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Forest Resources of Arizona

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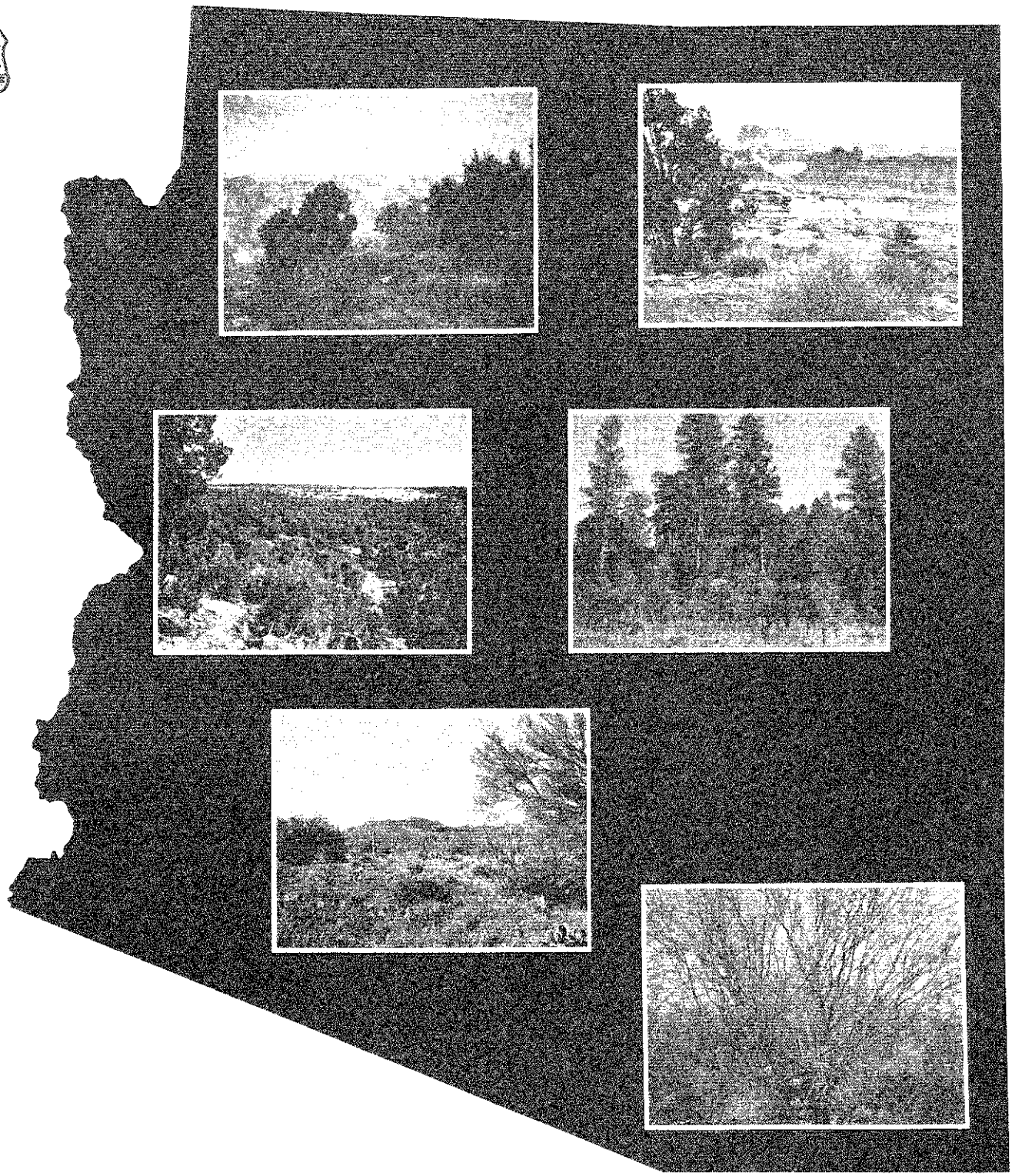

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PREFACE

Forest Survey is a continuing nationwide undertaking conducted by the Forest Service, U.S. Department of Agriculture, with the primary objective of providing an assessment of the renewable resources on the Nation's forests. This requires periodic State-by-State resource inventories. Originally, Forest Survey was authorized by the McSweeney-McNary Act of 1928. The current authorization is through the Renewable Resources Research Act of 1978.

The Intermountain Research Station with headquarters in Ogden, UT, administers the forest resource inventories for the Rocky Mountain States of Arizona, Colorado, Idaho, Montana, New Mexico, Nevada, Utah, and Wyoming. These inventories provide information on the extent and condition of forest lands outside the National Forests, volume of timber, and rates of timber growth and mortality. These data, when combined with similar information for National Forest lands, provide a basis for forest policies and programs and for the orderly development and use of the resources.

RESEARCH SUMMARY

Forests in Arizona occupy about 19.9 million acres. More than 5.5 million acres are timberland, including 1.6 million reserved from timber harvesting. Roughly 65 percent of the nonreserved timberland is on National Forests. The remaining area of forest land, some 14.3 million acres, is woodland, nearly all of which is nonreserved and over half is privately owned.

Net volume on the nonreserved timberland is almost 5.6 billion cubic feet of wood. Ponderosa pine is the dominant species and accounts for about 71 percent of the timberland volume. In 1984, timberland net annual growth was 122.8 million cubic feet and annual mortality was about 15.2 million cubic feet. Woodland net volume, found primarily in pinyon and juniper species, amounted to 6.5 billion cubic feet.

This report highlights additional information on the extent, nature, and condition of the forests in Arizona.

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HIGHLIGHTS

Area

- Total land area of Arizona is nearly 72.8 million acres. Over a quarter of this area is forest land.
- About 5.5 million acres are classified as timberland, including 1.6 million acres reserved from harvest. Roughly 3.9 million acres, or 71 percent, are in National Forests.
- At 14.3 million acres, Arizona's woodland area is more than two and one-half times that of timberlands. About 823,000 acres are reserved. Thirty-five percent of the woodland is owned by various Indian tribes.
- Sawtimber stands dominate—84 percent of the nonreserved timberland area is in this stand-size class.
- Ponderosa pine is the primary timberland species and, as a forest type, accounts for 86 percent of the timberland area.
- Pinyon-juniper is the dominant forest type on woodlands and occupies nearly 9.1 million acres.

Volume

- Total timberland net growing-stock volume is estimated to be just under 5.6 billion cubic feet, including 21.7 billion board feet (Scribner rule).
- Nearly two-thirds of the volume is found in the National Forests. Another one-third is on private land.
- Ponderosa pine accounts for the lion's share of the timber volume with an estimated 4.0 billion cubic feet. Almost 87 percent of this is in trees 9.0 inches diameter at breast height (d.b.h.) and larger.
- Woodland total volume amounts to more than 7.8 billion cubic feet, including 1.3 billion cubic feet of dead material.
- Pinyon and juniper species account for about 5.7 billion cubic feet of the total woodland volume.

Growth

- Timberland net annual growth was almost 123 million cubic feet in 1984. This averages to about 31 cubic feet per acre per year, which is 72 percent of potential.
- Woodland sites are typically low in productivity. The 81.8 million cubic feet of growth in 1984 represents an annual increase of less than 6.0 cubic feet of wood volume per acre.

Mortality

- Annual mortality on Arizona's timberlands is relatively low. About 15.2 million cubic feet of growing stock were lost to destructive agents in 1984. Over a third of the mortality was due to insects and disease.
- Engelmann spruce suffered the largest losses, primarily due to insects, and accounted for 6.1 million cubic feet of the annual mortality.
- Three-fourths of the growing-stock mortality was on private land.

Removals

- Arizona leads the Southern Rocky Mountain States in timber production. An estimated 63.6 million cubic feet were harvested in 1984, most of it in the form of sawlogs. Approximately two-thirds of the harvest came from National Forest lands.
- Not surprisingly, ponderosa pine makes up 91 percent of the industrial roundwood harvest.
- Fuelwood is the primary wood product harvested from Arizona's woodlands. The 231,305 cords of wood reportedly harvested in 1984 were primarily juniper and oak species.

