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# Incidence and Impact of Damage to Tennessee's Timber, 1982

Paul A. Mistretta, Carl V. Bylin, and Roger Baker

## SUMMARY

The Southern Forest Experiment Station in Starkville, MS, periodically inventories and evaluates forest resources in Alabama, Arkansas, Louisiana, Mississippi, Oklahoma, Puerto Rico, Tennessee, and Texas. Survey data were collected in 1979, 1980, 1981, and 1982 by the Forest Inventory and Analysis work unit of the Southern Forest Experiment Station as part of the fifth inventory of Tennessee's forests. Considerably more information was gathered for this inventory than in previous data collections, making possible the publication of this specialized report summarizing information on agents that damage timber in Tennessee's forests.

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## INTRODUCTION

During the periodic inventory of Tennessee's forests conducted from 1979 to 1982 by the Southern Forest Experiment Station, Starkville, MS, damage to live trees on sample plots was noted, and, where possible, a cause or damaging agent was specified. Since a plot is visited only once during the survey, and that visit can be at any time of the year, only agents that produce durable symptoms or signs of damage were reported.

Since the data reported here were gathered by people trained and experienced in forest inventory, not entomology or pathology, qualified people from Region 8, State and Private Forestry, Forest Pest Management, trained the field crews to use a damage-identification handbook (Anderson et al. 1980) before going out on the field survey. Specimen kits and forms were provided to crew members for submission of damage samples they might be unable to identify in the field. During the survey, field checks were made to ensure the accuracy and consistency of the recording and collection of the data.

Agents selected to be included in the survey were required to be (1) easily identifiable, (2) present year-round, and (3) present on trees at least 1 inch in diameter at breast height (d.b.h.). Therefore, small trees with problems such as brown spot and trees of all sizes with damage such as defoliation (which is not apparent in winter) are not included in this report.

There are several reasons why this report does not completely assess the incidence and impact of all damage observed in Tennessee's forests. First, damage is caused by a wide variety of agents; some are easily recognized, others are more difficult to identify. The data presented here for damaging agents that are easily identified and persistent, such as stem and branch rust, are reliable. The data for damaging agents that are more difficult to recognize, such as root rot, are underestimated.

Second, certain types of damage can only be observed during part of the year; these have not been included in this survey in a dedicated category. For example, defoliation caused by insects is only evident at the time of year during which trees normally have leaves, and insects are active. Since survey crews work year-round, defoliation data could not be consistently collected and is recorded only as "other insect" when observed during the summer.

Third, some damaging agents cause trees to die rapidly; these trees were recorded in a mortality (not a damage) category. For instance, trees attacked by bark beetles in summer tend to die rapidly. If the survey crew found a tree with evidence of bark beetle activity, there was a good chance that it was already dead and was tallied as such. Thus, many bark beetle damaged trees would not be recorded in the "Bark Beetle" damage category.

And finally, this was the first survey by the Southern Station crews where these detailed damage codes were recorded. Some inconsistency was seen in the early application of the codes.

Data presented in this Bulletin were compiled for this report in a separate computer run. Similarity will be seen between acres of forest types, timber removals, and mortality by species when compared to numbers presented in "Forest Statistics for Tennessee Counties" (USDA For. Serv. 1982). Differences in accumulation, definition changes, and rounding will account for the differences in numbers presented.

In spite of these problems the survey gives a good picture of the relative incidence of the preselected, easily recognized damage types (or agents) that persist year round.

## SAMPLING PROCEDURE

The sampling procedure used for this inventory was designed to provide reliable statistics on a statewide basis or for large groups of counties. It also accurately summarizes species having a relatively large total volume in the State. However, errors associated with relatively minor species, like cottonwood or pondcypress, exceed those for such major species as loblolly pine.

Paul Mistretta is a Supervisory Plant Pathologist with Southern Region, Forest Pest Management, Pineville, LA. Carl V. Bylin is a Forester with Southern Forest Experiment Station, USDA Forest Service, Starkville, MS. Roger Baker was formerly a Range Scientist, Southern Forest Experiment Station, Forest Inventory and Analysis, Starkville, MS. (Currently, Soil Scientist, Southern Forest Experiment Station, Forest Hydrology Laboratory, Oxford, MS.)

The data on forest acreage and timber volume in this report were obtained by a sampling method involving a forest-nonforest classification on aerial photographs linked to ground measurements of trees at sample locations. The sample locations were at the intersections of a grid of lines spaced 3 miles apart. In Tennessee, 123,516 photographic classifications were made and 6,941 ground locations were visited. The initial estimates of forest area obtained from aerial photographs were adjusted on the basis of the ground check.

A cluster of 10 variable-radius plots was installed at each ground sample location. Each sample tree on the variable-radius plots represented 3.75 square feet of basal area per acre. Trees less than 5.0 inches in diameter were tallied on fixed-radius plots around the plot centers. Trees on a subsample of plots were measured in detail to obtain data for calculating timber volumes.

Plots established during the fourth survey of Tennessee (Murphy 1972) were remeasured during this (the fifth) survey to determine the elements of change, and these remeasured plots are the basis for estimating growth, mortality, removals, and changes in land use.

## COMPUTATION METHODS

Limits on size classes of trees were: saplings, 1.0 to 4.9 inches d.b.h.; softwood poles, 5.0 to 8.9 inches d.b.h.; hardwood poles, 5.0 to 10.9 inches d.b.h.; softwood sawtimber ≥9.0 inches d.b.h.; and hardwood sawtimber ≥11.0 inches d.b.h. Volume equations based on measurements of standing trees in Tennessee were used to compute merchantable and total cubic volume.

Percentage of loss in an individual tree was estimated in the field. Volume loss by pest/tree combination and total volume loss attributable to all agents damaging a species were subsequently computed. Data on percent incidence of damage do not imply total economic loss; only a part of the volume in cull would fail to qualify for some commercial use, such as firewood. Cull includes loss due to crooks, limbs, decay, missing wood, sweep, large forks, and sections of the bole too rough to be used as pulpwood or sawtimber. The volume loss was determined by totaling the volume of cull by species.

Mortality could not be attributed to specific damaging agents because it was often impossible to determine the cause of death. In many cases, a tree which had been tallied in the fourth survey 10 years earlier (Murphy 1972) was simply missing. It was possible, however, to determine volume loss due to mortality for each tree species on each plot. Accumulating total volume per dead tree by tree species resulted in the total volume loss for poles and sawtimber by tree species. Economic impact was determined by multiplying the total wood fiber and quality loss for each tree species by the stumpage value per unit. These dollar estimates were taken from an average of a sample of timber sales in Tennessee in 1982.

## INCIDENCE OF DAMAGING AGENTS

Tennessee has 12,863,200 acres of commercial forest, and most of the acreage is in the oak-hickory, mixed hardwood, oak, Virginia pine, and Virginia pine/hardwood forest types. Table 1 shows the acreage in the various stand-size classes and forest types. The remaining tables in this report show how much of the timber resource was damaged and the agents responsible for the damage. Remember, the term "damage" refers to an injury the tree has suffered. A damaged tree is still living. The term "cull" as used in this report includes damage due to crooks, limbs, decay, missing wood, sweep, large forks, and volume in sections of the bole that are too rough to be utilized as pulpwood or as sawtimber.

Tables 2 and 3 show percentage of trees damaged, by size class and tree species. Overall, hardwoods had more damage than softwoods, and more sawtimber was damaged than poletimber or saplings. Eastern red cedar, Virginia pine, and shortleaf pine were the most abundant softwood species in Tennessee, and 25 percent or more of both poletimber- and sawtimber-size trees of all three species were damaged.

The percentage of saplings damaged was generally much higher for hardwoods than softwoods. In most hardwood species, 40 to 70 percent of the saplings were damaged. The most frequently damaged saplings were basswood and black walnut. Hardwood poletimber was damaged more often than saplings but less often than sawtimber. All of the cottonwood poletimber seen showed damage.The most frequently damaged hardwood sawtimber trees were beech, soft and hard maples, and blackgum. More than 70 percent of the trees in these species were damaged.

