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**Rocky Mountain
Forest and Range
Experiment Station**

Fort Collins
Colorado 80526

**General Technical
Report RM-234
(Revised)**

Forest Resources of the United States, 1992

Douglas S. Powell, Joanne L. Faulkner, David R. Darr, Zhiliang Zhu, Douglas W. MacCleery

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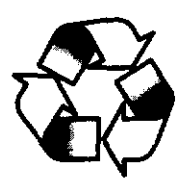

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Forest Resources of the United States, 1992

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Forest Resources of the United States, 1992

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HIGHLIGHTS

Information compiled for the 1992 Resource Planning Act (RPA) Assessment Update shows that the U.S. forest resources generally have continued to improve in condition and quality since before the 1960s. The area of forest cover has increased since 1987; and the quantity and quality of the forest resource also continued to improve.

Forest Land Area

- Forest land area increased 0.1% between 1987 and 1992, reversing a slight downward trend dating from 1963.
- About 33% of the U.S. land area, or 737 million acres, is forest land. This amounts to about two-thirds of the area that was forested in the year 1600 (1.04 billion acres). Some 307 million acres of forest land have been converted to other uses since 1600, chiefly to agricultural uses.
- More than three-quarters of the conversion of forests to other uses occurred in the 19th century. By 1920, clearing forests for agriculture had largely halted.
- Some 34% of all forest land is federally owned. This proportion of federal to other forest land has remained relatively stable for at least the past 40 years.
- About 47 million acres of forest land (6% of all U.S. forest land) is reserved from commercial timber harvest, in wilderness, parks and other classifications.

Timberland Area

- About 490 million acres of forest land (66% of all forest land) is classed as timberland—forest land capable of producing more than 20 cubic feet per acre per year and not withdrawn from timber production; 70% of this is in the East.
- Since 1952, the area of timberland has decreased by 4%, or about 19.3 million acres. This decline has been the result primarily of withdrawals of public timberland as wilderness or other land uses that do not permit timber harvest. These are **not** physical losses of forest, but are reclassifications of forest land. Such forests continue to provide benefits other than timber harvest.

Timber Inventories

- Growing stock volume on U.S. timberland increased by 2.6% between 1987 and 1992. Since 1952, net volume per acre has increased 33%. In the North, average volume per acre rose 95% between 1952 and 1992, 104% in the South, and 27% in the Rocky Mountains region. In the Pacific Coast region, however, average volume per acre dropped by 4% between 1952 and 1992.
- Some 57% of the volume of growing stock is softwoods, with the remaining 43% hardwoods. However, 90% of the hardwood timber is in the eastern United States. About 66% of the softwood timber is in the western United States, and 23% is in the South.
- Because hardwood growth greatly exceeds harvest, the quantity and quality of the hardwood resource continues to improve.
- The net growing stock volume of U.S. hardwoods increased by 7% between 1987 and 1992, and by 82% between 1952 and 1992.
- The volume of hardwoods in diameter classes greater than 19 inches has doubled since 1952, from 26 billion cubic feet to 52 billion in 1992.
- The net volume of U.S. softwoods increased by 4% between 1952 and 1992, but decreased by 0.7% between 1987 and 1992.
- For the first time since 1952, softwood and hardwood inventories declined on forest industry lands in the South.

- For the South as a whole, the volume of standing softwood inventory declined 2.5% between 1987 and 1992—the first such decline since at least 1952.

Timber Mortality

- Timber mortality increased substantially between 1986 and 1991, in all regions, on all ownerships, and for both hardwoods and softwoods. Nationally, the volume of mortality was up 24% from 1986 to 1991, from 4.4 billion cubic feet to 5.5 billion cubic feet—0.7% of the growing stock inventory. Annual mortality averaged 4.2 billion cubic feet between 1962 and 1986. Softwood mortality was up 18% between 1986 and 1991 and hardwood mortality was up 34%.

- Timber mortality in the South increased 32% between 1986 and 1991—37% for hardwoods and 27% for softwoods.

Timber Growth and Harvest on Timberland

- In the 1920s, timber growth nationally was about one-half the rate of harvest. By the 1940s, improving forest growth rates and modestly declining harvest rates resulted in timber growth and harvest coming into approximate balance. By 1952, timber growth nationally exceeded harvest by 17%. Since the 1950s, timber growth has consistently exceeded harvest.

- Net timber growth exceeded harvest by 54% in 1976, 38% in 1986, and 33% in 1991. Net growth rates have not been increasing as rapidly as in the past, while harvest levels have continued to increase.

- In 1991, growth exceeded removals in all regions: in the North by 92%; in the South by 10%; in the Rocky Mountains by 163%, and in the Pacific Coast region by 14%. For the United States, hardwood growth exceeds removals by 80%, and for softwoods, by 9%.

- Total timber growth declined about 2% between 1986 and 1991—the first decline since 1952. All of the decline was attributable to softwoods. Net annual hardwood growth increased 0.9%.

- In the South, softwood removals exceeded growth by 14% in 1991. This is the first time since 1952 that softwood removals exceeded growth.

Trends in Timber Removals

- Timber harvest levels continue at their historically high levels. In 1991, growing stock removals were 16.3 billion cubic feet, 2% greater than in 1986 and 21% higher than 1970. Average timber harvest levels have risen each decade since the 1950s.

- In 1991, about 67% of the volume of timber removals was softwoods and 33% was hardwoods, a proportion of softwood to hardwood removals that has remained approximately the same since 1952.

- The South accounted for 55% of growing stock removals in 1991, up from 45% in 1970.

- The predominant use of wood continues to be for lumber and plywood. Saw logs accounted for 41% of wood volume harvested in 1991, veneer logs—8%, and pulpwood—28%. The remaining 23% was used for fuelwood and other products.

- The use of wood for fuel continues at the increased levels experienced after the energy crisis of the early 1970s. In 1991, fuelwood comprised 3.2 billion cubic feet, or 18% of the volume of wood harvested. This compares with fuelwood production of 538 million cubic feet in 1970 or 4% of the volume of wood harvested in that year. Since 1980, the volume of fuelwood harvested has remained relatively stable, averaging about 3.1 billion cubic feet.

Ownership of Timberland and Harvest

- Seventy-three percent of timberland is privately owned; these lands account for 82% of growing stock removals in 1991.

- Non-industrial private ownerships comprise 59% (288 million acres) of U.S. timberland and account for 49% of the volume of growing stock removals in 1991. About 72% of the hardwood resource is on non-industrial private ownerships, which account for 67% of the volume of

hardwood harvest. Timber harvest on non-industrial private forest lands declined by about 2% between 1986 and 1991, but has increased by 17% since 1952.

- Industrial forests accounted for 14% of U.S. timberland (70 million acres) and 33% of the volume harvested in 1991. While forest industry ownerships contain only 16% of the volume of softwood timber, in 1991 they accounted for 38% of the volume of softwood harvest. Timber harvest on industrial forests increased by 6% between 1986 and 1991, and by 62% since 1952.
- Public forests comprise 27% of the U.S. timberland base and account for 18% of 1991 U.S. harvest volume. Three-quarters of all public forests are owned by the Federal Government.
- Federal forests comprise 20% (97 million acres) of U.S. timberland. National Forests are the largest federal ownership, comprising 17% of U.S. timberland and accounting for 12% of timber harvest in 1991. National Forest timber harvest levels declined by 10% between 1986 and 1991, after rising by 94% between 1952 and 1986.
- Other public forests comprised 10% of U.S. timberland and accounted for 6% of growing stock removals in 1991.

INTRODUCTION

Forest resource growth, harvests, and land use conversion can change inventories within states, among regions, and even among countries, and can significantly influence the future performance of resources. This can affect the state, regional, and national economies that depend on the affected resources, as well as the resource environments themselves. Periodic surveys provide information needed to assess the current status and performance of resources, and to estimate their future condition. As required by the Forest and Rangeland Renewable Resources Planning Act of 1974 (RPA), P.L. 93-378, 88 Stat. 4765, as amended, this report updates information on the Nation's forest resource, particularly the timber resource.[3]

This report updates resource statistics published by Waddell et al. (1989), and the analysis of the resource situation described in the 1989 RPA Assessment (Oswald

[3]*For information on procedures used, see Appendix A.*

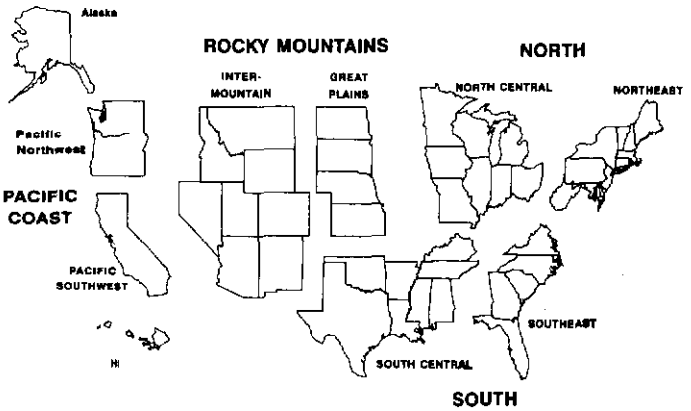


Figure 1.—Regions and subregions for RPA Assessment Update.

1990). Regions and subregions used to update forest statistics and analyze the resource situation are shown in figure 1. To provide a context to evaluate and interpret short-term changes in forest statistics, trends since 1952 are highlighted, and an historical perspective on the forest resource is presented. A forest type map produced from satellite imagery is provided to display the area and location of forest land in the United States.

FOREST LAND AREA

In 1992, 737 million acres, or 33% of the total land area of the United States, was in forest land (table 1). Much land is devoted to urban and suburban development. A significant, but unknown, portion of this area would meet the definition of forest land, if it were not classed as "nonforest." Forest land area increased about 0.1% since 1987, reversing a slight downward trend in forest area since 1963.

Forest land area now amounts to about 70% of the area that was forested in the year 1600 (fig. 2). About 307 million acres of forest land have been converted to other uses since 1630—mainly to agricultural uses. More than 75% of the net conversion to other uses occurred in the 19th century (fig. 3). After 1920, as agricultural production increased, cropland area stabilized, and so did forest area (fig. 4). Between 1850 and 1910, American farmers cleared more forest than the total amount that had been cleared in the previous 250 years — about 190 million acres (fig. 5). This amounts to an average of 13.6 square miles of forest cleared every day for 60 years.

As shown in the accompanying forest type map, forest land is widely, yet, unevenly distributed.[4] These areas vary greatly, from sparse scrub forests of the arid

[4]*For more information on the development of the forest type map, see Appendix B.*

interior West, to the highly productive forests of the Pacific Coast and the South; and, from pure hardwood forests to multispecies mixtures and coniferous forest. Land east of the Great Plains, that is not in agriculture or other developed uses, is heavily forested. The high elevation areas of the West that receive ample precipitation, and the humid portions of the Pacific Coast also are forested. North Dakota currently has the smallest percentage of forest cover (1%); Maine has the greatest (89%).

Two-thirds of the Nation's forests (490 million acres) are classed as timberland, defined as "forests capable of producing 20 cubic feet per acre of industrial wood annually and not reserved from timber harvest." An additional 36 million acres of productive forest land is reserved from harvesting, and is managed as parks or wilderness (table 1).