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INTRODUCTION

The most recent inventory of forest land in Arizona was completed in 1985. This latest effort, in contrast to the original survey conducted in 1962 that focused primarily on the State's timberland resource, includes detailed information collected from both timberland and woodland field locations on lands outside the National Forests. These data, combined with similar data for National Forest lands, represent the most comprehensive assessment of Arizona's forest lands to date. Due to differences in sampling design and intensity, and survey standards and definitions, comparisons of the results of this inventory with those of the original survey are possible only in general terms.

This report provides the basic statistics on forest area, wood volume, growth, mortality, and removals. In addition, the use of the State's forest lands as areas for recreation, grazing, and as wildlife habitat is briefly discussed.

GEOGRAPHY AND VEGETATION

Arizona's land features four distinct geographic regions . . .

Arizona is a land of many faces (fig. 1). Its famous landscapes are founded in the extraordinary environmental diversity created by its landforms and climate. The State's nearly 114,000 square miles of land area are dominated by four distinct geographic regions and vegetational zones that offer some unique contrasts: the plateaus of the north and northeast, the desert and plains of the south and southwest, the rather broad band of mountains in between, and the shrub steppe area in the southeast (fig. 2).

the plateau country, . . .

The plateau country is part of the Colorado plateau complex and includes, from west to east, the Shivwits, Kanab, Kaibab, Coconino, and Kaibito Plateaus, Black Mesa, and the vividly colored Painted Desert. The most famous feature of the plateau country, of course, is the mile-deep Grand Canyon carved out by the Colorado River flowing out of Utah, then winding its way west and south to Yuma and on into the Gulf of California.

Mogollon Rim and mountains, . . .

The wide ridge that marks the southern boundary of the plateau region narrows into the Mogollon Rim, a heavily forested escarpment, 2,000 feet high in places, that forms a natural barrier across the east-central part of the State. At the eastern end of the rim are a sizable number of short mountain ranges collectively making up the White Mountains.

Sonoran Desert, and . . .

the shrub steppe.

The southwestern portion of the State is dominated by the Sonoran Desert, which is marked by fault block mountain ranges separated by wide flat valleys. This region, because of its arid to semiarid nature and altitudinal variations, offers the opportunity to go from pure desert to spruce-fir forests within only a few minutes' driving time.

Humphrey's Peak in the San Francisco Range near Flagstaff is the highest point in the State at 12,670 feet. The land gradually tilts to the southwest, leaving the town of Yuma at about 141 feet above sea level.

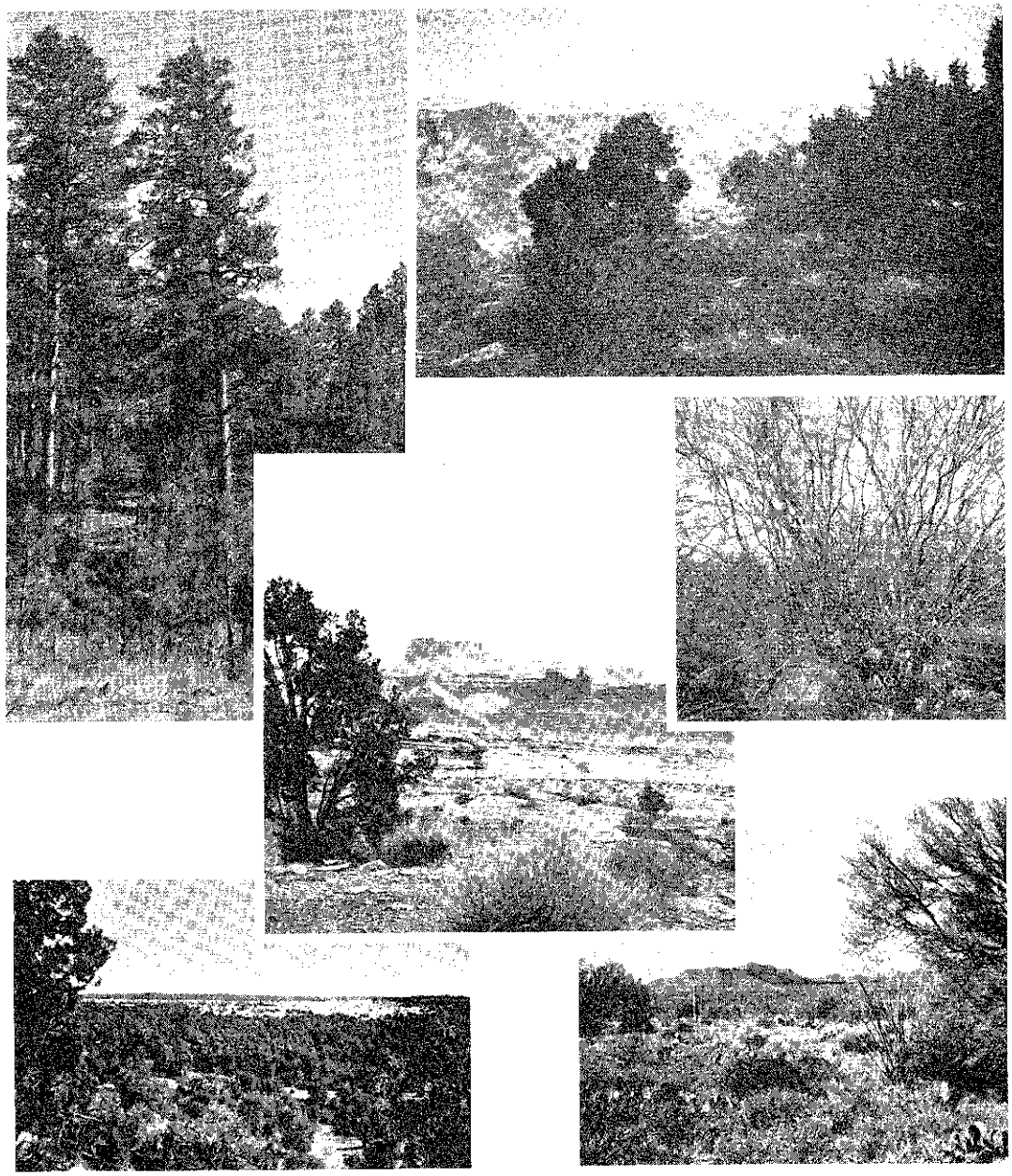


Figure 1—Varied landscapes and vegetation of Arizona.

Vegetation depends on rainfall and altitude.

The keys to vegetation kinds and location in Arizona are rainfall and altitude. At the lowest desert elevations, creosotebush dominates with extensive areas of pure stands with little or no other vegetation between the nearly evenly spaced plants. With increasing elevation and rainfall come large areas of cacti and desert shrubs, most armed with thorns. These are the landscapes, familiar in John Wayne movies, dominated by saguaro, cholla, ocotillo, barrel, and pricklypear cactus, with paloverde and mesquite on more moist sites and along the washes.

Moving up the slopes the desert flora give way to pinyon-juniper, chaparral, or oak woodlands, then to ponderosa pine at about 7,000 feet elevation and extending to around 8,000 feet, where it is replaced by Douglas-fir. At around 9,000 feet, the Douglas-fir zone merges into Engelmann spruce and fir. The vegetational zones in the mountains of Arizona are similar to those of the Rocky Mountains farther north but at higher elevations.