Table 4 shows the incidence of damage to various softwood hosts. The most common causes of softwood damage were suppression and stagnation, weather, and logging. These types of damage were reported for almost all of the softwoods. Fusiform (caused by *Cronurtium quercuum* (Berk.) Miy. ex Shirai f. sp. *fusiforme*), comandra (caused by *Cronartium comandrae* Pk.), and eastern gall rust (caused by *Cronartium quercuum* (Berk.) Miy. ex Shirai f. sp. *quercuum*) are lumped into the category gall rusts. These rusts were recorded only if the gall was on or within 12 inches of the main stem. If galls farther out on limbs had been recorded, the reported incidence of rust would have been much greater. Incidence of these three diseases was significantly lower than expected, affecting less than 1 percent of the loblolly, shortleaf,

and Virginia pines. Basal defect, branch stubs, and dieback were also commonly reported on softwoods.

Bark beetles are considered to be the most serious insect pest of the pine in the Southeast; however, no bark beetle damage on live softwood trees was reported. The main reason for this is that this survey only reports damage to living trees, and most often bark beetles kill their host trees and dead trees were recorded as mortality.

Reported incidence of damage due to insects on both hardwoods and softwoods was very low. However, it is believed that insect damage is significantly underestimated due to the difficulty in diagnosing and evaluating incidence and severity of many types of insect-caused damage.

Table 5 shows the incidence of damage to hardwoods. All of the reportable problems were recorded during the survey. The most common problems observed in hardwoods were branch stubs, dieback, root rots, weather, and suppression and stagnation. Saplings of all hardwoods had some degree of branch stubs; basswood was the worst, with 5.5 percent of the saplings damaged. Damage from branch stubs increased with increased age. Incidence averaged 7.1 percent in poletimber and 8.2 percent in sawtimber. Saplings also had a high incidence of damage due to suppression and stagnation; this damage was reported for 13 of the 16 hardwoods. Mean (unweighted) incidence of damage to the 13 hardwoods was 12.1 percent for saplings; but, as expected, by the sawtimber stage this problem was reported for only 3 of the 16 hardwoods (unweighted mean incidence of .2 percent for the three species). Other diseases were reported at a very high level. With only one exception (cottonwood, a minor forest component), damage in this heterogeneous class ranged from 10 to 65 percent incidence. Other diseases is the primary complex which affects major forest species in the merchantable classes. Generally other diseases ranged from 5 to 15 percent for softwood and 10 to 25 percent for hardwood.

Among the minor forest species, an extremely high percentage (74.9 percent) of the cottonwood poletimber was damaged by weather. Basswood saplings were damaged by other diseases in 65.9 percent of the sample. There are, however, only three other hardwoods where incidence of a specific damaging agent exceeds 30 percent.

## MORTALITY, LOSSES TO CULL, QUALITY LOSS, AND ECONOMIC IMPACT

Annual mortality of softwood timber is shown in table 6. Softwood poletimber mortality was more than 65 percent of the annual volume of poletimber removals while sawtimber mortality represented approximately 25 percent of the annual sawtimber removal volume. For hardwoods the figures are approximately 50 percent for poletimber and 15 percent for sawtimber. The mortality figures shown in table 6 are the total for the resource and do not reflect any discounting for trees whose death represented no economic loss. Table 6 also shows the estimated volumes of cull for the major species groups in Tennessee. Annual timber removal figures are given to place the volume losses in perspective.

There are approximately 7.3 hardwoods for each softwood in the state. When volume loss is compared (softwood:hardwoods), however, both the sawtimber (4.3:1) and poletimber (4.4:1) ratios suggest a much more severe volume loss per unit in softwoods. Analysis of this loss showed that hardwood poletimber cull was significantly greater per unit than softwood cull (20.3:1.0), but softwood mortality per unit is greater in both sawtimber (2.9:1.0) and poletimber (2.8:1.0) classes. Cull in the sawtimber category approximates the population ratio (8.1:1.0 vs 7.3:1.0).

The economic impact of damaging agents is greatest in hardwood sawtimber, which showed an annual loss of about $16.5 million (table 7). Poletimber value loss is similar for both hardwood ($789 million) and for softwoods ($658 million) despite a major discrepancy in volume lost (64 $MMft^3$). This is a reflection of the skew of pole value in favor of softwood poletimber. Overall, 80 percent of all economic impact was in hardwoods, and about 93.5 percent of the total economic impact was in sawtimber-size trees.

## DAMAGING AGENTS, GROWTH DEFECTS, AND SYMPTOMS

The definitions presented under the subheadings Diseases, Growth Defects, Natural Phenomena, Animals and Birds, Insects, and Human Activities are those used in the field manual prepared by Anderson, et al. (1980). They describe the problems reported by the field crews.

### Diseases

***Fusiform*** Rust.-Common host species: Slash, loblolly, and shortleaf pines. Symptoms and signs: Spindle-shaped galls formed on the stem or on branches within 12 inches (30.5 cm) of the bole. Older galls appear as cankers with sunken, rotten centers encircled by a callus ridge. Witches' brooms are common at galls. Bright orange spores are produced on the galls in the spring.

***Hardwood Cankers.*** -Common host species: All hardwoods. Symptoms and signs: Dead, sunken area formed on the stem, frequently with annual callus ridges around the dead area.

***Littleleaf Disease.*** -Common host species: Shortleaf and loblolly pines, but shortleaf is more suscepti-

ble. Symptoms and signs: Affected trees occur in groups. Short, yellow needles; reduced shoot growth and large crops of under-sized cones are typical symptoms. Littleleaf disease usually occurs in trees growing on heavy clay soils with poor internal drainage.

Pitch Canker.-Common host species: Most southern pines, but primarily slash, loblolly, and shortleaf. Symptoms and signs: Flagging at branch ends, pitch flow from affected area, slight swelling on affected stems and twigs, crooks in main stem, and wilting of current candles are all symptoms of this disease.

Root ***Rots.*** -Common host species: All tree species. Symptoms and signs: Diseased trees, often with thin, tufted crowns, frequently occur in groups that usually contain dead or windthrown trees. Conks (fruiting bodies) of various fungi may be present on or near the bases of diseased trees. Boot rots are more frequent in trees of reduced vigor, thinned stands, and in trees with butt or root injury. Trees with root rots are often subsequently attacked by bark beetles.

***Other*** Diseases.-Common host species: All tree species. Symptoms and signs: All damage caused by diseases not identified in separate categories (e.g., red heart of pine, brown spot, and leaf diseases). Trees showing degrade caused by diseases are included in this category.

### Growth **Defects**

**Brunch *Stubs.*** -Common host species: All tree species. Symptoms and signs: Branch holes or stubs greater than 4.0 inches in diameter on stems of trees 5.0 inches d.b.h. and larger or greater than 1.0 inch in diameter on stems of trees 1.0 to 4.9 inches d.b.h.

***Basal Defect.-Common*** host species: All tree species. Symptoms and signs: Butt swelling, curls, V-shaped stump sprouts, frost seams, and low stubs below 4.5 feet are symptoms of basal defect.

***Dieback***. -Common host species: All hardwoods. Symptoms and signs: Tips of the branches die back. Initially, only a few branches are affected, but in advanced stages, entire branches die with the possibility of tree mortality. **Dieback** is frequently associated with stress caused by an unfavorable environment.

***Suppression and Stagnation.-Common*** host species: All tree species. Symptoms and signs: Suppressed and stagnated trees are characterized by poor form and small crowns. Suppressed trees are overtopped and receive indirect sunlight. Stagnated trees have thin foliage despite receiving some direct sunlight. Stagnation is usually associated with poor growing sites or overstocking.

***Form (damaging)*** .-Common host species: All tree species. Symptoms and signs: All trees 5.0 inches d.b.h. and larger that are deformed due to unknown causes.

### **Natural** Phenomena

Fire.-Common host species: All tree species. Symptoms and signs: Fire scars are usually at the base of the stem and are widespread in the stand. **The** scars are usually on the uphill side of the tree, and signs of charring are generally present on the stem.

***Flooding.—Common*** host species: All tree species. Symptoms and signs: Yellowing and curling downward of leaves, premature leaf fall, branch and top **dieback,** tree mortality, and high water and silt marks on tree boles are the most common effects of flooding.

***Lightning.*** -Common host species: All tree species. Symptoms and signs: Lightning causes bark stripping or cracking, with damage running from the strike point to the ground in a straight or spiral line. Often, the foliage will fade due to root damage or top breakage. Bark beetles often invade struck trees.

***Weather.-Common*** host species: All tree species. Symptoms and signs: Windthrow, ice, frost cracks, broken tops, broken branches, marginal leaf burn, and winter burn are the common symptoms.

### Animals **and** Birds

Beaver.-Common host species: All tree species. Symptoms and signs: Beavers leave toothmarks and remove the bark from the bole of the tree. Trees are often flooded by water impoundment, which can lead to flooding damage and death.

***Other Animals.-Common*** host species: All tree species. Symptoms and signs: Branches clipped off or broken, bark removed, holes in the stem, and tears and toothmarks in the wood are all common signs of animal activity.

***Sapsucker.*** -Common host species: All tree species. Symptoms and signs: Horizontal rows of small holes that may encircle the tree's bole are seen. Bark below the holes is usually streaked or stained by oozing sap.

### **Insects**

***Bark Beetles***.-Common host species: All pines. Symptoms and signs: Symptoms include pitch tubes, bark beetle galleries on the inner bark surface and the surface of the **sapwood,** exit holes, and loose bark. Streaks caused by blue stain fungi are often evident in the **sapwood.** Foliage of infested trees gradually yellows and then turns red.

***Hardwood Borers.*** -Common host species: All hardwoods. Symptoms and signs: The initial symptom is a dark sap spot on the bark surface, often mixed with frass. Eventually, coarse boring particles appear in bark cracks and crevices beneath the point of attack. Old damage appears as knobby overgrowths or scars on the bark surface.

***Terminal Shoot and Stem*** Borers.-Common host species: All tree species. Symptoms and signs: Fresh attacks show boring dust and frass at the entrance holes, which are most often located at the base of leaf petioles and buds. Resin globs may be present at points of attack. Dieback results from larval tunneling within terminal shoots and branches. Foliage on the shoots turns yellow, red, and finally brown.

***Other Insects.*** -Common host species: All tree species. Symptoms and signs: All damage caused by insects not identified in separate categories. Includes hardwood defoliators (e.g., orangestriped oakworm and fall cankerworm), pine defoliators (e.g., redheaded pine sawfly), and pine weevils.

**Human Activities**

People.-Common host species: All tree species. Symptoms and signs: Initials in bark, nails in tree, burns from lanterns, stripped bark, wire around stem, and ax marks are signs of damage by people.

***Logging and*** Related.-Common host species: All tree species. Symptoms and signs: Logging scars on the stem will form callus ridges within 1 to 2 years after wounding. Trees with logging damage are scattered in stands and show no charring. Broken limbs and scars on the stem near the crown will occur from the felling of other trees. Skid trails, stumps, or other evidence of logging will be present.

## FOREST SURVEY TERMS

The following terms, used by the Forest Inventory Analysis group are presented to clarify some of the constraints placed on the data collected, and on subsequent data analysis.

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

***Annual Accumulated*** Cull.-Total cull divided by the intrasurvey period.

***Basal*** Area.-The area in square feet of the cross section at breast height of a single tree or of all the trees in a stand, usually expressed in square feet per acre.

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

***Cull*** Volume.-Total volume loss due to crooks, limbs, decay, missing wood, sweep, large forks, and volume in sections of the bole too rough to be used as sawtimber or pulp.

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

***D.b.h.*** (Diameter at breast height).-Tree diameter in inches, outside bark, measured at 4.5 feet above ground.

***Diameter Class.*** -A classification of trees based on diameter outside bark, at d.b.h. Two-inch diameter classes are commonly used in forest surveys, with the even numbered inch as the approximate midpoint for a class. For example, the 6-inch class includes trees 5.0 through 6.9 inches d.b.h.

***Growing-Stock Trees.*** -Live trees of commercial species excluding rough and rotten trees.

***Hard woods.*** -Dicotyledonous trees, usually broadleaved and deciduous.

***Incidence.*** -Percentage of susceptible trees affected by a damaging agent.

***Intrasurvey Period.*** -The number of years between the current survey and the past survey.

***Mortality.*** -Number or sound-wood volume of live trees that died from natural causes during the intrasurvey period.

***Poletimber Trees.*** -Live trees of commercial species at least 5.0 inches d.b.h. but smaller than sawtimber size, of good form and vigor.

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

***Saplings.*** -Live trees 1.0 to 4.9 inches d.b.h. and of good form and vigor.

***Saw*** Log.-A log meeting minimum standards of diameter, length, and defect, including logs at least 8 feet long, sound and straight, with a minimum diameter inside bark of 6.0 inches for softwoods and 8.0 inches for hardwoods.

***Sawtimber*** Trees.-Live trees of commercial species containing at least one 12-foot saw log, or two noncontiguous saw logs, each 8 feet or longer, with at least one-third of the gross board-foot volume between the l-foot stump and minimum saw log top being sound. Softwoods must be at least 9.0 inches d.b.h. and hardwoods at least 11.0 inches d.b.h.

***Sawtimber Volume.-Net*** volume of the saw log portion of live sawtimber in board feet of the International rule, l/Cinch kerf.

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

***Species Groups.-Sets*** of tree species pooled together for standard reporting.

. Hard maples: Florida, black, and sugar maples.
. Soft maples: Boxelder, red, and silver maples.
. Select red oaks: Cherrybark, northern red, and shumard oaks.
. Other red oaks: Scarlet, southern red, laurel, water, willow, black, and others not in select red oaks.
. Select white oaks: White, swamp white, bur, and swamp chestnut oaks.
. Other white oaks: Overcup, chestnut, post, live, and others not in select white oaks.

. Other eastern hardwoods: Buckeye, birch, hackberry, dogwood, persimmon, honeylocust, silverbell, holly, butternut, cucumbertree, mulberry, scrub oaks, willow, and other commercial species.

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

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

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

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

***Susceptible Trees.*** -All living trees. Includes desirable and acceptable trees, as well as rough and rotten trees.

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

*TSI*. -Timber stand improvement.

## LITERATURE CITED


Anderson, R. L.; Mistretta, P. A.; Earle, E.; Fisher, V.; Ghent, J.; Hoffard, W.; Johnson, K.; Lee, M.; Miller, R.; Stein, K.; Warlick, L. Forest insect and disease handbook: Renewable resource evaluation. Gen. Rep. SA-GR14. Atlanta, GA: U.S. Department of Agriculture, Forest Service, State and Private Forestry, Southeastern Area, Forest Insect and Disease Management; 1980. 58 p.

Birdsey, Richard A. Tennessee Forest Resources. Resour. Bull. SO-90. New Orleans, LA: U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station; 1983. 35 p.

Murphy, P. A. Forest Resources of Tennessee. Res. Bull. SO-35. New Orleans, LA: U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station; 1972. 33 p.

U.S. Department of Agriculture, Forest Service. Forest Statistics for Tennessee Counties. Res. Bull. SO-89. New Orleans, LA: U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station; 1982. 64 p.

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Table 1.—*Area of commercial forest land in Tennessee, by stand-size class and forest type*

| Forest classification | Thousands of acres[1] |
|---|---|
| Stand-size class: | |
| Sawtimber | 4,962.7 |
| Poletimber | 5,287.4 |
| Sapling-seedling | 2,545.1 |
| Understocked areas | 68.0 |
| All stand sizes | 12,863.2 |
| Forest type: | |
| White oak-red oak-hickory | 7,016.6 |
| Mixed hardwoods | 959.9 |
| Virginia pine-southern red oak | 523.2 |
| Yellow poplar-white oak-N. red oak | 488.1 |
| Virginia pine | 485.8 |
| Eastern redcedar-hardwood | 364.2 |
| Shortleaf pine-oak | 299.8 |
| Sweetgum-Nuttall oak-willow oak | 296.4 |
| Loblolly pine | 282.0 |
| Shortleaf pine | 259.5 |
| White oak | 241.3 |
| Sugarberry-American elm-green ash | 237.9 |
| Chestnut oak | 229.6 |
| Eastern redcedar | 229.3 |
| Sweetgum-yellow poplar | 197.8 |
| Post oak-black oak-bear oak | 112.8 |
| White pine-N. red oak-white ash | 97.0 |
| Loblolly pine-hardwood | 86.6 |
| Sycamore-pecan-American elm | 62.2 |
| Sweetbay-swamp tupelo-red maple | 59.6 |
| Maple-beech-birch | 59.6 |
| Cypress-tupelo | 42.3 |
| Other oak-pine | 39.8 |
| Sand pine | 38.4 |
| Pitch pine | 23.2 |
| Overcup oak-water hickory | 21.5 |
| Swamp chestnut oak-cherrybark oak | 20.9 |
| Willow | 20.3 |
| Cottonwood | 16.2 |
| Southern scrub oak | 14.0 |
| Hemlock | 10.7 |
| Table-mountain pine | 5.8 |
| All types | 12663.2 |

[1]Totals may not add due to rounding.

