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U.S. Forest Resource Facts and Historical Trends

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TREES

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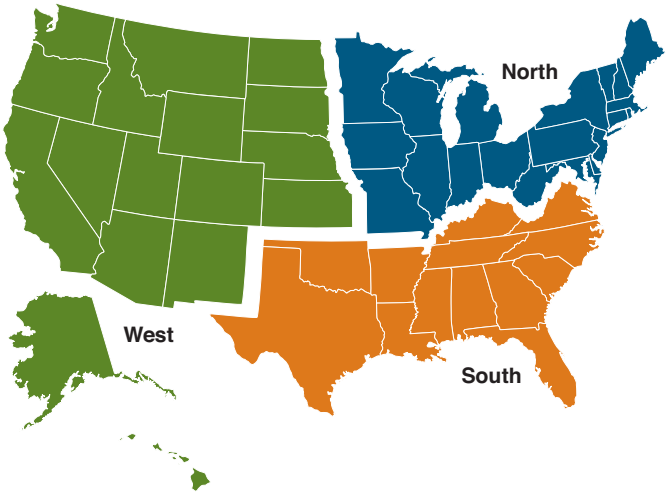
Introduction

The 2010 Resources Planning Act (RPA) Assessment is being developed in response to the mandate in the Forest and Rangeland Renewable Resources Planning Act of 1974, P.L. 93-378, 88 Stat. 475, as amended. This update consists of a summary report and supporting documents, which address outdoor recreation, wilderness, timber, fish and wildlife, water, and range (available at http://www.fs.fed.us/research/rpa).

The National Report on Sustainable Forests–2010 provides a comprehensive account of available data on the current condition of the Nation's forest resources. The report is based on 64 indicators for the conservation and sustainable management of forests. The indicators were endorsed by the United States and 11 other countries that house 90 percent of the world's temperate and boreal forests and 60 percent of all forests. Information on this report may be found on the Web at http://www.fs.fed.us/research/sustain/.

This brochure reports selected highlights of the findings of both reports. Much of the data for this brochure is reported regionally as North, South, and West.

Major reporting regions for the United States for this brochure



Forest Inventory Data

The Forest Inventory and Analysis (FIA) program of the Forest Service, U.S. Department of Agriculture, inventories various attributes of forest resources and reports them in the RPA Assessment and various supporting documents. FIA has been conducting field inventories for nearly 80 years using state-of-the art technology to provide estimates of the status, condition, and trends of the Nation's forests. These estimates are critical to the development and implementation of policies and practices that support sustainable forestry in the United States. Nine national reports based on FIA data have been produced since 1953.

Extensive field measurement from FIA inventories includes over 4.5 million remote sensing pixels interpreted for land use; over 125,000 permanent field plots systematically located across all forest lands in the United States; over 100 characteristics measured at each plot location; and over 3 million trees measured to evaluate volume, condition, and vigor.

Other Data

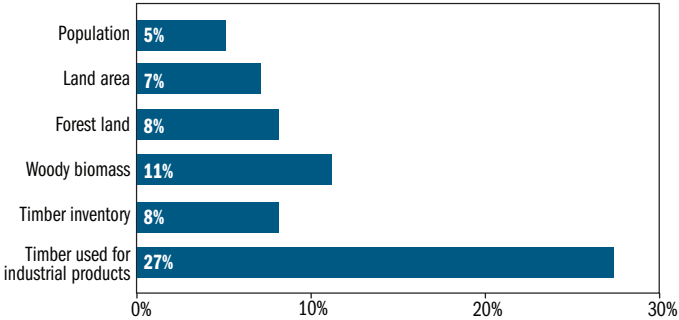
Data for forest ownership and products are from periodic FIA forest ownership and forest products studies. Data for wildlife, recreation, health, timber trade, and nonwood products are derived from Forest Service scientists' contributions to the National Report on Sustainable Forests–2010. Web sources for this and other related data are found at the end of this brochure.

This brochure is available in six languages: English, Spanish, French, Russian, Chinese, and Portuguese. Visit the FIA Web site at http://fia.fs.fed.us for more information.

The United States in a Global Context

Global forestry issues are of considerable significance to the United States, which has 5 percent of the world population and consumes 27 percent of the world's industrial wood products. Although domestic timber inventory is only 8 percent of the world total, 76 percent of U.S. consumption of industrial wood comes from domestic supplies. Additional demands for U.S. forests are also of interest, including protected areas for biodiversity and relative contributions of U.S. forests to carbon pools, among others.

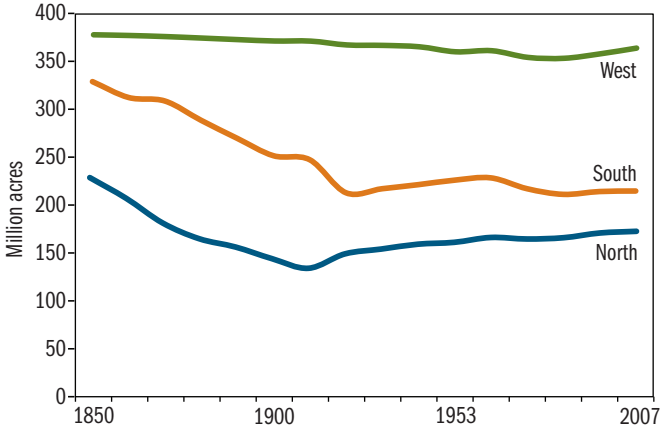
United States as a percent of world totals for selected measures



Land and Forest Area

It is estimated that in 1630 the area of forest land in the United States was 1,037 million acres or about 46 percent of the total land area. Since 1630, about 286 million acres of forest land have been converted to other uses—mainly agricultural. Nearly two-thirds of the net conversion to other uses occurred in the last half of the 19th century, when an average of 13 square miles of forest was cleared every day for 50 years. By 1910, the area of forest land had declined to an estimated 754 million acres, or 34 percent of the total land area. In 2007, forest land comprised 751 million acres, or 33 percent of the total land area of the United States. Forest area has been relatively stable since 1910.

Forest area trends in the United States, 1850–2007



Stable forest area, however, does not mean that there has been no change in the character of the forest. In addition to reversions to and from agriculture and more intensive land uses like urban development, there have been changes inside the forest as forests respond to human manipulation, aging, and other natural processes. The effects of these changes are reflected in the information presented in this brochure.

Land area and forest area trends in the United States

Category	Year	U.S.	Region		
			North	South	West
			million acres		
Land		2,263	413	525	1,325
Forest					
	2007	751	172	215	365
	1997	743	170	214	358
	1987	730	166	211	354
	1977	736	164	217	355
	1963	755	166	228	361
	1953	750	161	226	363
	1938[1]	746	159	221	366
	1910	754	134	247	372
	1850	935	227	329	379
	1630	1,037	298	354	385
Timber land					
	2007	514	164	204	146
	1997	504	159	201	143
	1987	485	155	195	135
	1977	491	153	198	139
	1963	515	156	209	150
	1953	509	154	205	150
Reserved forest[2]					
	2007	75	6	3	65
	1997	52	8	4	40
	1987	35	7	3	25
	1977	29	6	2	21
	1963	25	4	1	19
	1953	24	4	1	19

[1]In addition to land area of the United States at that time, estimates for 1938 include forest area in the regions that would become the States of Alaska and Hawaii. Estimates for 1630 represent the forest area in North America for regions that would become the 50 States within the current United States. Source: for 1938: U.S. Congress (1941). Source for 1630: R.S. Kellogg (1909).

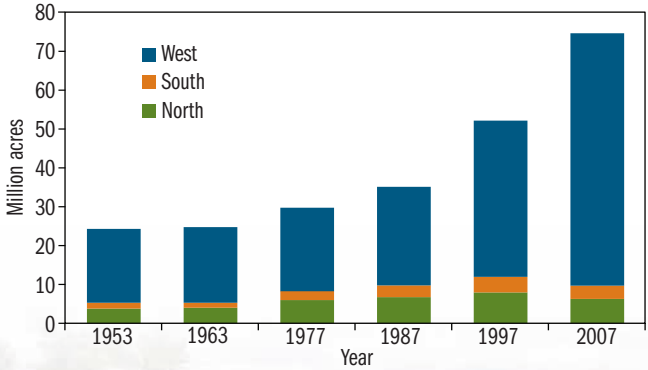
[2]Does not include some protected areas. National forest roadless areas are International Union for Conservation of Nature (IUCN) Class VI but not identified as "reserved" in FIA statistics and total approximately 32 million acres. Currently these lands are reported in timber land and other forest land in FIA reports. New inventories will provide more accurate data to place these lands in their proper IUCN classification.

Category	Year	U.S.	Region		
			North	South	West
			million acres		
Other forest					
	2007	162	2	7	153
	1997	187	3	9	175
	1987	211	4	13	194
	1977	215	5	17	194
	1963	216	5	18	192
	1953	217	3	20	194

Reserved Forest

Reserved forest land has tripled since 1953 and now stands at 10 percent of all forest land in the United States. This reserved forest area includes State and Federal parks and wilderness areas but does not include conservation easements, areas protected by non-governmental organizations, many wildlife management areas, and most urban and community parks and reserves. Significant additions to Federal forest reserves occurred after the passage of the Wilderness Act in 1964. See the description of protected forest by International Union for Conservation of Nature (IUCN) categories on page 50 for more information.

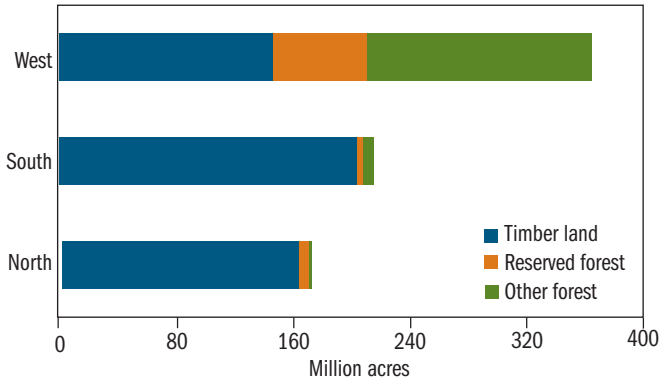
Trends in reserved forest land in the United States by region, 1953–2007



Timber Land and Other Forest Land

Timber land is fairly evenly distributed among the three major regions of the United States. Other forest land—such as slow-growing spruce forests in interior Alaska and pinyon-juniper in the interior West—dominates many western landscapes and comprises more than one-fourth of all U.S. forest land. Reserved forest is most common in the West, comprising 18 percent of all forests in that region. In contrast, only 3 percent of eastern forests are set aside as parks and wilderness areas.

Forest land by land class and region in the United States, 2007



Urban Influence on Forests

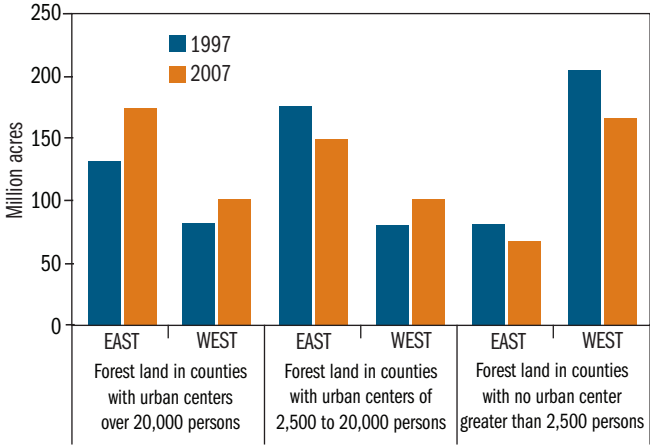
Urban land in the conterminous United States increased from 2.5 percent of total land area in 1990 to 3.1 percent in 2000. Urbanization affects the forest resource and its management in many ways. Not only does urban development directly eliminate some trees and forests, it also increases population density, human activities, and urban infrastructure, which can affect forests and their management. As urban landscapes increase across the Nation, rural forest landscapes are often converted to developed lands. With greater than 80 percent of the U.S. population living in urban areas, ecosystem services provided by urban trees and forests are significant and valued in the billions of dollars, annually.

Nationally, urban areas (cities, towns, or villages with at least 2,500 people) have an average tree cover of 27 percent. Estimated at nearly 4 billion, urban trees provide many valuable benefits based on their current composition and function. Beside the basic value of the trees—estimated at $2.4 trillion (Nowak et al. 2002)—two additional benefits of urban trees include air pollution removal and carbon sequestration. Annual pollution removal (O_3, PM_{10}, NO_2, SO_2 and CO) by urban trees

is estimated at 783,000 tons ($3.8 billion value according to Nowak et al. 2006), and storage is estimated at 776 million tons of carbon ($14.3 billion value) with a gross carbon sequestration rate of 25.1 million tC/yr ($460 million/yr).

One coarse measure of expanding urban influence on forests is a simple classification of forest area by county based on the population demographics. The following graphic demonstrates that, in the last 10 years, the area of forest in rural counties (no population centers over 2,500 persons) has declined by 52 million acres or 18 percent. That is, the number of counties with small populations and their associated forest area have declined.