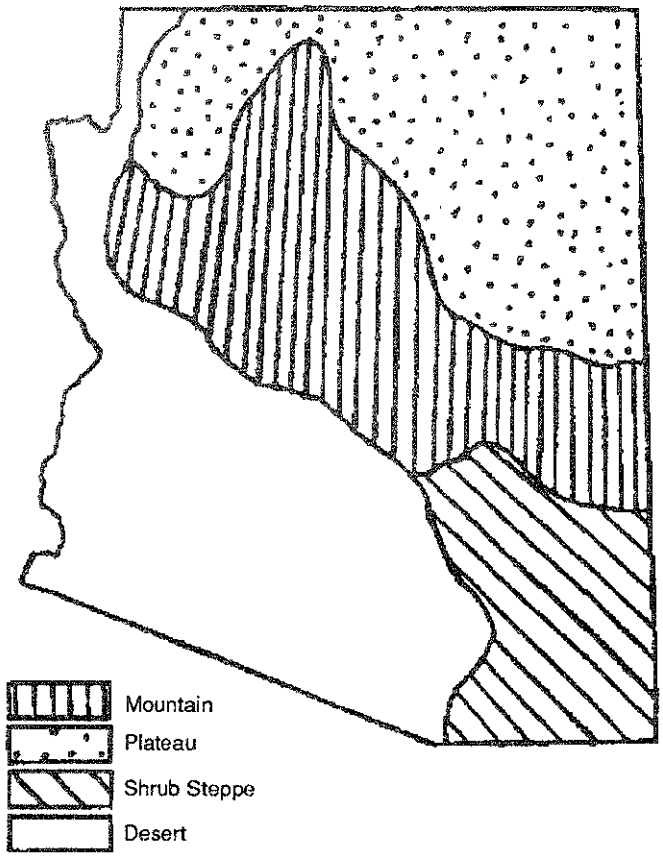


Figure 2—General ecological/vegetation zones in Arizona.

The southeast corner of the State is a semiarid shrub steppe area where grassy plains are separated by small mountains. Vegetation zones in this region include desert, pinyon-juniper and oak, and pines at the higher elevations. Douglas-fir and white fir can be found in some isolated pockets high in the Santa Catalina Mountains near Tucson.

ARIZONA'S FOREST LAND

Saguaro dominates much of the landscape but . . .

The saguaro cactus, rather than the pine tree, is conceivably the image that best characterizes much of the landscape of Arizona. The State's unique desert lands, where trees are often the exception rather than the rule, are admittedly what set it apart from all other Rocky Mountain States. However, the State is also endowed with a sizable area of forest land.

over a quarter of the State's land is forested.

In fact, forests cover more than a quarter of Arizona's total land area. By way of comparison, the State's 19.9 million acres of forest is second only to Colorado in the Southern Rocky Mountain States with respect to area of forest land. In addition, only Idaho and Montana in the Northern Rockies have more forested area (Green and Van Hooser 1983).

About 42 percent is in the National Forests . . . and 41 percent is private, primarily Indian land.

Forest land in Arizona is either public—largely National Forest—or private, the bulk of which is Indian trust lands (fig. 3 and table 1). The 6.3 million acres of Indian-owned forest land represents 31 percent of the total forested area in the State. About 8.4 million acres of forest land are in the six National Forests found, in whole or in part, within the State (fig. 4).

The distribution of forest land by owner is important because public agency goals and mandates, or personal preference, largely dictate the availability and

Table 1--Total area by land class and ownership class, Arizona, 1985

Ownership class	Land class: Nonreserved: Timberland	Nonreserved: Woodland	Nonreserved: Nonforest	Reserved	Total area[1]
	Acres				
Land:					
Public:					
National Forest	2,542,413	4,356,430	2,743,856	1,592,617	11,235,316
Other public:					
Bureau of Land Management	19,713	1,054,071	10,457,025	272,569	11,803,378
National Parks[2]	--	--	--	2,587,633	2,587,633
Miscellaneous federal	8,676	17,337	140,612	4,257,402	4,424,027
State	26,548	1,178,225	8,404,688	25,565	9,635,026
County and municipal	--	--	--	158,976	158,976
Total other public	54,937	2,249,633	19,002,325	7,302,145	28,609,040
Total public	2,597,350	6,606,063	21,746,181	8,894,762	39,844,356
Private:					
Indian	1,260,162	4,983,994	13,894,611	11,837	20,150,604
Other private	56,914	1,899,970	10,829,883	--	12,786,767
Total private	1,317,076	6,883,964	24,724,494	11,837	32,937,371
Total land area[3]	3,914,426	13,490,027	46,470,675	8,906,599	72,781,727
Water[4]					178,311
Total land and water					72,960,038

[1]On this and all following tables, totals may vary due to rounding.

[2]Not included with miscellaneous Federal, a component of other public, for purpose of clarity. These lands are reserved and are included in tables 1, 6, and 8 only.

[3]U.S. Department of Commerce, Bureau of Census, 1980.

[4]Estimated using satellite data. See description of procedures.

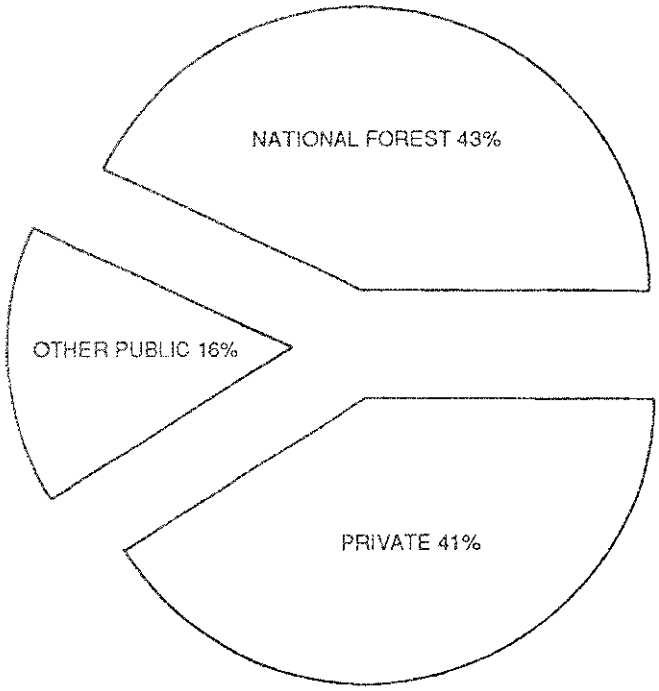


Figure 3—Percentage of forest land by ownership class, Arizona, 1985.

management of a particular resource. And as important as ownership is with respect to forest land, it can be even more important when the class of forest land is considered.

Forest land is either timberland or woodland.

Forest land falls into two major categories—timberland or woodland—based on levels of tree stocking. Timberland is forest land where tree species, such as ponderosa pine (*Pinus ponderosa*) and Douglas-fir (*Pseudotsuga menziesii*), traditionally used for industrial roundwood products, make up at least 10 percent stocking. Woodlands are all other forest lands where timber species are not present at the minimum stocking level. Woodland tree species, such as pinyon (*P. edulis*) and juniper (*Juniperus* sp.), are typically not used for roundwood products other than fenceposts, but are an important source of fuelwood and, in some cases, Christmas trees.

Woodland is twice the area of timberland.

Arizona has about 5.5 million acres of timberland, including some 1.6 million acres of reserved land where tree utilization is precluded by statute or administrative designation (fig. 5). The remainder of the State's forest land, over 14.3 million acres, is classified as woodland, and only 823,000 acres are reserved. The primary focus of this report is on Arizona's nonreserved forest land.

Forest types further differentiate forest land.

To further differentiate forest land, timberlands and woodlands are classified by forest cover type (fig. 6). The forest type descriptor is based upon stocking and indicates the predominant tree species within a stand. Arizona's timberlands are chiefly made up of one hardwood and five coniferous forest types. Woodlands are composed of four major types—two conifers and two hardwoods (fig. 7). An "other" category is included for both timberland and woodland to account for small areas of minor forest types that occur in Arizona.

Included in this report are brief descriptions of the timberland and woodland forest types occurring in Arizona. The descriptions are general and, along with figure 8, give some indication of the geographical distribution and local elevational range of each type.

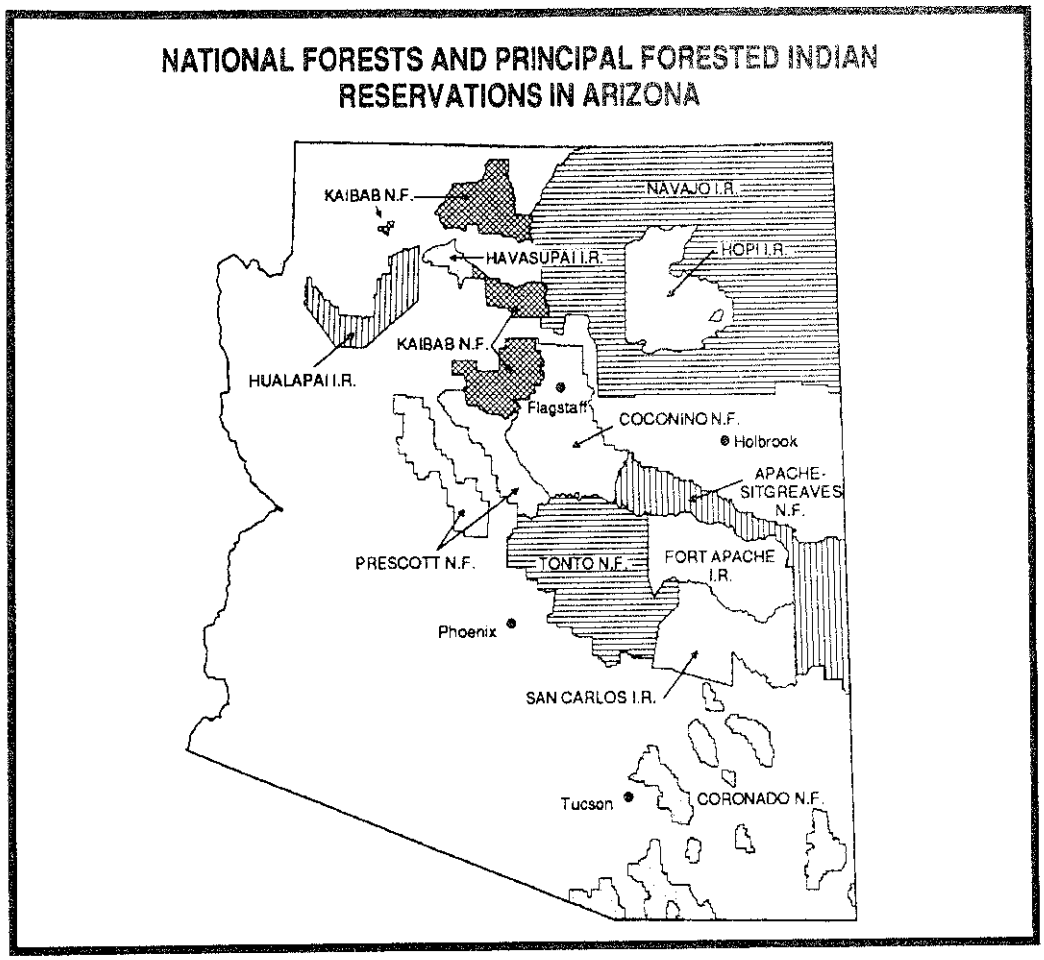


Figure 4—National Forests and principal forested Indian reservations in Arizona, 1985.

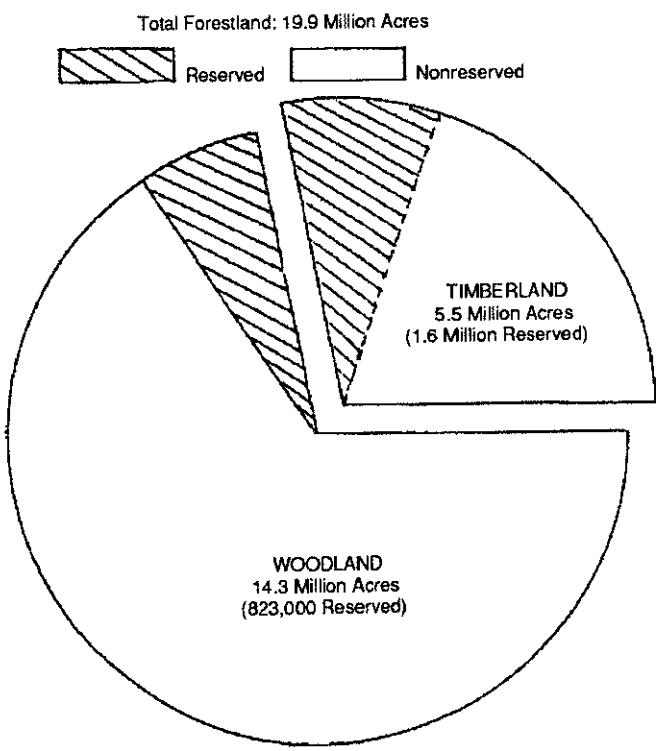


Figure 5—Distribution of total forest land by timberland and woodland, Arizona, 1985.

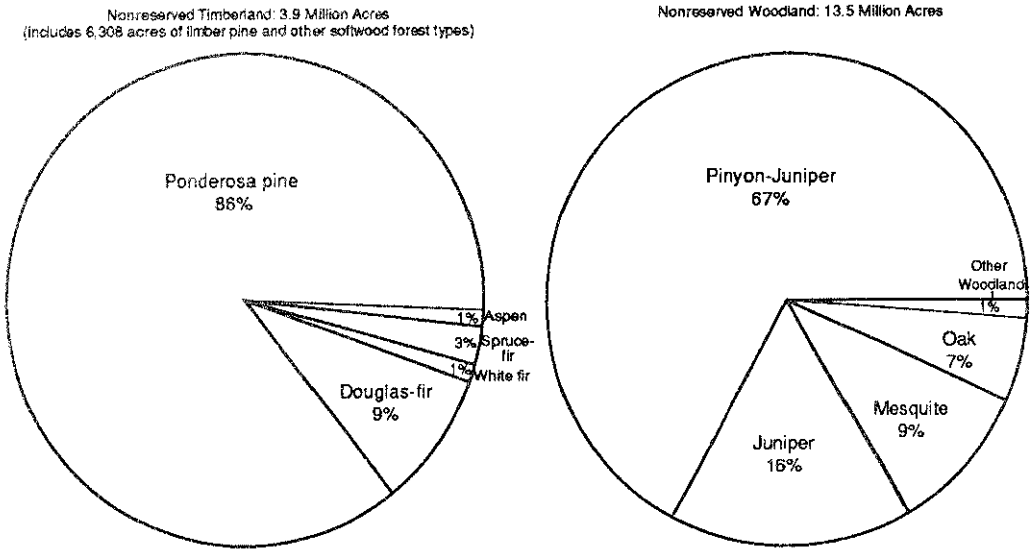
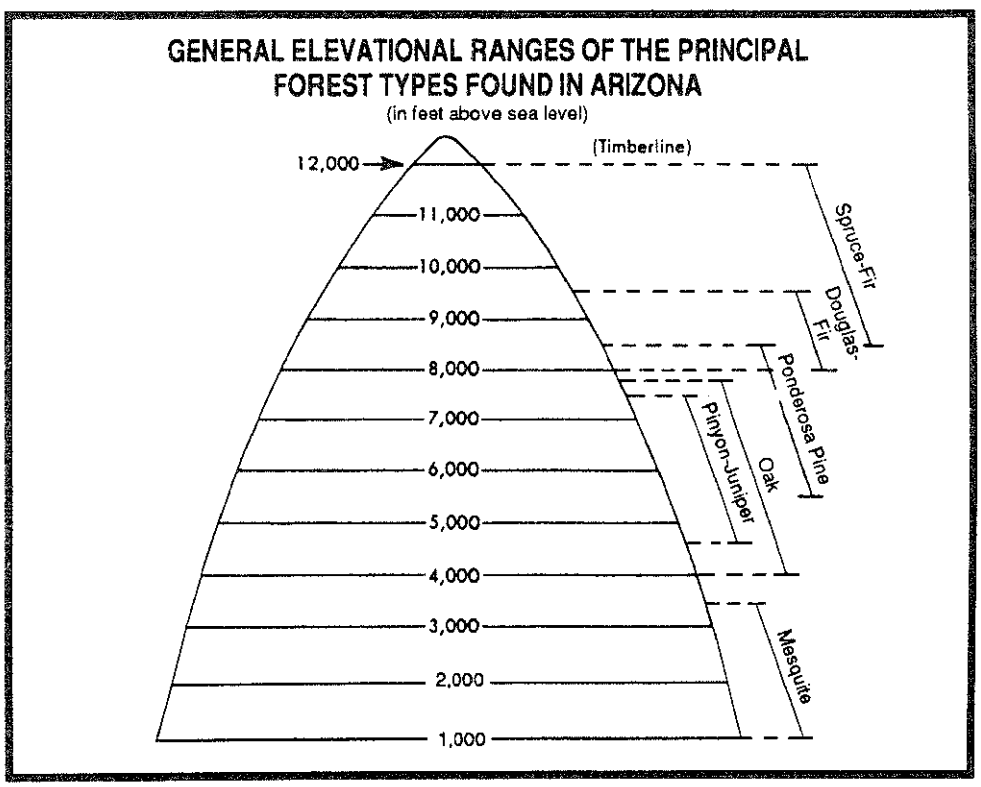


Figure 7—Distribution of nonreserved timberland and woodland area by forest type, Arizona, 1985.



Data from Little, 1950

Figure 8—General elevational ranges of the principal forest types found in Arizona, 1985.

TIMBERLAND

Forest Types and Ownership

Ponderosa pine is first in terms of area . . .

Ponderosa Pine—As a species, ponderosa pine is one of the most widely distributed conifers in North America. It ranges from British Columbia to central Mexico and from the Pacific Coast to Nebraska. In Arizona, the ponderosa pine forest type occupies sites in the transition zone between the warm, dry pinyon-juniper and oak woodlands, and the cooler, wetter Douglas-fir and mixed conifer types (fig. 9) (Little 1950). This generally coincides with an elevational range from 5,500 to 8,500 feet, with less frequent occurrences up to 10,000 feet.

Figure 9—Ponderosa pine stand with Gambel oak in the understory.

Most of the type found in Arizona occurs along the Mogollon Rim in a continuous stand often more than 25 miles wide and over 200 miles long. The nearly 3.4 million acres of ponderosa pine account for about 17 percent of Arizona's forest land area. Over 2.2 million acres of this type are in the National Forests:

Ownership class	Total forest area
National Forest	2,212,420
Other public	54,937
Private	1,091,840
All owners	3,359,197

with Douglas-fir a distant second.

Douglas-fir—The elevational range of the Douglas-fir forest type in Arizona is from around 8,000 to 9,500 feet. Douglas-fir mixes with ponderosa pine and Gambel oak (*Quercus gambelii*) on warm, dry sites at the lower end of its elevational range and most often with white fir (*Abies concolor*) on eastern and northern aspects at the upper end.

In terms of area, Douglas-fir is a distant second to ponderosa pine and occupies only 2 percent of the forest land in the State. Over half of the 369,000 acres of the Douglas-fir type found in Arizona is privately owned and the remainder occurs on National Forest land:

Ownership class	Total forest area
National Forest	171,232
Other public	—
Private	197,865
All owners	369,097

Douglas-fir is important commercially in Arizona but represents only a small portion of the annual timber harvest due to limited availability.

High mountain forests are primarily spruce-fir.

Spruce-Fir—The primary components making up the spruce-fir forest type are Engelmann spruce (*Picea engelmannii*) and subalpine fir (*Abies lasiocarpa*). As a type, spruce-fir reaches its southernmost point of distribution in Arizona and is found sporadically at upper elevations in the State's highest mountains (fig. 10). Both species are relatively long-lived and typically have a high proportion of stocking in sawtimber stands. Spruce generally is considered to be the more commercially valuable of the two species. However, due to the often remote location of spruce-fir sites, the type is valued more for summer wildlife habitat, watershed protection, and esthetics than for wood production.

Figure 10—The spruce-fir type occupies sites at higher elevations in Arizona's mountains.

This type occupies some of the most productive timberland sites. About a quarter of the spruce-fir acres are capable of producing more than 85 cubic feet of wood per year.

Less than 100,000 acres of spruce-fir forest occurs in Arizona and 79 percent of it is in the National Forests:

Ownership class	Total forest area
National Forest	76,671
Other public	—
Private	20,683
All owners	97,354

The remaining softwoods combined total only 60,000 acres.

White Fir, Limber Pine, and Other Softwoods—The white fir and limber pine forest types occur in Arizona but make up little of the timberland area. The same is true for the other softwoods category. Combined, these types occupy less than 60,000 acres, which is less than 1 percent of the forest land. The latest survey indicates that all of the area of these forest types is reportedly in the National Forests:

Ownership class	Total forest area
National Forest	59,769
Other public	—
Private	—
All owners	59,769

White fir occasionally grows in pure stands, but more often, a Douglas-fir component is present. Although only an estimated 53,461 acres of the white fir forest type are found in Arizona, it is nonetheless well distributed as a species. White fir is typically a major component of nearly every other timberland forest type found in the State.

The limber pine forest type primarily is found at upper elevations in the San Francisco Peaks near Flagstaff and in the Santa Rita and Chiricahua Mountains to the south. The latest estimate of the area of limber pine in Arizona is a mere 1,441 acres.

The other softwoods category is composed of 4,867 acres of Apache pine (*Pinus engelmannii*) or Chihuahua pine (*P. leiophylla* var. *chihuahuana*). Both are principally Mexican tree species but occur in scattered stands in southeastern Arizona.

Aspen is the major hardwood forest type.

Aspen—Aspen (*Populus tremuloides*) occupies a wide array of sites throughout its extensive range. It is typically a short-lived, small- to medium-sized tree often growing in pure stands and generally found between 6,500 and 10,000 feet in elevation.

Aspen is the only major timberland hardwood forest type occurring in Arizona. It generally is not considered important as a source of industrial wood products, although it is often used as fuelwood. The estimated 29,000 acres of aspen in Arizona are primarily stocked with small trees. Nearly two-thirds of the aspen growing-stock trees are less than 9 inches in diameter. About 23 percent of the type is privately owned:

Ownership class	Total forest area
National Forest	22,321
Other public	—
Private	6,688
All owners	29,009

The Timber Resource

Nonreserved timberland is 3.9 million acres—65 percent is National Forest land, 32 percent Indian trust land.

Arizona presently has 3.9 million acres of nonreserved timberland available for harvesting roundwood products. A closer look at the components of the three major owner groups—National Forest, other public, and private—shows that the State's timberlands are largely either in the National Forests or are found on private land, mostly Indian reservations (fig. 11). Together, they account for 97 percent of the nonreserved timberland area in Arizona. State-owned timberland amounts to less than 27,000 acres. The nearly 57,000 acres of other private timberland are principally farmer- and rancher-owned lands.

Table 2 shows the distribution of timberland area by stand-size class and owner. Stand size is a classification of timber stands based on the predominant size of the trees present. Stand size, to a certain degree, can indicate the type and size of timber products potentially available from an existing stand.

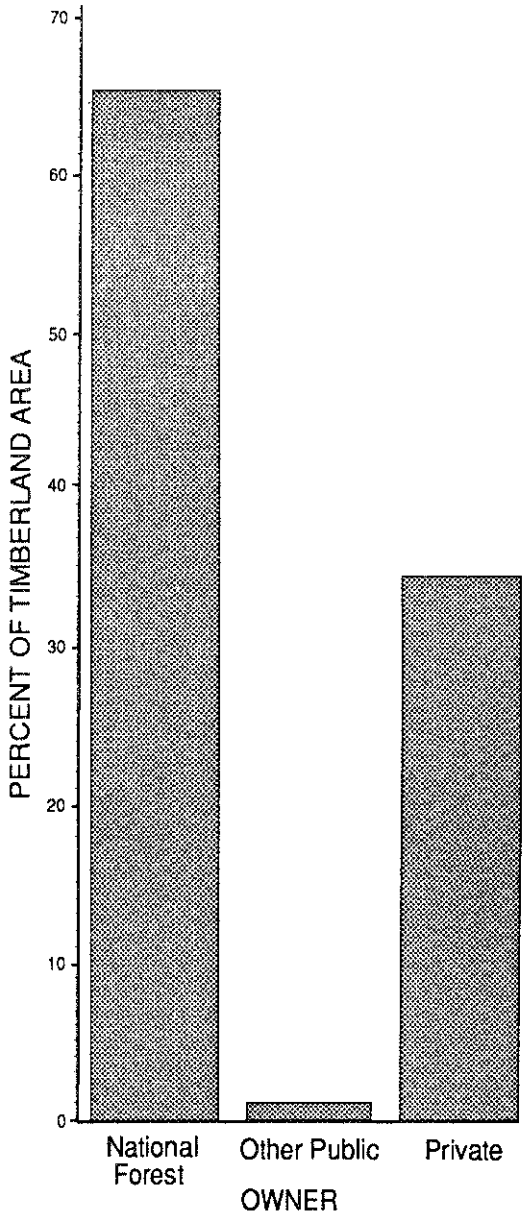


Figure 11—Distribution of timberland area by ownership class, Arizona, 1985.

Table 2--Area of timberland by ownership class, forest type, and stand-size class, Arizona, 1985

Ownership class	Forest type	Stand-size class: Sawtimber	Poletimber	Sapling/ seedling	Nonstocked	All classes
		Acres				
National Forest:						
	Douglas-fir	159,741	3,967	--	7,524	171,232
	Ponderosa pine	1,727,264	221,755	240,968	22,433	2,212,420
	Limber pine	1,441	--	--	--	1,441
	Spruce-fir	76,671	--	--	--	76,671
	White fir	53,461	--	--	--	53,461
	Other softwoods	4,867	--	--	--	4,867
	Aspen	11,609	7,705	3,007	--	22,321
	All types	2,035,054	233,427	243,975	29,957	2,542,413
Other public:						
	Douglas-fir	--	--	--	--	--
	Ponderosa pine	54,937	--	--	--	54,937
	Limber pine	--	--	--	--	--
	Spruce-fir	--	--	--	--	--
	White fir	--	--	--	--	--
	Other softwoods	--	--	--	--	--
	Aspen	--	--	--	--	--
	All types	54,937	--	--	--	54,937
Private:						
	Douglas-fir	195,578	--	2,287	--	197,865
	Ponderosa pine	969,187	43,127	36,781	42,745	1,091,840
	Limber pine	--	--	--	--	--
	Spruce-fir	14,478	--	--	6,205	20,683
	White fir	--	--	--	--	--
	Other softwoods	--	--	--	--	--
	Aspen	4,180	2,508	--	--	6,688
	All types	1,183,423	45,635	39,068	48,950	1,317,076
Total:						
	Douglas-fir	355,319	3,967	2,287	7,524	369,097
	Ponderosa pine	2,751,388	264,882	277,749	65,178	3,359,197
	Limber pine	1,441	--	--	--	1,441
	Spruce-fir	91,149	--	--	6,205	97,354
	White fir	53,461	--	--	--	53,461
	Other softwoods	4,867	--	--	--	4,867
	Aspen	15,789	10,213	3,007	--	29,009
	All types	3,273,414	279,062	283,043	78,907	3,914,426

Ponderosa pine sawtimber stands dominate.

Sawtimber stands dominate on about 3.3 million acres, of which 62 percent is in the National Forests (fig. 12). Not surprisingly, ponderosa pine accounts for the majority of the area in each stand-size class—84 percent of the sawtimber stands, 95 percent of the poletimber, and 98 percent of the sapling/seedling stands are predominantly stocked with ponderosa pine. Although 83 percent of the nearly 79,000 acres of nonstocked timberland is in the ponderosa pine type, this amounted to only 2 percent of the total area of the type.

Most of the Douglas-fir type, some 355,000 acres, is stocked with sawtimber trees, as is 94 percent of the spruce-fir stands. Douglas-fir and Engelmann spruce are generally the only other timber species, besides ponderosa, to be commercially harvested in Arizona.

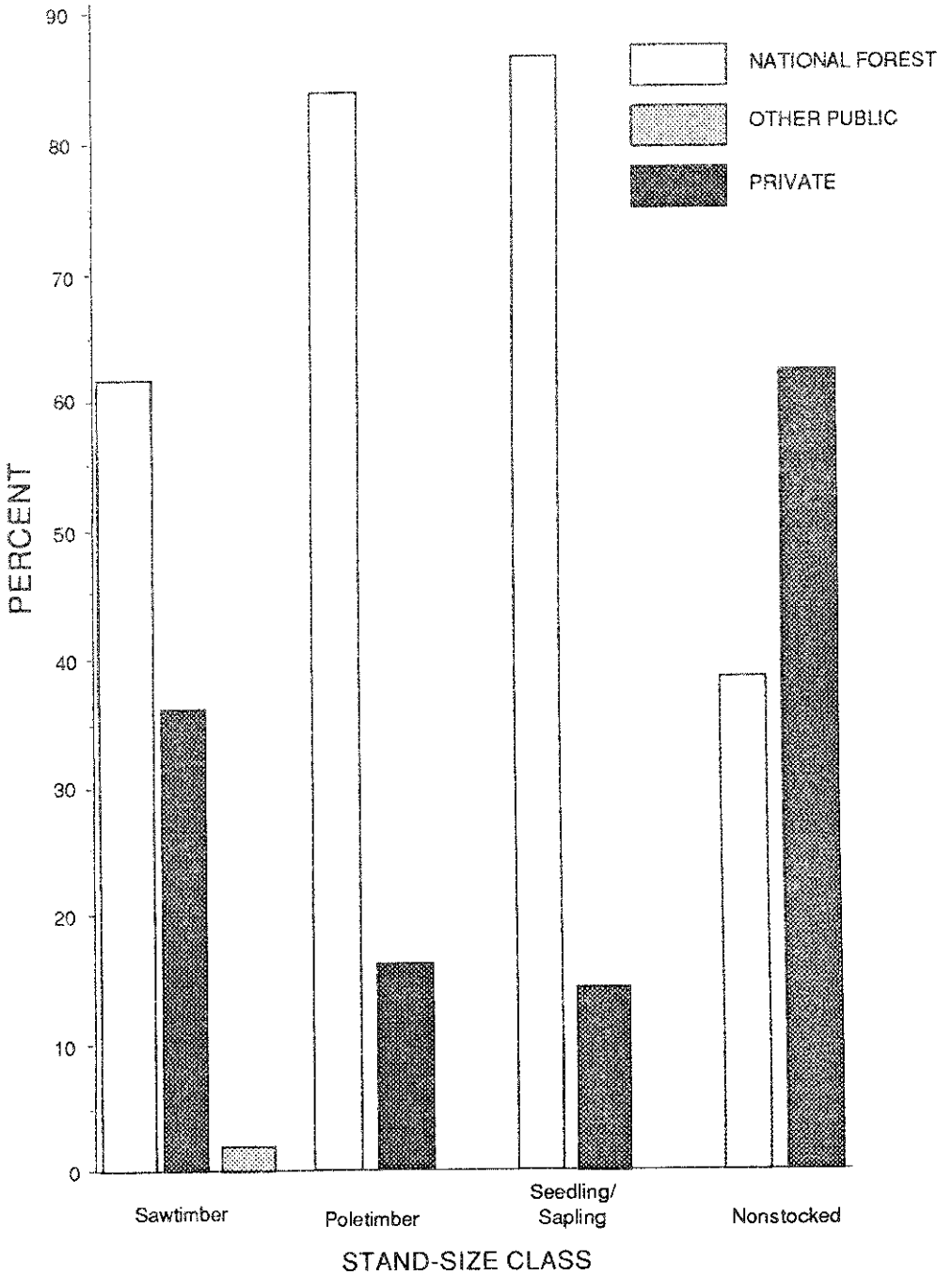


Figure 12—Area of timberland by stand-size class and owner, Arizona, 1985.

Net volume is 5.6 billion cubic feet and . . .

like area, is two-thirds publicly, one-third privately owned.

The net volume of wood on Arizona's timberlands is estimated to be approximately 5.6 billion cubic feet, and net sawtimber volume totals 21.7 billion board feet (Scribner rule). Virtually all of the growing-stock volume is in softwood species. Expectedly, most of the volume is ponderosa pine (fig. 13).

The timberland volume essentially is split between just two owner groups—two-thirds is in the National Forests and the other third is primarily on private lands. As was the case with private timberland area, most of the privately owned timber volume—all but 52.8 million cubic feet—is on Indian lands.

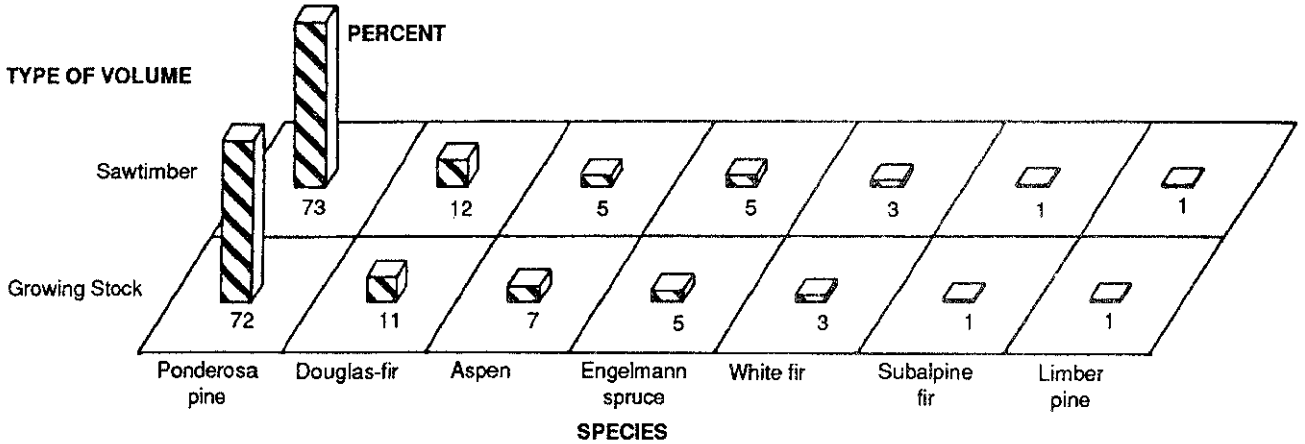


Figure 13—Percentage of growing-stock and sawtimber volume by species, Arizona, 1985.

Overall, Arizona's timberlands generally appear to be in good condition. Approximately two-thirds of the timber acres are medium to fully stocked with growing-stock trees and just 2 percent is nonstocked. About 197,000 acres of the sawtimber stands greater than 100 years of age are considered to be at high-risk to losses from mortality over the next 10 years.

Large sawlog material is available from most sawtimber stands.

Over half of the sawtimber stands in Arizona currently support more than 5,000 board feet of wood per acre, and a fifth average more than 10,000 board feet per acre (International 1/4-inch rule) (table 3). And the State does not lack for large sawlog material. Nearly 51 percent of the sawtimber volume is in trees 19.0 inches or greater in diameter.

Components of Change

Change is a constant.

Arizona's forest land is in a continual state of change. The cycle of tree birth, growth, and death is endlessly repeated at all levels within the forest, from single trees to entire stands. This process can be the result of natural causes such as fire or disease, or it can be initiated by human activity. Changes to the forest resource can be subtle and occur over a long period, or be more dramatic, taking place within the span of a few minutes.

Whatever the case, growth, mortality, and removals through harvest are the principal elements of change in Arizona's timberlands. Estimates of the current level of each component are used to assess the net change in wood volume available from the resource.

Table 3--Area of timberland by stand volume and ownership class, Arizona, 1985

Stand volume per acre[1]	Ownership class			
	National Forest	Other public	Private	Total
	Acres			
Less than 1,500 board feet	367,936	--	298,533	666,469
1,500 to 4,999 board feet	783,481	36,710	452,014	1,272,205
5,000 to 9,999 board feet	865,906	18,227	313,557	1,197,690
10,000 board feet or more	525,090	--	252,972	778,062
All classes	2,542,413	54,937	1,317,076	3,914,426

[1]International ¼-inch rule.

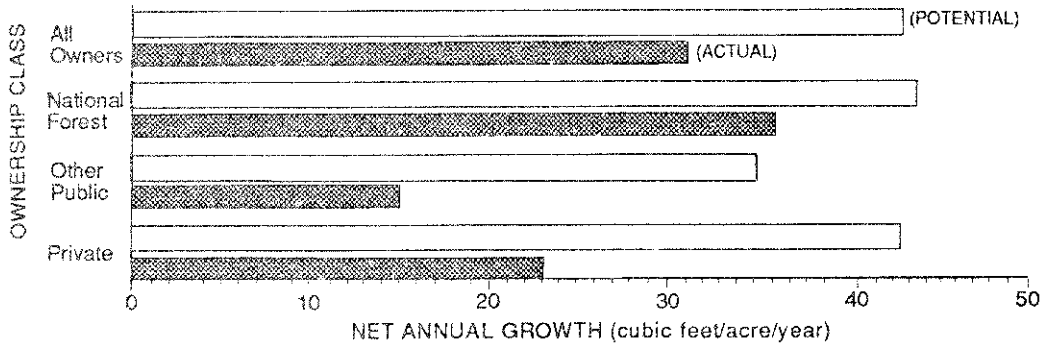


Figure 14—Potential and actual net annual growth on timberland, Arizona, 1984.

Net volume is increasing at just 2 percent annually.

Growth and Productivity—Growing-stock volume on Arizona's timberland increased by just over 138 million cubic feet in 1984. However, this increase was offset by the 15 million cubic feet of volume in trees that died during that same year. The difference is a net annual growth rate of nearly 123 million cubic feet or about 2 percent of net growing-stock volume. Net growth averages about 31 cubic feet per acre per year for all timberlands (fig. 14). Actual annual growth comes closest to potential on National Forest lands. Here, actual is about 82 percent of potential.

Insects and disease caused a third of the annual mortality.

Mortality—Annual mortality amounted to 15.2 million cubic feet in 1984, which is less than 1 percent of the net growing-stock volume. As is often the case, a major portion of volume lost was caused by insects and disease, which when combined, account for 34 percent of the mortality (fig. 15). Engelmann spruce was the species suffering the largest losses and accounted for nearly 6.1 million of the 13.4 million cubic feet of softwood mortality. Private timberland was the big loser among owners with 74 percent of the mortality occurring on these lands (table 4).

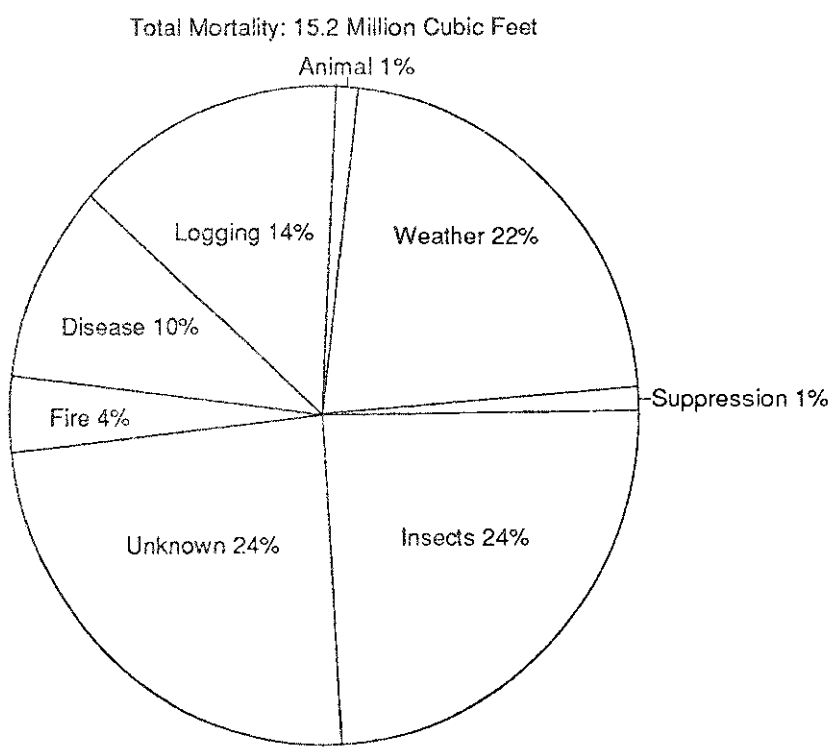


Figure 15—Distribution of annual mortality of growing stock on timberland by cause of death, Arizona, 1984.

Table 4--Annual mortality of growing stock on timberland by species and ownership class, Arizona, 1984

Species	Ownership class			Total
	National Forest	Other public	Private	
	Thousand cubic feet			
Douglas-fir	165	--	649	814
Ponderosa pine	701	151	4,832	5,684
Limber pine	--	--	156	156
Subalpine fir	233	--	190	423
White fir	--	--	298	298
Engelmann spruce	2,641	--	3,431	6,072
Total softwoods	3,740	151	9,556	13,447
Aspen	--	--	1,713	1,713
Cottonwood	--	--	--	--
Total hardwoods	--	--	1,713	1,713
All species	3,740	151	11,269	15,160

Current harvest level is roughly half the net annual growth.

Removals—Arizona is the leading timber producer of the Southern Rocky Mountain States. The 1984 industrial roundwood volume harvested totaled 63.6 million cubic feet (McLain 1988a). This harvest level is approximately 1 percent of the net growing-stock volume and 52 percent of the net annual growth.

Most of the harvest is milled in-State.

About two-thirds of the timber harvest came from the National Forests. The majority of the estimated 23 private sawmills operating in Arizona get their wood from public lands. However, a large proportion of the 21.4 million cubic feet of wood harvested from private lands was from Indian Reservation forests and directly supplied Indian-owned sawmills. Until recently, timber for these mills was supplied by Indian forest land alone. This practice has changed over the past few years due, in part, to the increased milling capacity. The Indian-owned sawmills now compete with other private mills for Forest Service timber.

Ponderosa pine is the life-blood of Arizona's timber industry.

Sawlogs have been the perennial primary timber product harvested from Arizona's timberlands (fig. 16). In 1984, the 56.3 million cubic feet of volume in sawlogs represented 89 percent of the total industrial roundwood harvest (table 5). Obviously, ponderosa pine plays a large role in the State's timber industry. Ninety-one percent of the harvest volume was from this tree species.

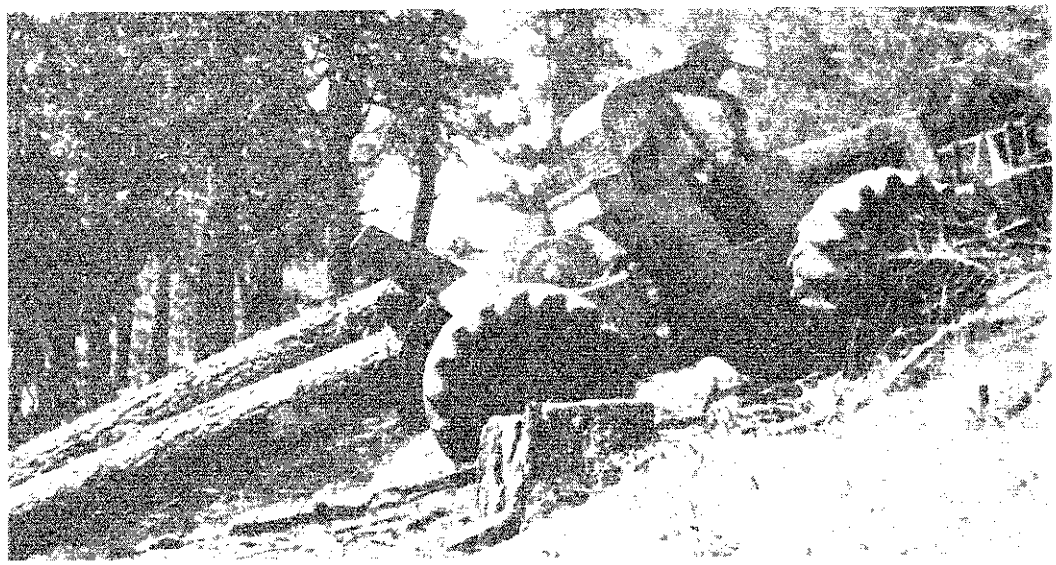


Figure 16—Most of the harvest volume is in the form of sawlogs.

Table 5--Cubic volume of timber products harvested by species and product, Arizona, 1984

Species	Product			All products
	Sawlogs	Pulpwood	Other[1] products	
	Thousand cubic feet			
True fir	1,394	136	--	1,530
Engelmann spruce	1,374	68	--	1,442
Ponderosa pine	50,769	6,698	185	57,652
Douglas-fir	2,658	208	--	2,866
Aspen	121	--	--	121
All species	56,316	7,110	185	63,611

[1]Includes utility poles, corral poles, and posts.

WOODLAND

Early use of woodlands was largely opportunistic—they supplied food and fuel.

Both prehistoric and present Native Americans have depended upon woodlands for fuelwood, food, and some building materials. European settlement beginning in the 1600's also depended to a large extent on woodlands for fuel and building materials. Later, woodlands provided materials and fuel for mining and other early industry (Ronco 1987).

Woodlands have always been important for wildlife habitat and forage and, since European settlement, for grazing livestock. The interaction between livestock and woodlands apparently has extended the range of mesquite, pinyon-juniper, and juniper. Livestock have carried the seeds of mesquite onto many grassland areas (Gilbert and Moore 1985). Reduced ground cover due to grazing has allowed woodland trees to become reestablished on many formerly occupied sites and to encroach into grassland areas (Buckman and Wolters 1987).

On the other hand, livestock interests began removing woodland trees in the 1940's, clearing millions of acres to improve forage conditions (Springfield 1976). Trees often reestablished on these cleared areas. However, increased costs for initial and maintenance removal have reduced the amount of land conversion (Dalen and Snyder 1987). Fire and climate also have played a role in determining the timing and amount of change between grassland and woodland (Jameson 1987).

Renewed interest in wood fuel, brought about by fossil fuel shortages in the late 1970's, peaked in 1982 (USDA Forest Service 1989). However, fuelwood use continues for subsistence heating and cooking, supplemental heating, and speciality cooking (mesquite). Currently, there is considerable interest in multiresource management of woodlands to optimize the mix of habitat, wood, and forage values (Garrett 1987). Watershed and recreation, including scenic values, must also be considered in the management process, particularly in Arizona where both considerations involve high values.

Today, multiple benefits are produced by design.

Woodlands are a component of "other" forest land and were classified as "noncommercial" forest land in a previous report (Spencer 1966). Prior to about 1975, area by forest type was the only Forest Survey information reported about woodlands in the Rocky Mountain States. The 1985 inventory of Arizona's forest resources was expanded to include the collection of detailed information about woodland ownership, volume, growth, mortality, condition, and understory vegetation.

Woodlands occupy a fifth of Arizona's land area.

Woodland types—pinyon-juniper, juniper, mesquite, oak, and others—cover about 14.3 million acres in Arizona, which is almost 20 percent of the State's total land area. Arizona has about 26 percent of the woodlands, more than any other State in the Rocky Mountain area. Over half of the total woodland area is on public lands with National Forests accounting for 60 percent.

The northern half of Arizona, Gila County and the five counties northward, account for about 10 million acres of woodland, or over three-fourths of the woodland area in the State. Coconino County alone has more than 19 percent of the woodland area and volume.

Seven of the nine counties that make up the southern half of the State each have less than 650,000 acres of woodland area, for a total of over 3.1 million acres. La Paz and Yuma Counties, in southwestern Arizona, were administratively designated nonforest and were not included in the inventory. Figure 17 shows woodland area by county and an approximate breakdown by National Forests and other owners.

Nearly all of the woodland area is nonreserved and . . .

Less than 6 percent of the total woodland area is within reserved areas, which are not included in this report except for tables 1, 6, and 8. The nearly 13.5 million acres of nonreserved woodland comprise the area considered "available" for wood production and utilization.

over half of this is privately owned.

Just over half of the nonreserved woodland is in private ownership (fig. 18). Collectively, Indian tribes are the largest woodland owner class in the State, with 72 percent of the private and 35 percent of all woodland.

Forests Types and Ownership

Pinyon-Juniper—The pinyon-juniper (P-J) type includes a wide range of mixtures of pinyon and juniper species as well as pure pinyon stands. Common pinyon, or pinyon (*Pinus edulis*), is the most abundant pinyon species in Arizona. Pinyon trees may have single needles or two-needle clusters, with the single needles occurring on the variety *fallax* (Wells 1987). Border pinyon (*P. discolor*) also occurs in Arizona, primarily in the southeastern portion of the State.

Several juniper species are found in mixture with pinyon. