red pine	53	19	0	0	0	4,355
Pitch pine	228	85	49	0	0	35,886
White pine	4,888	3,351	2,196	2,729	357	240,841
Hemlock	2,139	1,220	464	534	78	187,934
Other softwoods	12	0	0	0	0	32,543
All softwoods	7,467	4,703	2,735	3,263	435	534,684
Red maple	4,102	2,530	785	1,399	245	692,080
Sugar maple	996	580	369	505	198	159,865
Yellow birch	397	117	63	56	23	89,175
Sweet birch	919	252	17	47	0	117,671
Paper birch	111	77	46	28	0	33,897
Hickory	235	224	91	0	8	65,836
Beech	638	427	194	191	0	118,955
White ash	1,208	587	216	233	44	82,654
Aspen	62	0	42	28	8	26,534
Black cherry	612	130	142	5	0	46,583
White oak	1,257	585	422	380	22	107,477
Northern red oak	4,744	2,281	821	1,085	137	136,051
Other red oaks	2,044	936	601	778	25	159,847
Elm	46	27	0	0	0	15,096
Other commercial hardwoods	1,015	358	212	210	14	51,105
Noncommercial hardwoods	54	0	0	43	0	191,064
All hardwoods	18,441	9,111	4,021	4,989	725	2,093,892
All species	25,908	13,814	6,757	8,252	1,160	2,628,576

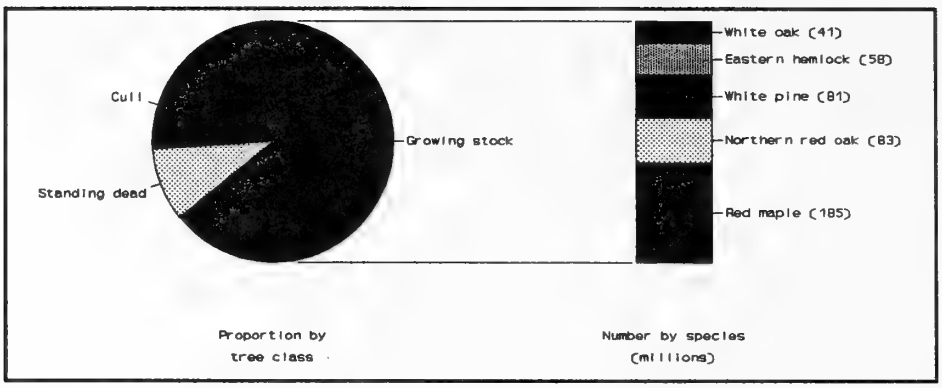

Figure 5.--Proportion of trees on timberland by tree class and number of growing-stock trees by species, Southern New England, 1985.

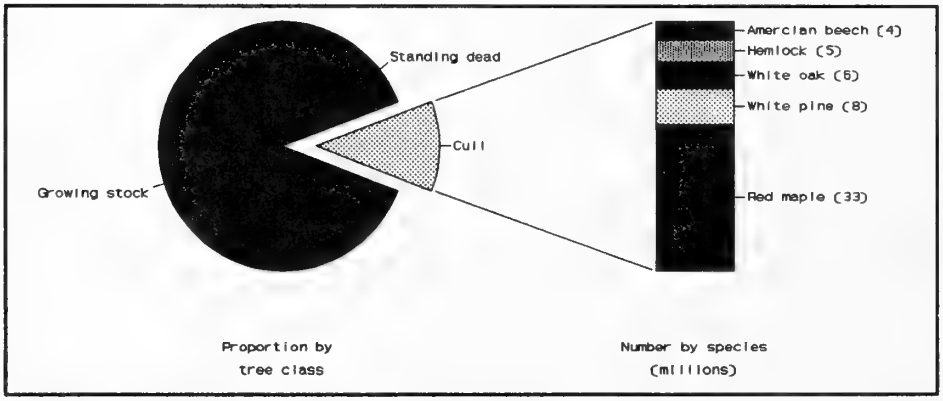

Figure 6.--Proportion of trees on timberland by tree class and number of cull trees by principal species, Southern New England, 1985.

Timber Volume, Biomass, and Value

Timber volume is reported in both cubic-foot units for growing-stock trees and board-foot units for sawtimber-size trees (that is, 9 inches d.b.h. for softwood and 11 inches d.b.h. for hardwood species). Growing-stock volume increased significantly (29 percent) to an estimated 7.9 billion cubic feet in 1985 (Tables 10-11). Increases were observed for all but the smallest diameter classes (Fig. 7). Volume increased by 58 percent in sawtimber-size hardwood trees, from 1,941.6 to 3,067.9 million cubic feet, the single largest change in any class of timber (Tables 12-13). This is now the predominant class of timber in growing-stock volume (Fig. 8).

Table 10. Net volume of growing-stock trees on timberland by species and diameter class, Southern New England, 1972

(In millions of cubic feet)

Species	Diameter class (inches at breast height)										All classes
	5.0-6.9	7.0-8.9	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9	29.0+	
Spruce/fir	9.5	19.0	21.6	11.2	14.8	2.7	1.4	.0	.0	.0	80.0
Red pine	7.4	20.7	29.8	14.6	15.6	6.4	1.3	.0	.0	.0	95.9
Pitch pine	13.2	20.1	20.9	14.8	10.6	4.8	2.2	.0	.0	.0	86.7
White pine	71.5	123.9	154.0	158.7	143.2	126.8	103.2	59.3	63.5	11.1	1,015.2
Hemlock	54.0	55.7	66.6	72.8	36.4	34.9	18.8	12.0	20.5	3.5	375.1
Other softwoods	4.1	2.0	4.9	3.6	5.0	.0	.0	.0	.0	.0	19.6
All softwoods	159.8	241.4	297.7	275.8	225.5	175.6	126.9	71.2	84.0	14.5	1,672.4
Red maple	220.5	264.7	201.2	123.2	66.6	46.5	13.7	13.0	12.8	5.0	967.3
Sugar maple	33.9	63.5	53.8	32.2	29.8	20.7	13.3	5.5	15.8	1.4	269.8
Yellow birch	23.5	26.6	15.8	10.6	12.9	.6	6.7	1.1	2.5	.0	100.3
Sweet birch	44.2	63.7	54.7	34.5	17.4	10.6	3.0	4.3	2.3	.0	234.7
Paper birch	29.4	22.8	34.4	16.4	8.4	2.8	.1	1.0	.0	.0	115.3
Hickory	22.1	42.9	34.4	28.7	15.3	8.3	5.2	7.9	7.7	.0	172.5
Beech	12.0	19.3	28.7	24.4	16.8	11.1	4.8	.0	3.6	.0	120.6
White ash	27.2	38.5	44.7	41.3	29.8	12.3	8.4	2.8	10.8	.0	215.9
Aspen	12.9	22.4	11.6	10.0	2.8	4.4	.7	.0	.0	.0	64.7
Black cherry	33.1	27.2	29.9	18.0	9.6	2.8	3.3	.0	1.1	.0	125.1
White oak	47.8	83.3	72.3	56.1	49.6	13.8	22.4	10.0	11.0	1.4	367.6
Northern red oak	67.6	124.3	175.2	145.1	108.4	100.2	66.2	45.6	40.9	8.9	882.4
Other red oaks	49.7	92.1	112.7	125.7	89.0	57.3	40.9	22.6	17.2	2.9	610.1
Elm	6.1	4.8	7.7	3.3	2.5	.7	.0	.0	1.9	.0	27.1
Other hardwoods	27.7	22.6	19.5	17.7	16.2	13.1	9.4	2.8	11.0	1.2	141.2
All hardwoods	657.8	918.8	896.5	687.2	475.2	305.4	198.0	116.6	138.6	20.7	4,414.7
All species	817.5	1,160.1	1,194.2	963.0	700.7	481.0	324.9	187.9	222.6	35.2	6,087.2

Table 11. Net volume of growing-stock trees on timberland by species and diameter class, Southern New England, 1985

(In millions of cubic feet)

Species	Diameter class (inches at breast height)										All classes
	5.0-6.9	7.0-8.9	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9	29.0+	
Spruce/fir	9.2	18.5	13.0	18.5	9.8	4.8	1.3	1.3	.0	.0	76.4
Red pine	.9	2.0	10.4	14.8	9.8	1.8	.8	.0	.0	.0	40.5
Pitch pine	10.4	22.8	20.9	16.9	8.3	6.2	2.4	2.0	.0	.0	90.0
White pine	61.2	113.0	140.4	168.6	159.9	162.1	142.2	120.8	199.8	39.0	1,306.8
Hemlock	54.3	81.2	87.7	105.0	86.1	64.8	47.1	24.4	39.8	9.9	600.2
Other softwoods	12.7	16.3	6.9	5.4	.8	.2	.0	.0	.0	.0	42.3
All softwoods	148.8	253.9	279.3	329.2	274.6	239.8	193.7	148.4	239.6	48.9	2,156.3
Red maple	189.5	332.4	296.9	288.8	170.6	103.1	83.0	31.0	66.2	11.8	1,573.2
Sugar maple	26.1	55.9	43.2	46.4	40.0	26.1	16.6	16.5	26.7	5.9	303.7
Yellow birch	16.5	32.7	26.4	23.6	13.5	7.4	3.2	2.5	3.4	3.6	132.9
Sweet birch	42.9	68.0	58.0	51.7	31.3	23.4	8.8	.9	2.1	.0	287.0
Paper birch	23.8	36.2	26.2	15.4	9.4	2.3	2.4	.0	.0	.0	115.7
Hickory	18.7	35.1	40.0	34.8	30.5	8.3	9.4	5.2	.0	.6	182.6
Beech	18.6	20.2	17.6	26.3	26.5	13.9	15.2	5.7	8.3	.0	152.2
White ash	29.3	45.2	51.9	45.7	50.3	34.5	23.5	9.6	14.2	.6	304.8
Aspen	6.4	19.6	22.6	19.9	10.4	1.9	.0	2.3	2.2	1.0	86.2
Black cherry	16.5	25.6	38.6	29.1	18.4	19.9	2.4	7.2	.5	.0	158.1
White oak	41.8	51.9	64.4	51.7	39.2	34.2	20.0	17.8	22.5	1.9	345.4
Northern red oak	55.8	122.1	177.3	203.1	159.9	143.2	88.5	41.6	68.0	21.3	1,080.9
Other red oaks	67.6	137.7	153.9	124.3	110.3	58.5	36.1	27.7	47.7	1.8	765.6
Elm	2.3	3.6	4.1	3.6	.4	1.4	1.0	.0	.0	.0	16.4
Other hardwoods	13.8	21.7	40.8	28.6	20.4	31.8	16.4	13.1	14.2	1.5	202.4
All hardwoods	569.5	1,007.7	1,062.0	992.9	731.1	509.9	326.5	181.2	276.1	50.1	5,707.0
All species	718.3	1,261.6	1,341.3	1,322.1	1,005.7	749.7	520.3	329.6	515.7	99.0	7,863.3

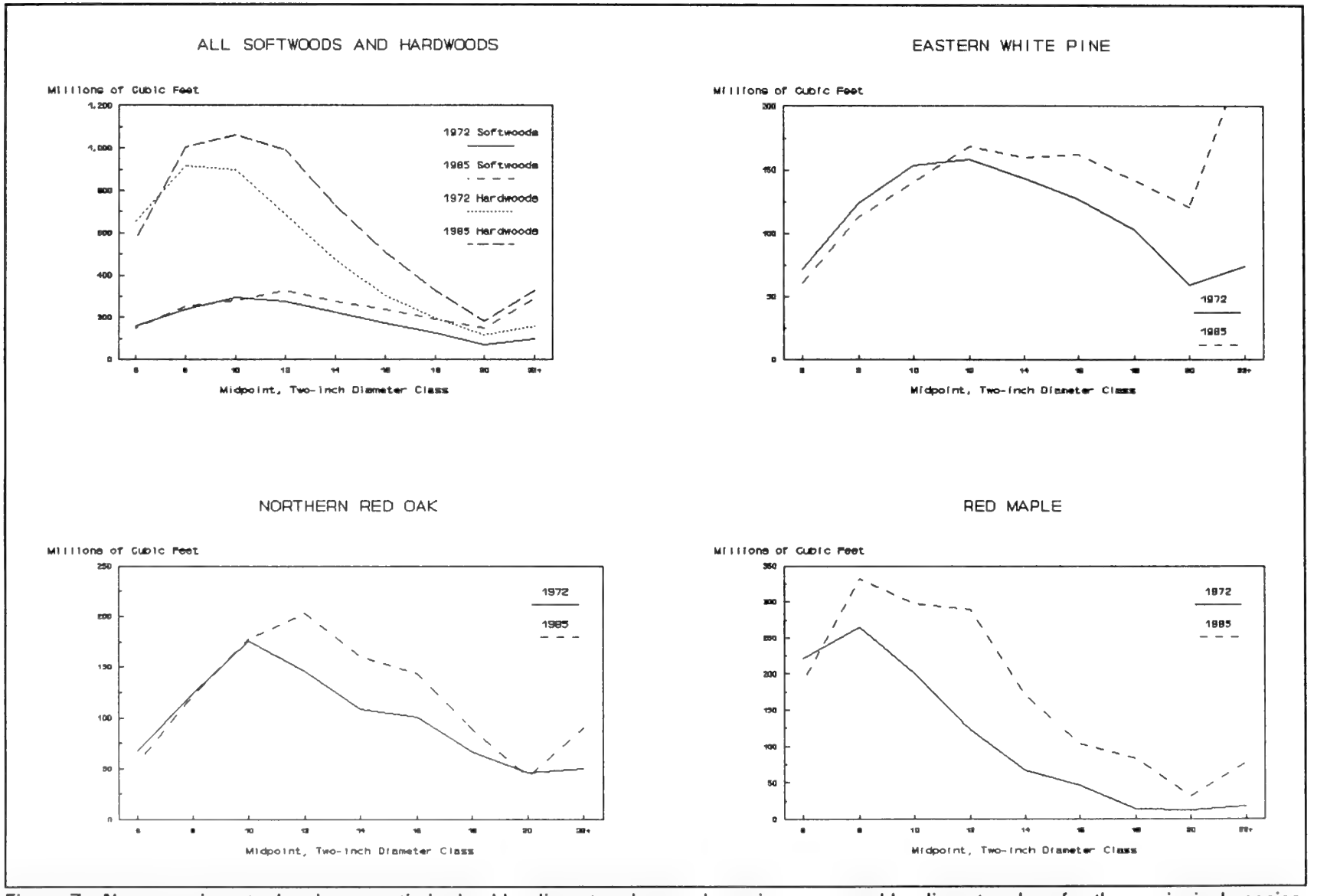

Figure 7.--New growing-stock volume on timberland by diameter class and species group and by diameter class for three principal species, Southern New England, 1972 and 1985.