Forest land area in the United States by population influence, 1997 and 2007



Forest Ownership

Over half of the forest land in the United States is privately owned and, of this, over half is owned by families and individuals. The other 44 percent of the forest land is controlled by Federal, State, and local governments.

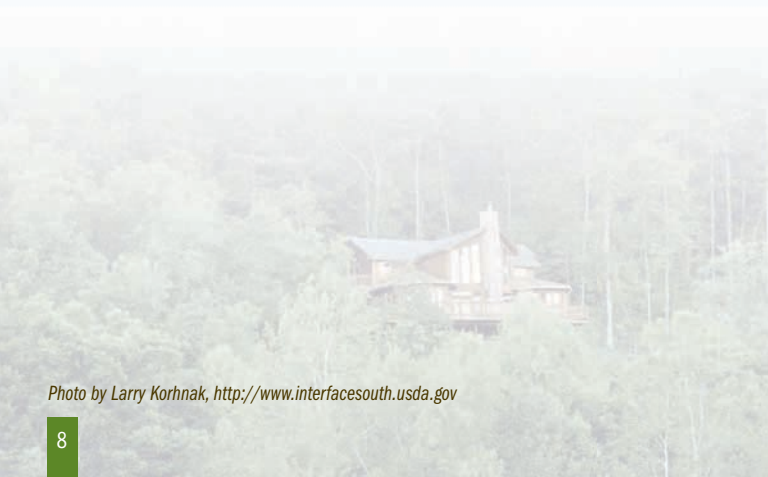
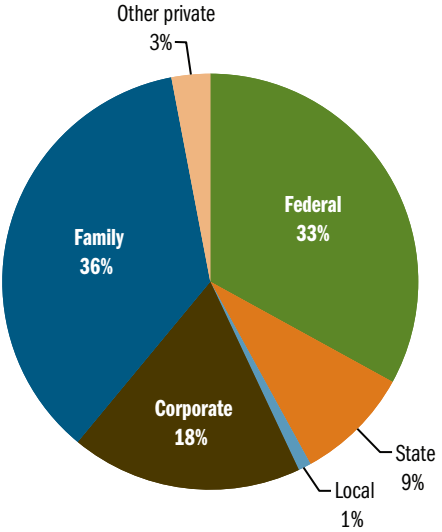


Photo by Larry Korhnak, http://www.interfacesouth.usda.gov

Distribution of forest land ownership in the United States, 2006

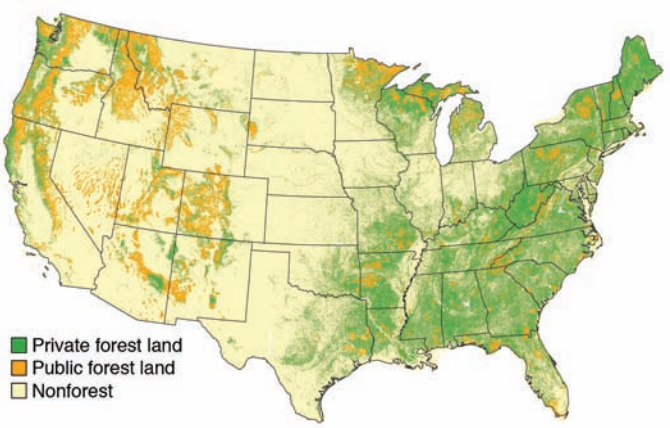


* Includes nongovernmental conservation organizations, unincorporated partnerships, and Native American lands.

Ownership Patterns

Ownership patterns vary immensely across the country. In the West, 70 percent of the land is publicly owned. In the East, 81 percent of the land is privately owned.

Pattern of forest ownership in the United States, 2006



*Alaska (not pictured) has 126 million acres of forest, 72 percent of which are publicly owned, and 34 percent of Hawaii's (not pictured) 1.7 million acres of forest are publicly owned.

Public Forests

Public forests are predominantly owned by the Federal Government in the West and State and county governments in the East. Seventy-six percent of all public forest acres are in the West. Most protected forests are in public ownership, while most production forests are in private ownership.

Forest Service national forests dominate the Federal lands, but the Bureau of Land Management, the National Parks Service, and the U.S. Department of Defense also have substantial forest holdings. State lands include lands designated as forests, parks, wildlife refuges, and for other purposes. The local category consists of lands controlled by municipal and county governments.

Forest land by owner class in the United States, 2007

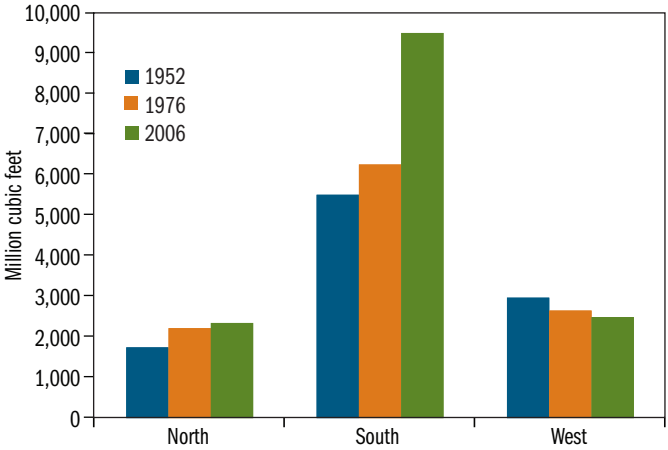
Owner class/ land class	U.S.	Region		
		North	South	West
		Million acres		
All owners	751	172	215	365
Timber land	514	164	204	146
Reserved forest	75	6	3	65
Other forest	162	2	7	153
National Forest	147	11	13	123
Timber land	99	10	12	76
Reserved forest	26	1	1	25
Other forest	22	0	0	22
Other public	181	33	16	133
Timber land	59	27	13	19
Reserved forest	48	5	3	40
Other forest	74	1	0	74
Private corporate	138	28	57	52
Timber land	106	28	57	21
Reserved forest	–	–	–	–
Other forest	32	0	0	31
Private noncorporate	285	100	129	57
Timber land	250	99	122	30
Reserved forest	–	–	–	–
Other forest	34	1	7	26

Harvests from public forests currently account for 8 percent of the Nation's total. Public harvesting has decreased since the 1980s. An increase in harvesting from private forests, particularly in the Southern United States, has largely offset this decrease at the national level.

Private Forests

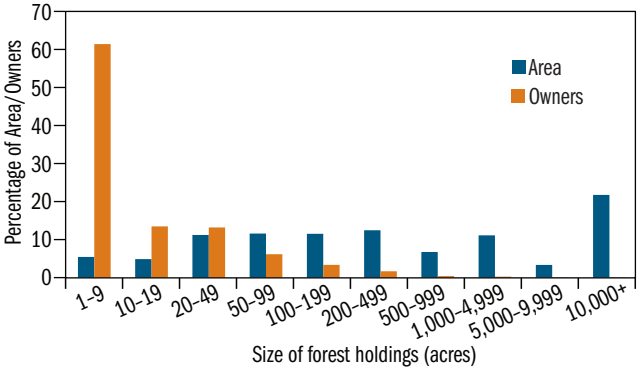
There are an estimated 11.3 million private forest owners in the United States. They range from industrial owners with millions of acres to families and individuals with just an acre of trees behind their homes.

Timber removal trends on private forest land, 1952–2006



Although more than 60 percent of private forest owners own between 1 and 9 acres of forest land, most of the private forest land is in holdings of at least 200 acres. More than 20 percent of private forest land is in holdings of at least 10,000 acres; these are owned primarily by corporations and are managed for commercial purposes.

Percent of forest area and private owners by holding size class, 2006



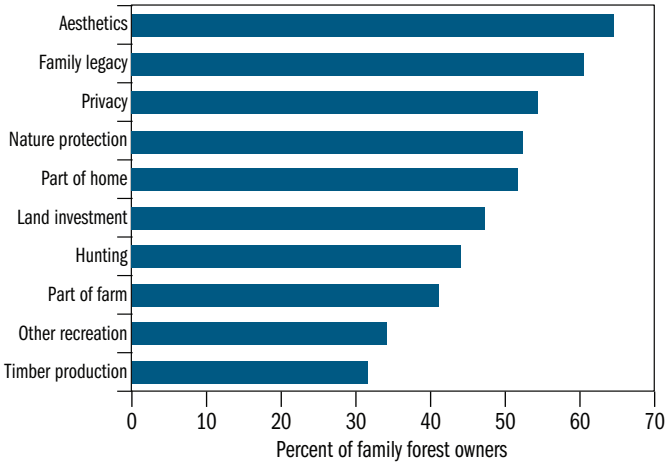
Private Corporate Forests

Corporate owners collectively control one-third of the private forest land in the United States. The major change in corporate forest ownership in the past decade or so has been the divestiture of forest land by vertically integrated forest products companies and the growth of timber investment management organizations and real estate investment trusts. This shift has been caused by changes in the tax code and changes in corporate strategies. The ultimate ramifications of these structural changes are still unknown.

Family Forests

The other two-thirds of the private forest land are owned by noncorporate owners, the vast majority of whom are families and individuals. They own their land for many purposes, most of which center around the amenity values their forests provide.

Primary reasons why families and individuals own forest land, 2006



Fifty-eight percent of family forest land is owned by people who have commercially harvested trees from their land. However, only 17 percent of that forest land is owned by people who also have a written management plan and only 37 percent is owned by people who have received management advice.

Twenty percent of the family forest owners are 75 years or older. Additionally, 23 percent of the land is owned by people who plan to sell or pass it on in the next 5 years. Family legacy is, therefore, an important objective to many of these owners.

Top Concerns of Family Forest Owners

1. Keeping land intact for heirs
2. Insects or plant diseases
3. Fire
4. Trespassing or poaching
5. High property taxes

Parcellation

Parcellation, the process of dividing a land holding into two or more smaller holdings, is one possible consequence of this intergenerational transfer of land. Between 1993 and 2006, the average size of private forest holdings decreased by 11 percent; between 1978 and 2006, it decreased by 20 percent. As the parcels become smaller, they become more difficult to economically manage, and issues—such as wildfire fighting—can become increasingly costly and difficult.

Fragmentation of Forests

The Forest Service used high-resolution satellite imagery to determine how much forest land experiences different types and degrees of fragmentation. Fragmentation is caused by human activities and natural processes, and may lead to the isolation and loss of species and gene pools, degraded habitat quality, and a reduction in the forest's ability to sustain the natural processes necessary to maintain ecosystem health. The fragmentation of forest area into smaller pieces changes ecological processes and alters biological diversity.

Analysis of fragmentation is scale dependent and, consequently, differs depending on whether the forest is separated into small or large pieces (landscapes) for analysis. Simply stated, places that are forested tend to be clustered in proximity to other places that are forested, but blocks of forest land are usually fragmented by inclusions of nonforest land. This pattern is repeated across a wide range of spatial scales. For landscapes up to 160 acres in size, at least 76 percent of all forest land is in landscapes that are at least 60 percent forested. For larger landscapes up to 119,000

acres in size, at least 57 percent of forest land is in forest-dominated landscapes. Forest landscapes fall into three main categories: (1) core, (2) interior and (3) edge.

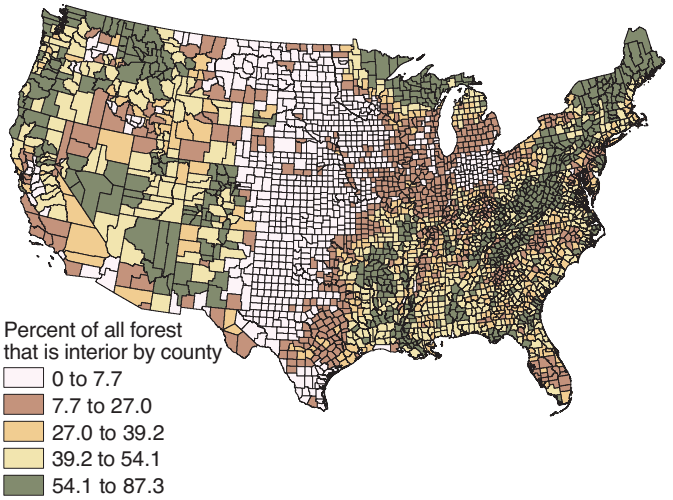
Core forests are landscapes that are completely forested. The larger the landscape being examined, the less likely it is that it will be core forest. For 10-acre landscapes, 46 percent of all forest land is classified as core forest. Less than 1 percent of forest land is classified as core forest in landscapes that are 1,500 acres or larger.

Interior forests are landscapes that are more than 90 percent forested. Larger landscapes are less likely to have interior forest. When examining landscapes that are 10 acres in size, 60 percent of all forest land is interior forest. For landscapes larger than 250 acres, however, less than one-third of forest land is classified as interior forest. Forest area in landscapes dominated by forest (more than 60 percent forest) is greater than either core or interior forest, and dominant forest area also decreases with increasing landscape size.

Edge forests have a different microclimate and often support a different species mixture than core or interior forests. Overall, 54 percent of forest land is within 555 feet of forest land edge, 74 percent is within 990 feet of forest land edge, and less than 1 percent is at least 5,700 feet (1.1 mile) from forest land edge.

The following figure shows the percent of all forest in a county that is interior forest (>90 percent forested) when analyzed at an approximately 40-acre scale. Larger values indicate that a larger share of the existing county forest is relatively intact, in comparison to forests in other counties.

Pattern of forest fragmentation by county in the United States

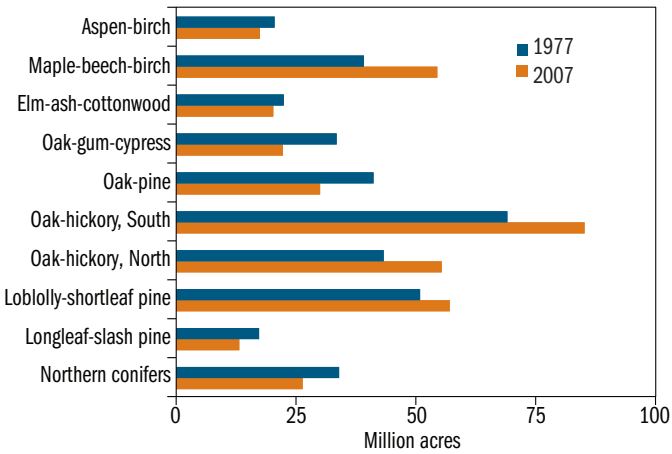


In general, western forests tend to be less fragmented than eastern forests (North and South regions). The available data permit analysis of overall forest land fragmentation but do not incorporate the influence of small roads nor differences in land ownership ("parcellation").

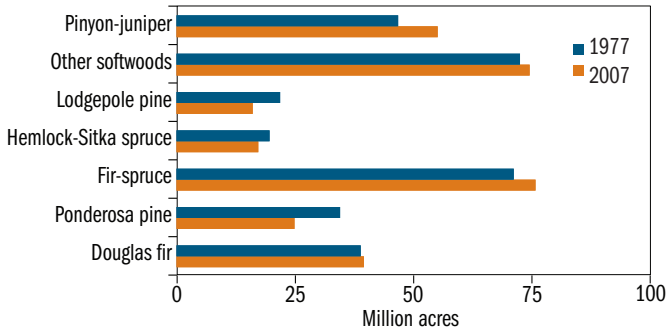
Forest Composition and Age

The forests of the United States are very diverse in composition and distribution. Oak-hickory and maple-beech-birch forests dominate the Northeast; expansive pine forests blanket the Southeast; and majestic Douglas-fir and ponderosa pine forests cloak the western landscape. In the last 30 years, as the Nation's forests age, eastern early seral types like aspen and spruce-fir have given way to mid and late seral types like oak-hickory and maple-beech-birch. In the West, decades of fire suppression are reducing areas of ponderosa and lodgepole pine.

Forest type area trends in the Eastern United States, 1977 and 2007

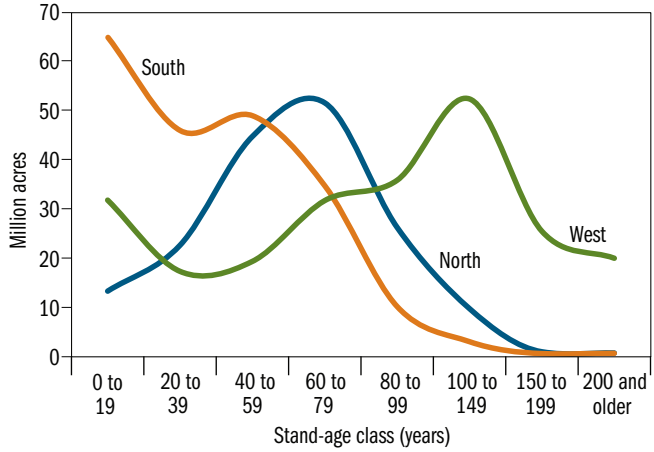


Forest type area trends in the Western United States, 1977 and 2007



Following intensive logging and regeneration in the late 19th century and again in the mid 20th century, 51 percent of the Nation's timber land is less than 50 years old. Five percent is more than 175 years old.

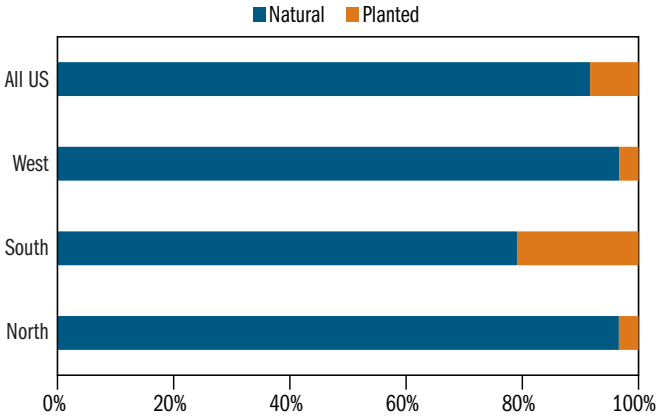
Forest area in the conterminous United States by region and stand-age class, 2007



Forest Origin

Forests in the United States are predominantly natural stands of native species. Planted forest land is most common in the East and heavily comprised of planted stands of native pine in the South. In the West, planting is generally used to augment natural regeneration.

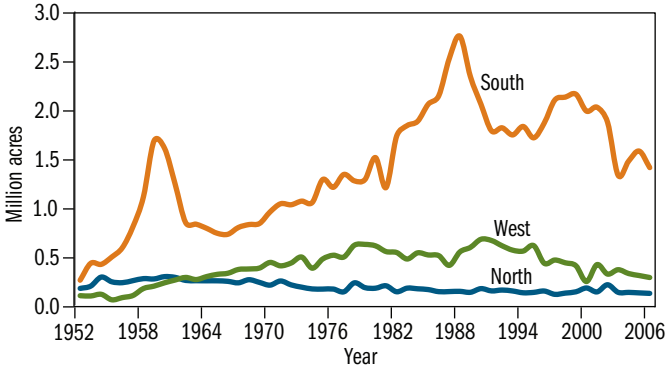
Primary origin of forest stands in the United States, 2007



Tree Planting

Forest planting in the United States currently averages about 1.8 million acres per year. Pine is the most commonly planted species in the South. Spikes in tree planting occurred in the South in the 1950s as a result of the Soil Bank Program and in the 1980s as a result of the Conservation Reserve Program, which resulted in the planting of nearly 3 million acres of nonforest land. Western planting has subsided in recent years, mirroring reduced harvesting in that region.

Forest planting in the United States by region, 1952–2006



Growing Stock Volume

Growing stock inventory, growth, removals, and mortality trends on timber land by region and species group in the United States, 1952–2007

Category	Year	Total	Region		
			North	South	West
		Million cubic feet			
Inventory	2007	932,082	248,000	288,522	395,560
	1997	835,663	214,246	256,354	365,063
	1987	781,662	190,035	244,631	346,968
	1977	733,042	163,021	223,364	346,685
	1963	665,591	128,276	174,065	363,250
	1953	615,895	103,753	148,466	363,675
Growth	2006	26,731	6,570	13,281	6,909
	1996	23,871	5,409	11,412	7,023
	1986	23,616	5,663	10,760	7,193
	1976	21,493	5,380	10,053	6,032
	1962	16,707	4,417	8,099	4,191
	1952	20,048	4,955	10,902	4,191

(cont. on next page)

(continued)

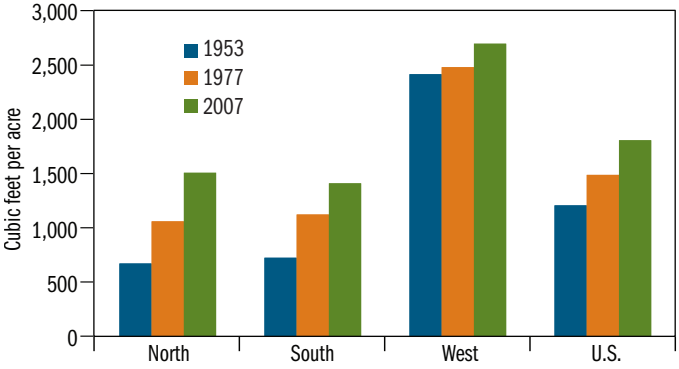
Category	Year	Total	Region		
			North	South	West
		Million cubic feet			
Removals	2006	15,546	2,832	9,684	3,030
	1996	16,027	2,775	10,194	3,058
	1986	16,452	2,718	8,693	5,040
	1976	14,215	2,662	6,570	5,012
	1962	11,950	2,067	5,522	4,361
	1952	11,440	2,209	5,493	3,766
Mortality	2006	7,815	2,039	2,860	2,945
	1996	6,315	1,614	2,237	2,464
	1986	4,644	1,246	1,671	1,727
	1976	4,106	1,161	1,274	1,671
	1962	4,333	934	1,161	2,237
	1952	3,908	680	963	2,237
Softwoods					
Inventory	2007	529,188	55,869	118,478	354,869
	1997	483,824	49,385	104,858	329,610
	1987	467,570	47,629	105,622	314,347
	1977	466,947	43,863	101,205	321,908
	1963	449,759	33,669	75,097	341,022
	1953	431,806	27,043	60,457	344,278
Growth	2006	15,235	1,501	7,646	6,116
	1996	13,762	1,189	6,400	6,201
	1986	13,394	1,218	5,947	6,230
	1976	12,035	1,246	5,578	5,210
	1962	9,599	1,218	4,701	4,616
	1952	11,242	1,444	6,116	3,653
Removals	2006	9,854	680	6,315	2,860
	1996	10,053	680	6,485	2,917
	1986	11,355	736	5,748	4,899
	1976	10,053	708	4,474	4,871
	1962	7,617	538	2,803	4,276
	1952	7,532	708	3,087	3,766

(continued)

Category	Year	Total	Region		
			North	South	West
		Million cubic feet			
Softwoods					
Mortality	2006	4,502	538	1,359	2,605
	1996	3,625	453	1,048	2,124
	1986	2,775	368	850	1,586
	1976	2,464	311	623	1,501
	1962	2,775	283	396	2,067
	1952	2,662	227	340	2,124
Hardwoods					
Inventory	2007	402,894	192,131	170,044	40,692
	1997	351,839	164,862	151,524	35,453
	1987	314,092	142,406	139,036	32,621
	1977	266,095	119,158	122,160	24,777
	1963	215,832	94,635	98,996	22,229
	1953	184,089	76,682	88,009	19,397
Growth	2006	11,497	5,097	5,635	765
	1996	10,081	4,219	5,012	850
	1986	10,194	4,446	4,814	963
	1976	9,458	4,163	4,502	821
	1962	7,108	3,200	3,398	481
	1952	8,807	3,511	4,757	538
Removals	2006	5,663	2,152	3,370	142
	1996	5,947	2,095	3,710	142
	1986	5,097	1,982	2,945	142
	1976	4,191	1,954	2,095	142
	1962	4,333	1,529	2,718	85
	1952	3,908	1,472	2,407	–
Mortality	2006	3,313	1,501	1,501	340
	1996	2,690	1,161	1,189	311
	1986	1,869	878	821	170
	1976	1,614	821	651	170
	1962	1,557	651	765	142
	1952	1,246	481	651	142

Average growing stock volume per acre continues to rise across the United States, with the largest gains in the North and South where volumes per acre are nearly double what they were in 1953.

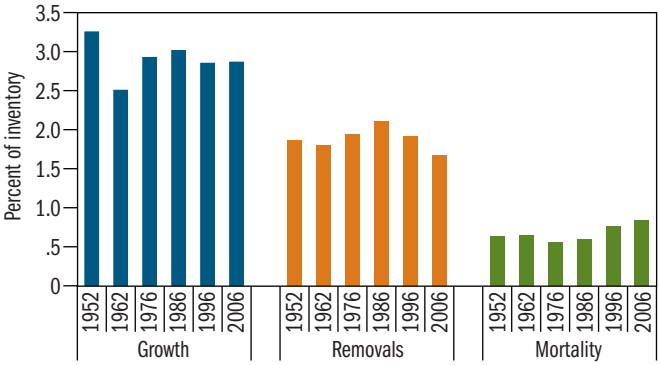
Average growing stock volume on timber land in the United States by region, 1953, 1977, and 2007



Net Growth, Removals, and Mortality Rates for Growing Stock

Over the past 50 years, net growth has consistently exceeded removals in the United States. Removals remain at about 2 percent of inventory, while net growth (growth minus mortality) is near 3 percent. Currently, the volume of annual net growth is 32 percent higher than the volume of annual removals. Mortality rates have remained well below 1 percent of inventory for at least 50 years.

Net annual growing stock growth, removals, and mortality as a percent of inventory in the United States, 1952–2006



Forest Carbon and Biomass

Forest Carbon

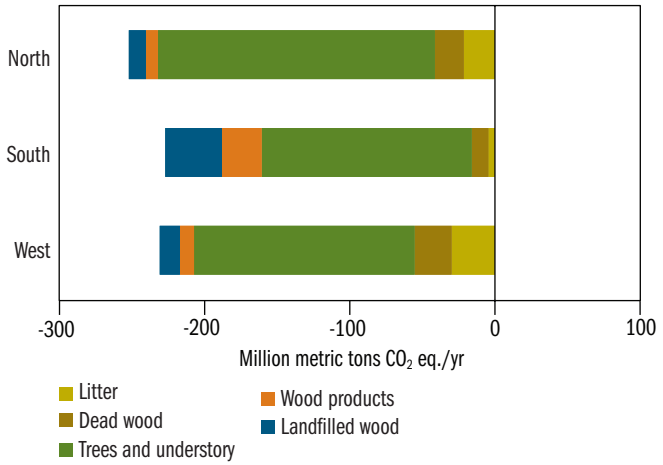
Concern over consequences of increasing greenhouse gas concentrations in the atmosphere has led the United States to develop an annual inventory of greenhouse gas sources and sinks since 1990. The U.S. Environmental Protection Agency (EPA) prepares the official inventory for all sources to comply with

commitments under the United Nations Framework Convention on Climate Change. The U.S. Department of Agriculture and the Forest Service provide the inventory for the agriculture and forestry sectors. In 2006, gross greenhouse gas emissions in the United States were equivalent to 7,054 million metric tons (15.5 trillion pounds) of carbon dioxide equivalents (CO_2 eq.).

Forests take in CO_2 and water, store carbon in wood, and release oxygen. The carbon stored in forests is released back into the atmosphere when trees are burned, such as in forest fires, or when dead trees and leaves decay. Forest management can affect greatly the amount of carbon stored; vigorously growing forests store more carbon than slow growing ones. When trees are made into lumber or paper, some CO_2 is released, but much continues to be stored in the products or eventually in landfills. Substituting wood for nonrenewable materials can also reduce CO_2 in the atmosphere by reducing fossil fuel energy use.

In 2006, a net 745 million metric tons (1.6 trillion pounds) of CO_2 eq. were removed from the atmosphere and stored in forests and forest products in the 48 conterminous States. This offsets about 11 percent of gross U.S. CO_2 emissions from all sources.

Net forest carbon stock change in the United States by carbon pool, 2006



Net forest carbon stock change during 2006, 48 States plus part of Alaska—soil not included, 2006. (Note: negative value corresponds to storage by forests.)

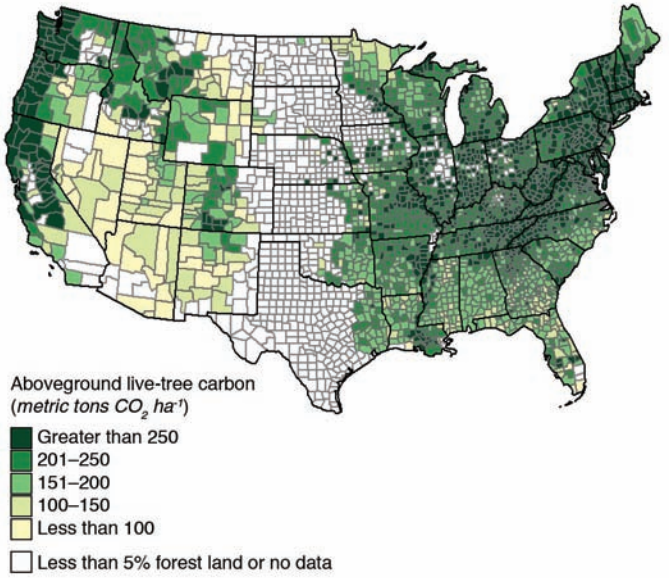
Forests stored an additional 204 million metric tons (0.4 trillion pounds) of CO_2 eq. This biomass was harvested and burned for energy as a substitute for fossil fuels, resulting in a net change of zero atmospheric CO_2. Forests sequestered an additional approximately 268 million metric tons CO_2 eq. that had been emitted during wildfires. This amount includes the contribution

of the non-CO_2 gases methane (CH_4) and nitrous oxide (N_2O). Urban forests also sequestered carbon, estimated at 95 million metric tons CO_2 eq. (200 billion pounds) for 2006.

Forest Biomass

The greatest amounts of biomass per area are located in the Pacific Northwest. Moderate levels are located along the Appalachian Mountains, from northern Georgia into central Maine, encompassing much of the hardwood region of the United States. The rest of the United States is occupied by forests containing between 1 and 494.2 tons/acre CO_2 on average, with infrequent extremely heavy biomass accumulations (865+ tons CO_2/acre). Overall, the conterminous U.S. forests contain 16 billion metric tons of carbon in aboveground live biomass.

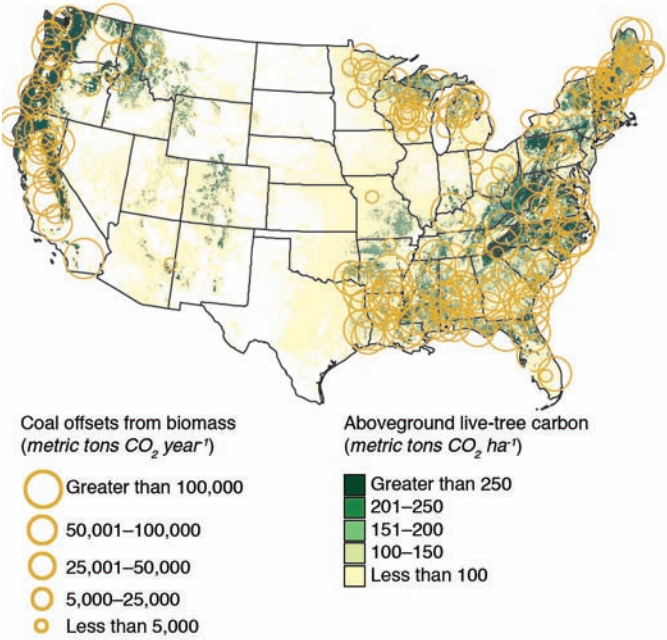
Aboveground live forest biomass stocks by county in the United States, 2006



Wood for Energy

Forest biomass sustainably harvested for electricity generation can represent an overall net reduction in greenhouse gas emissions because the burning of nonrenewable fuels, such as coal, is avoided. Across the United States, a great variety of electric utility plants used wood in 2007. Most of the electric utilities are located near sources of forest biomass. Overall, hundreds of electric utility plants are using wood for power generation and, thus, avoiding emission of greenhouse gases. However, relative to the use of fossil fuels, the use of forest biomass as an energy source is small.

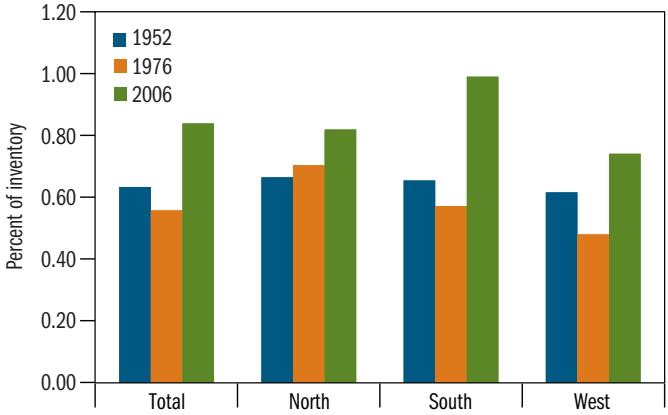
Location of avoided CO_2 emissions (assuming coal burning) of electric utilities using wood as a power generation source in the United States, 2007



Forest Health and Invasives

Mortality rates relative to inventory, although currently at the highest level in 50 years, remain less than 1 percent of inventory. Much of the recent increase, however, may be attributed to a confluence of local cyclic effects of forest stressors, such as the recent increase in forest fires and large outbreaks of beetles. Discerning whether the current high rates are beyond the range of normal variability from a regional or national perspective is, however, difficult.

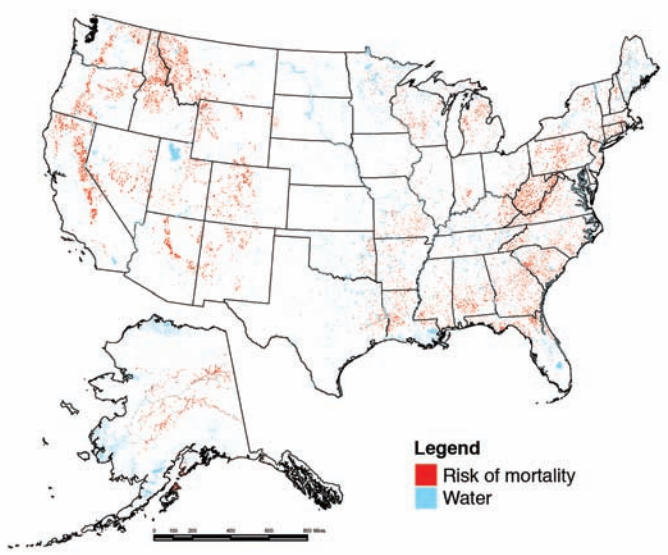
Annual mortality as a percent of inventory in the United States, 1952, 1976, and 2006



General Health Risk

Areas potentially at risk of 25 percent or higher mortality due to insects and disease over the next 15 years are depicted in the following graphic for the standing live volume of trees greater than 1 inch in diameter.

Areas at risk of mortality due to insect and disease in the next 15 years.

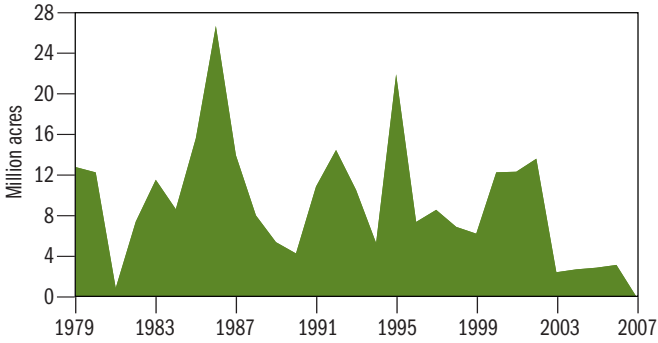


Major Forest Insects

Aerial detection surveys provide information on the extent of damage caused by major forest pests. Some of these pests include:

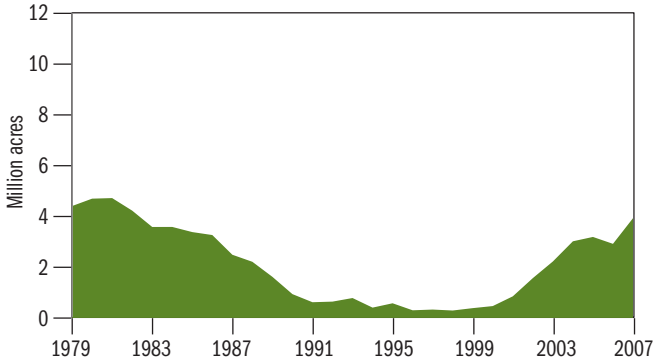
Southern Pine Beetle. Activity was at historically high levels throughout the last 20 years, reflecting the widespread availability of its preferred host, loblolly pine. Activity has recently begun to decline.

Southern pine beetle infestation



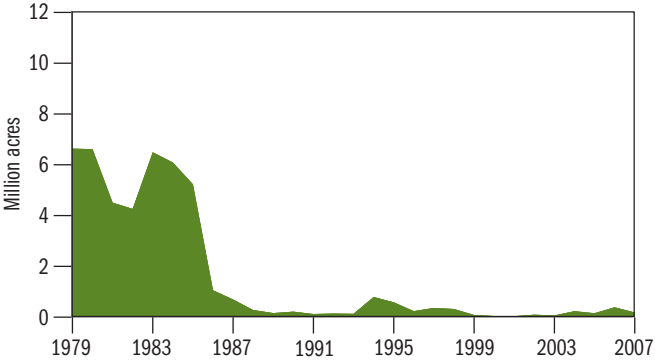
Mountain Pine Beetle. Activity gradually declined from the 1980s through 2002. Massive killing of host trees, especially lodgepole pine, greatly depleted the availability of suitable host trees. Activity has again increased slightly since 2002.

Mountain pine beetle infestation



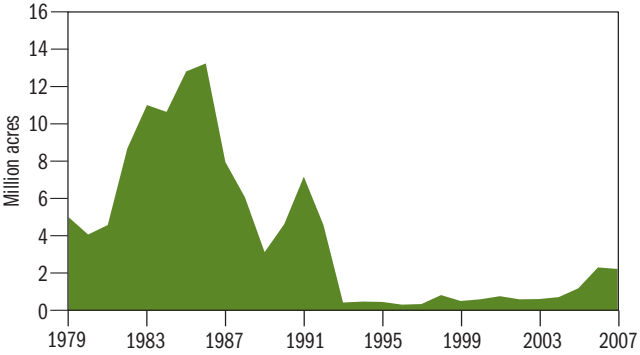
Spruce Budworm. Activity has been declining the past 20 years, with outbreaks restricted to the Lake States. Spruce budworm outbreaks are cyclic, with epidemics occurring at 30- to 50-year intervals as a new forest grows up from the old one killed by the budworm.

Spruce budworm infestation



Western Spruce Budworm. Defoliation peaked from 1983 to 1992. Many trees weakened by budworm defoliation were subsequently killed by bark beetle attacks.