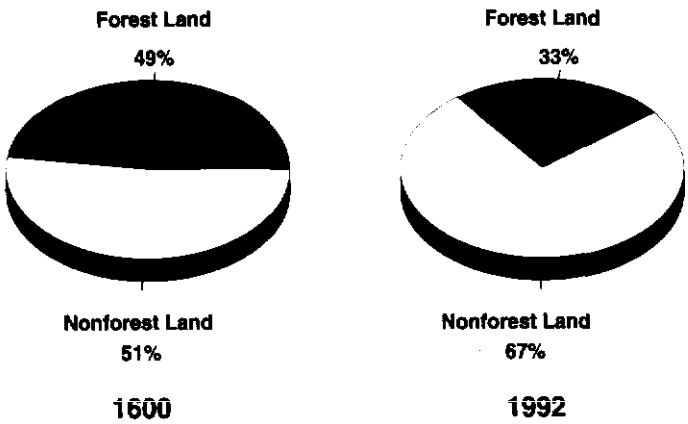


Figure 2.—Percent of U.S. land area in forests, 1600 and 1992.

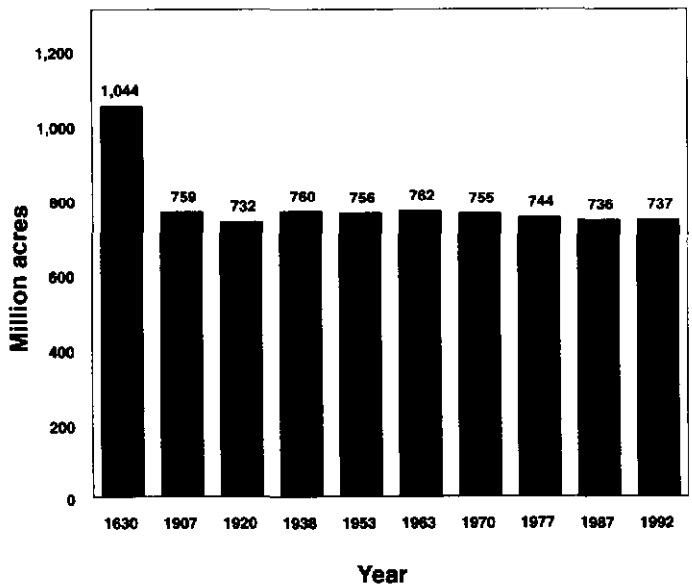


Figure 3.—Trends in U.S. forest land area, 1630-1992.

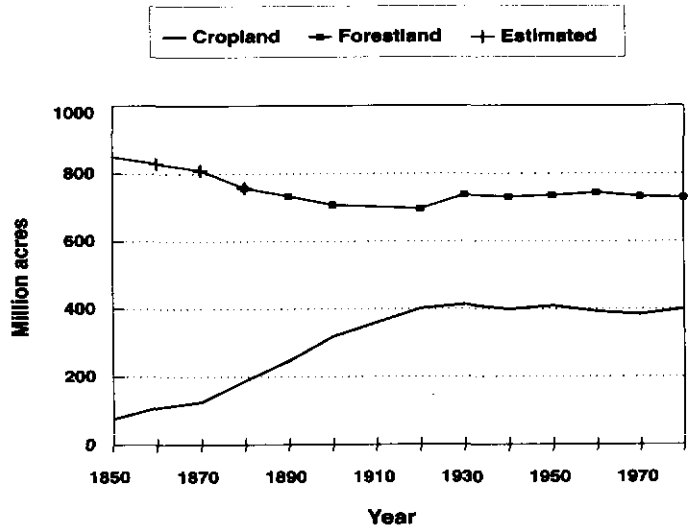
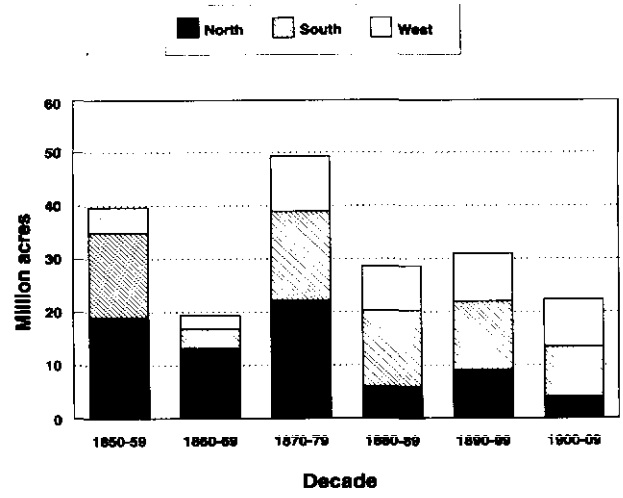


Figure 4.—U.S. crop and forest land area, 1850-1980 (Fedkiw 1989).



Source: M.L. Primack, "Farm Formed Capital in American Agriculture, 1850-1910"

Figure 5.—Area of forest land cleared for farming, 1850-1910.

Most of the Nation's forest land is in nonfederal ownership. In 1992, 488 million acres, 66% of the total, were owned by nonfederal public agencies, forest industry, farmers, and other private individuals (table 2). The Forest Service administers the largest portion of federal forest land—140 million acres, or 56% of the total federal forest land. Other federal agencies administering forest land include the Bureau of Land Management, National Park Service, Fish and Wildlife Service, and the Department of Defense. This proportion of federal to other forest land (1:2) has remained relatively stable for at least the past 40 years.

In the East, nonfederal ownership of forest land predominates (92%) in both the North and South. In the Rocky Mountains, 69% is in federal ownership, and in the Pacific Coast region, 56%.

Unreserved Forest Land Area

Forest inventories usually focus on forests that are available for harvesting, because of their commercial value and society's economic dependence on the timber resource, as well as the need for information on timber supply to meet the Nation's needs. Therefore, there is little inventory data for reserved forest land. Nationwide, 47 million acres of forest land (6% of all U.S. forest land) is reserved from timber harvest in wilderness, parks, and other classifications. The following discussion of productivity and forest type groups is limited to the 689 million acres of unreserved forest land, which includes timberland and other forest land.

Productivity

Potential productivity is a measure of the volume of timber a site is capable of producing under natural conditions. Trends in volume of timber produced—actual production levels—are discussed later.

Most of the Nation's high productivity forest lands (lands capable of producing more than 120 cubic feet per acre per year) are west of the Cascade Mountains, in the Pacific Northwest subregion of the Pacific Coast region, and in the South Central subregion of the South region (fig. 6). These two subregions have 14 million and 31 million acres, respectively, of high productivity lands (table 3). In the West, 79% of the redwood forest type is highly productive (table 4). However, the largest areas in the 120+ cubic-foot class are in the eastern oak-hickory and loblolly-shortleaf pine type groups, and in the western coastal Douglas-fir types.

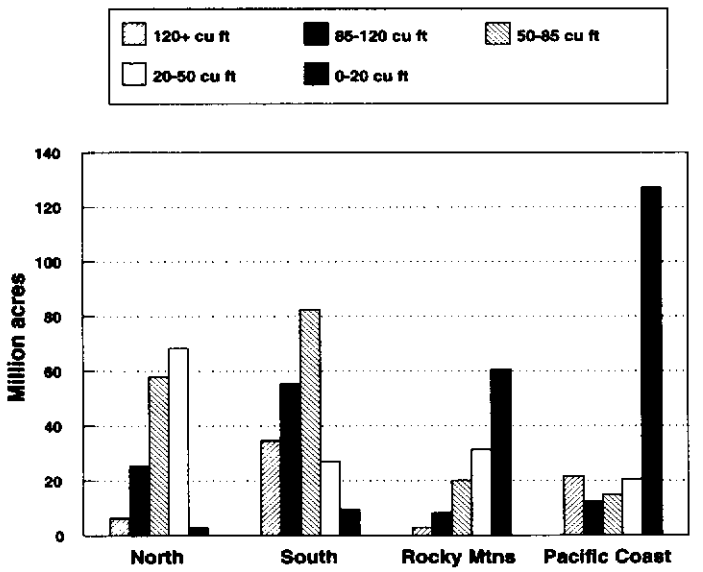


Figure 6.—Unreserved forest land productivity by region, 1992.

Most of the less productive forest lands are in the West—in high elevation, or northern latitude (i.e., Alaska) fir-spruce stands, or in the dry, open-grown pinyon-juniper lands of the Southwest. These forest lands, often called woodlands, are very important for watershed protection, wildlife habitat, livestock grazing, and other uses. Although these forest lands produce little amounts of industrial roundwood, they do produce other wood and tree products, which often are important for local use. Fuelwood is a primary commercial use in many areas with woodlands, such as the oak woodlands of California and the pinyon-juniper areas of the Southwest. Alaska has the greatest area of low productivity lands, in terms of timber production. The Intermountain subregion also has large areas that are relatively unproductive for timber production. Forty-four percent of the Intermountain forest land has the potential to produce no more than 20 cubic feet per acre per year; and 66% of it can produce no more than 50 cubic feet.

Forest Types of the East[5] and West[6]

The forest land of the United States spans a wide range of latitudes, elevations, precipitation, and soils. As a consequence, the species composition of the forests is quite diverse, ranging from pure stands of Ponderosa pine in the semiarid West to the complex multi-species hardwood forests of the Northeast.

Eastern hardwood forests.—Eastern hardwood forests account for 40% of the unreserved forest area of the United States, and 74% of all of the eastern forests (table 5). This group of multispecies types covers most of the forests in all five eastern subregions—North Central, Northeast, South Central, Southeast, and Great Plains. The most widespread forest type is oak-hickory (fig. 7), which is found throughout the South and the southern half of the North (see map); unreserved forest land in this type totals 127 million acres.

Maple-beech-birch forests are found on 46 million acres in the Northeast and North Central subregions. These forests, which have expanded in acreage in recent years, contain valuable hardwood species for wood products, including sugar maple and the birches.

Most of the 32 million acres of oak-pine forests are in the South. Much of this forest type emerged as a result of selective harvesting of natural pine forests. The acreage classed in the oak-pine type was declining before 1987, because of conversion to pine forests. However, the area has been relatively stable since 1987.

[5] *Includes Great Plains subregion.*

[6] *Does not include Great Plains subregion.*

The oak-gum-cypress forests, which total 29 million acres, are important to the southern hardwood industry. Although much of this forest type has been lost by conversion of bottomlands to agriculture, the acreage appears to have stabilized in recent years.

Most of the 17 million acres of aspen-birch forests are in the North Central subregion (80%). This forest type is made up of pioneer species that often take over areas after disturbances, such as fires, abandoned agricultural use, or removal of other forest types. This type supports a variety of northern wildlife species, such as white-tailed deer, and is a major source of fiber for the pulpwood and waferboard industries in the North.

Elm-ash-cottonwood forests are bottomland forests of the North and South. They account for 14 million acres, which often are wetland areas, mostly in the North Central and Northeast subregions. White ash is the most commercially valuable species in this type; and it is used for specialty wood products such as tool handles. The Great Plains has 1.3 million acres in this forest type.

Eastern softwood forests.—Eastern softwood forests occupy a much smaller area than the hardwood forests. In the pine region of the South, the loblolly-shortleaf pine and longleaf-slash pine forests account for 61 million acres. The loblolly-shortleaf pine forests account for more than one-half of the 96 million acres of conifer-bearing forests in the East.

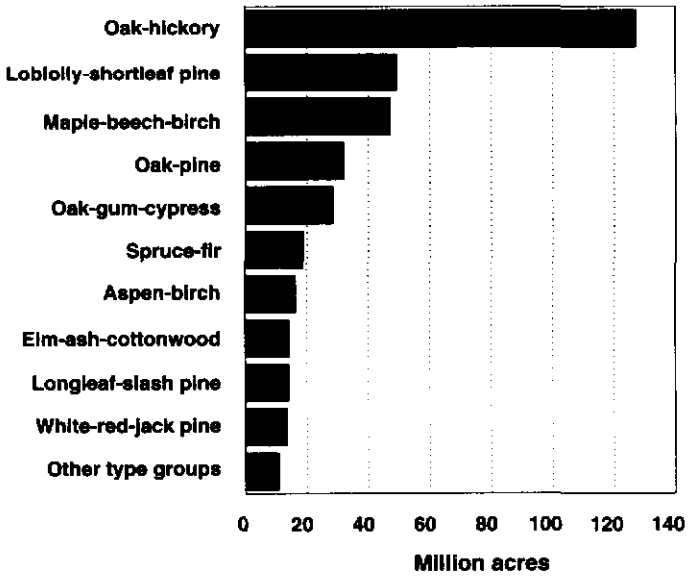


Figure 7.—Forest type groups on unreserved forest land in the East, 1992.

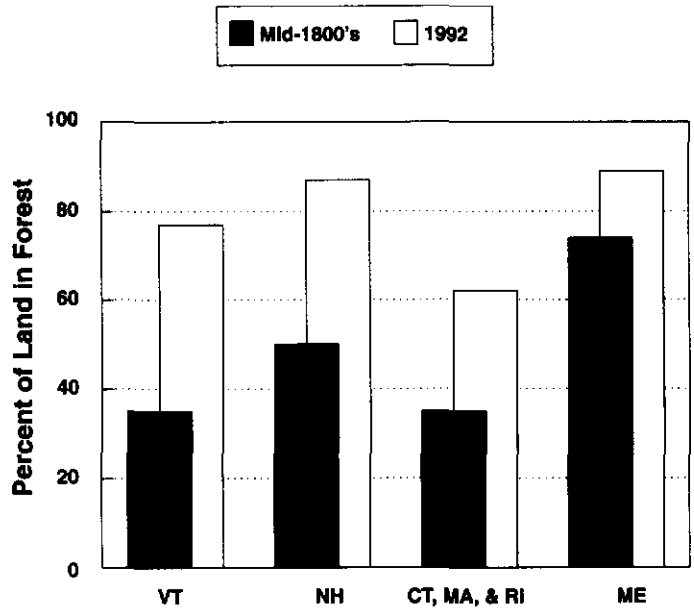


Figure 8.—Percent of New England land area in forests, 1850 and 1992.

Longleaf-slash pine forests, which account for less than 25% of the southern pine type acreage, are found in states bordering the South Atlantic and Gulf coasts; but most of the area in this type is concentrated in Florida and Georgia (see map).

The spruce-fir and white-red-jack pine forests are the softwood forests of the North. They account for one-third of the softwood forests of the east, but for only 5% of all of the unreserved forest land. The spruce-fir forests of the Northeast are an important source of pulpwood in that subregion.

The white-red-jack pine forests total 14 million acres. The species composition of this forest type varies. In the Northeast, white pine predominates; red and jack pines are the common pines of the North Central subregion. The Great Plains subregion has 1.5 million acres in this forest type group.

Evolution of the current eastern forest.—Much of the existing eastern forest has evolved by reversion of agricultural land to forest land. For example, in 1850, Vermont was 65% cleared in cropland and pasture; today it is 77% forested (fig. 8). This reversion to forest land began gradually in the mid-1800s, continued into the 1900s and was accelerated by the Great Depression. Between 1925 and 1945, almost 20 million acres of abandoned farms and depleted woodlands were incorporated into the eastern National Forests under the terms of the Weeks Act (Shands 1991). Much of the reversion to forest was because farmers in the East were unable to compete commercially with farmers in the Midwest and West.

Western forests.—Eighty-two percent of the unreserved western forest land is covered with softwoods; 16% has hardwood stands, and 1% is nonstocked (table 6).

Two of the three most extensive forest type groups are other softwoods and pinyon-juniper (fig. 9). The other softwoods group is primarily black spruce stands in interior Alaska. These type groups account for 112 million acres—more than one-third of the western forests. While nearly all of these forests are not productive for timber, they provide important values that include watershed and soil protection, wildlife habitat, and esthetic enjoyment.

Three softwood forest type groups account for another 37% of the West's unreserved forest land: fir-spruce, Douglas-fir, and ponderosa pine.

The fir-spruce forests occupy 53 million acres. These forests, found at mid- to-higher elevations throughout the forested West, have gained in value and use for wood products in recent decades, because of tightening supplies for other species.

The Douglas-fir type, which is found in all western subregions except Alaska, totals 37 million acres. The Douglas-fir forests, on the Pacific slope in the Northwest, are perhaps the most productive softwood forests in the United States in terms of volume per acre. Timber from these forests provides the raw material for sawmills, plywood mills, and other industries.

Ponderosa pine forests occupy 28 million acres of unreserved forest land in the West, more than 50% of which is in the Intermountain subregion. This species is also abundant east of the Cascade Range, in the Northwest subregion, and in California. The ponderosa pine forests of the West are a major source of raw material for lumber manufacturing.

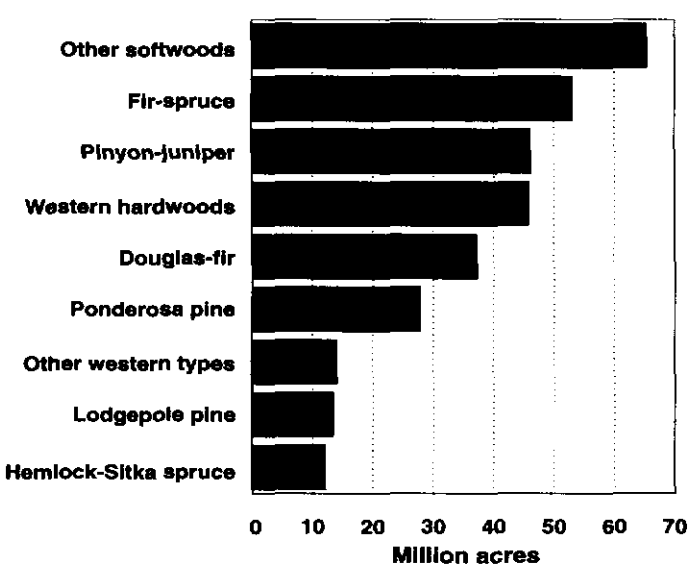


Figure 9.—Forest type groups on unreserved forest land in the West, 1992.

Lodgepole pine is another distinct forest type in the West, totaling almost 14 million acres. Although it is present throughout much of the West, this species is most abundant in the Intermountain subregion.

Hemlock-Sitka spruce forests are found primarily on the Pacific slope in Oregon and Washington, and in coastal Alaska. These forests account for about 12 million acres, and are made up of important commercial timber species, providing raw material for lumber products, pulping, and log exports on the Pacific Coast.

There are about 46 million acres of the western hardwoods forest type group. In California, oaks predominate in hardwood stands; in the Intermountain subregion, aspen is the most abundant hardwood. In the Pacific Northwest subregion, red alder is the most abundant hardwood species. In recent years, this species has increased in area, volume, and value to the wood products industry. It is used for fuelwood, lumber and specialty millstock, and pulp chips for both domestic use and export.

The other western types—larch, redwood, western white pine, chaparral, and non-stocked—total about 14 million acres. They are much more localized in occurrence, but contribute valued products to timber markets.

Timberland Area and Ownership

Trends in Timberland Area

For the entire United States, timberland area has remained fairly stable since the last RPA Assessment, with an apparent gain of 4.6 million acres (less than 1%) (tables 7 and 8). Net gains were reported in the North (2%), South (1%), and in the Rocky Mountains (2%) regions (fig. 10). On the Pacific Coast, timberland area decreased by more than 2 million acres (3%) from 1987 to 1992. Most of the decrease was in the Pacific Northwest subregion (1.1 million acres), followed by Alaska (695,000 acres), and the Pacific Southwest (512,000 acres). These shifts in timberland area are the result of a complex combination of timberland being withdrawn for reserved uses, such as parks and wilderness, and other influences. Other influences include reclassification from timberland to other forest as a result of re-evaluation of site productivity, and loss of timberland to various

nonforest land uses. In the South, the loss of timberland to agricultural uses has been stemmed, in part, because agricultural production was curtailed after 1981, and productivity per acre continued to increase.

Since 1952, the area of timberland has decreased 4%, or 19.3 million acres. This decline has been entirely the result of withdrawals of public timberland as wilderness or other land uses that do not permit commercial timber harvest. In total, 35.6 million acres of productive forest land have been withdrawn from timber production as wilderness and similar designations. This is more than double the area set aside in 1963. Although timber harvest is not allowed in these areas, they provide other benefits.

Seventy-three percent of the Nation's timberland is in the eastern United States. In the West, timberland is, as in the past, a small segment of the total forest area, although timberland does constitute more than one-half of all forest land in the Great Plains and Pacific Northwest subregions, and Colorado, Idaho, and Montana in the Rocky Mountains region (table 1).

Timberland Ownerships

Timberland ownership patterns vary throughout the United States. For descriptive and analytical presentation, timberland ownership has been divided into four broad classes: National Forest; other public; forest industry; and nonindustrial private. The balance between public and private has not appreciably changed since 1987 (table 7). Private lands are concentrated in the eastern part of the U.S., and public lands are mainly in the West (fig. 11). For the United States as a whole, 73% of all timberland is owned by private individuals and firms; federal, state, and other public owners account for the remaining 27%.

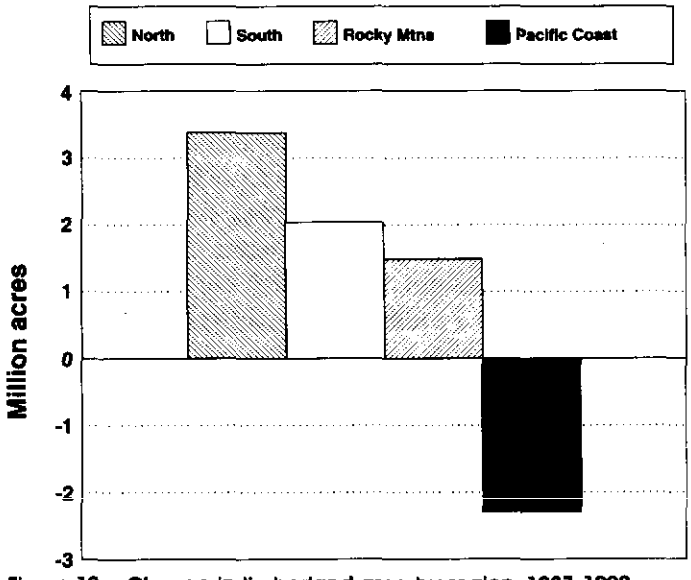


Figure 10.—Change in timberland area by region, 1987-1992.

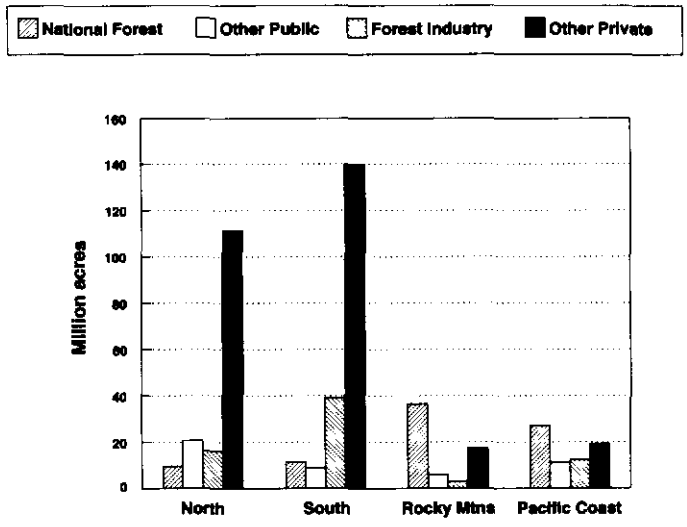


Figure 11.—Timberland ownership patterns by region, 1992.

National Forest.—National Forest timberland in the United States totals 85 million acres, or 17% of all timberland. Because most National Forests were created from unclaimed public lands in the West, around the turn of the century, most (three-quarters) of the current National Forest timberland is in the West. When the National Forest lands were reserved from entry, much of the more accessible, highly productive forested area was no longer in the public domain. As a consequence, National Forest timberland is, on average, of lower productivity and on steeper, higher elevation terrain than are private timberlands. Even in the East, mountainous areas predominate. Their terrain makes National Forests especially important in managing water flows and protecting and maintaining watershed condition. The National Forests in the Pacific Northwest contain some exceedingly productive forest lands. For example, about 22% of forest lands in site productivity classes of 85 and greater are on the National Forests.

Other public.—The other public category includes all lands managed by public agencies other than the Forest Service. Included are lands administered by the Bureau of Land Management, state, county, and municipal authorities. Timberland in this category accounts for 10% of the total timberland acreage. State-owned timberland, of which every state has some, constitutes more than 50% of the timberland area in the other public category (table 7).

The largest concentration of other public timberland is in the North (44% of the Nation's total), where it is made up primarily of state forests. Pennsylvania in the Northeast subregion and Michigan, Minnesota, and Wisconsin in the North Central subregion all have extensive state and local government management of timberlands. In this region, timberland that reverted to the states through tax delinquency during the depression accounts for much of the other public ownership. Oregon, Washington, and Alaska have large acreages of other public timberland—mostly state land in Alaska and Washington, and Bureau of Land Management (BLM) land in Oregon.

Forest industry.—Forest industry timberland holdings in the United States total more than 70 million acres, up 2% from 1977. These areas are owned by operators of primary wood products manufacturing facilities. Historically, they have been treated as an identifiable owner group because—unlike the nonindustrial private group—they are thought to have somewhat common objectives for ownership and management of timberland. Most of the forest industry timberland is in the eastern United States; 55% of all such lands are in the South, and 23% are in the North. The Pacific Coast has 18% of all industry timberlands, and the Rocky Mountains region only 4%. The location of forest industry timberland has been strongly influenced by the location and availability of highly productive forest land. The importance of these timberlands as a continuing source of wood raw material far exceeds what their proportional area indicates. The forest industry land ownership amounts to 14% of U.S. timberland area and accounts for one-third of U.S. timber harvest. In 1987, corresponding shares were 15% of area and 31% of harvest.

Nonindustrial private.—Timberland in this owner group includes individuals, trusts, and corporations. There are millions of owners in this group, which accounts for most (59%) of the timberland area in the United States. Within this broad class, the largest identifiable group is farmers, who own 82 million acres (17%) of all U.S. timberland.

Nonindustrial private timberland is concentrated in the eastern sections of the U.S.; 87% of all such land is in the North and South, accounting for about 70% of all timberland in both areas. In contrast, in the Rocky Mountain and Pacific Coast regions, this owner group accounts for about 28% of the timberland.

Nonindustrial private ownerships include many small parcels, and a smaller number of large tracts of land. The 288 million acres of non-industrial forests are owned by about 6 million individuals. However, only about 600,000 landowners have holdings larger than 100 acres; and these larger ownerships comprise about three-fourths of all non-industrial forests. Thus, 10% of the land owners hold three-quarters of the non-industrial forest land base.

More than 80% of timber harvesting on non-industrial forests occurs on the larger ownerships; and most economic opportunities to manage forests for wood production are found on them. The forested parcels in this owner group are found near urban areas, intermingled with cultivated land or land of other nonforest uses, as well as in remote areas.

Many different management objectives are held among the owners of this group. At any given time, some of the area is not available for the production and harvest of timber. However, ownership of timberland is transitory in this group, as are individual owner's objectives; changes in ownership and objectives often bring formerly unavailable resources onto the market (Birch et al.).

Although these owners account for 59% of timberland, they account for 49% of the U.S. growing stock timber harvest. This class of timberland continues to be extremely important to the health of timber economies and to the users of wood products, especially in the South.

STAND SIZE CLASS DISTRIBUTION

Stand size class distribution can be used to describe forest structure and age as well as distribution of stands suitable for various timber products. Four classes are generally recognized: (1) non-stocked, (2) seedling-sapling, (3) poletimber, and (4) sawtimber (see the Glossary for definitions).

On eastern[7] timberland, very few acres (1%) are nonstocked (fig. 12, table 9). With generally favorable climates and seed sources, few harvested areas, including clear-cuts, remain nonstocked for long. Such areas that are classed as non-stocked are mostly abandoned farm lands that are reverting to a forested condition. Seedling-sapling and poletimber stands are about evenly distributed in the East (23% and 28%, respectively). These stands form the core of the merchantable forests for the early 21st century. Sawtimber stands represent 47% of the timberland in the East. The bulk of timber harvesting is focused on these stands.

[7] *Includes the Great Plains subregion.*

In the West[8], the area of non-stocked stands is just 2% (table 10). The distribution of seedling-sapling and poletimber stands is 13% and 15%, respectively, and the balance (70%) is in sawtimber stands. In the West, the share of sawtimber-sized stands ranges from 61% in Alaska to 79% in the Pacific Southwest subregions.

Timber Volume

The Nation's timberland supports a wide variety of uses in addition to timber production, as do its other forest lands. The focus here, however, is on the volume of timber available now or prospectively for manufacture of wood products.

The Nation's timberland contains an estimated 858 billion cubic feet of timber, of which 92% is in growing stock—live, sound trees suited for roundwood products (table 11). About 6% of all timber volume is in live cull trees that, because of poor form or rot, are not suited for the production of all roundwood products. Only 2% of the volume of all timber is in dead trees that are sound enough to have value for some product uses. Softwood species have a higher proportion (95%) of all timber volume in growing stock than is the case for hardwood species (87%). The remainder of this discussion of timber volume focuses on growing stock volume.

Figure 13 provides a comparison of the average concentrations of timber volume in the different regions and how they have changed since 1987. The South, which had a 2.4% increase in total volume in the past 5 years, experienced a 1.4% gain in volume on a per acre basis. However, in the North, timber volume per acre increased 6.7% compared to a 9.0% total volume increase. Pacific Coast volume registered a slight (2%) decline, but volume per acre increased. The per acre volumes remove area changes from the comparisons.

[8]*Does not include the Great Plains subregion.*

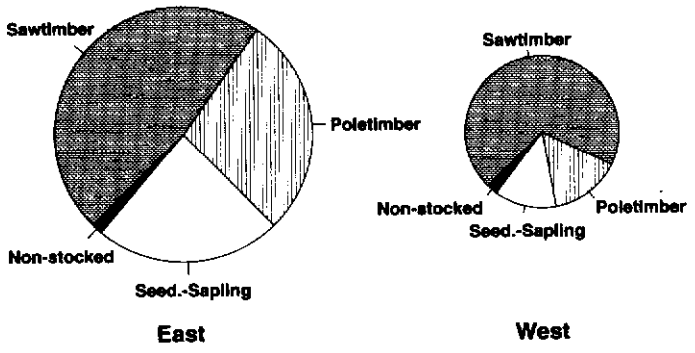


Figure 12.—Timberland area by stand size class, East and West, 1992.

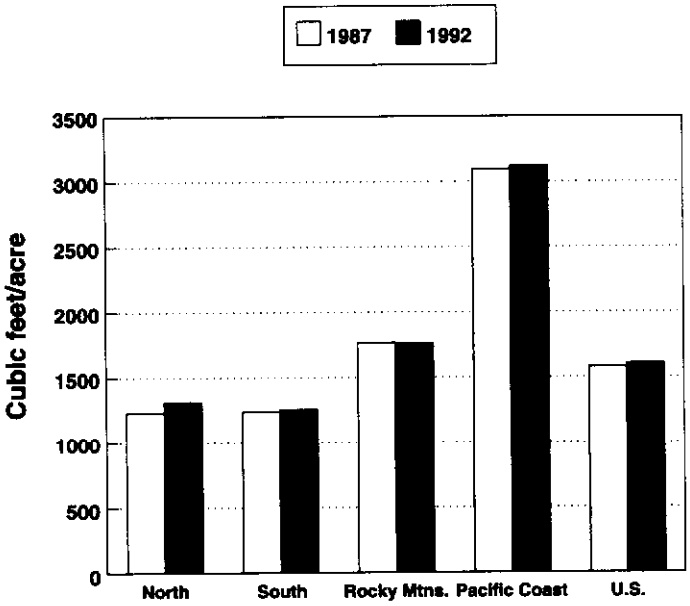


Figure 13.—Growing stock volume per acre by region, 1987 and 1992.

Because growth has exceeded harvest since the 1950s, timber volume on U.S. timberland has increased since then. Net volume per acre increased between 1952 and 1992 in all regions, except the Pacific Coast. In the North, average net volume per acre rose by 95% between 1952 and 1991. In the South, net volume per acre rose by 73%, and in the Rocky Mountains by 27%. In the Pacific Coast region, average net volume per acre decreased 4%. This was partly the result of harvest of mature timber on timberland with high volumes per acre, and partly because of withdrawals of federal timberland with mature timber.

The Nation's softwood growing stock volume totals 450 million cubic feet or 57% of all growing stock (table 12). Softwood volume is down 0.7% since 1987. The decline occurred in the South (down 2.5%) and the Pacific Coast (down 2.4%). Softwood volume increased 7% in the North and 1.2% in the Rocky Mountains region. The decline in softwood volume in the Pacific Coast region is a continuation of a trend since 1952. The decline in the South is a reversal of an increasing trend at least since 1952. Volume in the North and Rocky Mountains regions has been increasing at least since 1952. Softwood growing stock is concentrated in the West; the Pacific Coast region alone accounts for 43% of all softwood growing stock, despite its relatively small timberland base (fig. 14). The West contains stands that

have high per-acre volumes. Many of the younger, mature forests on the Pacific Coast have higher per-acre volumes because of the high productivity of their sites. Most of the remainder of softwood timber is evenly distributed between the South and the Rocky Mountain regions.

There were 336 billion cubic feet of hardwood growing stock volume on timberland in 1992, up almost 7% since 1987. Hardwoods account for 43% of all growing stock volume in the United States. More than 90% of all hardwood timber volume is in the eastern U.S., almost evenly distributed between the North and the South regions. Most of the remaining hardwood volume is in the Pacific Coast region (table 11).

Because hardwood growth greatly exceeds harvest, the quantity and quality of the hardwood resource have continued to improve. Since 1952, the net volume of U.S. hardwoods increased 82%, and the volume of hardwoods in diameter classes greater than 19 inches doubled. For softwoods, the net volume increased 4% between 1952 and 1992, and the volume of softwoods in diameter classes greater than 19 inches declined 30%.

Ownership

Because of many factors, including history of use, land productivity, and degree of management, the timber volumes are distributed unevenly among owners. National Forests, which account for only 17% of the Nation's timberland, have 27% of all growing stock volume, and 41% of all softwood growing stock volume

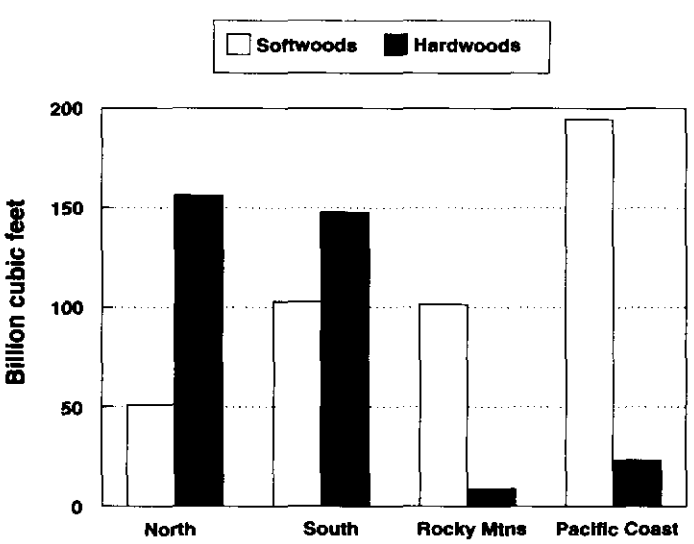


Figure 14.—Softwood and hardwood growing stock volume by region, 1992.

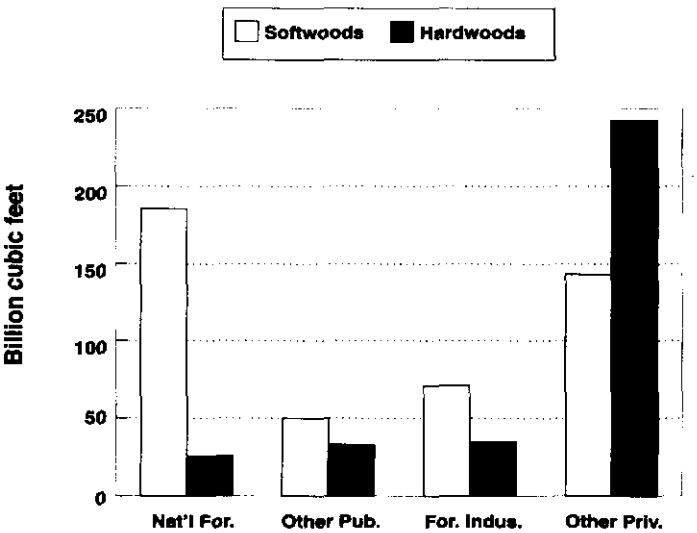


Figure 15.—Softwood and hardwood growing stock volume by ownership, 1992.

(tables 12 and 13). The National Forests, however, have less hardwood volume than the other owner groups (fig. 15).

Other public owners—states, federal agencies other than the Forest Service, counties and municipalities—account for about 11% of all growing stock, 60% of which is softwoods. The hardwood volume in this category is concentrated in the North, and softwood volume is mostly in the West, with the largest share in Oregon and Washington (tables 12 and 13).

Forest industries own about 13% of all growing stock volume in the United States, and 16% of all softwood volume. Softwood growing stock volume on forest industry lands declined 2.5% to 71 billion cubic feet, continuing a trend that goes back at least to 1952. For the first time since 1952, however, the forest industry ownership in the South registered a decline in softwood volume (0.7% between 1987 and 1992). Similarly for hardwoods, growing stock volume declined (4.5%) on forest industry ownerships in the South for the first time since 1952.

Nonindustrial private timberland accounts for nearly one-half of all growing stock in the United States. This owner group controls 32% of all softwood timber, and 72% of all hardwood timber. Both softwood and hardwood timber volume in this owner group is concentrated in the eastern United States — softwoods in the Northeast, Southeast, and South Central subregions; hardwoods are abundant on this ownership throughout the East.

Species

Douglas-fir is the most abundant softwood species; it totals 93 billion cubic feet or more than one-fifth of all softwood growing stock volume in the United States (fig. 16, tables 16-22). Sixty-one percent of all Douglas-fir volume is in the Pacific Northwest subregion (table 30). Other top-10 softwood species, in order of volume abundance, are: loblolly and shortleaf pines (67 billion cubic feet), true firs (42 billion cubic feet), ponderosa and Jeffrey pines (35 billion cubic feet), western hemlock (31 billion cubic feet), lodgepole pine (26 billion cubic feet), Engelmann and other western spruces (21 billion cubic feet), eastern spruces and balsam fir (19 billion cubic feet), longleaf and slash pines (16 billion cubic feet), and eastern white and red pines (15 billion cubic feet).

Although 65% of the softwood volume is in the western[9] United States, the softwood species in the South region have, in recent decades, become a principal focus for new investments by forest industries. The various southern pines together account for 96 billion cubic feet, which exceeds the Douglas-fir volume.

Of the top-10 hardwood species, all are found in the East,[10] with the exception of cottonwood and aspen, which span the continent (fig. 17 and forest type map). Oak *(Quercus)* is the most common genus, accounting for 113 billion cubic feet, or one-third of the hardwood volume (see the Glossary for the species that comprise the various oak groups). The maples are next in abundance, and are one of the fastest growing components of the hardwood resource. Soft and hard maples together account for 56 billion cubic feet, or 17% of all hardwoods.

[9]*Does not include the Great Plains subregion.*

[10]*Includes the Great Plains subregion.*

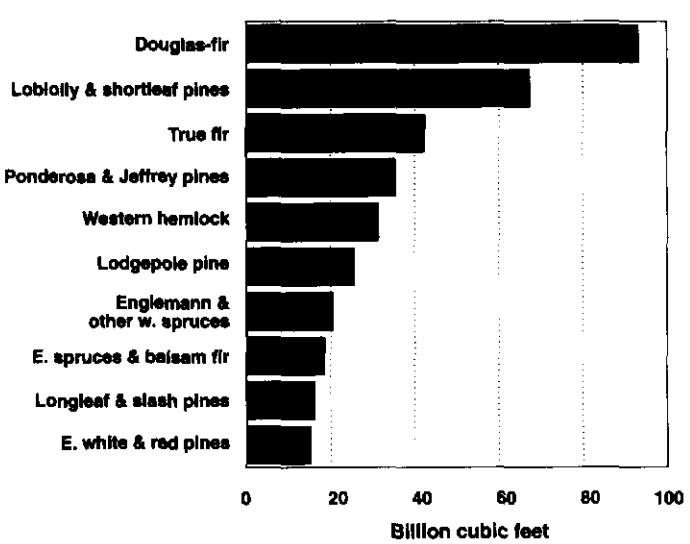


Figure 16.—Ten softwood species with most growing stock volume, 1992.

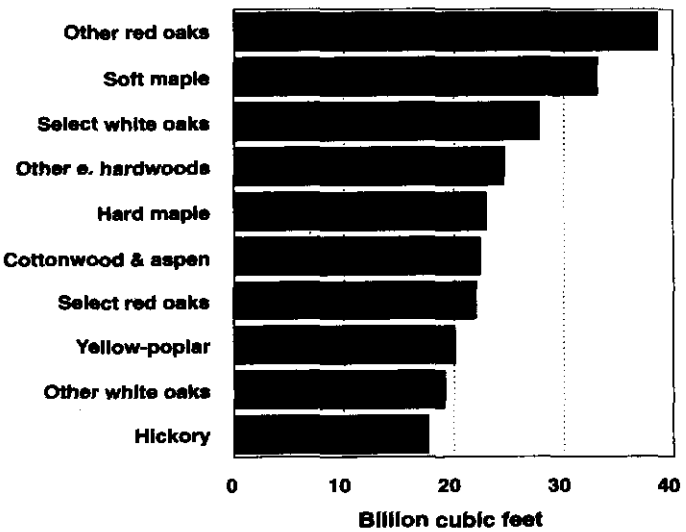


Figure 17.—Ten hardwood species with most growing stock volume, 1992.

From a timber supply perspective, the select species, which include select white and red oaks, hard maple, yellow birch, sweetgum, yellow-poplar, ash, black walnut, and black cherry, are most desirable. In 1992, their volume totaled 133 billion cubic feet, or 40% of all hardwood growing stock in the eastern[11] United States.

The use of western hardwoods is growing as softwoods become more limited in supply. Use of red alder, with an inventory of more than 7 billion cubic feet (table 20), has substantially increased in recent years. It is located almost entirely in western Oregon and Washington. The aspens in Colorado and other states in the Rocky Mountains region are also locally important for the manufacture of timber products and for the enjoyment of tourists when colors change in the fall.

Diameter Distribution

The distribution of growing stock volume by diameter classes provides important information about forest structure and the timber, wildlife, and esthetic resources. Because different timber products are made from different sized trees, and timber quality is generally better in larger-diameter trees, forest industries make extensive use of diameter data. Some species of wildlife are known to prefer stands of specific size trees to meet their habitat requirements (e.g., the red-cockaded wood-

[11]*Includes the Great Plains subregion.*

pecker and the northern spotted owl). While people's tastes in scenic beauty vary widely, many prefer to visit and recreate in stands with large diameter trees.

For trees from 5.0 inches to 20.9 inches in diameter, the patterns are similar for hardwoods and softwoods (fig. 18)—volume rises quickly to a peak in the 10- to 12-inch range, and then declines with increasing size (tables 22-31). Hardwoods continue this trend with little volume in large trees. Softwood volume, in contrast, increases after 21 inches to another peak. The pattern in diameter distribution varies little between 1987 and 1992 (figs. 19 and 20). Twenty-eight percent of softwood volume is in trees 21.0 inches in diameter and larger, while only 10% of hardwood volume is in trees that size. Comparable numbers for 1987 are 28% for softwoods and 9% for hardwoods.

The volume of softwood growing stock in trees of 19 inches or greater in diameter continued to increase in the East and decrease in the West between 1987 and 1992, a trend going back to 1952. The volume of hardwood growing stock in large-diameter trees continued to increase in the East.

The diameter distribution is also reflected in regional differences (fig. 21). The resource in the North is somewhat smaller, on average, than that in the South. The Rocky Mountains region has the most even distribution across diameter classes. The Pacific Coast region exhibits the softwood pattern most pronouncedly, with big jumps in volume in largest size classes.

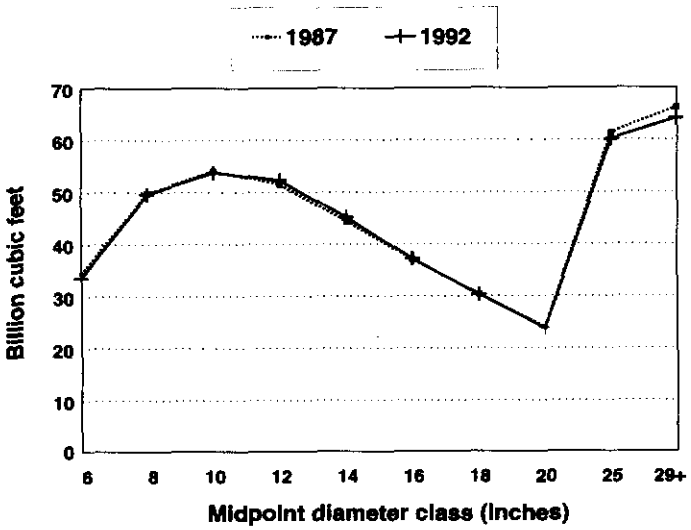


Figure 19.—Diameter distribution of softwood volume, 1987 and 1992.

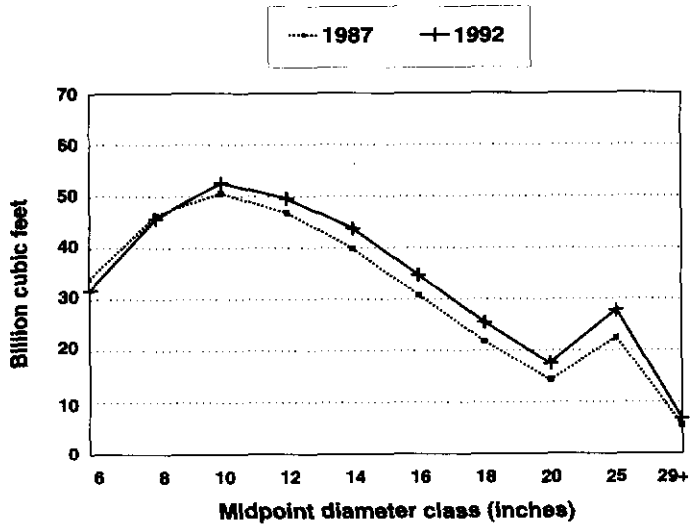


Figure 20.—Diameter distribution of hardwood volume, 1987 and 1992.

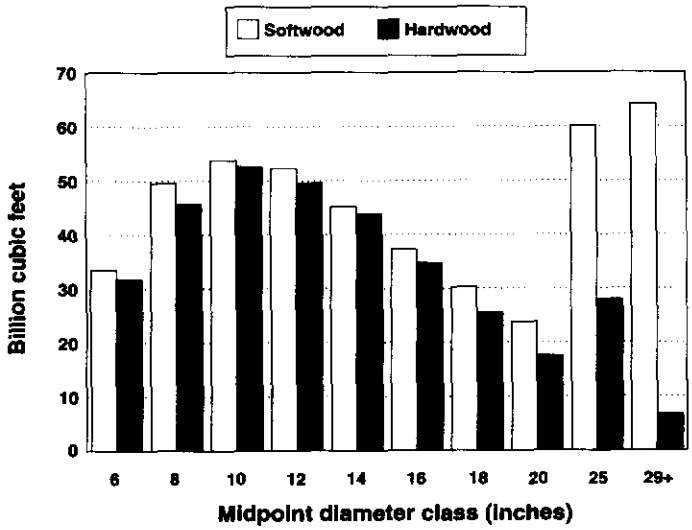


Figure 18.—Diameter distribution of softwood and hardwood volume, 1992.

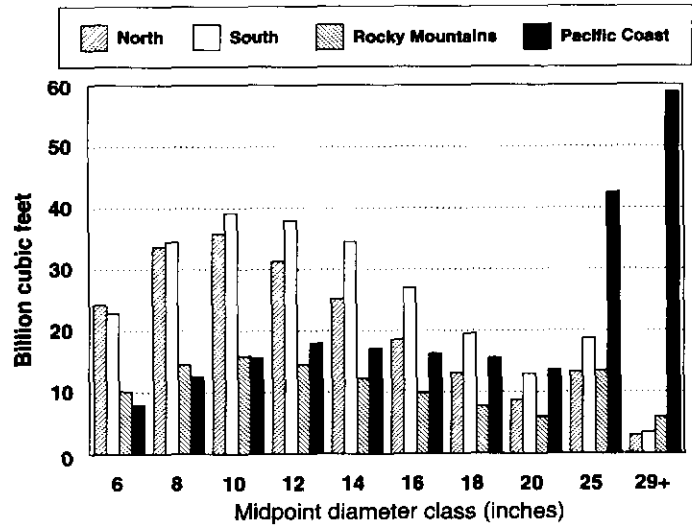


Figure 21.—Diameter distribution of growing stock volume by region, 1992.

Elements of Change in Timber Volume

Timber inventories are dynamic. This section focuses on the elements of change within forests—mortality, growth, and harvest.

Mortality

Timber mortality is commonly defined as the net volume of timber dying annually over a given period of time, as a result of natural causes, such as insects, disease, suppression, fire, and windthrow. Mortality is a part of every living forest. Usually, losses caused by insects, disease, and suppression occur at low and predictable rates. Little of this type of timber loss is captured for harvest, because the dead trees are widely scattered, and do not provide sufficient concentrations of timber volume to support a profitable harvest.

Timber volume loss to mortality can also occur in huge concentrations in localized areas, by epidemic insect infestations, wildfire, and windstorms. Timber killed, but not destroyed, in such catastrophic events often is salvaged and used to produce timber products.

Loss of growing stock to mortality totaled 5.5 billion cubic feet in 1991 (table 32), about 0.7% of the growing stock volume in the United States. The distribution of mortality is consistent and very predictable, except for periodic catastrophes. In 1986, mortality amounted to 0.6% of growing stock. For both softwoods and hardwoods, and for each owner group, the mortality rate (volume loss to mortality as a percent of growing stock) in 1991 varied between 0.6% and 0.8%. Mortality losses are greatest in the largest concentrations of timber. Even in areas of high timber volumes, the concentration of mortality is typically so small at the per-acre level, that trying to capture mortality by harvest is not practical. For the United States as a whole, growing stock mortality averages 11 cubic feet per acre annually. The mortality was highest on the Pacific Coast, averaging about 15 cubic feet per acre annually, and lowest in the North, averaging almost 10 cubic feet per acre per year.

Between 1962 and 1986, mortality averaged 4.3 billion cubic feet per year. Although it is a small portion of the inventory, the 5.5 billion cubic feet of mortality in 1991 is a considerable increase by historical standards. Mortality increased in all regions and on all ownerships between 1986 and 1991.

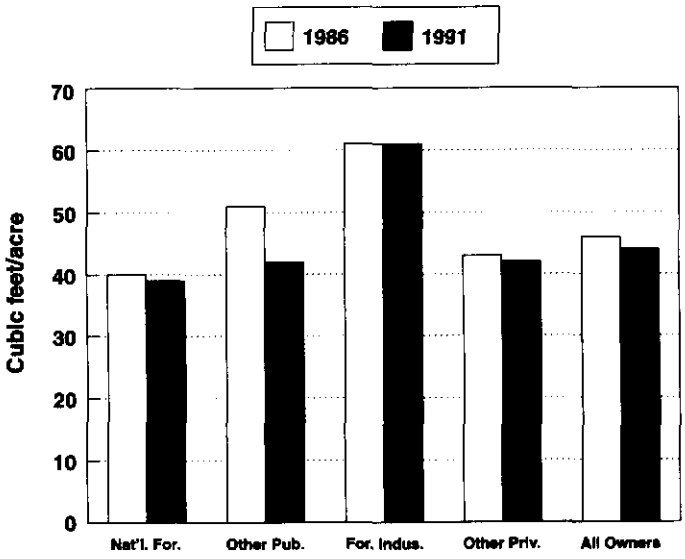


Figure 22.—Net annual growth per acre by ownership, 1986 and 1991.

Net Growth

Net annual growth is a commonly used measure of productivity and performance of timber resources. Net annual growth is annual timber volume growth, usually averaged over a period of time, less the volume lost to mortality and increase in cull volume. In other words, it is the net effect of natural gains and losses to timber volume.

Net annual timber growth.—Net annual growth totaled 21.6 billion cubic feet in 1991 (table 33), which translates to an annual growth rate of 2.7%. Fifty-six percent of all timber growth, and nearly three-quarters of all hardwood growth, was on nonindustrial private timberland. Forest industry accounted for one-fifth of all timber growth, and for more than one-quarter of all softwood growth. These percentages are much larger than its share of timberland and timber volume would indicate.

On a per acre basis, net growth on forest industry timberlands averaged 61 cubic feet annually, far greater than any other ownership (fig. 22). This reflects the high productivity of timberland in this owner-group, as well as the younger age of timber, higher stocking levels, and more intensive levels of management of these lands compared with other lands. For example, National Forests are generally composed of lands of poorer productivity and many old stands with relatively slow growth. As a consequence, they have the lowest per acre growth of any owner group (39 cubic feet).

Timber growth varies by region. The South accounts for more than 45% of all timber growth, 43% of softwood growth, and 49% of hardwood growth. The South and North regions combined account for nearly all (92%) of the total hardwood growth. The Rocky Mountains and Pacific Coast regions combined have 47% of all softwood growth, despite having 66% of all softwood volume. This may be because of the higher concentrations of older, slower growing softwood stands in the West.

On a per acre basis for all species, the Pacific Coast has the highest rate of growth (61 cubic feet) of all regions. The Rocky Mountains and North regions have the lowest per acre growth rates.

Trends in timber growth.—Total growing stock growth declined about 2% between 1986 and 1991. This is the first decline in net annual growth since 1952. All of the decline between 1986 and 1991 was attributable to softwoods, which registered a decline of 4.4% to 12 billion cubic feet. Net annual growth for hardwoods increased 0.9%. Declines in net annual softwood growth occurred in all regions, except the Rocky Mountains region, where it increased 1.4%. For the Pacific Coast region, the decline between 1986 and 1991 was the first since 1952.

For hardwoods, net annual growth increased in the South and Rocky Mountains regions, and decreased in the North and Pacific Coast regions. For the North and Pacific Coast regions, this is the first recorded decline in net annual growing stock growth of hardwoods since 1952.

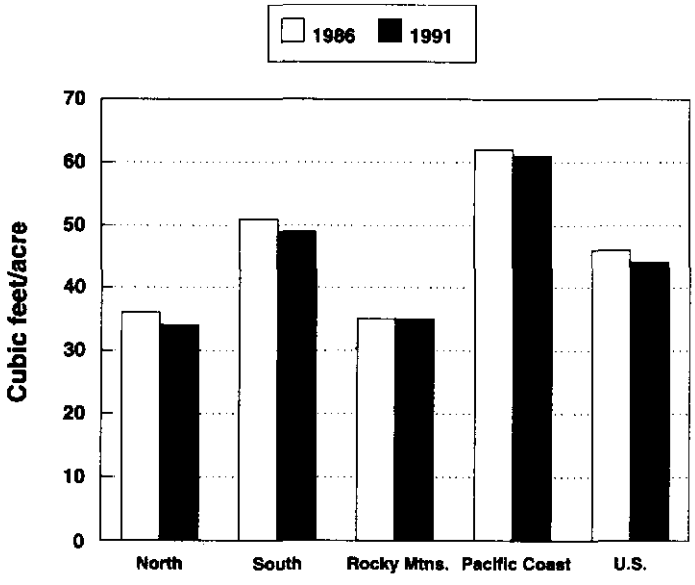


Figure 23.—Net annual growth per acre by region, 1986 and 1991.

Trends in growth per acre minimize the effects of change in area estimates. Net growth per acre decreased 1.3% in the Pacific Coast region, largely because of a 7.6% increase in mortality (fig. 23). Per acre growth in the South remains relatively high; but a slight negative trend is evident since 1986. Per acre growth has been stable in the Rocky Mountains region, and is now slightly higher than the per acre growth in the North, where there was about a 5% decline during the update period.

Removals of Timber Volume

Removals from timber inventories are losses that occur by other than natural causes (mortality). Removals from growing stock volume include: (1) harvest of roundwood products; (2) logging residues; and (3) other removals, such as pre-commercial thinning, and land clearing with resultant removal of timber. Not included in the removals are the timber inventories on timberlands withdrawn intact for parks and wilderness. The focus here is on timber removals from growing stock inventory that are or can be potentially used for wood products. Annual removal estimates in this report generally come from surveys of primary manufacturing plants (e.g., sawmills and pulpmills).

Timber removals from growing stock inventory in 1991 totaled 16.3 billion cubic feet (table 34). Almost 55% of all timber removals came from the forests of the South, which continued to increase its share of timber harvest in the United States—up from 45% in 1970. Twenty-three percent of all removals came from the Pacific Coast forests; 17% came from the North; only 5% came from forests in the Rocky Mountains.

Softwoods accounted for two-thirds of all growing stock removals in 1991. The forests of the South accounted for 53% of all softwood removals, the Pacific Coast 33%, the Rocky Mountains 7%, and the North 7%. Hardwood removals in 1991 were centered in the North and South, which accounted for 38% and 59% of the United States total, respectively.

Timber removals continued to be concentrated on private ownerships in 1991. Nonindustrial private owners had 49% of all timber removals, and industrial forests contributed another 33%. The National Forests accounted for one-eighth of total growing stock removals in 1991. Other public, with 6% of total removals, contributed the smallest volume of removals nationally, but contributed proportionally large volumes in some states and local areas.

Forest industry accounted for 38% of all softwood removals, nonindustrial private 40%, National Forests 16%, and other public 6%. Hardwood removals came primarily from nonindustrial private forests (67%).

Changes in timber removals.—Comparison of removals in 1991 with those in 1986 indicates an increase of about 2% (table 34). Average timber harvest levels have risen each decade since the 1950s. For example, removals in 1991 were 21% higher than in 1970.

Hardwood removals in 1991 were higher than in 1986 by nearly 7%, while softwood removals were virtually unchanged. In 1991, about two-thirds of removals were softwoods and one-third hardwoods, which was about the same mix of species as in 1952. Total removals from National Forests declined 10% between 1986 and 1991, and softwood removals dropped 13%. Much of this was the result of protection of land and associated habitat from harvest to conserve endangered species. Removals from other public lands were 7% lower. Removals from nonindustrial private lands increased 3%; and forest industry registered a 9% increase, with most of this in hardwood species.

In the North, removals were unchanged between 1986 and 1991 (table 34). In the South, there was a 9% increase, with most of that in the Southeast subregion. In the Rocky Mountains and the Pacific Coast regions, removals declined 5% and 10%, respectively.

The pattern of change in removals between 1986 and 1991 is the result of the workings of timber markets. Removals decreased on public lands in the West, and increased on industry and nonindustrial private lands in the East. If timber sold on federal lands continues to decline as a result of habitat protection for endangered species and other reasons, timber prices are likely to rise. Higher prices would set in motion market forces that could lead to additional pressures to harvest timber on private lands, increase timber product imports, and decrease exports. These market interactions will create opportunities and challenges for the private sector in managing the forest resource for timber production.

TIMBER GROWTH - REMOVAL BALANCES

Comparisons of net growth and removals estimates shown in table 35 provide a spot check of the balance between two of the components of change, and by inference, an indication of what will happen to the inventory for the year of comparison.

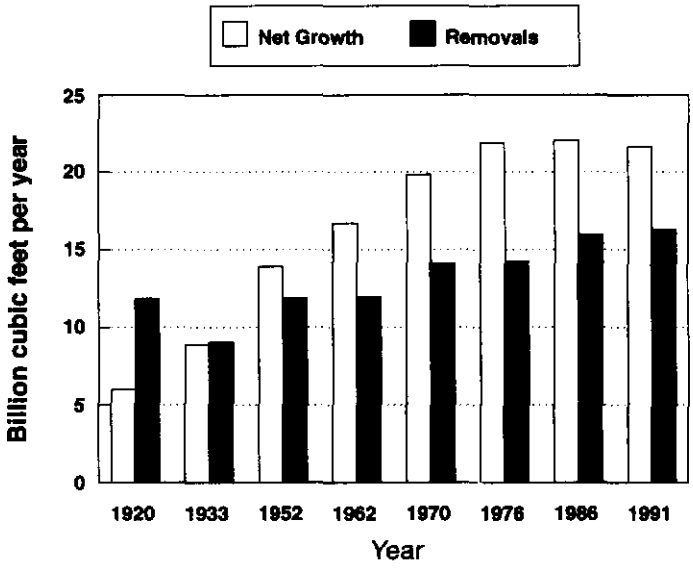


Figure 24.—U.S. timber growth and removals, 1920-1992.

The growth-removals ratio for the United States is greater than one for all species (1.3), for softwoods (1.1), and for hardwoods (1.8). These ratios are somewhat lower than comparable ratios for 1986. The ratios in the North are very high (1.9), indicating continued substantial increases in growing stock volume, if growth and removals remain at 1991 levels. The softwood ratio in the South continued to slide, and now has dipped below 1 (0.9). The growth-removals ratio in the Rocky Mountains region exceeds 2.6, and is higher than the 1986 ratio, because of lower removals and increased growth. The ratio on the Pacific Coast is 1.1; for softwoods it is 1.0. For this region, the ratios have increased since 1986, because of reductions in timber harvests.

In the 1920s, timber growth nationally was about one-half the rate of harvest (fig. 24). By the 1940s, improved forest growth rates (partly because of forest protection from fire), as well as declines in harvest rates, resulted in timber growth and harvest coming into approximate balance (Frederick and Sedjo 1991). By 1952, timber growth nationally exceeded harvest by 17%. Since the 1950s, timber growth has consistently exceeded harvest, even though timber harvest rates have risen steadily.

In 1976, net timber growth nationally exceeded harvest by 54%, and in 1986, by 38%. By 1991, the margin of growth over harvest had dropped to 33%. The narrowing margin of growth over harvest since 1977 is the result of increasing harvest rates and slowing growth rates, as compared with historical rates. The decline in the rate of increase in growth rates is partly the result of increasing mortality, and partly the maturation of forest stands in many parts of the U.S.

The current ratios by ownership are positive for all owner groups except forest industry (0.8). The 1991 growth-removals ratio for National Forests is 1.6; for other public forests it is 2.0 for all species, and 1.7 for softwoods; nonindustrial private lands have a ratio of 1.5 for all species, 1.1 for softwoods, and 2.0 for hardwoods.

The growth / removal ratios indicate balance only for the year or years cited, because the levels of removals are not stable from year to year.

TIMBER PRODUCTS OUTPUT

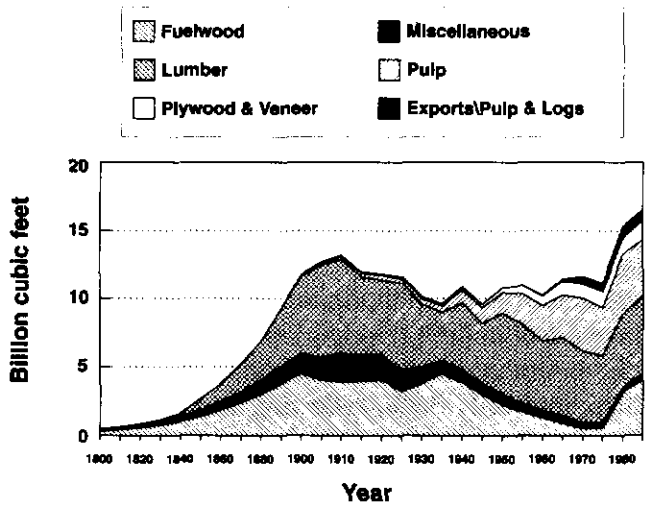
Information gathered from the primary manufacturing plants was used to describe timber products output for 1991 (tables 36-38). The removals information shown in tables 34 and 35 is the combination of roundwood products, logging residues, and other removals, all from growing stock sources, shown in table 38.

Historic Trends in Timber Production

Timber production in the United States rose rapidly during the last half of the 19th century (from 2.7 billion cubic feet in 1850 to 12.1 billion cubic feet in 1900). Production peaked in 1910, at 13 billion cubic feet (Frederick and Sedjo 1991). Because of replacement of wood fuels by coal and oil, more efficient use of wood, and use of wood substitutes, production of timber began a slow decline that lasted until after World War II. By the 1940s, U.S. wood production was about 20% less than in the early 1900s. After the war, increased demand for housing caused timber production to rise; and by the mid-1970s, timber production again reached record levels. Production has increased consistently since then.

Products From Growing Stock and Other Sources

As indicated, production of roundwood products has evolved over time. In the 1700s and 1800s, the uses of wood for fuel, fences, and railroad cross ties were especially important at various times (fig. 25). Over the past decades, the use of wood continues to evolve as new products are developed, applications change, and uses increase or decrease. Since 1952, pulpwood as a percent of the roundwood harvest on timberland increased from 15.7% to 28.2% in 1991, for example.



Source: Fredrick & Sedjo (1991)

Figure 25.—Domestic production of forest products, 1800-1985.

Most attention is focused on roundwood products from growing stock because of the overwhelming importance of that source, and because harvest from growing stock has an effect on growing stock inventories. These inventories are tracked and studied because of their commercial importance. However, roundwood products also are made from non-growing stock sources, such as dead trees, live cull trees that are largely rotten or are rough in form, very small trees, trees of seldom used species, and trees from nonforest land (fence rows, etc.).

In 1991, roundwood products from all domestic sources in the United States totaled 18 billion cubic feet, of which growing stock trees accounted for 78% (table 36). Only 12% of all softwood roundwood products came from non-growing stock. The situation was different for hardwoods, however, where 37% of roundwood products came from non-growing stock sources.

As has been the case since the jump in crude oil prices in the 1970s, a high proportion of the total hardwood harvest is fuelwood—38% in 1991 (table 36). Hardwoods accounted for 81% of all roundwood harvested for fuelwood in 1991. For fuelwood use, species, tree form, and size are less important in determining value than for other products. Location, availability, and low cost are primary concerns. Therefore, much fuelwood comes from species of lesser value for other roundwood products, small trees, or trees that are too poorly formed for timber and other products. Non-growing stock accounted for a minor part of the wood supply for all other products. The fuelwood harvest was concentrated in the eastern United States, where some 80% of the population lives (U.S. Bureau of the Census, 1991).

Saw logs accounted for the largest share of roundwood harvest in 1991—41%. This roundwood product, used in the production of lumber, accounted for 49% of all softwood harvested, but for only 29% of all hardwood harvest. Saw log harvest was concentrated in the South and Pacific Coast regions; these areas combined accounted for three-quarters of the timber harvested for saw logs (table 36). Softwood lumber production increased from 30.2 billion board feet in 1952 to 35.3 billion board feet in 1991 (Phelps 1991), an increase of 16.9%. The use of saw logs for softwood lumber manufacture increased only 3.8%, reflecting increased recovery of lumber per unit of saw log.

Pulpwood roundwood accounted for 28% of total timber harvest in the United States in 1991. Almost 61% of the pulpwood harvested was softwoods. Ninety percent of all pulpwood roundwood was harvested in the eastern United States, with the South accounting for 67%. Although the Pacific Coast has a substantial pulp industry, most of the wood raw material is from chips produced as the byproduct of lumber manufacturing.

Veneer logs accounted for 8% of the roundwood harvested, while other products such as cooperage, mine timbers, poles, pilings, posts, shakes, shingles, and logs for export accounted for the remaining 5%. Softwoods dominated both veneer logs and other products—91% and 89%, respectively. The South and Pacific Coast regions combined produced more than 90% of all veneer logs harvested in 1991. Fifty-six percent of the harvest for other products was concentrated in the Pacific Northwest subregion, the majority of which was logs for export.

Logging Residues

Logging residues are materials removed from growing stock in the process of timber harvest, which are left unutilized at the harvest site. Residues are materials from trees left in the woods, because they are uneconomical to remove for use in manufacturing products. Logging residues may be a source of raw material in the future as products, the price of raw materials, or the economics of manufacturing change.

Since 1986, the proportion of softwoods left as logging residues has decreased from 16% to 14%. The volume of hardwood logging residue as a percent of total hardwood removals declined from 18% to 17% (table 38). In the Pacific Coast region, logging residues were 19% of total removals; but in the South and North, logging residues were only 15% and 13%, respectively, of total removals. The higher proportion of removals left as logging residue in the West is partly the result of breakage and other factors associated with logging of old timber, and partly operation in steep, remote terrain.

In the eastern part of the United States, hardwood logging residues totaled 1.6 billion cubic feet, and accounted for 11% and 23% of hardwood removals in the North and South, respectively. Softwood logging residue in the South amounted to 10% of softwood removals.

Other Removals

Other removals consist largely of growing stock cut and burned or otherwise destroyed in the process of conversion of forest land to nonforest uses. Another source of other removals is growing stock removed in forestry cultural operations, such as precommercial thinning. These removals, like logging residues, are not a potential immediate source of raw materials; but changing economics may someday make more of this material available for product manufacture. In 1991, 7% of all growing stock removals fell into this category (table 38). Only 3% of softwood removals were in this category; but 12% of hardwood removals were so classified. Ninety-nine percent of the hardwood growing stock lost to other removals was in the South and the North. The losses in both regions were largely the result of removals of forests to yield land for a number of nonforest uses.

Most of the softwood growing stock classified as other removals in 1991 was in the South. This likely was scattered softwoods in predominantly hardwood stands that were converted to nonforest uses.

When timberland is converted to nonforest use, some wood raw material is usually destroyed in the process. But wood that is valuable for product manufacture, if in economic concentrations, is usually utilized and is included in the roundwood products category of removals.

CHANGES IN THE FOREST RESOURCE SINCE 1900

Peoples' attitudes towards U.S. forests have changed over the years, and they have affected the nature and extent of the forest resource. This synopsis of the evolution of U.S. forest policies and the U.S. forest resource since 1900 is intended to provide perspective on how the current forest came to be the way it is. The synopsis draws on material in MacCleery (1992).

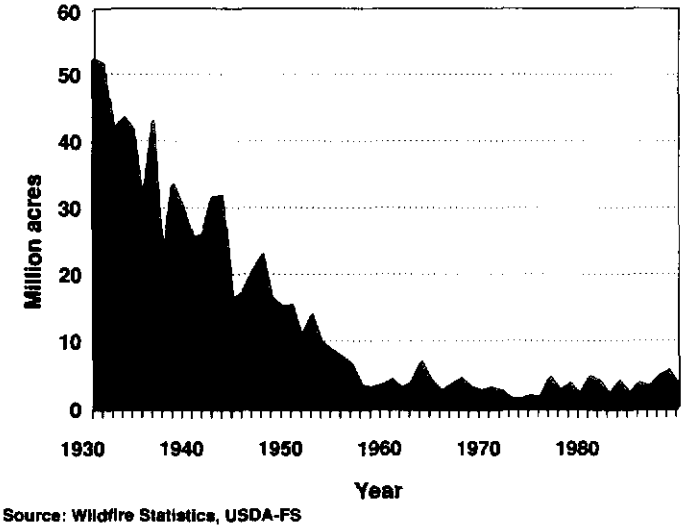
Native Americans used and managed the forests to serve their own needs. European Americans initially viewed forests as an encumbrance to agriculture, or as a virtually inexhaustible resource to be "mined." They initially used the forest—its wildlife, wood products, and land—to meet their subsistence needs for food and energy, much as Native Americans had done. However, the abundant wealth of the forests was later harvested to build the homes, cities, and infrastructure of a growing nation. In addition, the lands previously occupied by forests were used to feed a rapidly growing population.

Scarcely more than a century ago, peoples' attitudes toward the forest began a shift to viewing forests and wildlife, not as products to be mined or hunted, but as resources that could be managed over the long term, on a scientific basis, for both products and environmental services. This view was reinforced by individuals of the time that included Bernard Fernow, a German forester, and Theodore Roosevelt who, as President, in 1901, was in a position to have a profound effect on the conservation history of the Nation. Other people built upon the actions of the initial leaders; and, by the 1930s, a forest policy framework had emerged that emphasized protection of forests from wildfire and their management under scientific principles. Specific actions focused on:

- Fire suppression, prevention, and public education to protect the forest;
- Establishing and enhancing the profession of forestry and other natural resource disciplines, by establishment of accredited natural resource schools, professional societies, etc.;
- Improving the art and science of forest culture and management, by research at federal and state experiment stations and universities, and establishment of tree nurseries;
- Improving the efficiency with which wood products are utilized in the woods, at the mill, and in end-product applications;
- Improving the quality of forest management on private lands by improving economic incentives and removing tax and other disincentives, and providing technical and financial assistance to forest landowners;
- Establishing and expanding the National Forests for watershed protection, irrigation, and sustained timber production. A key element of the public policy framework was strong cooperation among federal, state, and private sector interests to achieve common goals (Steen 1976).

It is a measure of both the inherent resilience of U.S. forests, and of the policies that were put in place in response to public concerns in the early decades of this century, that forest conditions over much of the United States have improved since 1900. The following are highlights in the evolution of the U.S. forest resource since 1900.

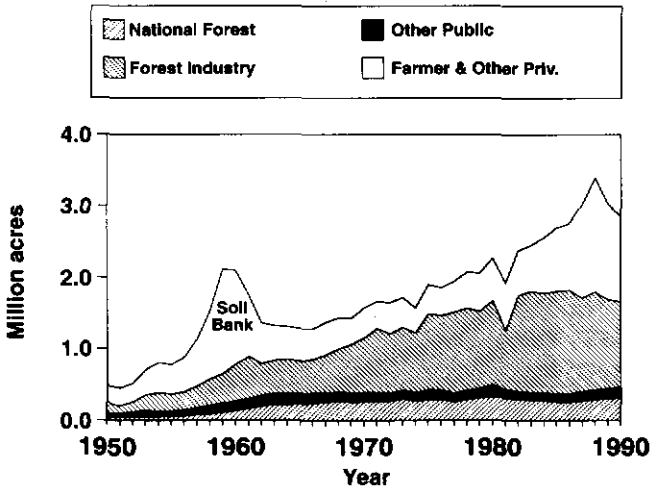
- By the 1920s the area of U.S. forests had stopped declining for the first time in more than 400 years. This was largely because of a stabilization in cropland acreage resulting from two major factors: (1) replacement of draft animals by internal combustion engines (in 1900, feeding draft animals was taking one-third of the U.S. farmland base), and (2) increasing farm productivity after 1930, because of the development of hybrid crops, fertilization, and other practices resulting from agricultural research (Frederick and Sedjo 1991).
- Forest fire protection improved and eventually reduced destructive wildfire by more than 90% — from 20 to 50 million acres per year to 2 to 5 million acres (Frederick and Sedjo 1991; fig. 26). This allowed millions of acres of forest to regenerate naturally, and set the stage for improving forest conditions, as well as for increasing investments and tree planting on both private and public lands (Williams 1989).



Source: Wildfire Statistics, USDA-FS

Figure 26.—Trends in U.S. forest land burned by wildfire, 1930-1989.

- The 50 to 80 million acres of "cutovers" or "stumplands" that existed in 1900, largely caused by repeated wildfires, have long since been reforested (Williams 1989). Today, many of these areas contain mature forests. Others have been harvested a second time and regenerated to young forests.
- In 1900, the growth of U.S. forests was a fraction of harvest. Today, net annual forest growth exceeds harvest by one-third. Because of this favorable growth/harvest situation, which has existed since about the 1940s (Frederick and Sedjo 1991), biomass in U.S. forests is at least 33% greater on a per acre basis than it was in 1950. In the eastern United States, biomass per acre has almost doubled since 1952. Today, annual forest growth is more than 3-1/2 times what it was in 1920 (Fedkiw 1989).
- Improving wood utilization technology, combined with increasing real prices for wood, resulted in substantially improved efficiency with which wood is used. Much less material is being left in the woods; many sawmills produce twice as much usable lumber and other products per log input as they did in 1900; engineering standards and designs have reduced the volume of wood used per square foot of building space; and preservative treatments have substantially extended the service life of wood. All of these have reduced by millions of acres the area of annual harvest that otherwise would have occurred (USDA Forest Service 1982).



Source: "Annual Tree Planters Notes," USDA Forest Service

Figure 27.—Trends in area planted to trees in the U.S., 1950-1990.

- Tree planting on all forest ownerships has increased dramatically since World War II, and was at record levels throughout the 1980s (fig. 27). Many private forest lands are now actively managed for tree growing (Frederick and Sedjo 1991).

IMPLICATIONS

This update of the forest resource situation and the historical perspective provided to it have many implications for assessing the evolution of U.S. forests.

The characteristics of the forest change slowly. Measures of changes in the forest resource since 1987 generally show a continuation of trends or indicators of stability, such as for species composition of the forest.

American forests are resilient and can be made to change under differing land management policies. This is evident from the evolution of the forest resource since 1900.

The U.S. population and economy are expected to continue to grow, and consumers are likely to demand more of all forest products. Maturation of much of the eastern hardwood forest, increasing demands on the southern softwood forest, and decreased harvesting on federal lands will lead to increased pressure on timber products prices. For the first time in history, the United States does not have a large reserve of high quality softwood sawtimber available for harvest. First the Northeast, then the South, the Lake States, the U.S. West Coast, British Columbia, and the South again provided softwood timber to meet the Nation's demands. The lack of such a reservoir of wood will create opportunities for hardwood utilization, engineering of wood, increased imports and may decrease exports. Therefore, increased harvest of hardwoods may be expected in the future, especially for pulpwood and fiber-based construction panels, such as oriented strand board.

The trend for more timber harvest in the East and on private lands is likely to continue as the harvest on federal lands declines in the West.

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