Table 12. Net volume of all live trees by class of timber and species group, Southern New England, 1972

(In millions of cubic feet)

Class of timber	Species group		All groups
	Softwoods	Hardwoods	
Sawtimber trees:			
Sawlog portion	1,127.6	1,549.4	2,677.2
Upper stem portion	143.6	392.2	535.8
Total	1,271.2	1,941.6	3,212.9
Poletimber trees	401.2	2,473.1	2,874.3
Total growing stock	1,672.4	4,414.7	6,087.2
Rough trees:			
Sawtimber size	77.1	130.9	208.1
Poletimber size	29.6	155.4	185.0
Total	106.7	286.4	393.1
Rotten trees:			
Sawtimber size	8.0	51.1	59.1
Poletimber size	.6	39.2	39.8
Total	8.6	90.3	99.0
All live trees	1,787.7	4,791.4	6,579.3

Table 13. Net volume of all live trees by class of timber and species group, Southern New England, 1985

(In millions of cubic feet)

Class of timber	Species group		All groups
	Softwoods	Hardwoods	
Sawtimber trees:			
Sawlog portion	1,571.5	2,460.2	4,031.7
Upper stem portion	182.0	607.7	789.7
Total	1,753.5	3,067.9	4,821.4
Poletimber trees	402.7	2,639.2	3,041.9
Total growing stock	2,156.3	5,707.0	7,863.3
Rough trees:			
Sawtimber size	51.2	147.8	199.1
Poletimber size	34.3	180.3	214.5
Total	85.5	328.1	413.6
Rotten trees:			
Sawtimber size	4.3	57.1	61.3
Poletimber size	5.7	47.7	53.4
Total	10.0	104.8	114.7
All-live trees	2,251.7	6,139.9	8,391.6

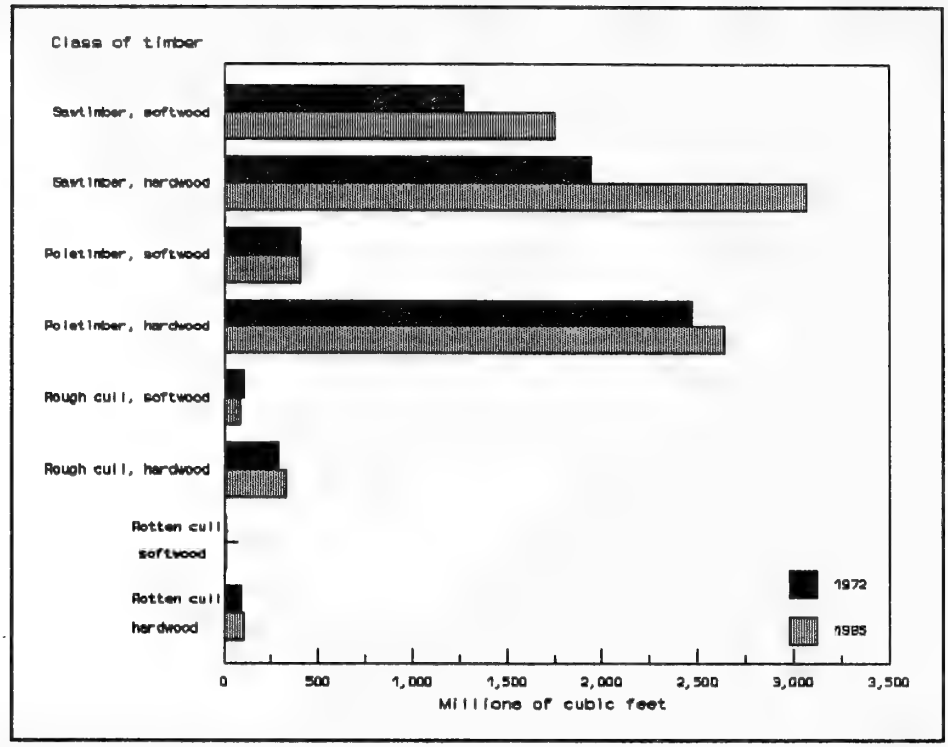

Figure 8.--Net growing-stock volume on timberland by class of timber and species group, Southern New England, 1972 and 1985.

Increases in growing-stock volume also were observed in every major species except white oaks, for which there was a nonsignificant decrease between surveys (Fig. 9). Removals (timber harvesting) and mortality for this species exceeded gross growth in Massachusetts and Rhode Island and in Southern New England as a whole. Volume increases were especially large for the three principal tree species of Southern New England. Red maple moved ahead of eastern white pine as the individual species with the largest growing-stock volume.

Volume increases by diameter class for the three principal species follow the general pattern for all softwoods and all hardwoods (Fig. 7). White pine volume declined in the smaller diameter class and grew, at an increasing rate in the larger diameters. For both red maple and northern red oak, the greatest increases were in the middle diameters. These examples are the result of the maturing of trees within each species. The pines probably were established earlier than the hardwoods. As a result, they are older and larger.

The estimated average annual net change in growing-stock volume between the last two surveys (1971-84) is little different than that estimated between the first and second surveys (1957-71) (Table 14). However, the components of the net change are quite different (Fig. 10). Over the first growth period, ingrowth and accretion on existing trees were comparable while accretion was nearly 3.5 times ingrowth over the second period. As the Southern New England forest matures, the recruitment of new trees is declining and the numbers of existing trees is stabilizing while the size of the existing population is increasing.

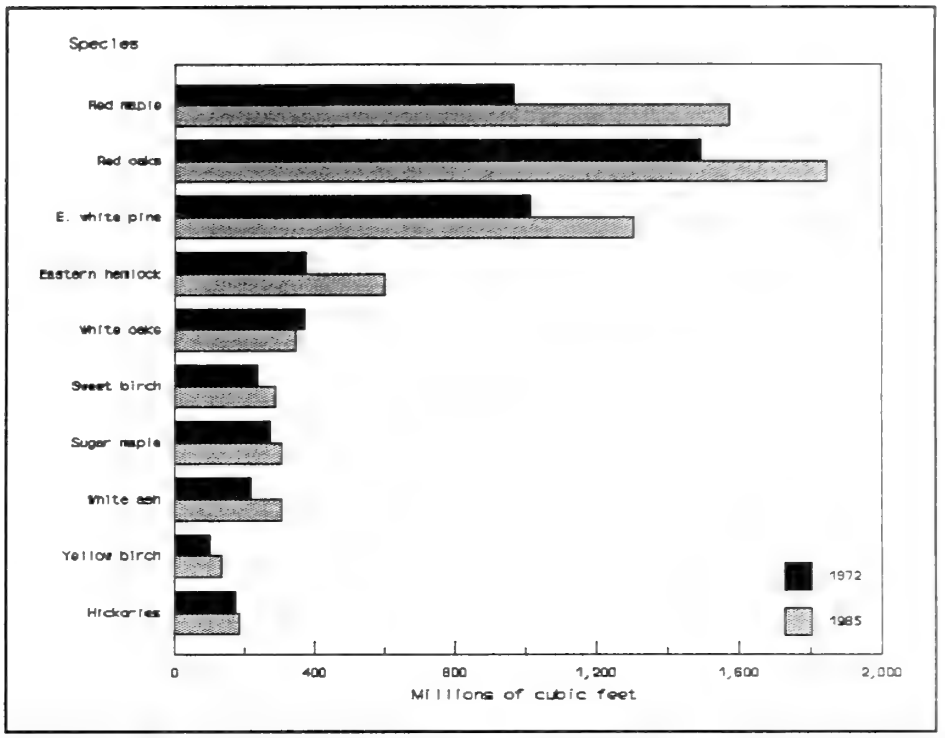

Figure 9.--Net growing-stock volume on timberland by principal species, Southern New England, 1972 and 1985.

Table 14. Average annual net change of growing-stock volume by components of growth and species group, Southern New England, 1957-71[1] and 1972-84[2]

(In thousands of cubic feet)

Components of growth	Softwoods		Hardwoods		All species	
	1957-71	1972-84	1957-71	1972-84	1957-71	1972-84
Ingrowth	34,486	14,416	83,436	43,285	117,922	57,701
Accretion	27,892	62,784	79,768	136,511	107,660	199,295
Gross growth	62,378	77,200	163,204	179,795	225,582	256,996
Mortality	-5,568	-6,358	-22,212	-29,177	-27,780	-35,535
Cull increment	-1,410	-2,220	-12,492	-7,593	-13,902	-9,793
Net growth	55,400	68,622	128,500	143,025	183,900	211,668
Removals	-11,444	-30,479	-31,076	-41,134	-42,520	-71,613
Net change	43,956	38,143	97,424	101,891	141,380	140,055

[1]Data from Kingsley (1974).

[2]Data from Dickson and McAfee (1988a, 1988b, 1988c).

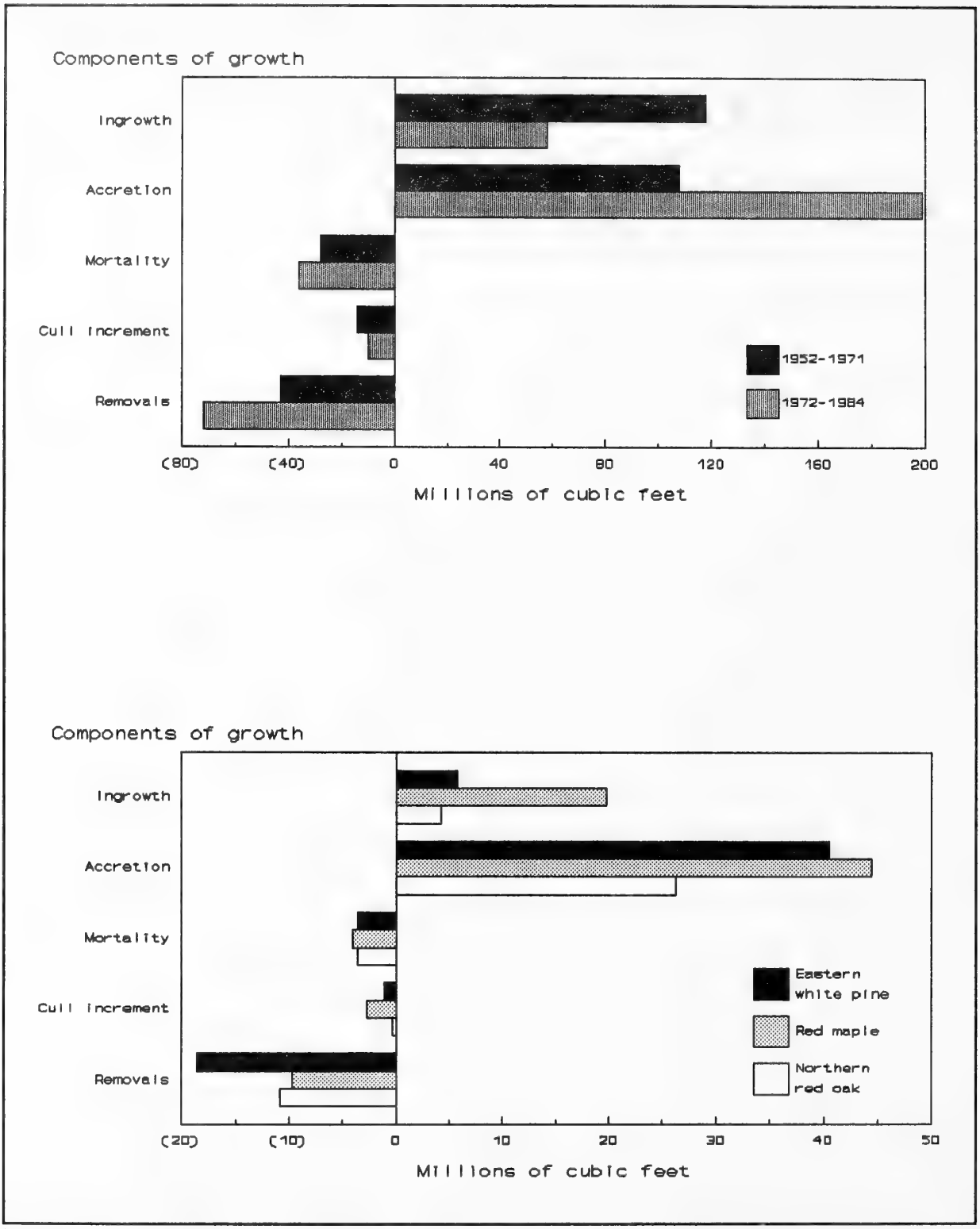

Figure 10.--Average annual net change of growing-stock volume on timberland by components of growth and growth period for all species combined and for three principal species, Southern New England, 1952-71 and 1971-84.

Loss of volume to mortality increased from the first to second growth period (Table 14), a probable consequence of natural factors (for example, competition, insects, and disease). The loss of growing-stock volume to cull increment has declined slightly due to a reduction of cull in hardwood species. Removals increased by an average of nearly 30 million cubic feet per year from the first to second growth period (Fig. 10). While the ratio of growth to removals has declined from the first growth period, it nevertheless remains 3 to 1 over the most recent growth period.

The change in growing-stock volume since the 1972 survey differs by species (Fig. 10). For the three principal species, based on growing-stock volume, accretion on standing volume was the major growth component over the period. Red maple accretion as a percentage of 1972 standing volume was the largest at 4.6 percent, but white pine and northern red oak were only slightly lower at 4 and 3.7 percent, respectively. While sampling errors were not calculated, it is possible there were no significant differences in accretion as a percentage of standing volume among the species.

Ingrowth was a relatively minor growth component for two of the three species. Ingrowth of red maple from seedling/sapling to poletimber-size trees was 31 percent of total gross growth but only about 13 percent for white pine and northern red oak. Mortality over the growth period was similar among the species.

As a percentage of standing volume, removals were greatest in absolute and relative terms for white pine. For each species, growth exceeded removals by 2.5 (white pine) to 6.6 (red maple) fold. Growth of northern red oak was 2.8 times removals.

Board-foot volume increased by a significant 50 percent to an estimated 20 billion board feet between 1972 and 1985 (Tables 15-16). The increase was observed across all diameter classes but was particularly large for hardwood species, as a large number of trees grew into the smallest diameter class for classification as sawtimber (11.0 to 12.9 inches) (Fig. 11). Board-foot volume increased for every principal tree species in Southern New England (Fig. 12) and for most lesser common species except paper birch and elm species (Tables 15-16). Red maple was predominant in board-foot volume among hardwood species, replacing northern red oak.

Board-foot volume has increased in every standard-lumber log grade for both softwood and hardwood species (Fig. 13). Rates of volume increase are greatest in the lesser grades (Tables 17-18). This was somewhat expected as size criteria, that is, minimum diameter and sawlog length, are primary considerations in grading and the majority of sawtimber-size trees and sawtimber volume are in the smaller diameter trees (Tables 9 and 16).

Wood has been increasingly used for fuelwood in recent years, not only for home use but also for industrial and commercial use and for the generation (or cogeneration) of electricity. Traditionally, fuelwood was sold by the cord (128 cubic feet). On commercial scales, wood for fuel is considered biomass and sold by weight, generally tons of green weight. In Southern New England, it is estimated that there are slightly less than 500 million tons green weight of tree biomass (Table 19). Nearly 60 percent of this resource is in growing-stock

Table 15. Net volume of sawtimber trees on timberland by species and diameter class, Southern New England, 1972

(In millions of board feet)

Species	Diameter class (inches at breast height)								All classes
	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9	29.0+	
Spruce/fir	76.2	45.0	65.7	12.9	6.0	.0	.0	.0	205.8
Red pine	110.7	64.0	69.3	32.2	5.8	.0	.0	.0	282.1
Pitch pine	65.1	53.9	46.5	21.7	8.7	.0	.0	.0	195.9
White pine	473.2	635.0	621.4	576.7	465.2	271.1	303.6	56.0	3,401.9
Hemlock	208.5	275.1	151.3	156.2	82.8	50.4	101.5	18.8	1,044.6
Other softwoods	15.9	12.6	19.8	.0	.0	.0	.0	.0	48.3
All softwoods	949.6	1,085.6	973.8	799.7	568.4	321.5	405.2	74.7	5,178.6
Red maple	-	464.7	263.7	201.1	58.0	60.4	56.9	25.8	1,130.6
Sugar maple	-	127.5	125.0	92.8	57.5	22.8	71.5	6.7	503.8
Yellow birch	-	45.6	55.0	2.2	22.2	5.3	10.3	.0	140.6
Sweet birch	-	129.9	72.2	47.6	13.7	22.1	10.6	.0	296.0
Paper birch	-	68.7	38.7	13.6	.5	2.4	.0	.0	123.9
Hickory	-	113.4	61.8	38.0	23.2	37.5	37.3	.0	311.1
Beech	-	106.4	74.3	49.8	25.9	.0	18.0	.0	274.4
White ash	-	173.7	122.3	48.8	38.1	11.4	48.3	.0	442.5
Aspen	-	42.7	12.8	19.0	3.1	.0	.0	.0	77.6
Black cherry	-	73.9	44.7	13.4	13.9	.0	4.0	.0	149.9
White oak	-	217.8	207.9	62.4	105.5	43.3	43.8	6.2	686.8
Northern red oak	-	560.9	455.7	444.8	306.2	209.1	193.1	40.9	2,210.6
Other red oaks	-	483.4	363.5	248.3	184.6	104.1	84.0	13.4	1,481.2
Elm	-	11.8	8.9	2.6	.0	.0	13.0	.0	36.3
Other hardwoods	-	72.2	67.4	55.5	43.9	14.1	58.0	7.1	318.2
All hardwoods	-	2,692.4	1,973.9	1,339.7	896.2	532.5	648.8	100.0	8,183.6
All species	949.6	3,778.1	2,947.8	2,139.4	1,464.6	853.9	1,053.9	174.7	13,362.1

Table 16. Net volume of sawtimber trees on timberland by species and diameter class, Southern New England, 1985

(In millions of board feet)

Species	Diameter class (inches at breast height)								All classes
	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9	29.0+	
Spruce/fir	43.1	72.5	42.8	22.5	6.5	5.5	.0	.0	192.9
Red pine	36.0	60.4	43.5	8.5	3.0	.0	.0	.0	151.3
Pitch pine	61.3	57.3	30.5	23.6	9.9	9.0	.0	.0	191.7
White pine	462.7	656.9	682.2	719.8	667.9	563.1	927.0	192.1	4,871.8
Hemlock	279.5	390.2	349.4	273.9	216.8	110.9	195.3	50.2	1,866.2
Other softwoods	18.2	17.8	2.5	.9	.0	.0	.0	.0	39.4
All softwoods	900.7	1,255.2	1,150.9	1,049.2	904.0	688.6	1,122.3	242.3	7,313.2
Red maple	-	1,074.1	682.6	442.6	372.4	140.9	289.6	59.8	3,062.1
Sugar maple	-	170.5	162.6	105.3	67.2	66.2	126.9	26.6	725.4
Yellow birch	-	88.9	54.9	28.7	15.4	9.7	17.2	14.3	228.9
Sweet birch	-	204.1	130.3	102.4	40.3	4.4	8.6	.0	490.3
Paper birch	-	62.0	36.9	10.7	10.5	.0	.0	.0	120.0
Hickory	-	139.6	135.2	39.7	47.1	27.8	.0	4.4	393.7
Beech	-	98.5	107.6	61.2	72.2	28.8	45.1	.0	413.3
White ash	-	178.1	209.3	139.6	100.3	40.5	60.8	4.1	732.7
Aspen	-	80.5	43.5	7.2	.0	11.8	11.7	5.8	160.5
Black cherry	-	107.3	72.6	87.7	11.3	30.8	3.2	.0	312.8
White oak	-	200.1	168.5	151.6	97.2	88.5	107.0	5.1	818.0
Northern red oak	-	755.5	655.0	621.9	393.0	189.1	333.2	105.5	3,053.2
Other red oaks	-	450.1	447.6	254.9	165.3	133.4	234.2	10.1	1,695.8
Elm	-	13.0	1.1	7.3	4.9	.0	.0	.0	26.3
Other hardwoods	-	106.3	81.7	138.7	80.8	67.6	69.5	9.6	554.2
All hardwoods	-	3,728.7	2,989.1	2,199.5	1,478.0	839.5	1,307.0	245.4	12,787.1
All species	900.7	4,983.9	4,140.0	3,248.6	2,382.0	1,528.1	2,429.3	487.7	20,100.4

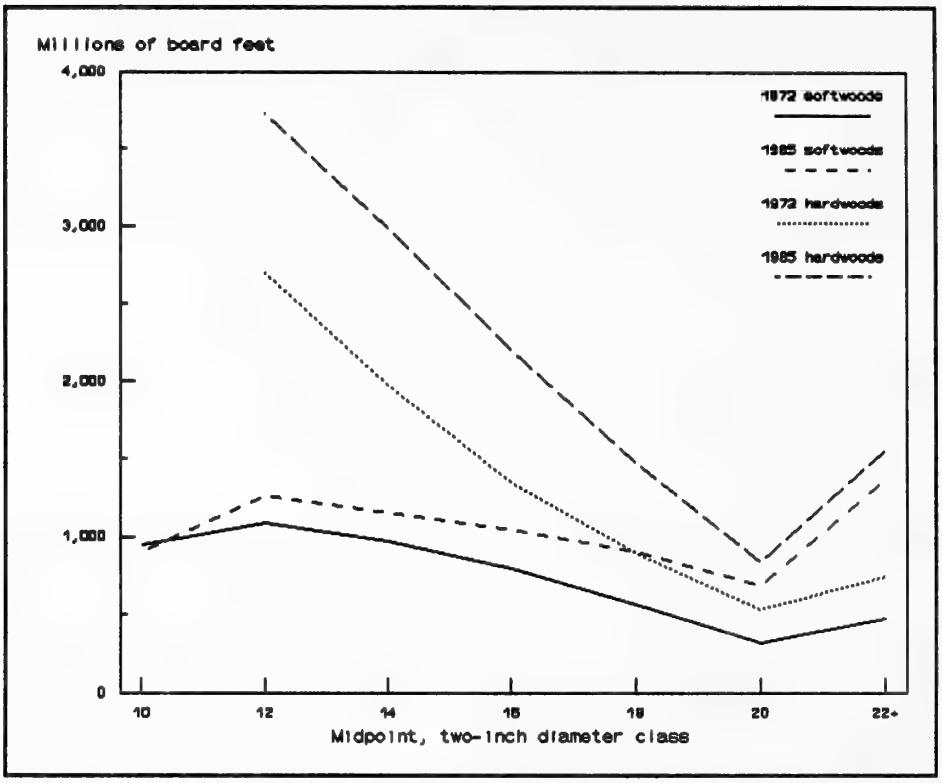

Figure 11.--Net board-foot volume on timberland by diameter class and species group, Southern New England, 1972 and 1985.

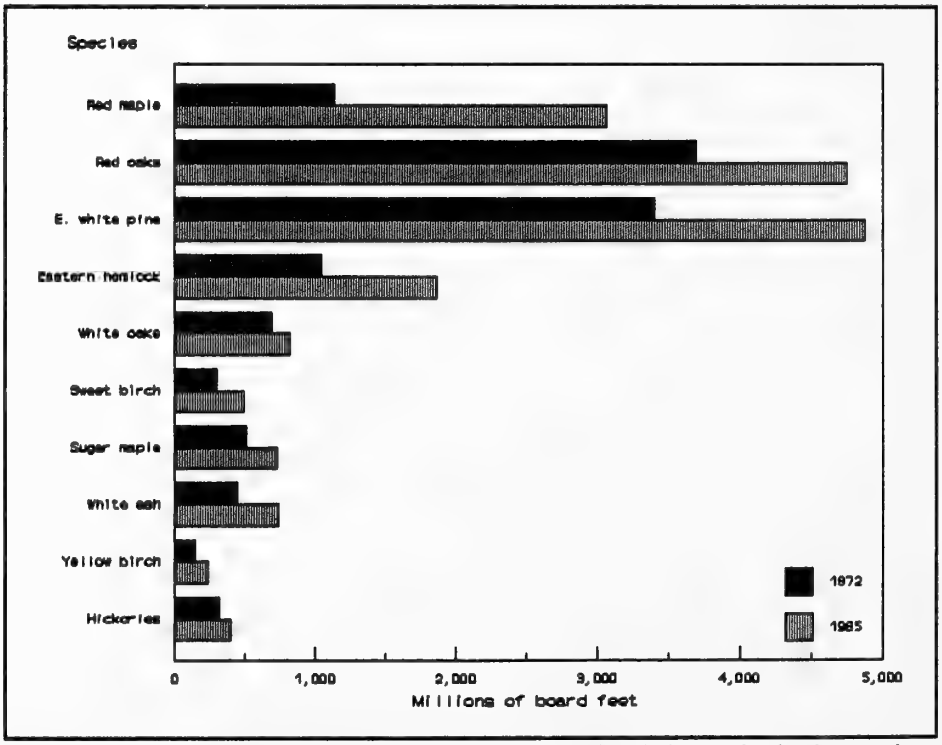

Figure 12.--Net board-foot volume on timberland by principal species, Southern New England, 1972 and 1985.

Table 17. Net volume of sawtimber trees on timberland by species, size class, and standard-lumber log grade, Southern New England, 1972

(In millions of board feet)

Species	All size classes					>15" Diameter at breast height				
	Grade 1	Grade 2	Grade 3	Grade 4	All grades	Grade 1	Grade 2	Grade 3	Grade 4	All grades
Spruce/fir	205.8	-	-	-	205.8	18.9	-	-	-	18.9
Red pine	133.7	17.7	130.8	-	282.1	20.1	2.7	15.2	-	38.0
Pitch pine	14.8	21.2	159.8	-	195.9	.0	2.6	27.7	-	30.4
White pine	117.4	477.1	1,708.4	1,099.0	3,401.9	73.6	208.5	752.2	638.1	1,672.5
Hemlock	1,044.6	-	-	-	1,044.6	409.7	-	-	-	409.7
Other softwoods	48.3	.0	.0	-	48.3	.0	.0	.0	-	.0
All softwoods	1,564.6	516.0	1,999.0	1,099.0	5,178.6	522.3	213.8	795.1	638.1	2,169.5
Red maple	27.6	129.8	744.1	229.1	1,130.6	24.9	59.4	247.9	70.1	402.3
Sugar maple	28.2	77.9	297.8	99.8	503.8	22.6	44.0	127.3	57.4	251.3
Yellow birch	4.9	22.4	77.4	36.0	140.6	3.8	3.0	24.7	8.4	40.0
Sweet birch	22.8	42.5	188.2	42.4	296.0	17.5	13.0	54.7	8.7	93.9
Paper birch	7.4	37.4	66.3	12.8	123.9	.0	6.1	8.9	1.5	16.5
Hickory	30.9	57.6	148.5	74.0	311.1	26.0	32.1	48.0	30.0	136.0
Beech	3.2	11.0	224.0	36.2	274.4	1.0	.4	80.7	11.5	93.6
White ash	75.8	118.1	190.8	57.8	442.5	38.5	41.7	49.4	17.0	146.5
Aspen	8.1	14.4	45.9	9.1	77.6	4.3	8.7	7.5	1.6	22.1
Black cherry	.0	23.2	104.3	22.4	149.9	.0	7.1	19.7	4.5	31.3
White oak	44.4	127.1	349.7	165.6	686.8	37.9	62.8	103.0	57.6	261.2
Northern red oak	340.3	548.3	1,095.8	226.2	2,210.6	284.9	338.0	469.7	101.4	1,194.0
Other red oaks	111.1	246.8	718.5	404.8	1,481.2	93.8	150.6	251.9	137.9	634.3
Elm	.0	8.7	23.1	4.5	36.3	.0	8.7	5.7	1.2	15.6
Other hardwoods	51.6	92.5	115.9	58.3	318.2	43.3	55.5	60.9	18.9	178.6
All hardwoods	756.3	1,557.8	4,390.3	1,479.2	8,183.6	598.3	831.1	1,560.0	527.7	3,517.2
Percent of hardwood in each grade	9	19	54	18	100	17	24	44	15	100

Table 18. Net volume of sawtimber trees on timberland by species, size class, and standard-lumber log grade, Southern New England, 1985[a]

(In millions of board feet[b])

Species	All size classes					>15" Diameter at breast height				
	Grade 1	Grade 2	Grade 3	Grade 4[c]	All grades	Grade 1	Grade 2	Grade 3	Grade 4	All grades
Spruce/fir[d]	192.9	-	-	-	192.9	39.6	-	-	-	39.6
Red pine	0.0	7.1	144.3	-	151.4	0.0	0.0	15.0	-	15.0
Pitch pine	0.0	32.4	159.3	9.1	200.8	0.0	10.9	29.8	-	40.7
White pine	70.8	769.7	2,484.2	1,547.0	4,871.7	66.0	485.3	1,565.2	1,068.9	3,185.4
Hemlock[d]	1,866.2	-	-	-	1,866.2	444.6	-	-	-	444.6
Other softwoods	36.3	0.0	3.0	-	39.3	4.5	0.0	0.0	0.0	4.5
All softwoods	2,166.2	809.2	2,790.8	1,556.1	7,322.3	554.7	496.2	1,610.0	1,068.9	3,729.8
Red maple	45.4	272.1	1,799.6	945.0	3,062.1	45.4	157.5	695.5	382.6	1,281.0
Sugar maple	81.8	78.5	331.9	233.2	725.4	78.3	45.6	140.9	140.7	405.5
Yellow birch	1.6	18.4	156.0	51.9	227.9	1.2	9.0	79.5	22.4	112.1
Sweet birch	17.4	41.9	279.9	151.1	490.3	14.1	6.1	63.3	66.7	150.2
Paper birch	0.0	27.1	67.5	25.4	120.0	0.0	0.0	15.5	2.1	17.6
Hickory	4.7	54.3	237.0	97.7	393.7	2.2	8.9	96.1	11.5	118.7
Beech	24.5	15.9	250.9	122.0	413.3	22.9	9.4	142.4	46.8	221.5
White ash	15.7	219.5	358.1	139.4	732.7	13.0	125.9	122.7	42.2	303.8
Aspen	8.4	39.9	78.4	33.9	160.6	8.4	22.4	24.3	6.0	61.1
Black cherry	25.2	52.6	149.3	85.7	312.8	25.2	28.2	43.9	12.5	109.8
White oak	100.5	147.8	344.5	225.2	818.0	88.0	110.0	187.3	121.4	506.7
Northern red oak	326.7	825.7	1,463.5	437.3	3,053.2	299.3	512.0	545.2	196.6	1,553.1
Other red oaks	109.8	335.1	751.4	499.4	1,695.7	105.6	228.2	103.3	182.3	619.4
Elm	0.0	7.9	14.0	4.4	26.3	0.0	6.0	7.8	1.5	15.3
Other hardwoods	107.6	91.5	247.7	107.4	554.2	100.3	69.3	134.9	55.0	359.5
All hardwoods	869.3	2,228.2	6,529.7	3,159.0	12,786.2	803.9	1,338.5	2,402.6	1,290.3	5,835.3
Percent of hardwood in each grade	7	17	51	25	100	14	23	41	22	100

[a]This table is created by summing data from Dickson and McAfee (1988a, 1988b, 1988c), Tables 44.

[b]International 1/4-inch rule.

[c]Grade 4 applies only to white pine. For hardwoods, the volumes in this column are for construction logs.

[d]These species are not divided into standard-lumber log grades.

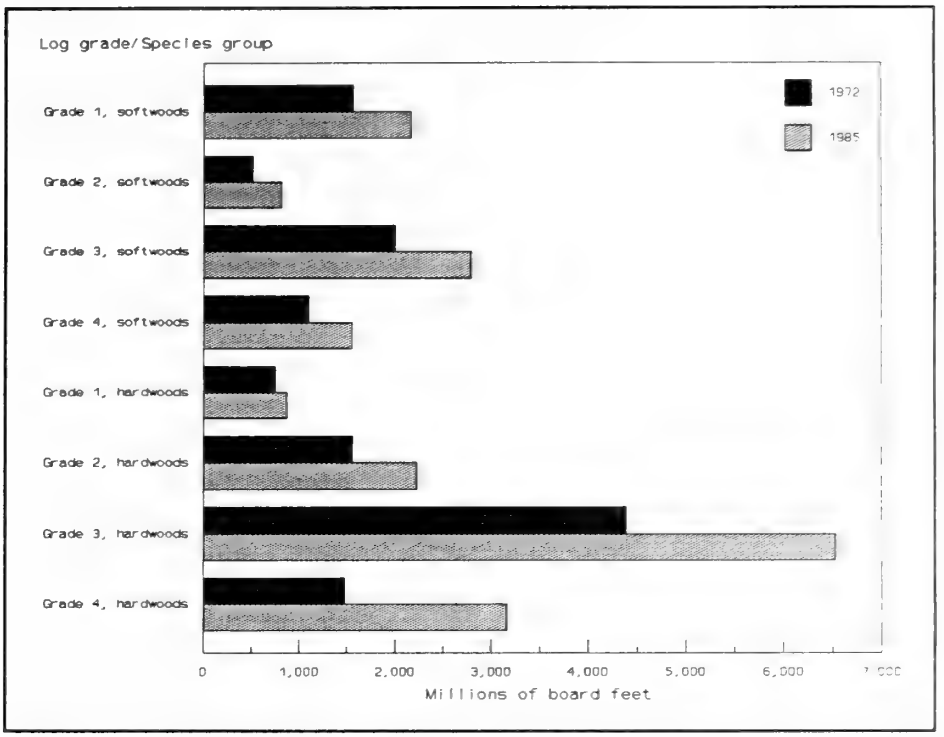

Figure 13.--Net board-foot volume on timberland by standard-lumber log grade and species group, Southern New England, 1972 and 1985.

volume; the remaining portion is in the tops of growing-stock trees, cull trees, salvable dead, stumps, and sapling-size trees. There also is a sizable resource in trees or parts of trees not typically considered as a commercial product.

The distribution of tree biomass by species is the same as the distribution of tree numbers or volume by species (Fig. 14). As expected, a large portion of the biomass resource is in red maple, a species of little commercial value as lumber or fiber. While we have no remeasurement of biomass, there is every reason to believe that it is accreting at a rate similar to or exceeding that of growing-stock volume.

Timber is the primary commodity product derived from New England's forests. Nevel and Wharton (1988) provide a discussion of the timber industries of Southern New England. Other detailed information on removals and commerial use are available from state forest survey reports. Volume growth as reported earlier has been converted to compound rates of value change for New England's timber stands (Arner et al. 1990) and trees (Gansner et al. 1990). While these reports are for all six New England States, the findings are applicable to Southern New England alone. On average, between the last two forest surveys, forest stands have appreciated by 4.2 percent (Arner et al. 1990). However, there is considerable variability in this estimate. Estimates of value change estimates for individual stands ranged from -26 to 43 percent.

Table 19. Net green weight[1] of all trees on timberland by class of timber and species group, Southern New England, 1985

(In thousands of tons)

Class of timber	Softwoods	Hardwoods	All groups
Sawtimber trees:			
Sawlog portion	55,470	92,861	148,331
Upper stem	6,110	22,585	28,695
Total	61,580	115,446	177,026
Poletimber trees	11,292	95,879	107,171
All growing stock	72,872	211,325	284,197
Rough cull trees[2]	3,418	19,389	22,807
Rotten cull trees[2]	646	6,644	7,290
Salvable dead trees[3]	3,663	9,752	13,415
Saplings[3]	6,036	32,110	38,146
Stumps[4]	1,112	5,711	6,823
Tops: Growing stock	24,000	77,496	101,496
Rough and rotten	1,417	9,614	11,031
All nongrowing stock	40,292	160,716	201,008
All classes	113,164	372,041	485,205

[1]Includes bark and sound cull; excludes rotten cull

[2]Bole portion of trees 5.0 inches d.b.h. and larger

[3]Includes entire tree aboveground

[4]Of all salvable dead and all live trees 5.0 inches d.b.h. and larger

The principal determinants of value change were species composition, tree size, and stocking. Stands with eastern white pine, white ash, or red oak appreciated more in value than stands dominated by other species. Stands with smaller initial average diameter appreciated more in value as they tended to grow into the more valuable sawtimber-size class. Finally, more lightly stocked stands grow faster than more heavily stocked stands and , therefore, appreciate more in value.

The average annual rate of value change for all trees averaged 3.2 percent between the last two forest surveys (Gansner et al. 1990). As reflected in determinants of timber stands appreciation, the species with the highest rates of value change were white ash (5.8 percent), northern red oak (4.8), and eastern white pine (3.7). Value increased most rapidly for trees that grew into the sawtimber-size class between the surveys. Value appreciation was inversely correlated to basal-area stocking, which is a primary determinant of volume growth.

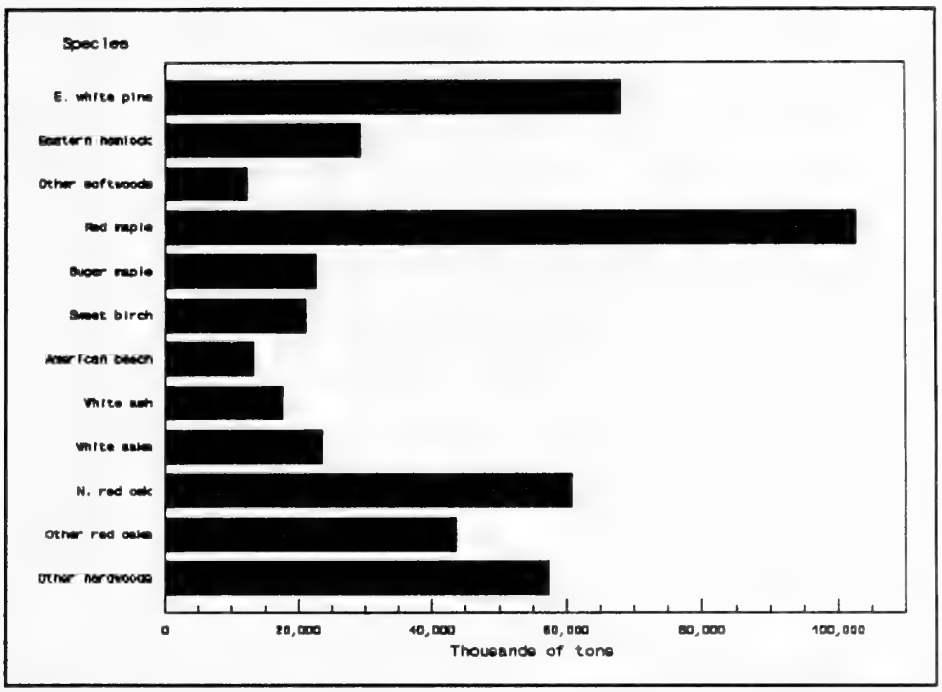

Figure 14.--Net all-live tree green weight on timberland by principal species, Southern New England, 1985.

Forest Wildlife Habitat

DeGraaf and Rudis (1986) listed 25 amphibians, 20 reptiles, 163 birds, and 59 mammals that are found in forested habitats. Most of these species occur in one or more states in Southern New England. A habitat evaluation for each wildlife species would be impractical. Alternatively, FIA collected field data that quantify the composition, vertical and horizontal structure, and selected special habitat features of Southern New England forests. While these data cannot evaluate habitat quality for individual species as precisely as a single-species habitat survey, they do provide information with which to evaluate habitat for a large number of wildlife species (Brooks and Birch 1988; Brooks 1989, 1990).

The woody-stemmed forest understory, composed of tree seedlings and saplings and shrubs, provides potential cover and browse and mast forage for wildlife. More than 70 species were recorded in the last Southern New England forest survey (Table 20). The average density of the woody understory is more than 12,000 individuals per acre of forest. Curiously, the highest density was estimated to occur in poletimber-size stands (15,692/acre) and the lowest density in sawtimber-size stands (10,063/acre). Sapling/seedling-size stands were intermediate in density (12,034/acre).

Hardwood tree seedlings and saplings had the greatest number of species but unidentified hardwood shrubs were the most common entry after blueberry species. On the basis of relative density (estimated numbers of individuals) and relative frequency (number of plots where recorded), blueberry species are the most "important" understory woody-stemmed plant species in Southern New

Table 20. Number of seedlings, saplings, and shrubs on timberland by species and stand-size class, Southern New England, 1985

(In millions of stems)

Species	Stand-size class				All classes	Percent saplings
	Sawtimber	Poletimber	Sapling/ seedling	Nonstocked		
Eastern redcedar	6	39	2	0	47	44
Spruce species	34	0	8	0	42	33
Pitch pine	21	8	3	0	32	69
Eastern white pine	496	151	32	0	679	22
Eastern hemlock	226	12	0	0	238	30
Other softwoods	42	30	0	0	71	8
All softwoods	826	239	45	0	1,110	
Red maple	1,481	1,045	172	0	2,698	14
Sugar maple	822	402	115	6	1,346	11
Other maple species	389	180	12	0	581	3
Serviceberry	98	87	3	0	188	5
Yellow birch	254	81	9	0	344	17
Sweet birch	304	191	98	0	593	14
Paper birch	146	34	0	0	180	7
Gray birch	137	85	6	0	229	25
American hornbeam	189	133	2	0	324	6
Hickory species	147	125	16	0	288	10
American chestnut	132	81	24	0	237	3
Flowering dogwood	109	54	2	0	165	3
Hawthorn	26	12	0	0	38	0
American beech	497	161	0	0	659	15
White ash	662	142	81	0	885	5
Other ash species	45	50	0	0	95	2
Yellow-poplar	4	3	0	0	8	25
Apple species	6	0	17	0	23	0
Blackgum	88	60	3	0	151	18
Eastern hophornbeam	256	74	73	0	403	2
Aspen species	74	13	66	0	154	12
Pin cherry	78	18	54	0	149	7
Black cherry	854	310	127	0	1,291	2
Chokecherry	128	155	0	0	282	0
Other cherries	0	5	15	0	20	75
White oak	352	388	15	0	755	10
Scarlet oak	36	79	13	0	127	20
Bear oak	14	32	103	0	148	2
Chestnut oak	42	55	3	0	99	2
Northern red oak	563	496	31	0	1,089	4
Black oak	394	375	95	0	864	5
Willow species	59	28	54	0	142	0
Sassafras	111	327	18	0	455	2
American basswood	24	3	0	0	27	0
American elm	32	20	9	0	61	21
Other hardwoods	147	8	0	0	156	3
All hardwoods	8,701	5,313	1,236	6	15,257	
All trees	9,527	5,552	1,281	6	16,367	

Table 20. continued

(In millions of stems)

Species	Stand-size class				All classes
	Sawtimber	Poletimber	Sapling/ seedling	Nonstocked	
Common juniper	100	11	0	0	111
Sheep laurel	284	1,035	14	0	1,333
Mountain laurel	1,570	884	18	0	2,472
Other evergreen shrubs	10	77	1	0	88
All evergreen shrubs	1,963	2,008	33	0	4,004
Alder	699	543	261	0	1,504
Azalea	186	383	0	0	570
Barberry	883	254 213	0	1,350	
Sweetfern	19	21	5	0	44
Silky dogwood	4	18	24	0	46
Other dogwood species	277	240	176	0	693
American hazelnut	339	49	0	0	388
Beaked hazelnut	79	3	0	0	82
Huckleberry species	321	467	279	0	1,067
Witch-hazel	698	438	38	0	1,174
Winterberry holly	18	32	0	0	50
Common spicebush	743	337	50	0	1,130
Bush honeysuckle	165	86	189	0	440
Buckthorn	224	258	2	0	484
Sumac species	20	34	56	2	112
Rose species	152	112	62	0	326
Rubus species	1,135	458	790	15	2,399
American elderberry	4	128	19	0	150
Spirea species	820	1,089	211	0	2,121
Blueberry species	4,949	10,190	638	0	15,778
Maple-leaved viburnum	1,895	519	0	0	2,414
Hobblebush viburnum	103	201	24	0	328
Wild raisin, witherod	52	70	0	0	122
Arrowwood	534	452	82	0	1,067
Other viburnum species	404	266	8	0	678
Other deciduous shrubs	3,285	2,891	493	0	6,669
All deciduous shrubs	18,009	19,540	3,620	17	41,186
All species	29,499	27,100	4,935	23	61,558

England forests (Fig. 15). This ranking is based on the relative density of the genus, accounting for more than 24 percent of all recorded plants (Table 21). Red maple is a distant second accounting for just over 5 percent of recorded plants. Red maple also is the most widely distributed understory species, occurring on more than 87 percent of the survey plots. Northern red oak is the second most widely distributed species. Of all species, blueberry is the most widely distributed shrub.

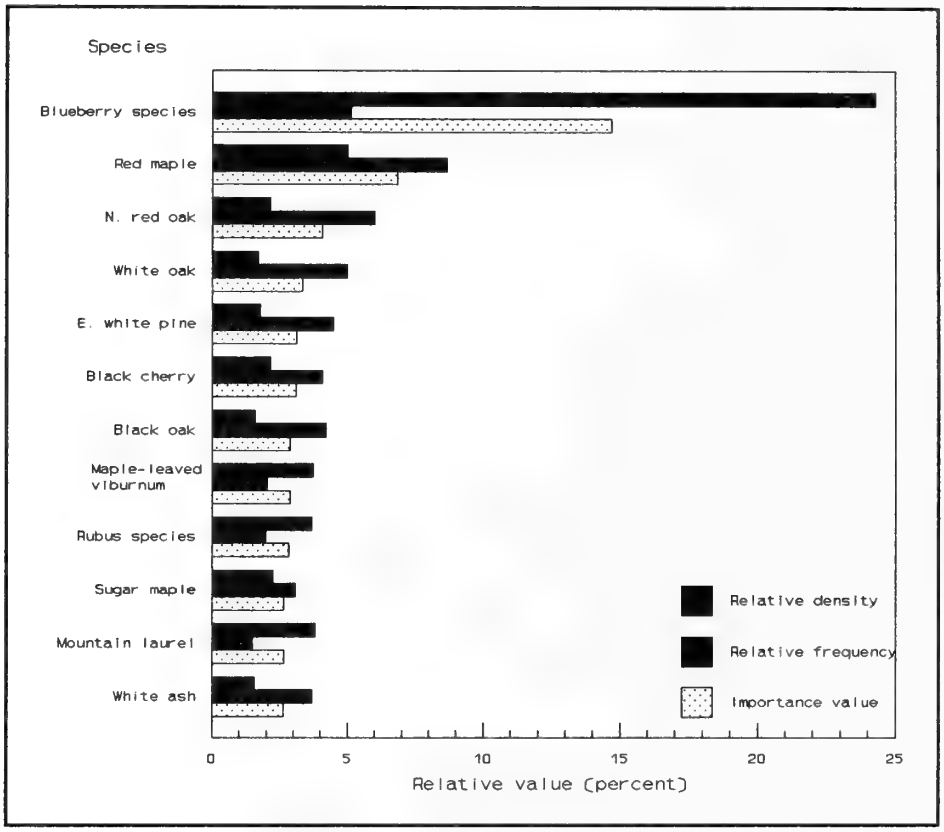

Figure 15.--Relative density, frequency, and importance value of lesser woody stems on timberland by principal species, Southern New England, 1985.

Mast, either as nuts, fruits, or large seeds, is an important forage resource for Southern New England forest wildlife. The principal overstory mast-producing tree species are the oaks (Table 22), accounting for an estimated 232 million trees, out of a total 312 million (74 percent). More than half of these oaks are either red or black oak. Other common mast-producing tree species are hickories, beech, and black cherry. Principal mast-producing shrub species include blueberries, Rubus, viburnums, and huckleberries (Table 20).

Mast production is related to tree competition, which influences crown volume for overstory trees (Spurr and Barnes 1980) or exposure to direct sunlight for shrubs (Gill and Healy 1974). The increase in average size of New England forest trees is beneficial to overstory mast production. However, the concomitant increase in stocking is detrimental to both overstory (competition between adjacent tree crowns) and understory (decrease in sunlight) mast producers.

Table 21. Relative density, relative frequency, importance value, and species frequency of lesser woody stems by species, Southern New England, 1985

Species	Relative density	Relative frequency	Importance value	Species frequency
Balsam fir	.12	.07	.10	.71
white-cedar	.01	.03	.02	.24
Common juniper	.18	.19	.18	1.89
Eastern redcedar	.13	.54	.34	5.43
Tamarack	.03	.07	.05	.71
Norway spruce	.02	.05	.04	.48
Red spruce	.18	.28	.23	2.84
Red pine	.04	.26	.15	2.60
Pitch pine	.19	.73	.46	7.32
Eastern white pine	1.78	4.46	3.12	45.05
Scotch pine	.01	.03	.02	.24
Northern white-cedar	.01	.03	.02	.24
Eastern hemlock	.69	2.13	1.41	21.47
Boxelder	.01	.03	.02	.24
Striped maple	.77	.56	.67	5.67
Red maple	5.01	8.67	6.84	87.74
Silver maple	.01	.03	.02	.24
Sugar maple	2.24	3.06	2.65	30.90
Mountain maple	.13	.19	.16	1.89
Ailanthus	.01	.03	.02	.24
Alder species	2.32	.66	1.49	6.61
Serviceberry	.30	.59	.44	5.90
Chokeberry species	.05	.03	.04	.24
Azalea species	.88	.38	.63	3.78
Barberry	2.08	.59	1.33	5.90
Yellow birch	.66	2.52	1.59	25.48
Sweet birch	1.15	3.52	2.34	35.62
Paper birch	.44	1.50	.97	15.10
Gray birch	.42	1.03	.72	10.38
American hornbeam	.51	.70	.61	7.08
Hickory species	.33	1.68	1.01	16.99
Bitternut hickory	.01	.03	.02	.24
Pignut hickory	.07	.70	.39	7.08
Shagbark hickory	.10	.84	.47	8.50
Mockernut hickory	.01	.12	.07	1.18
American chestnut	.37	.75	.56	7.55
American bittersweet *	-	-	-	1.18
Clematis species *	-	-	-	.24
Sweetfern	.07	.17	.12	1.66
Flowering dogwood	.26	.56	.41	5.67
Alternate-leaved dogwood	.11	.14	.13	1.42
Silky dogwood	.08	.12	.10	1.18
Round-leaved dogwood	.07	.07	.07	.71

Table 21. continued

Species	Relative density	Relative frequency	Importance value	Species frequency
Panicled dogwood	.67	.35	.51	3.54
Red-osier dogwood	.23	.17	.20	1.66
Canadian bunchberry *	-	-	-	1.18
Hawthorn species	.06	.19	.13	1.89
American hazelnut	.60	.66	.63	6.61
Beaked hazelnut	.13	.19	.16	1.89
American beech	1.15	1.82	1.49	18.40
White ash	1.55	3.69	2.62	37.27
Black ash	.16	.33	.25	3.31
Green ash	.01	.05	.03	.48
Creeping snowberry *	-	-	-	2.84
Teaberry *	-	-	-	12.51
Huckleberry	1.65	.24	.94	2.36
Witch-hazel	1.81	2.17	1.99	21.94
Winterberry holly	.08	.14	.11	1.42
Butternut	.01	.14	.08	1.42
Sheep laurel	2.05	.80	1.43	8.02
Mountain laurel	3.81	1.50	2.65	15.10
Common spicebush	1.74	1.40	1.57	14.16
Yellow-poplar	.02	.35	.19	3.54
Bush honeysuckle	.68	.45	.56	4.49
Vine honeysuckle *	-	-	-	.24
Apple species	.05	.33	.19	3.31
Partridgeberry *	-	-	-	10.38
Black tupelo	.25	.54	.39	5.43
Eastern hophornbeam	.63	1.01	.82	10.15
Virginia creeper *	-	-	-	3.54
Ninebark	.01	.03	.02	.24
American sycamore	.01	.05	.03	.48
Balsam poplar	.01	.03	.02	.24
Eastern cottonwood	.02	.14	.08	1.42
Bigtooth aspen	.10	.73	.41	7.32
Quaking aspen	.24	.80	.52	8.02
Cherry species	.04	.05	.04	.48
Pin cherry	.28	.59	.43	5.90
Black cherry	2.15	4.06	3.10	41.04
Chokecherry	.44	.66	.55	6.61
White oak	1.71	4.97	3.34	50.24
Swamp white oak	.01	.07	.04	.71
Scarlet oak	.31	1.96	1.14	19.82
Scrub, bear oak	.23	.17	.20	1.66
Pin oak	.01	.05	.03	.48
Chestnut oak	.20	.66	.43	6.61

Table 21.-continued

Species	Relative density	Relative frequency	Importance value	Species frequency
Northern red oak	2.15	5.99	4.07	60.62
Post oak	.01	.03	.02	.24
Black oak	1.59	4.20	2.89	42.46
Buckthorn species	.75	.24	.49	2.36
Smooth sumac	.02	.03	.02	.24
Staghorn sumac	.14	.26	.20	2.60
Poison ivy *	-	-	-	13.45
Poison sumac	.03	.07	.05	.71
Currant species	.02	.03	.03	.24
Black locust	.01	.03	.02	.24
Rose species	.51	.40	.45	4.01
Rubus species	3.69	1.99	2.84	20.05
Willow species	.22	.14	.18	1.42
American elderberry	.24	.14	.19	1.42
Sassafras	.71	1.45	1.08	14.63
Greenbrier *	-	-	-	12.98
American mountain ash	.01	.05	.03	.48
European mountain ash	.01	.03	.02	.24
Spirea species	3.27	1.29	2.28	12.98
American basswood	.05	.24	.14	2.36
Elm species	.01	.10	.05	.95
American elm	.17	.61	.39	6.14
Slippery elm	.01	.03	.02	.24
American bladdernut	.03	.05	.04	.48
Blueberry	24.27	5.13	14.70	51.89
Viburnum species	.33	.28	.31	2.84
Maple-leaved viburnum	3.72	2.03	2.87	20.52
Hobblebush viburnun	.51	.40	.46	4.01
Wild raisin	.19	.31	.25	3.07
Arrowwood	1.65	1.29	1.47	12.98
Nannyberry	.43	.40	.42	4.01
Blackhaw	.04	.05	.05	.48
Highbush cranberry	.26	.07	.17	.71
Grape *	-	-	-	6.14
Unknown vine *	-	-	-	2.13
Unknown dwarf shrub *	.00	.00	.00	1.66
Unknown deciduous shrub	10.17	2.73	6.45	27.60
Unknown evergreen shrub	.14	.19	.17	1.89
Unknown tree	.29	.54	.41	5.43

* Not included in calculation of Importance value.

Table 22. Number of all-live nut- and fruit-producing trees on timberland by species and diameter class, Southern New England, 1985

(In thousands of trees)

Species	Diameter class (inches at breast height)										All classes
	5.0-6.9	7.0-8.9	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9	29.0+	
Eastern redcedar	5,130	2,866	714	215	51	12	0	0	0	0	8,988
Serviceberry	228	80	80	0	0	0	0	0	0	0	388
Hickory	7,451	5,512	3,517	1,855	1,179	235	224	91	0	8	20,072
American chestnut	156	0	0	0	0	0	0	0	0	0	156
Dogwood	571	144	0	0	0	0	0	0	0	0	715
Hawthorn	86	0	0	0	0	0	0	0	0	0	86
Beech	9,132	4,592	1,901	1,917	1,172	638	427	194	191	0	20,163
Butternut	0	110	77	54	30	31	0	0	27	0	329
Apple	924	514	168	39	88	27	0	0	0	0	1,760
Blackgum	1,313	652	712	269	121	76	17	9	0	0	3,170
Eastern hophornbeam	1,149	198	42	67	0	0	0	0	0	0	1,456
Pin cherry	786	31	86	39	0	0	0	0	0	0	942
Black cherry	7,875	4,855	3,732	1,782	862	612	130	142	5	0	19,997
Chokecherry	0	0	38	19	0	0	0	0	0	0	57
White oak	19,963	11,071	7,137	3,871	2,075	1,257	585	422	380	22	46,784
Swamp white oak	555	418	263	27	0	0	0	0	0	0	1,263
Scarlet oak	13,640	9,388	6,824	3,584	2,116	732	170	217	40	0	36,711
Swamp chestnut oak	0	0	0	0	0	28	0	0	0	0	28
Pin oak	142	68	63	22	22	0	0	26	52	0	395
Chestnut oak	3,193	1,700	1,624	740	316	291	64	44	19	0	7,991
Northern red oak	21,385	19,938	17,056	12,341	7,030	4,744	2,281	821	1,085	137	86,818
Post oak	0	0	63	0	0	0	0	0	0	0	63
Black oak	17,140	15,039	8,702	4,811	2,842	1,312	766	358	685	25	51,681
Sassafras	1,553	332	307	140	32	28	0	0	0	0	2,391
Mountain ash	54	0	0	0	0	0	0	0	0	0	54
All species	112,426	77,508	53,107	31,791	17,937	10,024	4,664	2,325	2,486	192	312,459

Cavities in forest trees are used by many wildlife species for both temporary shelter and as nesting sites. It is estimated that there are 87 million trees with observed cavities in Southern New England forests (Table 23). While the largest number with cavities is in growing-stock hardwood stems, dead trees with broken tops are the most likely to have an observed cavity (Fig. 16). There are at least two reasons for this: 1) dead trees without foliage are more reliably searched for cavities, and 2) trees with broken tops are likely to be infected with heart rot and, therefore, more likely to be excavated by primary cavity-nesting birds. Nevertheless, cavities in live trees are an important wildlife resource and should be retained whenever possible during silvicultural activities (Healy et al. 1989).

Standing-dead trees account for slightly less than 10 percent of all trees in Southern New England, or an estimated 95 million stems (Table 24). When compared with equivalent categories of live trees, standing-dead trees are more likely to be softwoods (21.9 versus 29.1 percent, respectively). Eastern white pine is the most common species of standing-dead tree constituting 17 percent of all standing-dead stems and estimated to number 16 million trees (Fig. 17). Standing-dead hardwoods are more likely to be of the white-oak group. White oaks, especially chestnut oak, are preferentially susceptible to mortality from gypsy moth (Lymantria dispar) defoliation. Finally, standing-dead trees are more likely to be smaller in diameter than live trees (89 percent of standing-dead stems are 5.0 to 10.9 inches d.b.h. versus 79 percent of live trees). This is undoubtedly due in part to competition and suppression as a result of high levels of stocking.

Ownership

Forest ownership patterns in Southern New England have been surveyed by FIA. Timberland in Southern New England is essentially privately owned, with only 14 percent (692,400 acres) in public ownership. The privately owned forest is, in turn, principally held by individuals and farmers. Corporate and forest industry timberlands account for less than 10 percent of the privately owned timberland.

It is estimated that there are nearly 360,000 private timberland ownership units (individuals, farmers, corporations, etc.) in Southern New England. There is an inverse relationship between the size (in acres) of ownership units and the number of owners, with 77 percent of all ownerships holding 1 and 9 acres (Fig. 18). This relationship differs when the distribution of timberland by size of ownership unit is considered. The 77 percent of timberland owners holding fewer than 10 acres each cumulatively own nearly 600,000 acres of timberland, or 13 percent of the total. Owners of 20 to 199 acres hold larger proportions of timberland than owners of smaller units but the latter are greater in number (Fig. 18).

Table 23. Number of trees (5.0+ inches d.b.h.) with observed cavities on timberland by species and condition class, Southern New England, 1985

(In thousands of trees)

Species	Live				Total live	Dead		Total dead	All trees
	No cull	Intact live top	Broken top	Dead top		Intact top	Broken top		
Spruce/fir	0	0	0	0	0	0	337	337	337
Red pine	0	0	0	0	0	0	124	124	124
Pitch pine	0	0	0	0	0	35	113	148	148
White pine	162	65	55	0	282	788	2,261	3,049	3,331
Hemlock	316	276	64	29	685	132	756	888	1,573
Other softwoods	285	68	0	0	353	35	265	300	653
All softwoods	763	409	120	29	1,320	990	3,855	4,845	6,165
Red maple	19,167	8,041	1,182	563	28,953	662	3,914	4,577	33,530
Sugar maple	1,194	1,593	199	0	2,987	354	725	1,079	4,065
Yellow birch	1,184	1,886	98	79	3,247	0	1,104	1,104	4,351
Sweet birch	2,814	1,208	83	33	4,138	340	1,159	1,500	5,638
Paper birch	225	793	0	115	1,133	113	1,195	1,309	2,442
Hickory	1,211	61	54	0	1,326	0	100	100	1,426
Beech	1,885	748	386	0	3,020	77	805	882	3,901
White ash	1,384	88	93	0	1,565	641	371	1,011	2,577
Aspen	295	0	0	0	295	118	109	227	522
Black cherry	777	218	241	0	1,235	121	565	686	1,921
White oak	891	125	168	133	1,318	673	1,232	1,906	3,224
Northern red oak	4,336	1,449	301	73	6,159	993	699	1,693	7,852
Other red oaks	2,440	1,195	57	80	3,771	84	730	815	4,586
Elm	36	0	0	0	36	0	425	425	461
Other commercial hardwoods	849	425	0	0	1,274	282	203	485	1,759
Noncommercial hardwoods	670	771	157	0	1,598	136	915	1,051	2,649
All hardwoods	39,360	18,602	3,019	1,076	62,057	4,596	14,252	18,848	80,905
All species	40,122	19,011	3,139	1,105	63,377	5,586	18,107	23,693	87,070

Table 24. Number of standing dead trees on timberland by species, condition class, and diameter class, Southern New England, 1985

(In thousands of trees)

Species	Intact top				Broken top				All trees
	Diameter class (inches at breast height)				Diameter class (inches at breast height)				
	5.0-10.9	11.0-14.9	15+	Total	5.0-10.9	11.0-14.9	15+	Total	
Spruce/fir	709	0	57	766	1,217	256	55	1,529	2,295
Red pine	113	0	0	113	348	0	0	348	461
Pitch pine	298	35	0	333	1,902	159	0	2,061	2,394
White pine	8,631	253	112	8,997	5,911	709	315	6,935	15,931
Hemlock	1,514	322	137	1,973	2,224	271	147	2,642	4,615
Other softwoods	853	116	0	969	907	0	0	907	1,875
All softwoods	12,119	726	306	13,151	12,509	1,396	517	14,422	27,573
Red maple	4,066	81	0	4,147	7,867	907	401	9,175	13,322
Sugar maple	467	0	55	523	1,461	219	125	1,805	2,327
Yellow birch	175	0	0	175	1,854	206	60	2,120	2,295
Sweet birch	1,102	125	39	1,267	1,977	346	27	2,351	3,619
Paper birch	484	203	26	713	1,965	118	0	2,084	2,796
Hickory	229	0	0	229	317	33	0	351	579
Beech	0	131	25	155	797	355	146	1,298	1,454
White ash	1,385	146	0	1,531	1,669	63	0	1,732	3,263
Aspen	855	118	0	973	1,045	69	0	1,114	2,087
Black cherry	904	137	0	1,041	1,971	162	0	2,133	3,174
White oak	4,226	465	109	4,800	6,741	211	161	7,113	11,913
Northern red oak	4,221	559	210	4,990	2,500	186	69	2,755	7,745
Other red oaks	3,212	473	96	3,781	1,781	132	0	1,913	5,694
Elm	331	89	0	420	425	298	74	797	1,217
Other commercial hardwoods	657	70	57	784	877	66	0	943	1,727
Noncommercial hardwoods	1,347	0	0	1,347	2,330	216	71	2,618	3,965
All hardwoods	23,662	2,597	617	26,876	35,579	3,591	1,134	40,304	67,180
All species	35,781	3,323	923	40,027	48,088	4,987	1,651	54,726	94,753

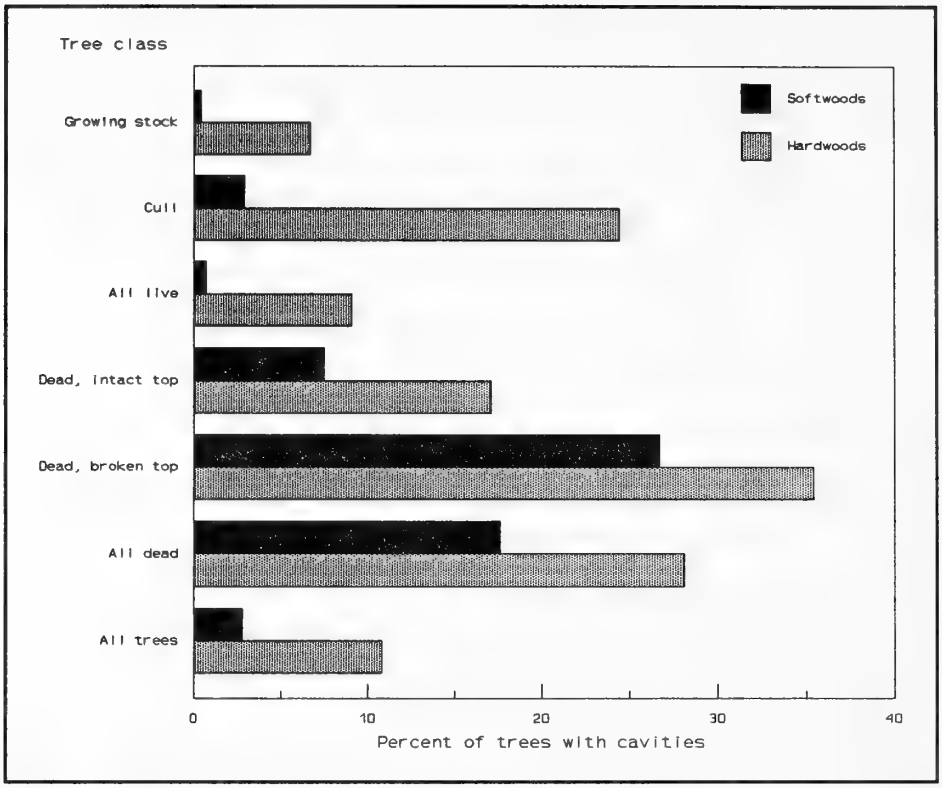

Figure 16.--Percentage of trees on timberland with observed cavities by tree class and species group, Southern New England, 1985.

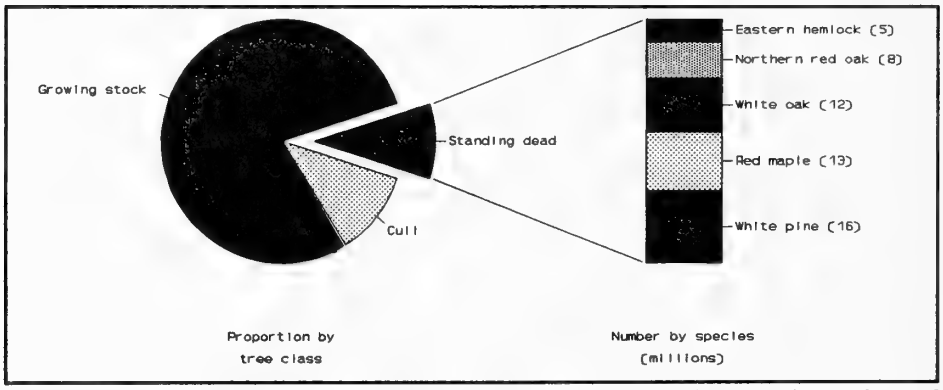

Figure 17.--Proportion of trees on timberland by tree class and number of standing-dead trees by principal species, Southern New England, 1985.

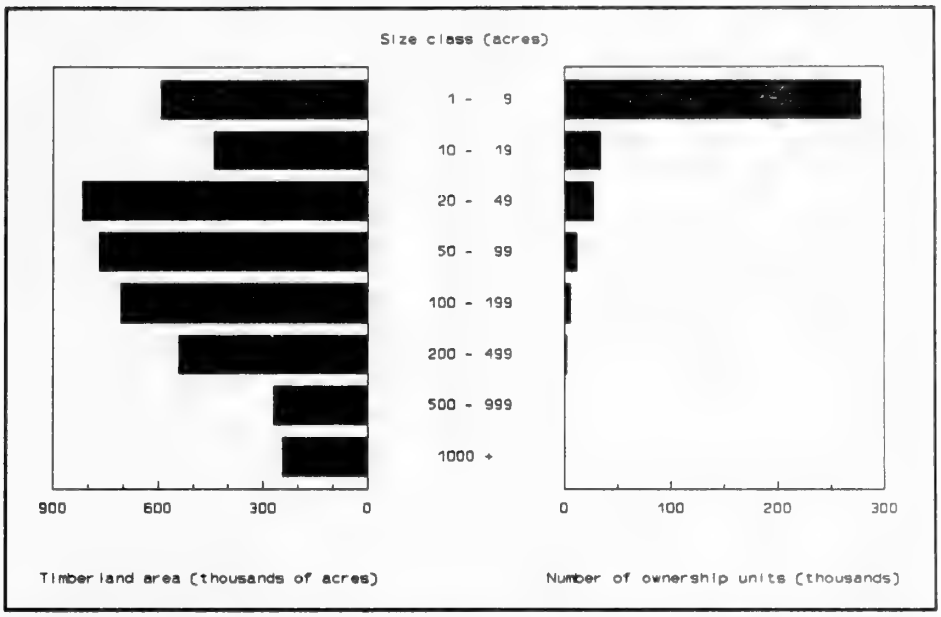

Figure 18.--Number of private timberland ownership units and acres of timberland owned by size of ownership class, Southern New England, 1985.

The pattern of forest ownership between 1972 and 1985 has been one of fragmentation of large ownerships. Ownerships of less than 10 acres make up the majority in 1972 (Kingsley 1976), and their numbers have increased by 164 percent between forest surveys (Fig. 19). The timberland area in ownerships of less than 10 acres has increased by 62 percent between surveys but at the expense of ownerships between 20 and 500 acres, which have decreased in area and numbers of owners. For all forest owners, the average forest ownership is calculated to have been 21.5 acres from the 1972 forest survey; that figure has fallen to 10.3 acres as of the 1985 forest survey. This trend is not likely to change as the age of the majority of private forest owners continues to be over 50 years (Kingsley 1976). There is an increased likelihood that these forest lands will be changing ownership through the estate and probate process and so be exposed to subdivision.

This fragmentation of forest ownerships creates management issues, whether managing for wood products, wildlife, or other resources. The first issue is whether or not management is desired by the owner. Owners of 10 or 20 acres probably are less motivated toward active management for any resource and more inclined to simply enjoy or take for granted the forest land they own. If management is desired, small-area ownerships create problems in application of management. One's management choices are greatly restricted when working with only several acres. For either wood products or wildlife, low-intensity, single-tree or group-selection regeneration methods are most appropriate.

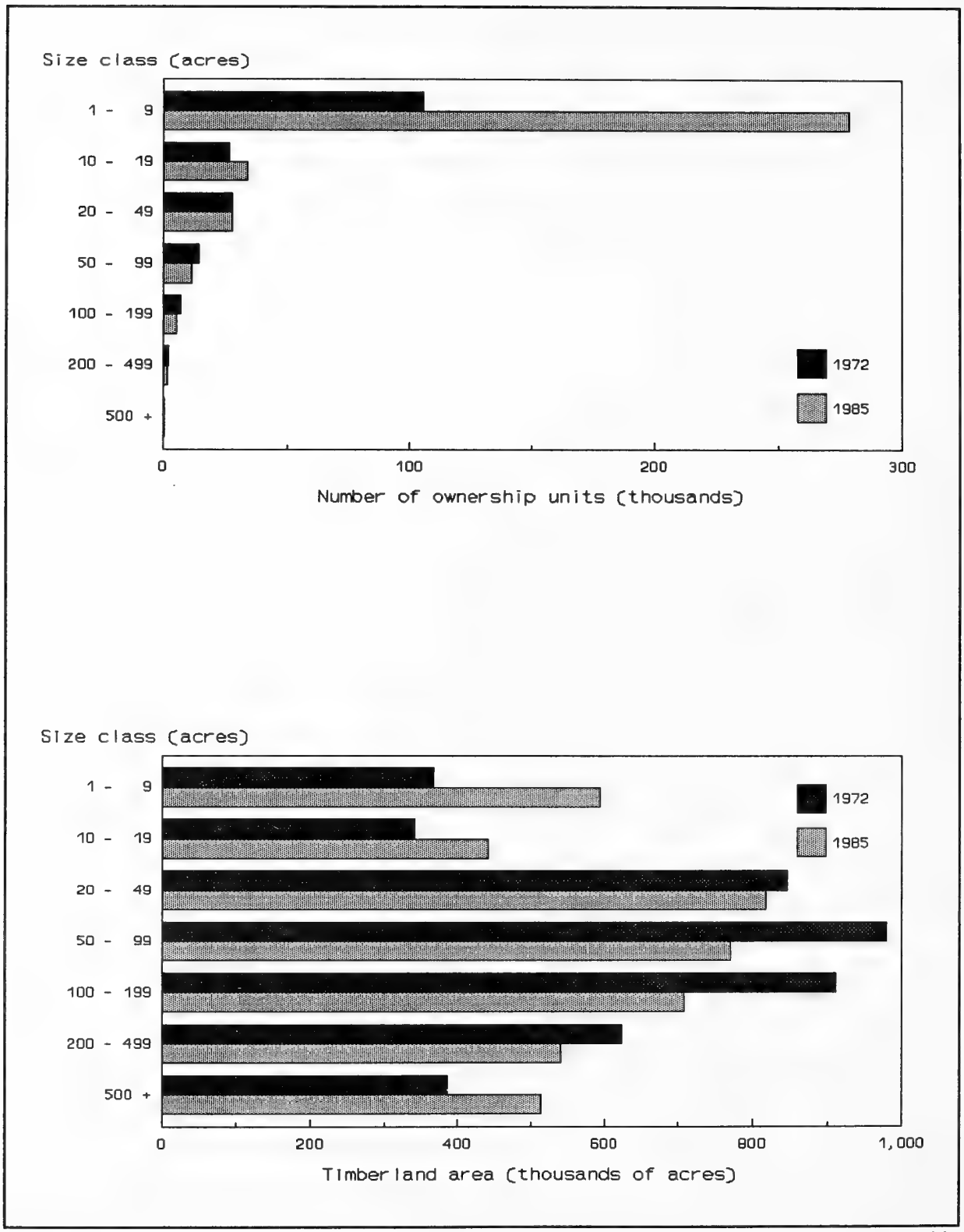

Figure 19.--Number of private timberland ownership units and timberland area by size of ownership class, Southern New England, 1972 and 1985.

Management Opportunities

The growing preponderance of timberland acreage in sawtimber-size stands and the declining numbers of smaller diameter trees is an indication that Southern New England forests are maturing and that younger forests are not being created. Over the decade prior to the last forest survey, 23 percent of timberland acres had evidence of some timber harvest (Table 25). However, only 7 percent of these harvested acres were clearcut and the remaining acres were only partially cut. It is unlikely that these harvesting patterns will result in an early successional stand critical to the establishment of a particular tree species (for example, the number of aspen saplings declined from an estimated 28.6 million trees in 1972 to 17 million in 1985) and to the continued abundance of certain wildlife species in Southern New England.

At the time of the most recent forest survey, it was estimated that 57 percent of timberland was in a condition such that no silvicultural treatment was recommended (Table 26). however, this determination was qualified in that the recommended treatment must be commercially viable, that is, must pay for itself, which precludes precommercial thinning. Management recommendations for the remaining timberland ranged from intermediate treatments such as precommercial and commercial thinning to regeneration harvests. It also is estimated that there are no equipment limitations that would impede typical timber harvesting operations on more than 75 percent of Southern New England timberland (Table 27).

Future of Forest Resources of Southern New England

The results of the inventories from Connecticut, Massachusetts, and Rhode Island provide the reader with a snapshot of the forest resource situation in 1972 and 1985. While no specific future modeling or trend analysis has been undertaken, we can envision to some extent what the forest resource might be like in the future.

The overall forest land area did not change considerably between the two surveys. Indirect indications are that there was fragmentation of forest land due to an increase in the number of forest owners. This subdivision of forest land probably is closely linked to the general economy of the region, and is driven by land values and housing starts. Unless the economy of New England changes dramatically, development of forest land provably will continue but at a lesser rate than that experienced during the boom of the 1980's.

Forest ownership surveys indicate, however, that more than 50 percent of nonindustrial private landowners are more than 50 years old. As these owners continue to age, and eventually die, their land can be expected to go through inheritance proceedings, and possibly be subdivided to pay for the high costs of estate taxes. The judicious application of conservation easements to nonindustrial private forest land can minimize the value of the land, and thus soften the tax burden both annually and as part of an estate. There are more than 200 nonprofit land trusts throughout the region capable of assisting landowners with the development of conservation easements.

Table 25. Area of timberland by stand history class and time since harvest, Southern New England, 1985

(In thousands of acres)

Stand history class	Time since harvest			All classes
	No harvest recently	Harvest within last 3 years	Harvest 3-10 years before	
No harvesting	3,923.9	.0	.0	3,923.9
Clearcut	.0	42.2	35.1	77.3
Partial cut	.0	490.1	587.1	1,077.2
All classes	3,923.9	532.3	622.2	5,078.4

Table 26. Area of timberland by timber management class and state, Southern New England, 1985

(In thousands of acres)

Timber management class	State			All states
	Connecticut	Massachusetts	Rhode Island	
Impractical to manage	133.3	298.8	41.3	473.4
Remove and regenerate	28.4	46.9	8.2	83.5
Precommercial treatment	17.8	43.9	.0	61.7
Type conversion	24.9	.0	.0	24.9
Sanitation and salvage	48.0	14.6	41.6	104.2
Improvement cut	152.8	530.2	.0	683.0
Commercial thinning	131.5	35.2	36.4	203.1
Harvest	268.4	246.1	13.4	527.9
No treatment	972.2	1,713.7	230.8	2,916.7
All classes	1,777.3	2,929.4	371.7	5,078.4

Table 27. Area of timberland by equipment limitation class and state, Southern New England, 1985

(In thousands of acres)

Equipment limitation class	State			All states
	Connecticut	Massachusetts	Rhode Island	
None	1,107.3	2,501.7	233.4	3,842.4
Slight	495.9	389.6	102.6	988.1
Moderate	145.7	23.4	29.4	198.5
Severe	28.4	14.7	6.3	49.4
All classes	1,777.3	2,929.4	371.7	5,078.4

The area of timberland probably will remain approximately the same, and the volume of wood will continue to increase. Growth exceeded removals by a factor to 3 to 1 from 1972 to 1984 (Table 14), resulting in a tremendous accumulation of wood in the forest. This increase in wood volume has not been significantly utilized through timber harvesting; only 23 percent of timberland is estimated to have been harvested in any fashion over the period (Table 25). Of the harvested forest, 93 percent were only partially cut and the remainder clearcut. In general, there has been only a small impact of harvesting on timberland both in extent and intensity.

Fifteen percent of timberland was classified as warranting a regeneration or other harvest and an additional 19 percent would benefit from an intermediate treatment (Table 26). Based on these findings, it can be safely assumed that active silvicultural treatments will not be imposed on the majority of the region's timberland over the near future and, hence, growth will continue to exceed removals by a considerable margin.

Landowner attitudes play a significant role in determining the fate of forest land. The forest ownership survey indicates that 32 percent of owners believed they would never permit harvesting on their property. Individuals with this attitude own 17 percent of the forest land. Another 36 percent who believed they would schedule a timber harvest sometime within the next 10 years own 61 percent of the timberland base. A final 32 percent who were uncertain about plans to harvest own the remaining 22 percent of the forest. In general, it can be concluded that only a minority of forest land owners holding an even smaller portion of forest are opposed to any form of harvesting. This information indicates that timber harvesting is a viable management alternative as the region's forests reach silvicultural maturity.

Economic research has indicated that landowners are more likely to have their timber harvested when the stumpage price increases (Binkley 1981). A decrease in the supply of timber in the Pacific Northwest may translate into an increased demand for northeastern timber. Additionally, as timber volume of commercially important species increases in the more valuable grades, stumpage prices will increase along with an increase in owner incentive for harvesting.

The survey results show fewer trees in the smaller diameter classes and fewer acres of timberland in the seedling sapling-size class. In the probable event that harvesting levels of regional timber remain roughly equivalent to current levels, and harvesting practices do not change appreciably, the number and acres of smaller trees will decrease further. At the regional scale, this trend probably will have a significant impact on wildlife habitat. Species requiring early successional habitats will most likely decline in numbers as their required habitat decreases in extent.

In general, the period until the next survey probably will not be one of major change for the Southern New England forest. Forest area will change little but forest ownership patterns will continue to change and volumes will continue to increase, though perhaps at a slower pace as the forest continues to mature.

Conclusion

The forest resources of Southern New England are clearly a vital part of the landscape of the region. Despite recent significant population growth and its related industrial, commercial, and residential development, the area remains predominantly forested. Due to past land use practices and abandonment, these forests are generally even-aged, and predominantly characterized by trees in the sawtimber-size class. Repeated forest surveys indicate impressive growth rates of the timber resource, and such growth exceeding removals by a factor of 3 to 1. On the basis of area, volume, and growth estimates from several survey periods, it appears that the forest remains a predominant factor in the overall landscape and is even increasing in volume and value. Residents of Southern New England enjoy impressive direct and indirect benefits from the forest, including timber and fuelwood, outdoor recreational opportunites, attractive landscapes, and habitat for wildlife.

The Southern New England forest is not without problems. While not shrinking in size and actually growing in volume, this resource is increasingly fragmented by development and subdevelopment of private forest ownerships. Since most of the region's forest is owned by private individuals, this trend will likely continue. Increased fragmentation of ownerships ultimately will result in increased fragmentation of forest land, with an impaired ability to commercially produce timber and a decline in both recreational opportunities and the quality of wildlife habitat.

Definitions of Terms

Accretion. The estimated net growth on growing-stock trees that are measured during the previous inventory, divided by the number of growing seasons between surveys. It does not include the growth on trees that were cut during the period, nor those trees that died.

Agricultural/herbaceous land. Land with herbaceous plant cover, both grasses and/or forbs, including cropland, pasture land, and natural grass lands.

Aquatic edge. An edge condition created when a terrestrial land use abuts a lake, pond, river, stream, or major wetland.

Board foot. A unit of lumber measurement 1 foot long, 1 foot wide, and 1 inch thick, or its equivalent.

Browse. Forage resource; defined here as current twig growth of woody-stemmed plants occurring between 1 and 8 feet in height.

Cavity. A hollowed out space in a tree, either natural or faunal caused; frequently used as a nesting site or temporary refuge by many species of wildlife.

Commercial species. Tree species presently or prospectively suitable for industrial wood products. Excludes species of typically small size, poor form, or inferior quality, such as hawthorn or sumac.

Condition class. Classification of trees based on live or dead and condition of top of the tree (intact, broken, or dead).

Cord. See Standard Cord.

Cropland. Land that currently supports agricultural crops including silage and feed grains, bare farm fields resulting from cultivation or harvest, and maintained orchards.

Cull tree. A rotten or rough tree. See Rotten tree and Rough tree.

Cull increment. The net volume of growing-stock trees in the previous inventory that became rough or rotten trees in the current inventory, divided by the number of growing seasons between surveys.

Cultural land. Land with human development as the major land cover; includes industrial, commercial, and residential land uses.

Diameter at breast height (d.b.h.). The diameter outside bark of a standing tree measured at 4.5 feet above the ground.

Forest land. The total of timberland and all noncommercial forest land (productive reserved forest land and woodland). Includes land that is at least 10 percent stocked with trees of any size, or that formerly had such tree cover and is not currently developed for a nonforest use. The minimum area for classification of forest land is 1 acre.

Forest type. A classification of forest land based on the species that form a plurality of live tree basal area stocking.

Forest-type group. A combination of forest types that share closely associated species or site requirements. The many forest types in Southern New England were combined into the following major forest-type groups (the descriptions apply to forests in Southern New England):

a. White/red pine--forests in which white pine, hemlock, or red pine make up the plurality of the stocking, singly or in combination; common associates include red spruce, maple, and yellow-poplar.

b. Spruce/fir--forests in which red spruce, northern white-cedar, balsam fir, white spruce, black spruce, or tamarack, singly or in combination, make up a plurality of the stocking; common associates include yellow birch and red maple.

c. Hard pine--forest in which loblolly, shortleaf, or other southern yellow pines (except longleaf or slash pine), or pitch pine in New England, singly or in combination, comprise a plurality of the stocking; common associates include hickory and maple.

d. Oak/pine--forests in which northern red oak or white ash, singly or in combination, make up a plurality of the stocking but where pines or eastern redcedar contribute 25 to 50 percent of the stocking; hemlock, maple, sweet birch, and yellow-poplar are associates.

e. Oak/hickory--forests in which upland oaks, red maple (when associated with central hardwoods), or hawthorn, singly or in combination, make up a plurality of the stocking and in which white pine makes up less than 25 percent of the stocking; common

associates include hard pines, hemlock, maple, birch, hickory, and yellow-poplar.

f. Elm/ash/red maple--forests in which black ash, elm, red maple (when growing on wet sites), willow, or green ash, singly or in combination, make up a plurality of the stocking; common associates include sugar maple, hickory, yellow-poplar, and black cherry.

g. Northern hardwoods--forests in which sugar maple, beech, yellow birch, red maple (when associated with northern hardwoods), pin cherry, or black cherry, singly or in combination, make up a plurality of the stocking; common associates include hard pines, hemlock, hickory, ash, and yellow-poplar.

h. Aspen/birch--forests in which aspen, paper birch, or gray birch, singly or in combination, make up a plurality of the stocking.

Fuelwood. Round, split, or chipped woody material (with or without bark) that is converted to household, commercial, or industrial energy.

Green weight. The weight of wood and bark as it would be if it had been recently cut. It is usually expressed in pounds or tons.

Gross growth. The sum of accretion and ingrowth.

Growing-stock trees. Live trees of commercial species classified as sawtimber, poletimber, saplings, or seedlings; that is, all live trees of commercial species except rough and rotten trees.

Growing-stock volume. Net volume, in cubic feet, of growing-stock trees 5.0 inches d.b.h. and larger 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 cull.

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

Harvested cropland. All land from which crops were harvested or hay was cut, all land in orchards, citrus groves, and vineyards, and nursery and greenhouse products.

Importance value. Average of relative density and relative frequency of a species.

Ingrowth. The estimated net volume of growing-stock trees that became 5.0 inches d.b.h. or larger during the period between inventories, divided by the number of growing seasons between surveys.

International 1/4-inch rule. A log rule or formula for estimating the board-foot volume of logs. The mathematical formula is:

$$(0.22D^2 - 0.71D)(0.904762)$$

for 4-foot sections, where D = diameter inside bark at the small end of the log section. This rule is used as the USDA Forest Service standard log rule in the Eastern United States.

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

Land-use edge. A condition created by the juxtaposition of two different land uses.

Mast. Seed produced by woody-stemmed perennial plants; generally refers to soft (fruit) and hard (nuts) mast.

Mortality. The estimated net volume of growing-stock trees at the previous inventory that died from natural causes before the current inventory, divided by the number of growing seasons between surveys.

Net change. The difference between the current and previous inventory estimates of growing-stock volume, divided by the number of growing seasons between surveys. Components of net change are ingrowth plus accretion, minus mortality, minus cull increment, minus removals.

Net green weight. The green weight of woody material less the weight of all unsound (rotten) material.

Net growth. The change, resulting from natural causes, in growing-stock volume during the period between surveys, divided by the number of growing seasons. Components of net growth are ingrowth plus accretion, minus mortality, minus cull increment.

Noncommercial forest land. Productive reserved forest land and woodland.

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

Nonforest land. Land that has never supported forests, or land formerly forested but now in nonforest use such as cropland, pasture, residential areas, or highways.

Nonsalvable dead tree. A dead tree with most or all of its bark missing that is at least 5.0 inches in d.b.h. and is at least 4.5 feet tall.

Nonstocked area. A stand-size class of forest land that is stocked with less than 10 percent of minimum full stocking with all live trees.

Other cropland. Includes cropland used for cover crops and soil improvement (legumes).

Pasture land. Includes any pasture land other than cropland and woodland pasture. Can include lands that had lime fertilizer or seed applied or that had been improved by irrigation, drainage, or control of weeds and brush.

Pastured cropland. Includes rotation pasture and grazing land that would have been used for crops without additional improvement.

Poletimber stand. A stand-size class of forest land that is stocked with at least 10 percent of minimum full stocking with all-live trees with half or more of such stocking in poletimber or sawtimber trees or both, and in which the stocking of poletimber exceeds that of sawtimber.

Poletimber trees. Live trees of commercial species meeting regional specifications of soundness and form and at least 5.0 inches d.b.h., but smaller than sawtimber trees.

Productive reserved forest land. Forest land sufficiently productive to qualify as timberland, but withdrawn from timber utilization through statute, or administrative designation; land exclusively used for Christmas tree production.

Relative density. Number of individuals of a given species as a percentage of the total of all species.

Relative frequency. Frequency of a given species as a percentage of the total of all frequencies (Frequency is the total number of plots where a given species occurs divided by the total number of plots).

Removals. The net growing-stock volume harvested or killed in logging, cultural operations (such as timber stand improvement) or land clearing, and also the net growing-stock volume neither harvested nor killed but growing on land that was reclassified from timberland to noncommercial forest land or nonforest land during the period between surveys. This volume is divided by the number of growing seasons.

Rights-of-way. Highways, pipelines, powerlines, canals.

Rotten tree. A live tree of commercial species that does not contain at least one 12-foot sawlog or two noncontiguous sawlogs, each 8 feet or longer, now or prospectively, and does not meet regional specifications for freedom from defect primarily because of rot; that is, more than 50 percent of the cull volume in the tree is rotten.

Rough tree. (a) The same as a rotten tree except that a rough tree does not meet regional specifications for freedom from defect primarily because of roughness or poor form; also (b) a live tree of noncommercial species.

Salvable dead trees. A tree at least 5.0 inches in d.b.h. that has recently died and still has fairly tight bark. The tree may be standing, fallen, windthrown, knocked down, or broken off.

Sampling error. A measure of the reliability of an estimate, generally called the coefficient of variation, and expressed as a percentage of an estimate. The sampling errors given in this report correspond to one standard deviation and

are calculated as the square root of the variance, divided by the estimate, and multiplied by 100.

Saplings. Live trees 1.0 inch through 4.9 inches d.b.h.

Sapling-seedling stand. A stand-size class of forest land that is stocked with at least 10 percent of minimum full stocking with all live trees with half or more of such stocking in saplings or seedlings or both.

Sawlog. A log meeting regional standards of diameter, length, and freedom from defect, including a minimum 8-foot length and a minimum diameter inside bark of 6 inches for softwoods and 8 inches for hardwoods. (See specifications under Log Grade Classification.)

Sawlog portion. That part of the bole of a sawtimber tree between the stump and the sawlog top; that is, the merchantable height.

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

Sawtimber stand. A stand-size class of forest land that is stocked with at least 10 percent of minimum full stocking with all-live trees with half or more of such stocking in poletimber or sawtimber trees or both, and in which the stocking of sawtimber is at least equal to that of poletimber.

Sawtimber trees. Live trees of commercial species at least 9.0 inches d.b.h. for softwoods or 11.0 inches for hardwoods, containing at least one 12-foot sawlog or two noncontiguous 8-foot sawlogs, and meeting regional specifications for freedom from defect.

Sawtimber volume. Net volume in board feet, by the International 1/4-inch rule, of sawlogs in sawtimber trees. Net volume equals gross volume less deductions for rot, sweep, and other defects that affect use for lumber.

Seedlings. Live trees less than 1.0-inch d.b.h. and at least 1 foot tall.

Shrub. Woody-stemmed perennial plant, generally with no well-defined main stem and less than 12 feet tall at maturity; defined by species.

Snag. Standing dead tree, with most or all of its bark missing that is at least 5.0 inches in d.b.h. and at least 4.5 feet tall (does not include salvable dead).

Softwoods. Coniferous trees, usually evergreen and having needles or scalelike leaves.

Species frequency. Number of plots where a given species occurs expressed as a percentage of the total number of plots.

Stand. A group of forest trees growing on forest land.

Stand-size class. A classification of forest land based on the size class (that is, seedlings, saplings, poletimber or sawtimber) of all-live trees in the area.

Standard cord. A unit of measure for stacked bolts of wood, encompassing 128 cubic feet of wood, bark, and air space.

Standard-lumber log grade. A classification of sawtimber quality based on standard sawlog grades for hardwoods, white pine, and Southern pine. (Note: Red pine was graded using southern pine guidelines.) All specifications are shown under Log-Grade Classification.)

Stocking. The degree of occupancy of land by trees, measured by basal area and/or number of trees in a stand compared to the basal area and/or number of trees required to fully use the growth potential of the land (or the stocking standard). In the Eastern United States this standard is 75 square feet of basal area per acre for trees 5.0 inches d.b.h. and larger, or its equivalent in numbers of trees per acre for seedlings and saplings.

Two categories of stocking are used in this report: all-live trees and growing-stock trees. The relationships between the classes and the percentage of the stocking standard are: nonstocked = 0 to 9, poorly stocked = 10 to 59, moderately stocked = 60 to 99, fully stocked = 100 to 129, and overstocked = 130 to 160.

Stump. The main stem of a tree from ground level to 1 foot above ground level, including the wood and bark.

Timberland. Forest land producing or capable of producing crops of industrial wood (more than 20 cubic feet per acre per year) and not withdrawn from timber utilization. Formerly known as commercial forest land.

Top. The wood and bark of a tree above the merchantable height (or above the point on the stem 4.0 inches in diameter outside bark). Generally includes the uppermost stem, branches, and twigs of the tree, but not the foliage.

Transportation right-of-way. Land associated with highways and railroads.

Tree class. A classification of the quality or condition of trees for sawlog production. Tree class for sawtimber trees is based on their present condition. Tree class for poletimber trees is a prospective determination--a forecast of their potential quality when they reach sawtimber size (11.0 inches d.b.h. for hardwoods, 9.0 inches d.b.h. for softwoods).

Tree grade. A classification of sawtimber quality based on guidelines for tree grades for hardwoods, white pine, and Southern pine. (Note: Red pine was graded using southern pine guidelines. All specifications are shown under Tree-Grade Classification.)

Trees. Woody plants that have well-developed stems and are usually more than 12 feet tall at maturity.

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

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.

Urban forest land. Noncommercial forest land within urban areas that is completely surrounded by or nearly surrounded by urban development (not parks), whether commercial, industrial, or residential.

Utility right-of-way. Land associated with pipeline and electric transmission lines; identified only if vegetative cover differs from adjacent land use.

Windbreak/hedgerow. Linear areas, less than 120 feet in wide, with predominantly tree and/or shrub vegetation.

Literature Cited

Arner, Stanford L.; Gansner, David A.; Birch, Thomas W. 1990. **Rate of value change in New England timber stands**. Res. Pap. NE-639. Radnor, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 4 p.

Atwood, Sanford S., chairman. 1970. **Land use and wildlife resources**. Washington, DC: National Academy of Sciences, Committee on Agricultural Land Use and Wildlife Resources. 262 p.

Binkley, Clark S. 1991. **Timber supply from non-industrial forests**. Bulletin no. 92. New Haven, CT: Yale School of Forestry. 97 p.

Brooks, Robert T. 1989. **Status and trends of raptor habitat in the Northeast**. In: Proceedings, northeast raptor management symposium and workshop; 1988 May 16-18; Syracuse, NY. Natl. Wildl. Fed. Sci. Tech. Ser. No. 13. Washington, DC: National Wildlife Federation, Institute for Wildlife Research: 123-132.

Brooks, Robert T. 1990. **State-of-the-art methodology of forest inventory: wildlife habitat assessment in the northeastern United States**. In: Proceedings, state-of-the-art methodology of forest inventory: a symposium; 1989, July 30-August 5; Syracuse, NY. Gen. Tech. Rep. PNW-263. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station: 538-543.

Brooks, Robert T.; Birch, Thomas W. 1988. **Changes in New England forests and forest owners: implications for wildlife habitat resources and management**. Transactions of the North American Wildlife and Natural Resources Conference. 53:78-87.

Brooks, Robert T.; Frieswyk, Thomas F.; Ritter, Arthur. 1986. **Forest wildlife habitat statistics for Maine-1982**. Resour. Bull. NE-96. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 146 p.

Brooks, Robert T.; Sykes, Karen J. 1984. **Sampling land use edge from aerial photographs--line transect vs. circular pattern**. Res. Note NE-321. Broomall,

PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 6 p.

Burns, Barbara A.; Houston, David R. 1987. **Managing beech bark disease.** Northern Journal of Applied Forestry. 4: 28-32.

Connecticut Department of Economic Development. 1991. **Connecticut market data 1990-1991**. Rocky Hill, CT: Connecticut Department of Economic Development, Policy, Planning, and Research Division. 87 p.

Cronon, William. 1983. **Changes in the land: Indians, colonists, and the ecology of New England.** New York: Hill and Wang. 241 p.

DeGraaf, Richard M.; Rudis, Deborah D. 1986 **New England wildlife: habitat, natural history, and distribution.** Gen. Tech. Rep. NE-108. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 491 p.

Dickson, David R.; Bowers, Teresa M. 1986. **Forest statistics for Connecticut.** Resour. Bull. NE-44. Upper Darby, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 40 p.

Dickson, David R., McAfee, Carol L. 1988a. **Forest statistics for Connecticut-1972 and 1985**. Resour. Bull. NE-105. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 102 p.

Dickson, David R.; McAfee, Carol L. 1988b. **Forest statistics for Rhode Island--1972 and 1985**. Resour. Bull. NE-104. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 96 p.

Dickson, David R.; McAfee, Carol L. 1988c. **Forest statistics for Massachusetts--1972 and 1985**. Resour. Bull. NE-106. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 112 p.

Ferguson, Roland H.; Howard, Milford C. 1956. **The timber resources in Massachusetts**. Upper Darby, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 44 p.

Ferguson, Roland H.; McGuire, John R. 1957. **The timber resources of Rhode Island**. Upper Darby, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 38 p.

Gansner, David A.; Arner, Stanford L.; Birch, Thomas W. 1990. **Timber value growth rates in New England**. Res. Pap. NE-632. Radnor, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 14 p.

Gill, John D.; Healy, William M. 1974. **A handbook on shrubs and vines**. Gen. Tech. Rep. NE-9. Upper Darby, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 180 p.

Greenbaum, D. S.; O'Donnell, A. 1987. **Losing ground: the case for land conservation in Massachusetts**. Lincoln, MA: Massachusetts. Audubon Society. 34 p.

Griswold, Norman B.; Ferguson, Roland H. 1957. **The timber resources of Connecticut**. Upper Darby, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 36 p.

Healy, William M.; Brooks, Robert T.; DeGraaf, Richard M. 1989. **Cavity trees in sawtimber-size oak stands in central Massachusetts**. Northern Journal of Applied Forestry 6: 61-65.

Kingsley, Neal P. 1974. **The timber resources of Southern New England**. Resour. Bull. NE-36. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 50 p.

Kingsley, Neal P. 1976. **The forest-land owners of Southern New England**. Resour. Bull. NE-41. Upper Darby, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 27 p.

Little, Elbert L., Jr. 1979. **Checklist of United States Trees (native and naturalized)**. Agric. Handb. 541. Washington, DC: U.S. Department of Agriculture. 375 p.

Millar, Scott. 1984. **Rhode Island forest resources management plan**. Rep. No. 45. Providence, RI: Rhode Island Office of State Planning and Division of Forest Environment.

More, Muriel E. 1985. **Massachusetts forest resources--a working guide to action**. Amherst, MA: Division of Forests and Parks, Massachusetts Department of Environmental Management. 112 p.

Nevel, Robert L.; Wharton, Eric H. 1988. **The timber industries of Southern New England-a periodic assessment of timber output**. Resour. Bull. NE-101. Radnor, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 28 p.

Peters, John R.; Bowers, Teresa M. 1977a. **Forest statistics for Massachusetts**. Resour. Bull. NE-48. Upper Darby, PA: U.S. Department Agriculture, Forest Service, Northeastern Forest Experiment Station. 43 p.

Peters, John R.; Bowers, Teresa M. 1977b. **Forest statistics for Rhode Island**. Resour. Bull. NE-49. Upper Darby, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 38 p.

Spurr, Stephen H.; Barnes, Burton V. 1980. **Forest Ecology**, 3rd edition. John Wiley & Sons, N.Y. 687 p.

Smith, David M. 1986. **The practice of silviculture**, 8th ed. New York: John Wiley & Sons. 527 p.

U.S. Department of Commerce, Bureau of the Census. 1987. **Statistical abstract of the United States: 1988**, 108th ed. Washington, DC: U.S. Department of Commerce, Bureau of the Census. 943p.

Tree, Shrub, and Vine Species of Southern New England as Encountered on Field Plots)

Common name	Scientific name[1]
	SOFTWOOD TREES
Balsam fir	*Abies balsamea*
Atlantic white-cedar	*Chamaecyparis thyoides*
Eastern redcedar	*Juniperus virginiana*
Tamarack (native)	*Larix laricina*
Norway spruce	*Picea abies*
Red spruce	*P. rubens*
Red pine	*Pinus resinosa*
Pitch pine	*P. rigida*
Eastern white pine	*P. strobus*
Scotch pine	*P. sylvestris*
Northern white-cedar	*Thuja occidentalis*
Eastern hemlock	*Tsuga canadensis*
	HARDWOOD TREES
Boxelder[2]	*Acer negundo*
Striped maple[2]	*A. pensylvanicum*
Red maple	*A. rubrum*
Silver maple	*A. saccharinum*
Sugar maple	*A. saccharum*
Mountain maple[2]	*A. spicatum*
Ailanthus[2]	*Ailanthus altissima*
Serviceberry species[2]	*Amelanchier sp.*
Yellow birch	*Betula alleghaniensis*
Sweet birch	*B. lenta*
Paper birch	*B. papyrifera*
Gray birch[2]	*B. populifolia*
American hornbeam[2]	*Carpinus caroliniana*
Hickory species	*Carya* sp.
Bitternut hickory	*C. cordiformis*
Pignut hickory	*C. glabra*
Shagbark hickory	*C. ovata*
Mockernut hickory	*C. tomentosa*
American chestnut[2]	*Castanea dentata*
Flowering dogwood[2]	*Cornus florida*
Hawthorn species[2]	*Crataegus* sp.
American beech	*Fagus grandifolia*
White ash	*Fraxinus americana*
Black ash	*F. nigra*
Green ash	*F. pennsylvanica*
Butternut	*Juglans cinerea*
Yellow-poplar	*Liriodendron tulipifera*
Apple species[2]	*Malus* sp.
Black tupelo	*Nyssa sylvatica*
Eastern hophornbeam[2]	*Ostrya virginiana*

American sycamore	*Platanus occidentalis*
Balsam poplar	*Populus balsamifera*
Eastern cottonwood	*P. deltoides*
Bigtooth aspen	*P. grandidentata*
Quaking aspen	*P. tremuloides*
Cherry	*Prunus* sp.
Pin cherry[2]	*P. pensylvanica*
Black cherry	*P. serotina*
Chokecherry[2]	*P. virginiana*
White oak	*Quercus alba*
Swamp white oak	*Q. bicolor*
Scarlet oak	*Q. coccinea*
Bear oak, scrub oak[2]	*Q. ilicifolia*
Pin oak	*Q. palustris*
Chestnut oak	*Q. prinus*
Northern red oak	*Q. rubra*
Post oak	*Q. stellata*
Black oak	*Q. velutina*
Black locust	*Robinia psuedoacacia*
Willow species[2]	*Salix* sp.
Sassafras[2]	*Sassafras albidum*
American mountain-ash[2]	*Sorbus americana*
European mountain-ash[2]	*S. aucuparia*
American basswood	*Tilia americana*
Elm species	*Ulmus* sp.
American elm	*U. americana*
Slippery elm	*U. rubra*

DECIDUOUS SHRUBS

Alder species	*Alnus* sp.
Chokeberry species	*Aronia* sp.
Azalea species	*Azalea* sp.
Barberry species	*Berberis* sp.
Sweetfern	*Comptonia peregrina*
Alternate-leaved dogwood	*Cornus alternifolia*
Silky dogwood	*C. amomum (obliqua)*
Round-leaved dogwood	*C. rugosa (circinata)*
Gray-stemmed/panicled dogwood	*C. racemosa (paniculata)*
Red-osier dogwood	*C. stolonifera*
American hazelnut	*Corylus americana*
Beaked hazelnut	*C. cornuta (rostrata)*
Huckleberry species	*Gaylussacia* sp.
Witch-hazel	*Hamamelis virginiana*
Winterberry holly	*Ilex verticillata*
Common spicebush	*Lindera benzoin*
Honeysuckle species	*Lonicera sp.*
Ninebark	*Physocarpus opulifolius*
Buckthorn species	*Rhamnus* sp.
Smooth sumac	*Rhus glabra*
Staghorn sumac	*R. typhina*
Poison sumac	*R. vernix*
Currant species	*Ribes* sp.

Rose species	*Rosa* sp.
Brier, bramble species	*Rubus* sp.
American elderberry	*Sambucus canadensis*
Spirea species	*Spirea* sp.
American bladdernut	*Staphylea trifolia*
Blueberry species	*Vaccinium* sp.
Viburnum species	*Viburnum sp.*
Maple-leaved viburnum	*V. acerifolium*
Hobblebush viburnum	*V. alnifolium*
Wild raisin	*V. cassinoides*
Nannyberry	*V. lentago*
Blackhaw	*V. prunifolium*
Highbush cranberry	*V. trilobum*
EVERGREEN SHRUBS	
Common juniper	*Juniperus communis*
Sheep Issrel	*Kalmia angustifolia*
Mountain laurel	*K. latifolia*
DWARF SHRUBS	
Canadian bunchberry	*Cornus canadensis*
Creeping snowberry	*Gaultheria hispidula*
Teaberry	*G. procumbens*
Partridgeberry	*Mitchella repens*
VINES	
American bittersweet	*Celastrus scandens*
Clematis species	*Clematis* sp.
Virginia creeper	*Parthenocissus quinquefolia*
Poison ivy	*Rhus radicans*
Greenbrier species	*Smilax* sp.
Grape species	*Vitis* sp.

[1]Names according to Little (1979).

[2]Noncommercial tree species.

Sampling Errors for Selected Estimates, Southern New England, 1972 and 1985

Timberland classification	1972 estimate	1985 estimate
	----------Percent----------	
All timberland	1.3	0.9
Forest-type group		
White/red pine	9.9	8.1
Spruce/fir	56.6	43.9
Hard pine	30.5	21.2
Oak/pine	18.9	15.5
Oak/hickory	5.2	4.3
Elm/ash/red maple	26.0	16.0
Northern hardwoods	9.4	6.8
Aspen/birch	60.6	39.3
Stand-size class		
Sawtimber	6.2	3.4
Poletimber	6.1	5.5
Sapling/seedling	9.0	13.1
Nonstocked	-	98.4

Sampling Errors for Selected Estimates, Southern New England, 1972 and 1985

Species and diameter class	Number of trees		Volume			
			Growing-stock		Sawtimber	
	1972	1985	1972	1985	1972	1985
	-------Percent-------		----------Percent----------			
Spruce/fir	43.2	37.6	55.0	30.2	61.9	32.7
Red pine	34.5	46.4	48.4	51.9	56.8	54.3
Pitch pine	25.4	25.5	28.4	18.8	36.5	21.5
White pine	9.1	12.2	9.9	8.7	9.5	9.7
Hemlock	15.3	14.0	16.8	11.1	18.1	12.4
Other softwoods	28.3	40.9	56.8	41.6	75.2	30.1
All softwoods	6.6	8.0	7.2	6.2	7.4	7.3
Red maple	5.8	6.9	8.3	5.5	13.2	7.5
Sugar maple	13.5	12.6	16.2	12.8	20.7	15.3
Yellow birch	16.5	16.6	17.7	13.1	25.4	18.4
Sweet birch	12.0	12.1	15.3	10.9	19.6	13.1
Paper birch	17.9	19.0	17.3	15.3	30.9	23.0
Hickory	14.2	15.2	17.9	11.3	28.3	15.1
Beech	17.9	19.9	18.7	12.6	24.9	16.0
White ash	12.8	15.8	16.3	11.0	21.1	14.2
Aspen	17.5	27.1	24.2	17.5	39.8	21.9
Black cherry	14.5	16.9	20.1	13.2	24.8	20.1
White oak	11.3	11.6	9.1	7.1	11.0	9.7
Northern red oak	10.2	8.7	8.2	6.9	9.9	7.8
Other red oaks	10.5	9.7	10.1	6.3	12.0	7.5
Elm	19.4	39.0	22.9	21.9	44.1	36.2
Other hardwoods	25.5	19.0	16.7	12.8	22.7	15.0
All hardwoods	3.2	3.7	3.5	2.4	5.3	3.4
All species	2.7	3.4	2.4	2.1	3.5	3.3
D.b.h. class (inches)						
5.0 to 6.9	4.0	3.0	5.3	3.4	-	-
7.0 to 8.9	3.8	2.9	4.3	3.1	-	-
9.0 to 10.9	3.9	3.0	4.1	3.3	11.7	9.8
11.0 to 12.9	4.5	3.1	4.3	3.3	5.1	3.3
13.0 to 14.9	5.8	3.4	5.9	3.6	5.8	3.6
15.0 to 16.9	6.0	4.5	6.0	4.8	5.8	4.9
17.0 to 18.9	6.9	6.1	7.4	6.6	7.4	6.6
19.0 to 20.9	8.7	7.9	9.4	8.3	9.0	8.3
21.0 to 28.9	9.1	7.9	10.3	8.9	10.4	9.0
29.0+	17.2	16.9	22.3	22.8	22.5	22.2

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Brooks, Robert T.; Kittredge, David B.; Alerich, Carol L. 1993. **Forest resources of southern New England.** Resour. Bull. NE-127. Radnor, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 71 p.

An analytical report of the third forest inventory of the three southern New England states of Connecticut, Massachusetts, and Rhode Island. Included is a discussion of forest area, number of trees, timber volume, tree biomass, timber value, forest wildlife habitat, ownership, management opportunities, and the future of forest resources in southern New England.

Keywords: Forest survey, inventory, area, volume, biomass, wildlife habitat, ownership, management opportunities

Headquarters of the Northeastern Forest Experiment Station is in Radnor, Pennsylvania. Field laboratories are maintained at:

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