Table *Z.-Percentage of susceptible softwood trees damaged, by species and tree size in Tennessee*

| Host | Total population | Trees damaged | | | Volume of cull[1] | |
|---|---|---|---|---|---|---|
| | | Sapling | Poletimber | Sawtimber | Poletimber | Sawtimber |
| | *Thousands* | *Percent* | | | *Mft³* | *Mfbm* |
| Eastern redcedar | 385,692.4 | 34.1 | *38.8* | 44.4 | 6,997.0 | 5,050.2 |
| Virginia pine | 302,329.9 | 30.8 | *29.6* | 39.7 | 7,581.9 | 67,154.7 |
| Shortleaf pine | 153,729.3 | 32.2 | *27.4* | 25.0 | 1,797.9 | 24,992.7 |
| Loblolly pine | 118,874.7 | 15.3 | *21.4* | 29.6 | 1,219.0 | 16,336.5 |
| Eastern hemlock | 48,175.0 | 13.9 | *17.0* | 31.6 | 0.0 | 6,415.6 |
| Eastern white pine | 46,104.8 | 18.1 | *20.0* | 21.3 | 128.5 | 6,343.9 |
| Pitch pine | 16,067.7 | 54.7 | *27.4* | 35.7 | 597.2 | 9,640.9 |
| Table-mountain pine | 4,603.9 | 25.1 | *59.7* | 44.7 | 324.2 | 2,139.8 |
| Baldcypress | 2,326.6 | 0.0 | *41.7* | 70.7 | 159.6 | 9,285.1 |
| Balsam fir | 588.5 | 0.0 | *0.0* | 0.0 | 0.0 | 0.0 |
| Red spruce | 228.2 | 0.0 | *0.0* | 0.0 | 91.3 | 0.0 |
| Totals[2] | 1,078,721.1 | 29.57 | *29.43* | *33.55* | 18,896.5 | 147,359.4 |

[1]Cull due to crooks, limbs, decay, missing wood, sweep, large forks, and volume in sections of bole that are too rough to be utilized as pulpwood or as sawtimber.

[2]Totals may not add due to rounding.

Table 3.—*Percentage of susceptible hardwood trees damaged, by species and tree size in Tennessee*

| Host | Total population | Trees damaged | | | Volume of cull' | |
|---|---|---|---|---|---|---|
| | | Sapling | Poletimber | Sawtimber | Poletimber | Sawtimber |
| | *Thousands* | *Percent* | | | *Mft³* | *Mfbm* |
| Other eastern hardwoods | 2,871,071.7 | 32.8 | 52.1 | *72.3* | 98,180.7 | 123,756.6 |
| Hickories | 770,086.7 | 39.5 | 39.8 | 51.9 | 44,529.4 | 109,160.9 |
| Soft maple | 703,010.5 | 42.3 | 55.2 | 74.7 | 31,340.8 | 65,189.0 |
| Select white oaks[2] | 624,015.9 | 32.5 | 37.1 | 47.2 | *23,247.1* | 121,596.9 |
| Other red oaks | 577,024.8 | 29.5 | *36.5* | 53.0 | 37,513.7 | 228,069.3 |
| Blackgum/ tupelo | 506,981.7 | 54.1 | *62.7* | 71.7 | 13,935.8 | 33,549.7 |
| Other white oaks | 388,241.6 | 34.7 | 41.0 | 60.1 | 41,296.5 | 142,506.3 |
| Hard maple | 270,561.2 | 39.5 | 60.6 | 75.0 | 11,250.0 | 23,164.8 |
| Ash | 266,390.4 | 59.9 | 58.9 | 62.6 | 18,808.1 | 61,318.2 |
| Yellow-poplar | 260,684.1 | 26.3 | 39.4 | 48.9 | 10,638.4 | 91,065.8 |
| Sweetgum | 216,773.8 | 38.1 | 41.1 | 59.4 | 11,087.2 | 57,468.5 |
| Select red oaks[3] | 128,408.0 | 43.5 | 37.3 | *53.7* | 20,833.7 | 62,872.4 |
| Noncommercial | 110,480.4 | 10.0 | 8.5 | *6.9* | 1,436.5 | 345.4 |
| Beech | 90,392.7 | 47.9 | 59.3 | *77.2* | 5,318.7 | 43,856.7 |
| Black walnut | 29,198.2 | 62.1 | 57.2 | *69.0* | 3,678.1 | 11,245.4 |
| Basswood | 13,628.0 | 71.5 | 63.3 | *59.2* | 1,576.6 | 9,522.8 |
| Cottonwood | 982.3 | 0.0 | 100.0 | *65.5* | 0.0 | 2,999.4 |
| Totals[4] | 7,827,932.3 | 36.9 | 45.1 | 57.6 | 374,671.1 | 1,187.688.0 |

'Damage due to crooks, limbs, decay, missing wood, sweep, large forks, and volume in sections of bole that are too rough to be utilized as pulpwood or as sawtimber.

[2]White, swamp white, swamp chestnut, and bur oaks.

[3]Cherrybark, N. red, and shumard oaks.

[4]Totals may not add due to rounding.

Table 4.—*Approximate number of trees and percentage of damage/defect by softwood species and damaging agent or defect in Tennessee*

| Agent | Incidence of damage | | |
|---|---|---|---|
| | Saplings | Poletimber | Sawtimber |
| Eastern redcedar | 328,358,000 | 49,423,000 | 7,911,000 |
| Diseases-other | 1.9 | 7.0 | 14.2 |
| Boot rots | 0.0 | 0.4 | 0.0 |
| Cankers | 0.0 | 0.0 | 0.5 |
| Branch stubs | 1.4 | 5.6 | 5.7 |
| Dieback | 0.2 | 0.7 | 0.4 |
| Fire | 0.0 | 0.7 | 0.0 |
| Sapsucker | 0.0 | 0.3 | 0.0 |
| Weather-other | 5.8 | 6.6 | 6.3 |
| Suppression, stagnation | 13.9 | 1.3 | 0.0 |
| Unknown | 0.4 | 0.2 | 1.6 |
| Other-misc. (old age, etc.) | 9.3 | 14.8 | 14.7 |
| Peoule | 0.2 | 0.0 | 0.0 |
| Logging-damage | 0.8 | 0.0 | 0.6 |
| Offsite tree | 0.2 | 1.3 | 0.5 |
| Virginia pine | 185,556,000 | 84,390,000 | 32,384,000 |
| Insects-other | 0.0 | 1.1 | 2.0 |
| Diseases-other | 4.9 | 1.4 | 4.6 |
| Gall rusts | 0.0 | 0.5 | 0.0 |
| Branch stubs | 3.8 | 14.0 | 12.9 |
| Basal defects | 1.3 | 0.4 | 1.4 |
| Dieback | 0.0 | 0.0 | 0.5 |
| Pitch canker | 0.0 | 0.1 | 0.0 |
| Fire | 0.9 | 0.7 | 1.6 |
| Sapsucker | 0.0 | 0.0 | 0.2 |
| Weather-other | 0.3 | 1.4 | 3.1 |
| Flooding | 0.0 | 0.0 | 0.1 |
| Suppression, stagnation | 8.4 | 0.8 | 0.2 |
| Unknown | 0.0 | 0.3 | 0.3 |
| Other-misc. (old age, etc.) | 9.5 | 8.7 | 11.5 |
| Peoule | 0.0 | 0.0 | 0.5 |
| Logging-damage | 1.3 | 0.2 | 0.6 |
| Offsite tree | 0.6 | 0.0 | 0.2 |
| Shortleaf pine | 79,648,000 | 46,259,000 | 27,822,000 |
| Insects-other | 0.7 | 1.4 | 2.6 |
| Diseases-other | 1.5 | 2.5 | 0.9 |
| Gall rusts | 0.8 | 0.9 | 0.6 |
| Branch stubs | 0.9 | 3.1 | 6.1 |
| Basal defects | 0.0 | 0.5 | 0.5 |
| Dieback | 0.0 | 0.0 | 0.1 |
| Fire | 0.7 | 0.2 | 0.6 |
| Sapsucker | 0.0 | 0.0 | 0.3 |
| Weather-other | 3.5 | 5.2 | 2.9 |
| Suppression, stagnation | 12.0 | 1.4 | 0.4 |
| Unknown | 2.2 | 0.6 | 0.2 |
| Other-misc. (old age, etc.) | 7.9 | 10.6 | 9.1 |
| Logging-damage | 2.1 | 1.2 | 0.7 |
| Offsite trees | 0.0 | 0.2 | 0.0 |
| Loblolly pine | 69,458,000 | 39,941,000 | 9,475,000 |
| Insects-other | 0.0 | 0.2 | 0.0 |
| Diseases-other | 1.1 | 0.2 | 0.0 |
| Gall rusts | 0.0 | 0.4 | 0.4 |
| Branch stubs | 0.0 | 1.0 | 8.7 |
| Basal defects | 0.0 | 0.0 | 0.2 |
| Dieback | 0.0 | 0.2 | 0.0 |
| Sapsucker | 0.0 | 0.0 | 0.7 |
| Weather-other | 0.9 | 6.4 | 7.8 |
| Suppression, stagnation | 6.9 | 0.9 | 0.0 |
| Other-misc. (old age, etc.) | 6.4 | 11.6 | 10.7 |
| Logging-damage | 0.0 | 0.2 | 0.0 |
| Offsite tree | 0.0 | 0.4 | 1.0 |