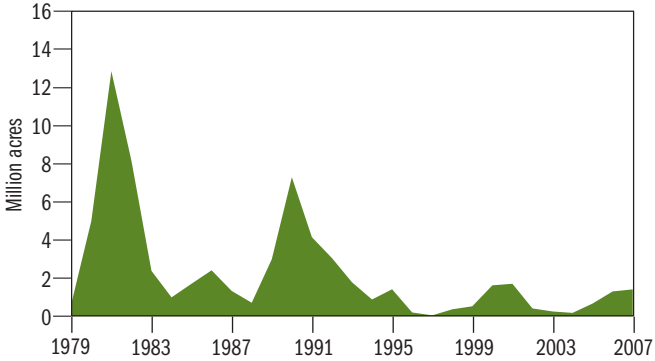
Western spruce budworm infestation



Gypsy Moths. Gypsy moths defoliated almost 12.9 million acres of hardwoods in 1981, and defoliation averaged 2.2 million acres annually during the past 25 years. Activity reached unprecedented levels as it spread south and west into better habitat; the great reduction in recent years appears to reflect the effect of *Entomophaga maimaiga* (a fungal pathogen of the Gypsy moth).

Photo by David McComb, http://www.bugwood.org

Gypsy moth infestation



Major Forest Diseases

Dozens of diseases affect U.S. forests each year. The following is a list of the 10 most commonly found tree diseases in the United States:

Disease	Primary Species Affected
Beech bark disease	beech
Dutch elm disease	American elm
Dogwood anthracnose	dogwood
Dwarf mistletoes	conifers
Fusiform rust	southern pines
Oak wilt	eastern oaks
Port-Orford cedar root disease	Port-Orford cedar
Root rots	many conifers and hardwoods
Sudden oak death	California oaks, tanoak
White pine blister rust	5-needle pines

Air Pollution

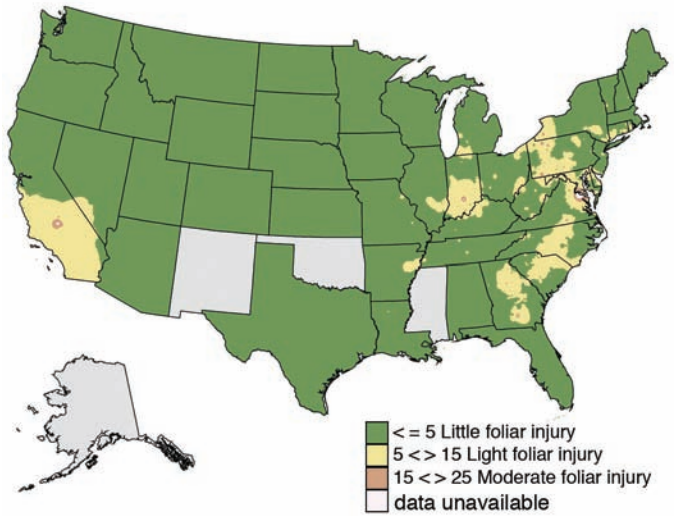
Ozone has been shown to alter forest ecosystems in areas of high deposition. At high ozone levels, sensitive trees show ozone-related injury; while lower ozone levels have been shown to reduce photosynthesis of trees—affecting tree health.

The EPA provides information on the ozone concentration at points across the United States. Combined with FIA data collected on plots designed to detect ozone damage on sensitive species, this information can be used to locate sites for further research regarding air quality impacts on forest species.

EPA data show ambient ozone concentrations to be highest at points in the Sierra Nevada, some areas of the semiarid Western States, and scattered points along the southern Appalachian piedmont, northeast coast, and Great Lakes ecological regions, where major cities and travel corridors occur. Plot data from FIA show similar trends with more damage detected on sensitive

plant species in the following areas than anywhere else in the United States: the Sierra Nevada; the area east of Los Angeles; the travel corridor of Interstate 85 across the Southern States of Georgia, South Carolina, and North Carolina; the urban hotspots of Atlanta, GA, Cincinnati, OH, and Buffalo, NY; and the greater Washington, DC, area. The Midwestern and Northwestern States, along with Maine, Vermont, and New Hampshire, appear to have the lowest levels of ozone concentration and damage to forest species. The following map shows mean average ozone injury estimates and risk to forests of injury from ozone exposure, 2000–2006.

Mean ozone injury estimates and risk to forests of injury from ozone exposure, 2000–2006



Invasive Species

Expanding global trade and travel have increased the risk of introducing new, exotic organisms. When brought into new ecosystems, exotic (invasive) species often have no natural enemies and, therefore, can cause extensive damage. Invasive plant species are defined as species being moved beyond their natural range or natural zone of potential dispersal, including all domesticated species and hybrids. The introduction of invasive species can have major ecological and economic consequences and can directly affect human health. There are an estimated 3,723 plants with species of origin outside the United States. Areas with the highest rates of introduction tend to be along the coasts or major inland waterways. In general, human disruptions of natural communities, such as by soil alterations, removal of vegetative cover, or suppression of natural disturbance regimes, seems to promote opportunities for invasive species.

Area of forest affected by woody invasive species in the United States

Common name	Scientific name	Area	Source
Trees		000 ac.	
Tallowtree, Popcorntree	*Triadica sebifera*	3,818	2/
Tree-of-Heaven	*Ailanthus altissima*	3,444	3/
Silktree, Mimosa	*Albizia julibrissin*	1,127	2/
Chinaberrytree	*Melia azedarach*	1,080	3/
White mulberry	*Morus alba*	915	3/
Princesstree, Paulownia	*Paulownia tomentosa*	726	3/
Siberian elm	*Ulmus pumila*	487	3/
Melaleuca	*Melaleuca quinquenervia*	212	3/
Bebb willow	*Salix bebbiana*	137	3/
Russian Olive	*Elaeagnus angustifolia*	101	3/
Shrubs			
Chinese / European Privet	*Ligustrum sinense*	15,969	2/
Non-native roses (Multiflora, Macartney, Cherokee)	*Rosa multiflora, bracteata, laevigata*	5,339	2/
Japanese / Glossy Privet	*Ligustrum japonicum*	1,656	2/
Other honeysuckle (Amur, Morrow's, Tatarian, Sweet-breath-of-spring)	*Lonicera amur, morrowii, tatarica, fragrantissima*	1,363	2/
Autumn Olive	*Elaeagnus umbellata*	648	2/
Sacred Bamboo, Nandina	*Nandina domestica*	229	2/
Winged Burning Bush	*Euonymus alata*	54	2/
Silverthorn, Thorny Olive	*Elaeagnus pungens*	59	2/
Saltcedar	*Tamarix ramosissima*	35	4/
Vines			
Japanese Honeysuckle	*Lonicera japonica*	46,959	2/
Kudzu	*Pueraria montana*	582	2/
Common/Bigleaf periwinkles	*Vinca minor, major*	240	2/
Nonnative climbing yams-air yam/chinese yam	*Dioscorea oppositifolia, alata, bulbifera*	252	2/
Chinese/Japanese wisteria	*Wisteria sinensis, floribunda*	191	2/

(continued on next page)

(continued)

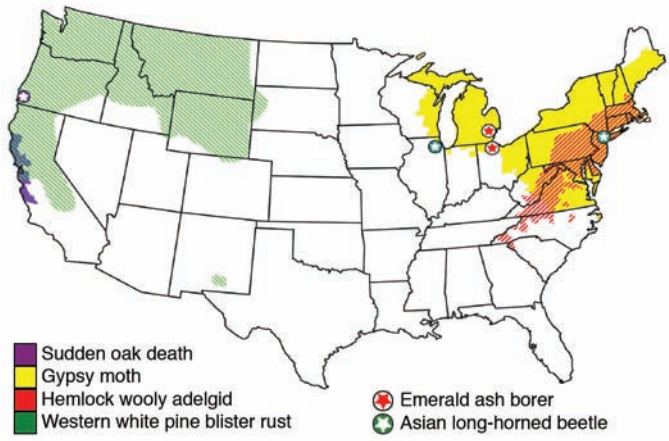
Common name	Scientific name	Area	Source
Vines			
Winter Creeper	*Euonymus fortunei*	65	2/
Oriental Bittersweet	*Celastrus orbiculatus*	51	2/
English Ivy	*Hedera helix*	78	2/
	TOTAL	85,816	

1/ The total forest area affected by woody invasive species is not necessary the sum of the values above, as these may be overlapping. Area reported is area affected by woody invasives, not actual area covered by the invasive species.
2/ http://srsfia2.fs.fed.us/nonnative_invasive/southern_nnis.php
3/ FIADB, http://www.fia.fs.fed.us
4/ IWFIA data

Source: FIADB and FIA unit data

Additionally, invasive insects and pathogens threaten many forests throughout the United States. This map shows the areas and invasive species currently having major impacts.

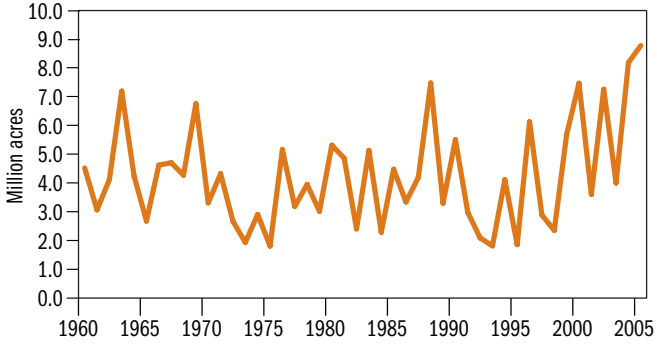
Current invasive insects and pathogens threatening forests in the United States, 2005



Wildland Fire

Wildland fires burn millions of acres of forest land in the United States each year, and the intensity of fires and area burned have been increasing in recent decades (Running 2006, Westerling et al. 2006, Miller et al. 2008). Federal agencies alone now spend more than $1 billion annually on suppression efforts (U.S. Government Accountability Office 2006) with costs increasing rapidly. While less than 5 percent of wildfires become large and uncontrollable, these fires can be especially problematic and account for more than 95 percent of the area burned (Running 2006, Peterson and McKenzie 2008). Suppression efforts directed at large severe wildfires are very costly and put firefighters' lives at risk. Substantial property damage may result despite these efforts, with effects often greatest in the wildland-urban interface—areas where homes and businesses have been built among trees, brush, and other flammable vegetation.

Annual area burned in the United States, 1960–2006

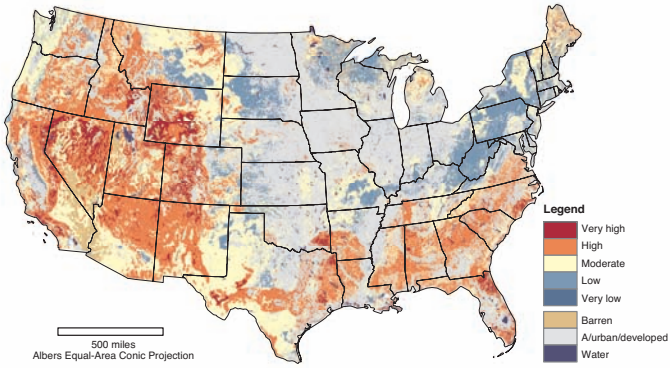


The potential for an area of forest to experience wildfire activity depends on several factors, including the likelihood of ignition, the availability of dead fuel near the ground surface and combustible fuel in the forest canopy, regional climate, and year-to-year variations in weather that influence the length of fire seasons. Understanding the relative contribution of these factors, along with their spatial patterns and trends over time, is important for developing management strategies to mitigate wildfire hazards. For example, decades of fire suppression resulting in the accumulation of dead fuel, small trees, and brush is often cited as a cause of increased fire activity in some western U.S. forest types. However, recent research shows that changes in climate are closely associated with increased wildfire in some areas of the West over the last few decades. Increases in spring and summer temperatures and decreases in precipitation have resulted in longer fire seasons in these areas, along with increases

in the burn time of large fires (Running 2006, Westerling et al. 2006). In areas where climate change appears to be a major driver of wildfire activity, ecological restoration and management of hazardous fuel alone may not be sufficient to alter recent wildfire trends (Westerling et al. 2006). The availability of spatial information describing vegetation and fuel conditions, coupled with information on likely climate trends, can help target fuel reduction projects for maximum effectiveness and could improve land use planning that reduces wildfire risk to human communities.

The following map of wildand fire potential combines spatial information about fire behavior and fire probability under extreme weather conditions. Fire behavior includes both crown fire potential and surface fire potential, while fire probability includes both fire weather and historic fire occurrence.

Wildland fire potential in the conterminous United States by risk class

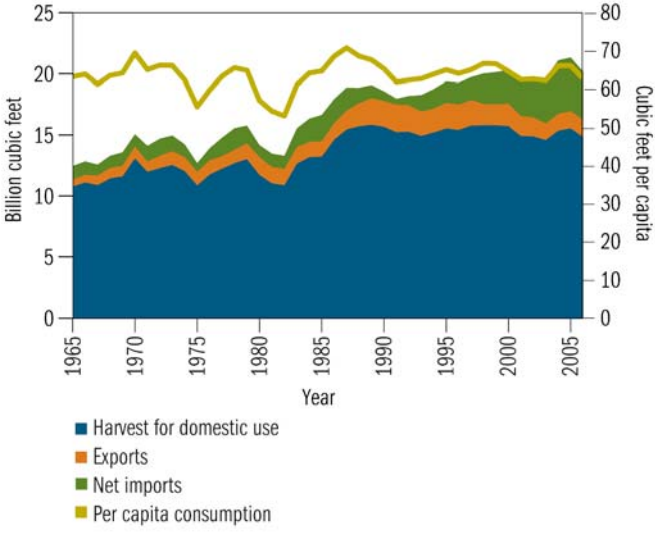


Source: Wildland fire potential data were provided by Jim Menakis, Fire Modeling Institute, Rocky Mountain Research Station, Forest Service. Geographic base data were provided by the U.S. Department of Agriculture, National Agricultural Statistics Service and the National Atlas of the United States.

Timber Products and Residues

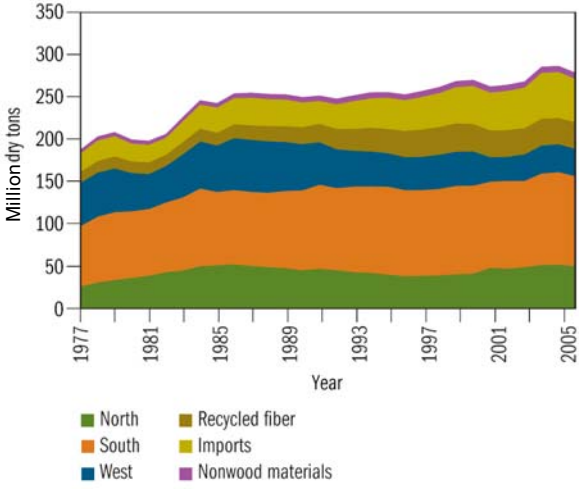
Solidwood and paper products consumed in the United States require roundwood harvest in the United States and other countries, plus recycled paper and solidwood products. Since the late 1980s, roundwood harvest for export has declined, and roundwood equivalent of imports has increased. Domestic roundwood harvest increased from 1950 through the mid-1980s and has remained steady since then, maintaining a volume of 15 billion cubic feet in 2006.

Total and per capita roundwood consumption by category, 1965–2006



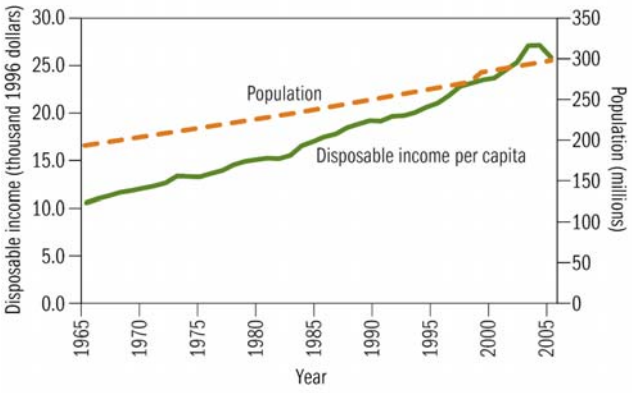
Total domestic roundwood harvest has been stable to declining due to increasing imports and an increase in use of recycled paper. With these increases, total consumption of solidwood and paper products has increased steadily since 1950. In 2006, consumption for the North, South, and West was 55.7, 116.5, and 35.4 million dry short tons, respectively.

Solidwood and paper products consumption and material sources with region of roundwood harvest, 1977–2006



Drivers of Timber Demand

Demands for the products and services of forests are driven largely by population and disposable income Per capita disposable income (constant 1996 U S dollars) more than doubled between 1965 and 2006, increasing from $10 6 thousand in 1965 to $25.9 thousand in 2006 Total U S population increased by 54 percent during this time, reaching 299.2 million in 2006

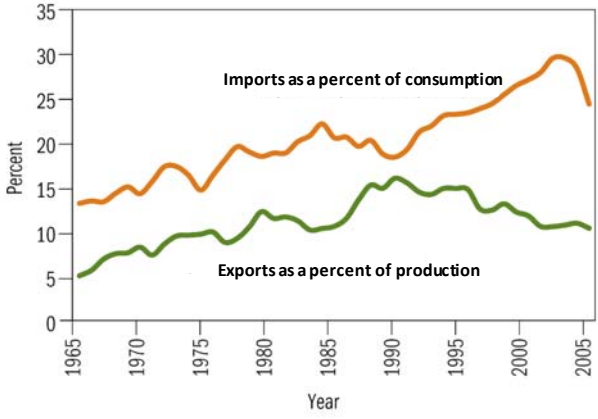


Per capita disposable personal income and population, 1965-2006

Imports and Exports

Imports accounted for an increasing share of the Nation's timber supply, reaching a maximum value of 29 percent in 2004 and 2005. While most of the imports originated in Canada, there were increased shipments from Chile, New Zealand, Finland, and other countries during this time. However, this trend reversed in 2006 when imports as a percent of consumption dropped to 28 percent. Exports as a percent of production peaked at 16 percent in 1991 and generally declined after that point, reflecting a strong dollar and decreased demands in key markets such as Japan. Exports as a percent of production declined to 11 percent in 2006 Because of their effects on U S harvest, both imports and exports affect the condition of the domestic forest resource.

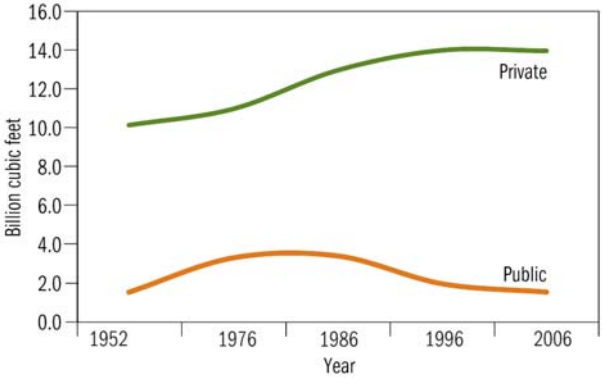
Imports as a percent of consumption and exports as a percent of production of industrial roundwood, 1965-2006



Shifting Timber Sources

Changes in public land policy have had significant impacts on private forests. As harvesting declined on public lands in the West, harvesting increased on private lands in the East, particularly in the South. Overall, domestic harvesting has remained steady to declining for the past decade, and increased demand has been supported by increased imports and paper recycling.

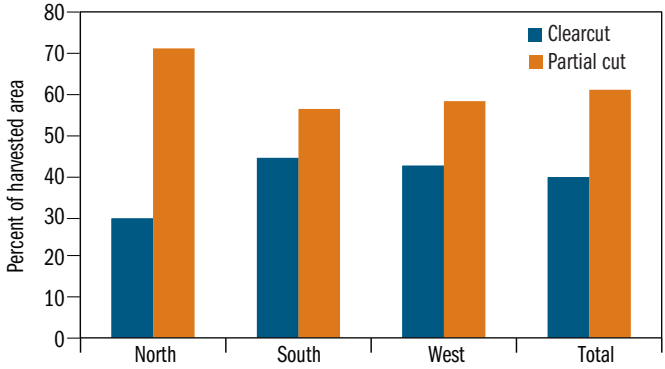
Growing stock removals in the United States by owner group, 1952-2006



Harvest Methods and Efficiency

Timber harvests occur on 10.8 million acres annually. Selective harvesting is prevalent on 61 percent of harvested acres in the United States. Clearcutting, used on the remaining 39 percent of harvested forest, is most prevalent in areas of managed plantations in the South and areas in the North where pioneer species such as aspen, jack pine, and spruce-fir—which need open sunlight to regenerate—are being managed for timber production. In the West, clearcutting is generally followed by planting to augment natural regeneration.

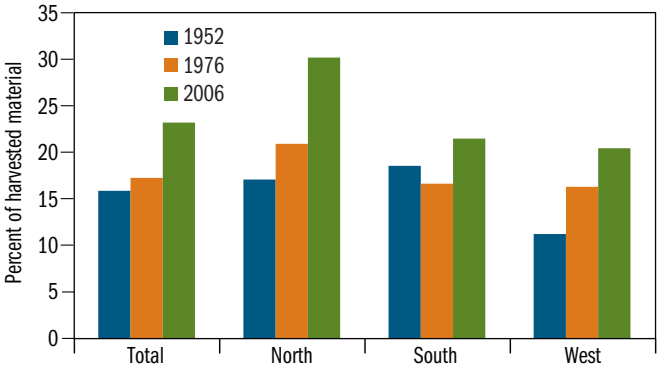
Proportion of harvested timber land in the United States by method of harvest, 2001–2005



Logging Residues

Logging residues are portions of trees' stems left behind after logging, and are increasingly being considered as a possible resource for bioenergy use. Overall, this material has ranged from an equivalent of 20 to 30 percent of the material taken for products. In 2006, logging residues totaled 4.5 billion cubic feet. Even after leaving a portion of this material for nutrient cycling and soil protection, the volume has the potential to be a significant resource.

Logging residues in the United States as a percent of total harvest by region, 1952, 1976, and 2006



Nontimber Forest Products

Nontimber forest products involve more species than timber products and include trees, woody and herbaceous plants, fungi, and other biological material harvested from within and on the edges of forests. Plant parts harvested include the roots, tubers, leaves, bark, twigs and branches, fruit, sap, and resin, as well as the wood (Chamberlain et al. 1998). These products are commonly classified into five product categories:

- Medicinal Plants
- Food and Forage
- Floral
- Arts and Crafts
- Horticultural

As demand for these products grows, it becomes increasingly important to monitor the removal of products from forests, and the effects of their removal on the viability of current and future forest ecosystems. However, despite the importance of these products, they are difficult to track because of the revolving variety of products they encompass, and regional variability within product categories. Domestic values of nontimber forest products may be estimated from contract and permit sales on public lands operated by the Forest Service and the Bureau of Land Management. These extrapolations assume that national forests account for approximately 20 percent of nontimber forest products and Bureau land accounts for about 2 percent of nontimber forest products. If these assumptions are true, the wholesale domestic value of nontimber forest products (not including personal use) exceeds $600 million.

Estimated wholesale value of wild-harvested nontimber resources in the United States extrapolated from Forest Service and Bureau of Land Management sales receipts

Product category	2005	2006	2007
	Million U.S. dollars (unadjusted for inflation)		
Landscaping	35	29	31
Crafts/florals	87	93	152
Regeneration seed/ cones	5	3	4
Edible fruits, nuts, sap	46	37	46
Grass/forage	24	20	20
Herbs, medicinals	2	2	2
Subtotal	199	183	254
Fuelwood	271	286	331
Posts and poles	33	28	26
Christmas trees	82	69	71
Subtotal	386	382	428
Total	**585**	**565**	**682.4**

Domestic nontimber forest products of particular national economic importance include Christmas trees, maple syrup, furbearing animals, and products related to the arts and crafts industry. Economically important exports include pecans, floral products, wild blueberries, ginseng, and honey. Overall, the United States is a net importer of nontimber forest products, particularly vanilla beans (from Madagascar), which heavily influence the net value of the U.S. nontimber forest product trade.

Nontimber forest products trade and wholesale values in the United States

Category	2003	2004	2005	2006	2007
	Million U.S. dollars (unadjusted for inflation)				
U.S. imports minus exports	244	205	71	105	61
Total wholesale value adjusted for trade	461	425	270	288	315
Total wholesale value adjusted for trade, plus firewood, posts and poles, and Christmas trees	853	801	656	670	743

Ecosystem Services

Healthy forest ecosystems are ecological life-support systems. In addition to traditional products, forests provide a full suite of goods and services that are vital to human health and livelihood, natural assets we call environmental services or ecosystem services.

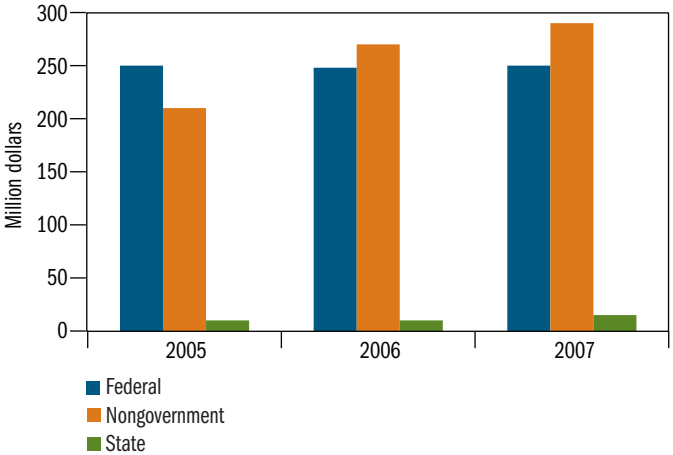
Many of these goods and services are traditionally viewed as free benefits to society, or "public goods"—wildlife habitat and diversity, watershed services, carbon storage, and scenic landscapes, for example. Lacking a formal market, these natural assets are traditionally absent from society's balance sheet; their critical contributions are often overlooked in public, corporate, and individual decisionmaking.

While it is difficult to establish the value of ecosystem services, an illustrative subset of ecosystem services can be highlighted for which actual markets and/or payments to landowners exist. Although this example does not measure the full value of the benefits supplied by forests to society, it does measure the amount of revenues landowners actually received for producing specific ecosystem services.

Payments to forest landowners from all sources from which data are available were $553 million in 2007 with Federal agencies providing $248 million, States $12 million, and nongovernment sources accounting for $294 million. Of the nongovernment sources, greenhouse gas offsets amounted to $5.5 million, conservation easements $110 million, and fee simple purchases $176 million.

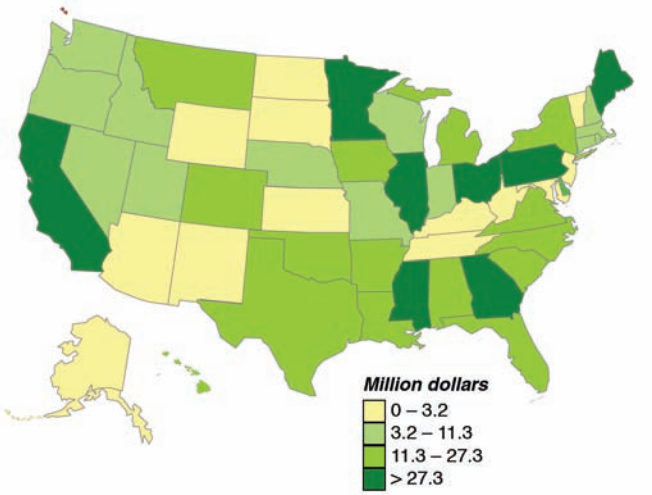
From 2005 to 2007, government payments—Federal and State—remained fairly constant, ranging from $256 million in 2005 to $260 million in 2007. In contrast, payments by nongovernment organizations for carbon offsets and conservation easements grew from $213 million in 2005 to $294 million in 2007.

Payments by government and nongovernment organizations for carbon offsets and conservation easements, 2005–2007



For the example presented, the distribution of payments among States for ecosystem services from all sources in 2007 is shown in the following map. Alaska landowners received the lowest payments ($276,000), while Georgia received the highest ($52 million).

Average revenues from ecosystem services by State, 2005–2007



Toward Stronger Policies and Actions

The Food, Conservation, and Energy Act of 2008 takes a significant first step towards facilitating landowner participation in emerging markets for ecosystem services. Section 2709 of the conservation title requires the Secretary of Agriculture, in consultation with other agencies and interests, to "establish

technical guidelines that measure the ecosystem services benefits from conservation and land management activities."

To implement this act, a governmentwide Conservation and Land Management Environmental Services Board was established. The purpose of this board is to assist the Secretary of Agriculture in adopting the technical guidelines that the Federal Government will use to assess ecosystem services provided by conservation and land management activities and provide for reporting protocols, registries, and verification processes.

Technical guidelines will focus on scientifically rigorous and economically sound methods for quantifying environmental services, such as carbon sequestration, air and water quality, wetlands, and endangered species benefits, in an effort to facilitate the participation of farmers, ranchers, and forest landowners in emerging ecosystem markets.

Improving our ability to quantify ecosystem services will enable them to be taken into account, alongside merchantable timber and nontimber forest products when decisions are made regarding forest resources.

Learn more at http://www.fs.fed.us/ecosystemservices/.

Water Supplies

In the conterminous 48 States, 24 percent of the water supply originates on Federal land. Land owned by the Forest Service serves 18 percent of originating water sources. Regardless of ownership, about 53 percent of the conterminous water supply originates on forest land. National forests and grasslands supply 51 percent of the water supply in the West.

Water Uses

Estimates of water use in the United States indicate that about 408 billion gallons per day were withdrawn for all uses during 2000. This total has varied less than 3 percent since 1985 as withdrawals have stabilized for the two largest uses—thermoelectric power and irrigation. In 2000, about 48 percent of all withdrawals were used for thermoelectric power and 34 percent for irrigation.

Watershed Management

Water quality is becoming an increasingly serious concern in the United States, as well as globally. High-quality watersheds trap sediments; slow runoff; and provide cooling shade and excellent habitat for wildlife, fish, and plants. Potential watershed management issues include habitat loss and fragmentation,

hydrologic alterations, nutrient enrichment of surface waters, and pathogens and toxins. Forests offer significant mitigation opportunities for water management.

Effective watershed management must be based on a planning process that integrates both scientific analysis and public participation. To explore current efforts in watershed management, visit http://www.partnershipresourcecenter.org/watersheds/index.php.

Drought

Another aspect of water is the lack of it. Many forests have recently experienced fires of unprecedented intensity and extent, and this is partially the result of forest management practices that have allowed decades of dead wood (fuels) to accumulate. This has been exacerbated by climate variability in the form of prolonged periods of drought that have left forests in tinder dry conditions, and, thus, more susceptible to intense fires. Public resource agencies are shifting their fire policies from complete suppression to recognition that fire is an integral component of the landscape. Presuppression forests experienced fires more frequently, but these fires were less destructive. These less intense fires served as a means of keeping fuels from accumulating on the forest floor and maintaining low stand density. Current information on drought conditions can be found at NOAA's Hydrologic Information Center at http://www.nws.noaa.gov/oh/hic/current/drought/index.html and the University of Nebraska–Lincoln, National Drought Mitigation Center at http://drought.unl.edu/risk/us/usimpacts.htm.

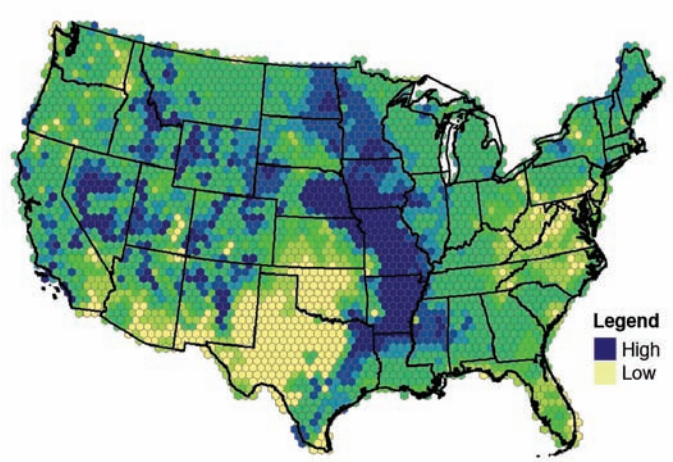
Forest Wildlife

Wildlife and Climate Change

Wildlife biologists face many challenges in developing recommendations to manage wildlife habitat under a changing climate. The Forest Service has developed a consistent and holistic approach to analyzing potential threats of climate change to terrestrial wildlife habitat. The terrestrial climate stress index was developed to rank areas along a gradient of high to low future climate stress to terrestrial wildlife habitat, based on components that quantify the degree of change in temperature, precipitation, habitat types, and habitat quality. Areas of relatively high or low stress across the coterminous United States can be identified in a consistent and repeatable manner. To evaluate future climate change threats with existing threats to wildlife habitat management, this information can be integrated with the geographic location of current stressors—for example, intensive

land use—or with areas having large numbers of at-risk species. The Forest Service analysis to date indicates that the areas of greatest stress to terrestrial habitats from future climate change were associated with transitions between major biomes or in areas of high topographic relief. The least sensitive geographic areas on this relative scale were in the southern Great Plains, the Appalachian Mountains, and the eastern coast of Florida. The States with the greatest proportional area in relatively high climate stress include Missouri and Arkansas. The least stress States include Texas and Oklahoma.

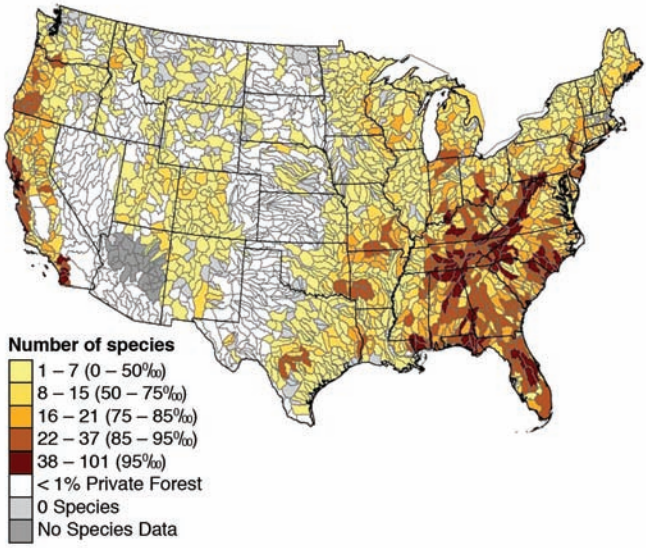
Wildlife habitats stressed by climate change



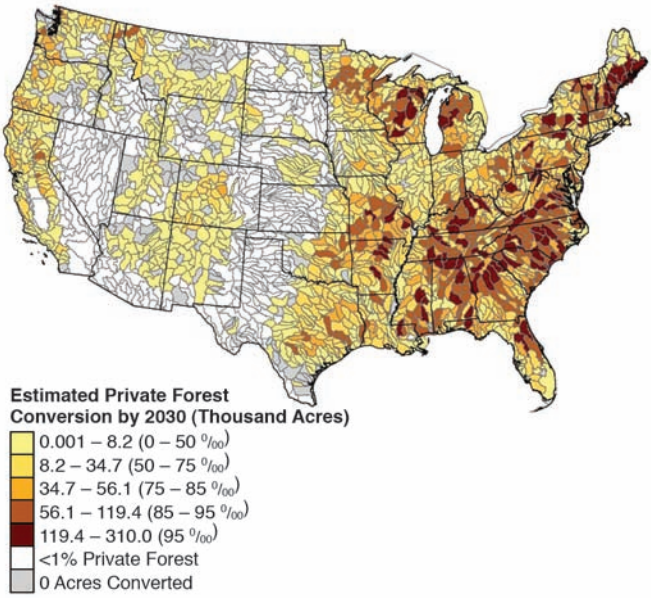
Land Ownership and Forest Wildlife

Conservation of biological diversity on public forest lands is often a focus in resource planning. However, privately owned forest lands also make an important contribution to the conservation of species that are at risk of extinction. At-risk species are defined as those species listed under the U.S. Endangered Species Act or with a global conservation status rank of critically imperiled, imperiled, or vulnerable. Analyses by the Forest Service and key partners indicate that two-thirds of the watersheds in the conterminous United States contain at-risk species associated with private forests, with counts ranging from 1 to 101 species. Those watersheds with the greatest number and density of such species are found in the Southeast, Midwest, and west coast States. Many private forests are threatened by land-use conversion. Those forests projected to experience the greatest increase in housing density within the next 25 years—and with relatively high densities of at-risk species—are found in over 100 watersheds, most of them in the Southeastern States.

Number of at-risk species that occur on privately owned forest land by watershed



Area of privately owned forest land predicted to experience increased housing density by 2030



Forest Recreation

In the United States, with a few exceptions, public forest lands at all levels of government are open for public recreation. Open Federal lands include forested areas on national forests, national parks, Bureau of Land Management lands, wildlife refuges, and most other federally managed land. Open State forest lands include State forests, State parks, wildlife management areas, and other State management areas. Local government forests include municipal watersheds, local parks, local forest preserves, greenways, and other local forest areas.

Forest industry and other corporate and noncorporate private forest lands are usually also open to recreational uses, although access to them is more restricted than is the case with public lands. Over half of forest industry lands are in the South. Large portions of other corporation forest lands (not owned by forest industry) are located in the West and South regions. Almost half of the family and individually owned private forest land is in the South region; nearly 36 percent is in the North. The National Woodland Ownership Survey estimated that about 54 percent of family forest land was open only to family or friends, and no others (Butler 2008). Just 14.6 percent of the family forest area was open to the public with permission of the owner. Almost 8 percent of the family forest area was leased in the last 5 years for recreational uses. The percentage of nonindustrial forest available for public recreation has been on a downward trend over the last three decades.

Recreation Use of Forests

The top 10 forest recreation activities, in terms of numbers of times people have participated, are walking for pleasure; viewing and photographing natural scenery; viewing and photographing flowers, trees, and other forest vegetation; viewing and photographing birds; viewing and photographing wildlife; day hiking; visiting wild areas; off-highway driving; attending outdoor family gatherings; and visiting nature centers. The annual total number of forest recreation activity days among these activities ranges from an estimated high of almost 7.5 billion to just over 680 million. Snowmobiling, mountain climbing, cross-country skiing, rock climbing and snowshoeing engage much smaller numbers of recreation activity days, but still the estimated totals add up to sizeable numbers ranging from about 20 million to over 62 million.

The percentage of forest-based activity days that occur on public lands ranges from under 50 percent (for example, small-game hunting, horseback riding, off-road driving, and gathering mushrooms and berries) to over 75 percent (for example, visiting wilderness, day hiking, visiting nature centers, and backpacking).

Over all activities, the percentage of forest-based recreation activity days that occur in urban forests ranges between roughly 15 percent to around 45 percent.

Millions of annual forest recreation activity days* and percentage on public and private forest land in the United States by activity, 2007–2008

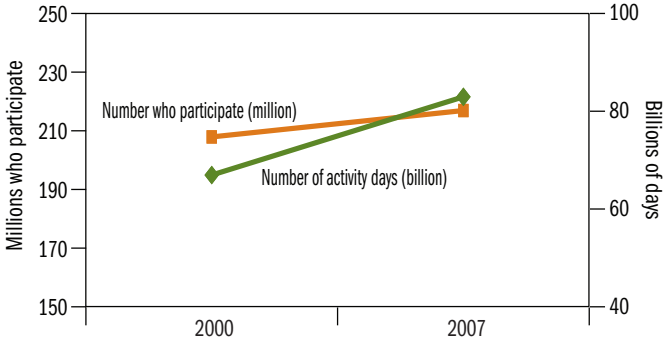
Forest recreation activity	Number of activity days in forest	Percent on public forest	Percent in urban forests
Walk for pleasure	7,493.30	53.8	44.5
View/photograph natural scenery	6,170.60	61.9	31.8
View/photograph wild-flowers, trees, etc.	4,858.94	55.4	36.3
View/photograph birds	3,738.27	51.3	37.6
View/photograph other wildlife	3,086.85	57.7	32.2
Day hiking	1,234.82	76.2	34
Visit a wilderness or primitive area	947.559	76.4	24.6
Off-highway driving	837.541	50.4	23.2
Family gathering	805.291	55.9	43.5
Visit nature centers, etc.	683.85	77.6	45.2
Gather mushrooms, ber-ries, etc.	623.372	47.9	32.3
Mountain biking	463.324	60.2	32.1
Picnicking	455.942	68.4	44.4
Developed camping	355.966	72.8	21.3
Big game hunting	279.781	45.7	16.5
Primitive camping	211.448	75.8	21.4
Backpacking	198.787	78.5	22.1
Visit historic sites	182.755	60	39.1
Horseback riding on trails	177.453	50.8	34.4
Small game hunting	161.488	46.8	17..4
Visit prehistoric/archaeo-logical sites	138.932	70	41.6
Snowmobiling	62.111	55.1	27.4
Mountain climbing	57.091	78.6	20.5
Cross country skiing	41.874	60.5	33.7
Rock climbing	34.088	68.8	26.9
Snowshoeing	19.938	60.2	27.6

Source: NSRE 2005–2008, Versions 1-3b

*Recreation activity day=recreation in each activity equivalent to the activity completed by one person in 1 day.

Overall, between 2000 and 2007, recreation use increased modestly. As reported in Forest History Today (Cordell 2008), the total number of people who participated in one or more outdoor activities grew by 4.4 percent between 2000 and 2007. At the same time, the number of recreation activity days, summed across all participants and activities, increased approximately 25 percent. The number and capacity of public and private forest-based recreation sites have remained about constant or increased slightly.

Growth in number of participants and recreation days across 60 outdoor recreation activities on all land in the United States, 2000–2007 (reproduced from *Forest History Today* article, Cordell 2008)



Caribbean and Pacific Forests

Island Forests

The U.S. Caribbean Islands are composed of Puerto Rico and the U.S. Virgin Islands. In general, the Caribbean Islands are a 3,900 mile arc of islands, tectonically uplifted from the sea floor separating the Atlantic Ocean from the Caribbean Sea. Low-lying islands often are capped with limestone from ancient coral reefs, and other islands exhibit volcanic activity that has pushed up steep peaks that divert the moisture-laden northeasterly trade winds upward, greatly increasing rainfall.

The U.S. affiliated Pacific Islands include American Samoa, Guam, Hawaii, the Republic of the Marshall Islands, the Federated States of Micronesia, the Commonwealth of the Northern Mariana Islands, and the Republic of Palau. These islands span a vast and diverse area from Hawaii, 3,900 miles west of the U.S. mainland, to Palau, about 566 miles east of the Philippines. Land masses vary widely and include small coral atolls, small sand islands, moderate-sized islands of mixed limestone and volcanic substrates, and large, high-elevation, volcanic islands.

Geographic location of U.S. affiliated islands relative to the U.S. mainland

Tropical islands serve as the proverbial "canary in the coal mine," alerting society to the problems inherent to living on a constrained land base. The challenges we face in our mainland forests—such as land use change, altered fire regimes, nonnative species invasions, insect and disease outbreaks, climate change, and other human-caused disturbances—become critical for societies with restricted, more immediately finite resource bases, such as those found on these islands.

Tropical island forests are intimately linked to the surrounding ocean. The climate of the ocean impacts island vegetation, topography, and soils. Conversely, the islands influence the adjacent ocean as vegetation, soils, and pollutants make their way to the aquatic environment. Forests filter sediment, keeping it on the islands. Mangrove and coastal strand forests buffer the islands against the ocean's erosive force and storm surges. Forests play a key role in keeping both terrestrial and aquatic resources in good health.

FIA offers resource monitoring assistance in the tropical Caribbean Islands of Puerto Rico and the U.S. Virgin Islands, the Pacific Islands of American Samoa, Guam, the Republic of Palau, the Commonwealth of the Northern Mariana Islands, the Federated States of Micronesia, the Republic of the Marshall Islands, and Hawaii. Inventories are conducted on a rotating periodic basis (5 years in the Caribbean, 10 years in the Pacific) across island groups.

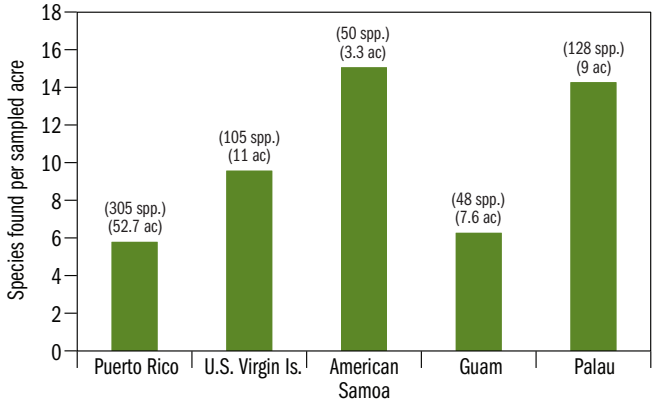
Population, land area, forest area, and percent forest cover for U.S. affiliated island groups

Region and island group	Population	Land area	Forest area	Forest cover
		acres	acres	percent
Caribbean				
Puerto Rico	3,808,610	2,191,816	1,261,332	58
U.S. Virgin Is.	108,612	85,592	52,478	61
Pacific				
Am. Samoa	57,663	48,433	43,630	90
Guam	173,456	135,661	63,832	47
Palau	20,842	111,544	96,689	87
CNMI	84,546	73,536	53,664	73
FSM	107,862	149,805	76,526	51
RMI	61,815	44,477	43,143	97
Hawaii	1,211,537	4,127,336	1,490,902	43
Islands total	**5,634,943**	**6,951,339**	**3,439,298**	**67**

The Caribbean Islands

Puerto Rico and the U.S. Virgin Islands were almost entirely deforested for agriculture by the mid-20th century. Forest cover has steadily increased on Puerto Rico as economic activities moved away from agriculture, resulting in abandoned agricultural lands being re-colonized by forest. The naturally high species diversity of Caribbean tropical forests has been further augmented by human introduction of tree species from around the world, some beneficial and others invasive.

Species diversity per sampled acres in the Caribbean and Pacific Islands



This has also occurred in the U.S. Virgin Islands. As urbanization

increases, however, forest loss is accelerating. The U.S. Virgin Islands lost 7 percent of their forest cover from 1994 to 2004, mostly on the more densely populated island of St. Thomas.

The Pacific Islands

General trends across the Pacific Islands show that in areas more accessible to tourists, urbanization has led to decreases in forest cover. However, there is some recovery and maturation of forests in other areas that in the past had been disturbed or denuded, especially from the effects of World War II and agriculture.

The most important forestry concerns within the Pacific Islands involve losses of forest cover owing to urbanization, damage from invasive species, and the erosion of soils with subsequent siltation of coral reefs. Island resource managers are anxious to cultivate additional partnerships to strengthen their efforts to reforest and reclaim areas via planting and control of exotics.

Terms

Forest land—Land at least 120 feet wide and 1 acre in size with at least 10 percent tree cover (or equivalent stocking) by live trees of any size, including land that formerly had such tree cover and that will be naturally or artificially regenerated and is not subject to nonforest use(s) such as extensive livestock or human activity that prevent normal tree regeneration and succession.

Growing stock volume—Live trees on timber land of commercial species meeting specified standards of quality and vigor. Cull trees are excluded. Includes only trees 5 inches in diameter or larger at 4.5 feet above ground.

Growth (Net Annual)—The net increase in the volume of growing stock trees during a specified year. Components include the increment in net volume of trees at the beginning of the specific year surviving to its end, plus the net volume of trees reaching the minimum size class during the year, minus the volume of trees that died during the year, and minus the net volume of trees that became cull trees during the year.

Hardwood—A dicotyledonous tree, usually broad-leaved and deciduous.

IUCN Protection Categories—The International Union for Conservation of Nature protected area classifications are as follows:

> **Category I** is defined as (a) an area of land and/or sea possessing some outstanding or representative ecosystems, geological or physiological features and/or species,

or available primarily for scientific research and or environmental monitoring, or (b) a large area of unmodified or slightly modified land and/or sea, retaining its natural character and influence, without permanent or significant habitation, that is protected and managed so as to preserve its natural condition.

Category II land is a natural area of land and/or sea designated to (a) protect the ecological integrity of one or more ecosystems for present and future generations; (b) exclude exploitation or occupation critical to the purposes of designation of the area; and (c) provide a foundation for spiritual, educational, recreational, and visitor opportunities, all of which must be environmentally and culturally comparable.

Category III land is an area containing one, or more, specific natural or natural/cultural feature that is of outstanding or unique value because of its inherent rarity, representative or aesthetic qualities, or cultural significance.

Category IV is an area of land and/or sea subject to active intervention for management purposes so as to ensure the maintenance of habitats and/or to meet the requirements of specific species.

Category V is an area of land with coast and sea as appropriate, where the interaction of people and nature over time has produced an area of distinct character with significant aesthetic, ecological, and/or cultural value, and often with high biological diversity. Safeguarding the integrity of this traditional interaction is vital to the protection, maintenance, and evolution of such an area.

Category VI is an area containing predominantly unmodified natural systems, managed to ensure long-term protection and maintenance of biological diversity, while providing at the same time a sustainable flow of natural products and services to meet community needs.

Logging residues—The unused portions of growing-stock trees cut or killed by logging and left in the woods.

Mortality—The volume of sound wood in growing-stock trees that died from natural causes during a specified year.

National forest—An ownership class of Federal lands, designated by Executive order or statute as national forests or purchase units, and other lands under the administration of the Forest Service.

Other Federal—An ownership class of Federal lands other than those administered by the Forest Service. Primarily lands owned by the Bureau of Land Management, National Park Service, U.S. Fish and Wildlife Service, and the U.S. Departments of Energy and Defense.

Other forest land—Forest land other than timber land and reserved forest land. It includes available land that is incapable of producing annually at least 20 cubic feet per acre of industrial wood under natural conditions because of adverse site conditions, such as sterile soils, dry climate, poor drainage, high elevation, steepness, or rockiness.

Removals—The net volume of growing stock trees removed from the inventory during a specified year by harvesting, cultural operations such as timber stand improvement, or land clearing.

Reserved forest land—Forest land withdrawn from timber utilization through statute, administrative regulation, or designation. Does not include all land in IUCN protection categories.

Roundwood products—Logs, bolts, and other round timber generated from harvesting trees for industrial or consumer use.

Softwood—A coniferous tree, usually evergreen, having needles or scale-like leaves.

Timber land—Forest land that is capable of producing crops of industrial wood and not withdrawn from timber utilization by statute or administrative regulation. (Note: Areas qualifying as timber land are capable of producing in excess of 20 cubic feet per acre per year of industrial wood in natural stands.)

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Web Resources

Forest Service
http://www.fs.fed.us

Forest Inventory and Analysis
http://fia.fs.fed.us

National Resource Assessment
http://www.fs.fed.us/research/rpa

Forest Health
http://www.fs.fed.us/foresthealth/
http://www.na.fs.fed.us/sustainability/index.shtm

National Report on Sustainable Forests
http://www.fs.fed.us/research/sustain

Recreation/Wilderness
http://www.srs.fs.usda.gov/trends
http://www.fs.fed.us/recreation

Forest Wildlife
http://www.fs.fed.us/research/rpa

Fire
http://www.nfic.gov
http://www.fs.fed.us/fire/

Forest Products
http://ncrs2.fs.fed.us/4801/fiadb/rpa_tpo/wc_rpa_tpo.asp
http://www.fpl.fs.fed.us

Nontimber Forest Products
http://www.sfp.forprod.vt.edu
http://www.fao.org/forestry/site/6367/en
http://ifcae.org/ntfp

Forest Ownership
http://familyforestresearchcenter.org/projects01.html

Protected Areas
http://www.IUCN.org
http://www.consbio.org
http://www.protectedlands.net/main/home.php

Water Resources
http://water.usgs.gov/watuse
http://www.partnershipresourcecenter.org/watersheds/index.php

Drought
http://www.drought.unl.edu
http://www.nws.noaa.gov/oh/hic/current/drought/index.html

Global Forest Information
http://www.fao.org/forestry

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