Table 4.—*Approximate number of trees and percentage of damage/defect by softwood species and damaging agent or defect in Tennessee-Continued*

| Agent | Incidence of damage | | |
|---|---|---|---|
| | Saplings | Poletimber | Saw-timber |
| Eastern hemlock | **41,558,000** | 3442,000 | **3,175,000** |
| Diseases-other | 0.0 | 0.0 | 6.1 |
| Branch stubs | 1.5 | 11.8 | 12.3 |
| Fire | 2.5 | 0.0 | 0.0 |
| Flooding | 0.0 | 0.0 | 0.8 |
| Suppression, stagnation | 3.1 | 0.0 | 0.0 |
| Unknown | 0.0 | 0.0 | 0.4 |
| Other-misc. (old age, etc.) | 6.9 | 5.2 | 12.0 |
| Eastern white pine | **34,220,000** | **5,846,000** | **6,039,000** |
| Diseases-other | 1.6 | 0.0 | 1.6 |
| Branch stubs | 0.0 | 0.0 | 3.6 |
| Dieback | 0.0 | 0.0 | 0.6 |
| Sapsucker | 0.0 | 3.1 | 0.7 |
| Weather-other | 0.0 | 3.9 | 4.4 |
| Suppression, stagnation | 8.4 | 0.0 | 0.4 |
| Unknown | 0.0 | 0.0 | 0.5 |
| Other-misc. (old age, etc.) | 4.9 | 12.4 | 7.7 |
| People | 0.0 | 1.4 | 0.5 |
| Logging-damage | 3.2 | 0.0 | 1.5 |
| Pitch pine | **6,321,000** | **6,131,000** | **3,615,000** |
| Insects-other | 0.0 | 12.6 | 3.9 |
| Diseases-other | 0.0 | 1.6 | 5.2 |
| Branch stubs | 9.4 | 0.0 | 12.9 |
| Fire | 0.0 | 0.0 | 2.6 |
| Suppression, stagnation | 37.3 | 4.0 | 1.5 |
| Unknown | 0.0 | 5.0 | 2.3 |
| Other-misc. (old age, etc.) | 8.1 | 4.3 | 7.3 |
| Table-mountain pine | **2,295,000** | **1,524,000** | 785,000 |
| Diseases-other | 0.0 | 9.5 | 0.0 |
| Branch stubs | 0.0 | 23.2 | 0.0 |
| Fire | 25.1 | 7.9 | 26.2 |
| Suppression, stagnation | 0.0 | 7.2 | 10.4 |
| Other-misc. (old age, etc.) | 0.0 | 11.9 | 8.1 |
| Baldcypress | 667,000 | 212,000 | **1,448,000** |
| Diseases-other | 0.0 | 0.0 | 15.6 |
| Branch stubs | 0.0 | 0.0 | 9.8 |
| Dieback | 0.0 | 0.0 | 15.2 |
| Weather-other | 0.0 | 0.0 | 3.2 |
| Suppression, stagnation | 0.0 | 41.7 | 2.1 |
| Unknown | 0.0 | 0.0 | 1.5 |
| Other-misc. (old age, etc.) | 0.0 | 0.0 | 23.3 |

Table 5.—*Approximate number of trees and percentage of damage incidence by hardwood species group and damaging agent or defect in Tennessee*

| Agent | Incidence of damage | | |
|---|---|---|---|
| | Saplings | Poletimber | Sawtimber |
| Other eastern hardwoods | **2,606,951,000** | **236,561,000** | **27,559,000** |
| Insects-other | ***0.7*** | 1.7 | ***0.6*** |
| Diseases-other | ***2.7*** | 13.6 | ***24.1*** |
| Root rots | ***0.0*** | 0.2 | ***0.5*** |
| Hardwood cankers | ***0.0*** | 0.4 | ***0.6*** |
| Branch stubs | ***0.7*** | 5.1 | ***5.9*** |
| Basal defects | ***0.0*** | 0.1 | ***0.0*** |
| Dieback | 0.1 | 1.2 | 1.1 |
| Fire | ***0.3*** | 0.2 | 0.4 |
| Animals | 0.1 | 0.1 | 0.2 |
| Beaver | 0.0 | 0.1 | 0.2 |
| Sapsucker | 0.0 | 0.0 | 0.3 |
| Weather-other | ***1.6*** | 4.3 | 6.6 |
| Flooding | 0.1 | 0.3 | 1.0 |
| Suppression, stagnation | 8.1 | 1.7 | 0.2 |
| Unknown | 0.2 | 0.7 | 0.4 |
| Other-misc. (old age, etc.) | 16.4 | 21.5 | 29.4 |
| People | 0.0 | 0.2 | 0.1 |
| Logging-damage | 1.6 | 0.8 | 0.8 |
| Offsite tree | 0.3 | 0.2 | 0.3 |
| Hickories | **596,333,000** | **138,884,000** | **34,870,000** |
| Insects-other | 2.8 | 1.1 | 0.9 |
| Diseases-other | 2.2 | 5.5 | 12.3 |
| Root rots | 0.1 | 0.3 | 0.3 |
| Hardwood cankers | 0.0 | 0.0 | 0.2 |
| Branch stubs | 1.7 | 5.8 | 9.3 |
| Dieback | 0.8 | 1.3 | 1.6 |
| Fire | 0.6 | 1.1 | 2.3 |
| Sapsucker | 0.0 | 0.3 | 0.8 |
| Weather-other | 2.7 | 3.7 | 3.2 |
| Flooding | 0.0 | 0.0 | 0.1 |
| Suppression, stagnation | 12.2 | 0.3 | 0.1 |
| Unknown | 0.2 | 0.8 | 0.2 |
| Other-misc. (old age, etc.) | 14.1 | 18.0 | 19.6 |
| People | 0.0 | 0.1 | 0.3 |
| Logging-damage | 1.8 | 1.0 | 0.5 |
| Offsite tree | 0.4 | 0.6 | 0.2 |
| Soft maple | **624,695,000** | 65765,000 | **12,550,000** |
| Insects-other | 0.9 | 0.0 | 0.0 |
| Diseases-other | 3.6 | 13.5 | 29.4 |
| Root rota | 0.1 | 0.0 | 0.0 |
| Hardwood cankers | 0.1 | 0.3 | 0.1 |
| Branch stubs | 1.7 | 6.7 | 9.8 |
| Dieback | 0.2 | 2.2 | 1.3 |
| Fire | 0.6 | 1.0 | 1.9 |
| Sapsucker | 0.0 | 0.0 | 0.5 |
| Weather-other | 1.5 | 2.6 | 2.7 |
| Flooding | 0.5 | 0.9 | 0.9 |
| Suppression, stagnation | 8.0 | 0.3 | 0.0 |
| Unknown | 0.3 | 0.4 | 0.4 |
| Other-misc. (old age, etc.) | 22.4 | 24.2 | 26.3 |
| People | 0.1 | 0.5 | 0.4 |
| Logging-damage | 2.2 | 2.5 | 0.4 |
| Offsite tree | 0.2 | 0.0 | 0.5 |
| Select white oaks[1] | **445,983,000** | **133,057,000** | **44,976,000** |
| Insects-other | 0.7 | 0.3 | 0.3 |
| Diseases-other | 1.2 | 4.6 | 7.8 |
| Root rots | 0.0 | 0.3 | 0.4 |
| Hardwood cankers | 0.0 | 0.0 | 0.2 |
| Branch stubs | 1.8 | 6.4 | 10.6 |

Table *5.-Approximate number of trees and percentage of damage incidence by hardwood species group and damaging agent or defect in Tennessee-Continued*

| Agent | Incidence of damage | | |
|---|---|---|---|
| | Saplings | Poletimber | Sawtimber |
| Select white oaks[1]—Continued | | | |
| Dieback | ***0.6*** | 1.7 | 1.9 |
| Fire | ***0.1*** | 0.6 | 0.7 |
| Animals | 0.1 | 0.0 | 0.0 |
| Sapsucker | 0.0 | 0.2 | 0.2 |
| Weather-other | ***1.6*** | 3.6 | 3.6 |
| Suppression, stagnation | ***11.4*** | 0.8 | 0.0 |
| Unknown | ***0.0*** | 0.3 | 0.3 |
| Other-misc. (old age, etc.) | ***12.4*** | 17.1 | 20.2 |
| People | ***0.0*** | 0.1 | 0.2 |
| Logging-damage | ***2.4*** | 0.9 | 0.7 |
| Offsite tree | 0.1 | 0.3 | 0.2 |
| Other red oaks | 376,563,000 | 142,843,000 | 57,619,000 |
| Insects-other | ***0.8*** | 0.1 | 0.4 |
| Diseases-other | ***2.9*** | 7.9 | 15.6 |
| Root rots | ***0.0*** | 0.4 | 0.4 |
| Hardwood cankers | ***0.2*** | 0.2 | 0.1 |
| Branch stubs | ***2.9*** | 10.0 | 13.4 |
| Dieback | ***0.9*** | 1.2 | 1.6 |
| Fire | ***0.6*** | 1.4 | 1.0 |
| Weather-other | ***2.1*** | 1.8 | 3.0 |
| Suppression, stagnation | ***6.5*** | 0.9 | 0.2 |
| Unknown | 0.1 | 0.4 | 0.6 |
| Other-misc. (old age, etc.) | 10.2 | 11.5 | 16.4 |
| Logging-damage | 1.8 | 0.5 | 0.3 |
| Offsite tree | 0.6 | 0.1 | 0.2 |
| Blackgum/tupelo | 462,052,000 | 36,862,000 | 8,067,000 |
| Insects-other | 0.4 | 0.0 | 0.0 |
| Diseases-other | 1.9 | 11.1 | 29.3 |
| Root rots | 0.1 | 0.3 | 1.8 |
| Hardwood cankers | 0.0 | 0.0 | 0.2 |
| Branch stubs | 0.6 | 3.6 | 4.5 |
| Dieback | 0.7 | 1.4 | 2.6 |
| Fire | 0.2 | 0.9 | 0.6 |
| Beaver | 0.0 | 0.0 | 0.3 |
| Weather-other | 4.5 | 7.1 | 5.6 |
| Flooding | 0.0 | 0.0 | 0.4 |
| Suppression, stagnation | 21.3 | 4.8 | 0.0 |
| Unknown | 0.1 | 0.2 | 1.5 |
| Other-misc. (old age, etc.) | 21.2 | 29.6 | 24.3 |
| People | 0.1 | 0.6 | 0.0 |
| Logging-damage | 2.8 | 2.8 | 0.0 |
| Offsite tree | 0.1 | 0.3 | 0.6 |
| Other white oaks | 231,640,000 | 115,713,000 | 40,888,000 |
| Insects-other | 0.0 | 0.5 | 0.4 |
| Diseases-other | 2.2 | 7.6 | 15.0 |
| Root rots | 0.0 | 0.0 | 0.3 |
| Hardwood cankers | 0.0 | 0.3 | 0.2 |
| Branch stubs | 1.6 | 8.2 | 12.7 |
| Dieback | 0.0 | 0.5 | 1.2 |
| Fire | 1.1 | 1.3 | 1.7 |
| Animals | 0.3 | 0.0 | 0.0 |
| Sapsucker | 0.0 | 0.0 | 0.1 |
| Weather-other | 2.6 | 2.6 | 2.9 |
| Suppression, stagnation | 8.8 | 0.2 | 0.0 |
| Unknown | 0.0 | 0.9 | 1.2 |
| Other-misc. (old age, etc.) | 15.3 | 18.1 | 24.0 |
| People | 0.3 | 0.0 | 0.0 |
| Logging-damage | 2.1 | 0.7 | 0.3 |
| Offsite tree | 0.5 | 0.0 | 0.2 |

Table 5.—*Approximate number of trees and percentage of damage incidence by hardwood species group and damaging agent or defect in Tennessee-Continued*

| Agent | Incidence of damage | | |
|---|---|---|---|
| | Saplings | Poletimber | Sawtimber |
| Hard maple | 228,928,000 | 32,227,000 | 9,406,000 |
| Insects—other | 0.3 | 0.6 | 0.2 |
| Diseases-other | 2.8 | 9.9 | 25.4 |
| Root rots | 0.0 | 0.2 | 1.5 |
| Hardwood cankers | 0.3 | 0.4 | 0.4 |
| Branch stubs | 1.7 | 15.8 | 12.8 |
| Dieback | 0.5 | 2.2 | 1.7 |
| Fire | 0.2 | 1.2 | 2.0 |
| Animals | 0.0 | 0.0 | 0.1 |
| Sapsucker | 0.2 | 0.1 | 2.4 |
| Weather-other | 0.7 | 2.7 | 1.8 |
| Suppression, stagnation | 9.2 | 1.0 | 0.0 |
| Unknown | 0.2 | 0.0 | 0.1 |
| Other-misc. (old age, etc.) | 21.0 | 23.2 | 26.1 |
| People | 0.3 | 0.0 | 0.0 |
| Logging-damage | 1.6 | 1.0 | 0.5 |
| Offsite tree | 0.5 | 2.3 | 0.2 |
| Ash | 217,030,000 | 39,981,000 | 9,379,000 |
| Insects-other | 2.2 | 0.2 | 1.3 |
| Diseases-other | 3.1 | 5.9 | 13.1 |
| Root rota | 0.0 | 0.2 | 0.9 |
| Hardwood cankers | 0.7 | 0.0 | 0.0 |
| Branch stubs | 1.5 | 4.4 | 3.3 |
| Dieback | 0.3 | 0.4 | 0.6 |
| Fire | 0.0 | 0.6 | 0.8 |
| Beaver | 0.0 | 0.1 | 0.0 |
| Sapsucker | 0.3 | 0.0 | 0.1 |
| Weather-other | 7.7 | 4.8 | 3.7 |
| Flooding | 1.9 | 1.7 | 2.7 |
| Suppression, stagnation | 12.3 | 0.7 | 0.0 |
| Unknown | 0.2 | 0.3 | 1.5 |
| Other-misc. (old age, etc.) | 28.0 | 37.4 | 30.6 |
| People | 0.2 | 0.2 | 0.3 |
| Logging-damage | 1.2 | 0.7 | 1.9 |
| Offsite tree | 0.5 | 1.2 | 1.4 |
| Yellow-poplar | 173,052,000 | 59,518,000 | 28,114,000 |
| Diseases-other | 2.7 | 4.8 | 9.2 |
| Root rots | 0.0 | 0.1 | 0.4 |
| Hardwood cankers | 0.0 | 0.2 | 0.1 |
| Branch stubs | 0.6 | 6.9 | 11.6 |
| Dieback | 0.0 | 0.4 | 1.4 |
| Fire | 0.0 | 0.1 | 0.7 |
| Sapsucker | 0.0 | 0.0 | 0.7 |
| Weather-other | 1.3 | 5.8 | 4.3 |
| Suppression, stagnation | 7.8 | 0.3 | 0.0 |
| Unknown | 0.3 | 0.0 | 0.6 |
| Other-misc. (old age, etc.) | 12.2 | 19.5 | 18.9 |
| People | 0.0 | 0.2 | 0.0 |
| Logging-damage | 1.3 | 0.9 | 0.4 |
| Offsite tree | 0.0 | 0.2 | 0.7 |
| Sweetgum | 169,605,000 | 36,438,000 | 10,731,000 |
| Diseases-other | 1.5 | 7.5 | 21.1 |
| Root rots | 0.0 | 0.1 | 0.5 |
| Hardwood cankers | 0.0 | 0.0 | 0.4 |
| Branch stubs | 0.3 | 3.5 | 6.9 |
| Dieback | 0.0 | 2.9 | 4.9 |
| Beaver | 0.0 | 0.3 | 1.4 |
| Weather-other | 2.8 | 6.7 | 7.3 |
| Flooding | 0.0 | 0.0 | 0.4 |
| Suppression, stagnation | 16.0 | 1.1 | 0.0 |

Table 5.-Approximate number *of trees* and percentage *of* ***damage incidence*** by *hardwood species group* and ***damaging*** *agent or defect* in Tennessee-Continued

| Agent | Incidence of damage | | |
|---|---|---|---|
| | Saplings | Poletimber | Sawtimber |
| Sweetgum-Continued | | | |
| Unknown | 0.3 | 0.5 | 0.0 |
| Other-misc. (old age, etc.) | 15.9 | 16.6 | 15.0 |
| People | 0.0 | 0.0 | 0.2 |
| Logging-damage | 1.3 | 1.4 | 0.9 |
| Offsite tree | 0.0 | 0.4 | 0.5 |
| Select red oaks[2] | 74,762,000 | 33,337,000 | 20,309,000 |
| Insects-other | 3.1 | 0.6 | 0.4 |
| Diseases-other | 1.5 | 8.3 | 15.8 |
| Root rots | 0.0 | 0.1 | 0.4 |
| Branch stubs | 3.2 | 9.7 | 10.5 |
| Dieback | 0.0 | 2.0 | 2.6 |
| Fire | 0.0 | 0.0 | 0.7 |
| Animals | 0.0 | 0.0 | 0.1 |
| Weather-other | 3.9 | 4.1 | 5.9 |
| Flooding | 0.0 | 0.0 | 0.2 |
| Suppression, stagnation | 9.6 | 0.6 | 0.0 |
| Unknown | 0.0 | 0.3 | 0.4 |
| Other-misc. (old age, etc.) | 22.2 | 11.1 | 15.9 |
| People | 0.0 | 0.1 | 0.0 |
| Logging—damage | 0.0 | 0.4 | 0.7 |
| Offsite tree | 0.0 | 0.0 | 0.3 |
| Noncommercial | 596,333,000 | 138,884,000 | 34,870,000 |
| Diseases-other | 1.0 | 2.9 | 0.0 |
| Fire | 1.0 | 0.0 | 0.0 |
| Suppression, stagnation | 4.6 | 3.8 | 0.0 |
| Other-misc. (old age, etc.) | 3.4 | 0.6 | 6.9 |
| Logging-damage | 0.0 | 1.1 | 0.0 |
| Beech | 64,605,000 | 17,006,000 | 8,782,000 |
| Insects-other | 0.8 | 0.0 | 0.0 |
| Diseases-other | 2.1 | 14.6 | 37.4 |
| Root rots | 0.0 | 0.0 | 0.8 |
| Hardwood cankers | 0.0 | 0.0 | 0.3 |
| Branch stubs | 0.0 | 10.0 | 8.8 |
| Dieback | 0.0 | 1.1 | 3.3 |
| Fire | 0.0 | 1.3 | 2.5 |
| Weather-other | 2.7 | 0.9 | 1.9 |
| Suppression, stagnation | 11.0 | 2.9 | 0.2 |
| Unknown | 0.0 | 0.7 | 0.8 |
| Other-misc. (old age, etc.) | 29.4 | 20.2 | 18.6 |
| People | 0.0 | 0.7 | 0.0 |
| Logging—damage | 2.0 | 6.3 | 2.1 |
| Offsite tree | 0.0 | 0.7 | 0.4 |
| Black walnut | 16,284,000 | 10,169,000 | 2,745,000 |
| Insects-other | 3.4 | 0.0 | 0.9 |
| Diseases-other | 6.8 | 16.1 | 21.1 |
| Root rots | 0.0 | 0.8 | 1.4 |
| Branch stubs | 0.0 | 6.1 | 6.5 |
| Dieback | 0.0 | 3.1 | 0.0 |
| Fire | 0.0 | 0.0 | 1.8 |
| Sapsucker | 0.0 | 0.0 | 0.3 |
| Weather-other | 3.7 | 1.0 | 6.1 |
| Suppression, stagnation | 10.6 | 0.6 | 0.0 |
| Other-misc. (old age, etc.) | 37.6 | 28.8 | 29.0 |
| People | 0.0 | 0.0 | 1.9 |
| Logging-damage | 0.0 | 0.7 | 0.0 |
| Basswood | 9,337,000 | 2,300,000 | 1,990,000 |
| Diseases-other | 0.0 | 16.9 | 25.7 |
| Root rots | 0.0 | 0.0 | 0.6 |
| Branch stubs | 5.5 | 11.3 | 2.6 |

Table 5.-*Approximate number of trees and percentage of damage incidence by hardwood species group and damaging agent or defect in Tennessee-Continued*

| Agent | Incidence of damage | | |
|---|---|---|---|
| | Saplings | Poletimber | Sawtimber |
| Basswood-Continued | | | |
| Dieback | 0.0 | 2.1 | 0.0 |
| Sapsucker | 0.0 | 3.6 | 3.1 |
| Weather-other | 0.0 | 0.0 | 7.9 |
| Suppression, stagnation | 0.0 | 11.1 | 0.0 |
| Unknown | 0.0 | 0.0 | 3.0 |
| Other-misc. (old age, etc.) | 65.9 | 14.8 | 16.4 |
| Offsite tree | 0.0 | 3.5 | 0.0 |
| Cottonwood | .0 | 372,000 | 610,000 |
| Diseases-other | 0.0 | 0.0 | 31.3 |
| Branch stubs | 0.0 | 0.0 | 2.5 |
| Weather-other | 0.0 | 74.9 | 19.8 |
| Flooding | 0.0 | 25.1 | 9.1 |
| Other-misc. (old age, etc.) | 0.0 | 0.0 | 2.7 |

[1]White, swamp white, swamp chestnut, and bur oaks.
[2]Cherrybark, N. red, and shumard oaks.

Table 6.—*Poletimber and sawtimber removals and wood losses in Tennessee*

| Species | Annual timber removals | | Volume loss | | | |
|---|---|---|---|---|---|---|
| | | | Annual mortality | | Annual accumulated cull[1] | |
| | Poletimber | Sawtimber | Poletimber | Sawtimber | Poletimber | Sawtimber |
| | *Mft³* | *Mfbm* | *Mft³* | *Mfbm* | *Mft³* | *Mfbm* |
| Softwoods | | | | | | |
| Eastern redcedar | 1,975.3 | 6,508.4 | 2,089.0 | 2,161.0 | 743.8 | 536.1 |
| Virginia pine | 2,847.8 | 56,184.8 | 2,093.8 | 14,458.7 | 785.8 | 7,241.1 |
| Shortleaf pine | 5631.9 | 67,411.4 | 5,744.2 | 12,858.0 | 194.6 | 2,674.3 |
| Loblolly pine | 7,732.1 | 24,630.1 | 1,998.8 | 6,064.3 | 131.2 | 1,771.6 |
| Eastern hemlock | 58.8 | 3,968.5 | 0.0 | 0.0 | 0.0 | 680.6 |
| Eastern white pine | 108.1 | 14,442.0 | 229.4 | 2,450.3 | 14.0 | 696.5 |
| Pitch pine | 218.9 | 3,583.8 | 336.5 | 3,428.1 | 61.5 | 995.1 |
| Table-mountain pine | 0.0 | 0.0 | 122.1 | 782.9 | 32.0 | 214.0 |
| Baldcypress | 0.0 | 336.4 | 0.0 | 1,253.6 | 15.9 | 998.9 |
| Bed spruce | 0.0 | 0.0 | 0.0 | 0.0 | 10.5 | 0.0 |
| Totals | 18,572.9 | 177,065.5 | 12,603.7 | 43,456.9 | 1,989.3 | 15,808.1 |
| Hardwoods | | | | | | |
| Other eastern hardwoods | 5,539.5 | 50,540.8 | 7,372.0 | 35,805.4 | 10,634.2 | 13,465.7 |
| Hickories | 6,144.9 | 88,075.9 | 3,599.1 | 21,006.5 | 4,786.3 | 11,864.3 |
| Soft maple | 1,074.6 | 15,393.3 | 574.5 | 2,772.8 | 3,391.0 | 6,967.0 |
| Select white oaks[2] | 7,244.6 | 154,515.5 | 1,461.8 | 9,176.2 | 2,517.7 | 13,260.1 |
| Other red oaks | 9,574.9 | 201,138.3 | 2,986.3 | 20,327.0 | 4,055.7 | 24,736.4 |
| Blackgum/tupelo | 1,859.1 | 12,875.7 | 856.1 | 3,450.8 | 1,520.4 | 3,602.6 |
| Other white oaks | 6,615.9 | 81,254.0 | 1,669.9 | 6,580.3 | 4,420.3 | 15,164.6 |
| Hard maple | 616.4 | 16,612.7 | 571.1 | 1,907.1 | 1,243.9 | 2,561.4 |
| Ash | 914.7 | 26,510.2 | 1,297.0 | 1,851.7 | 1,958.2 | 6,470.9 |
| Yellow-poplar | 2,957.8 | 64,072.5 | 461.0 | 4,563.6 | 1,153.1 | 9,762.0 |
| Sweetgum | 2,673.2 | 50,120.7 | 1,273.8 | 4,234.4 | 1,216.0 | 6,243.2 |
| Select red oaks[3] | 1,977.4 | 73,834.9 | 477.7 | 10,072.3 | 2,263.1 | 6,700.3 |
| Noncommercial hardwoods | 0.0 | 6.0 | 6.0 | 0.0 | 154.4 | 34.5 |
| Beech | 285.1 | 14,036.6 | 229.4 | 1,157.0 | 561.0 | 4,714.8 |
| Black walnut | 471.0 | 3,839.8 | 465.8 | 2,017.0 | 397.0 | 1,181.4 |
| Basswood | 0.0 | 3,343.6 | 318.8 | 345.2 | 169.2 | 1,030.9 |
| Cottonwood | 0.0 | 4,364.0 | 84.6 | 704.5 | 0.0 | 307.3 |
| Totals | 47,949.0 | 860,528.1 | 23,699.0 | 125,971.7 | 40,441.7 | 128,067.3 |

[1]Cull due to crooks, limbs, decay, missing wood, sweep, large forks, and volume in sections of bole that are too rough to be utilized as pulpwood or sawtimber.
[2]White, swamp white, swamp chestnut, and bur oaks.
[3]Cherrybark, Northern red, and shumard oaks.

Table 7.—*Annual economic impact of damage on the timber resource in Tennessee*

| Species | Annual volume wood fiber loss | Stumpage value per unit | Annual loss |
|---|---|---|---|
| | | *Dollars* | |
| Softwoods | | | |
| Poletimber ($Mft^3$) | 14,593.0 | 45.10 | 658,143.20 |
| Sawtimber (Mfbm) | 59,265.0 | 62.00 | 3,674,432.23 |
| Hardwoods | | | |
| Poletimber ($Mft^3$) | 64,140.7 | 12.30 | 788,930.43 |
| Sawtimber (Mfbm) | 254,039.1 | 65.00 | 16,512,540.72 |
| All species | | | |
| Poletimber ($Mft^3$) | 78,733.7 | | 1,447,073.62 |
| Sawtimber (Mfbm) | 313,304.1 | | 20,186,972.95 |
| Total | | | 21,634,046.57 |

# Appendix II-Scientific Names of Tree Species Mentioned

| Common Name | Scientific Name |
|---|---|
| American elm | Ulmus americana L. |
| Ash | Fraxinus spp. |
| Baldcypress | Taxodium distichum (L.) Rich. |
| Balsam fir | Abies balsamea (L.) Mill. |
| Basswood | Tilia americana L. |
| Bear oak | Quercus ilicifolia Wangenh. |
| Beech | Fagus grandifolia Ehrh. |
| Black maple | Acer nigrum Michx. |
| Black oak | Quercus velutina Lam. |
| Black walnut | Juglans nigra L. |
| Blackgum | Nyssa sylvatica Marsh. |
| Birch | Betula spp. |
| Boxelder | Acer negundo L. |
| Buckeye | Aesculus spp. |
| Bur oak | Quercus macrocarpa Michx. |
| Butternut | Juglans cinerea L. |
| Cherrybark oak | Quercus falcata var. pagodifolia Ell. |
| Chestnut oak | Quercus prinus L. |
| Cottonwood | Populus deltoides Bartr. ex Marsh. |
| Cucumbertree | Magnolia acuminata L. |
| Cypress | Cupressus spp. |
| Dogwood | Cornus florida L. |
| Eastern hemlock | Tsuga canadensis (L.) Carr. |
| Eastern red cedar | Juniperus virginiana L. |
| Eastern white pine | Pinus strobus L. |
| Florida maple | Acer barbatum Michx. |
| Green ash | Fraxinus pennsylvanica Marsh. |
| Hackberry | Celtis occidentalis L. |
| Hickories | Carya spp. |
| Holly | Ilex opaca Art. |
| Honeylocust | Gleditsia tricanthos L. |

# Appendix II-Scientific Names of Tree Species Mentioned—Continued

| Common Name | Scientific Name |
|---|---|
| Laurel oak | Quercus laurifolia Michx. |
| Live oak | Quercus virginiana Mill. |
| Loblolly pine | Pinus taeda L. |
| Maples (soft or hard) | Acer spp. |
| Mulberry | Morus spp. |
| Northern red oak | Quercus rubra L. |
| Nuttall oak | Quercus nuttallii Palmer |
| Oaks (red or white) | Quercus spp. |
| Overcup oak | Quercus lyrata Walt. |
| Pecan | Carya illinoiensis (Wangenh.) K. Koch. |
| Persimmon | Diospyros virginiana L. |
| Pines | Pinus spp. |
| Pitch pine | Pinus rigida Mill. |
| Post oak | Quercus stellata Wangenh. |
| Bed maple | Acer rubrum L. |
| Bed spruce | Picea rubens Sarg. |
| Sand pine | Pinus clausa (Chapm. ex Engelm.) Vasey ex Sarg. |
| Scarlet oak | Quercus coccinea Muench. |
| Scrub oak | Quercus spp. |
| Shortleaf pine | Pinus echinata Mill. |
| Shumard oak | Quercus shumardii Buckl. |
| Silver maple | Acer saccharinurn L.SilverbellHalesia spp. |
| Southern red oak | Quercus falcata Michx. |
| Sugar maple | Acer saccharum Marsh. |
| Sugarberry | Celtis laevigata Willd. |
| Swamp chestnut oak | Quercus michauxii Nutt. |
| Swamp tupelo | Nyssa aquatica L. |
| Swamp white oak | Quercus bicolor Willd. |
| Sweetbay | Magnolia virginiana L. |
| Sweetgum | Liquidambar styraciflua L. |
| Sycamore | Platanus occidentalis L. |
| Table-mountain pine | Pinus pungens Lamb. |
| Tupelo | Nyssa spp. |
| Virginia pine | Pinus virginiana Mill. |
| Water hickory | Carya aquatica (Michx. f.) Nutt. |
| Water oak | Quercus nigra L. |
| White ash | Fraxinus americana L. |
| White oak | Quercus alba L. |
| Willow | Salix spp. |
| Willow oak | Quercus phellos L. |
| Yellow poplar | Liriodendron tulipifera L. |

Mistretta, Paul A.; Bylin, Carl V.; Baker, Roger. Incidence and impact of damage to Tennessee's timber, 1982. Resour. Bull. SO-110. New Orleans, LA: U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station; 1986. 18 p.

Data collected during a 1979-80 survey of Tennessee's forests are tabulated and discussed.

**Additional keywords:** forest resources, injury, insect, disease, survey.

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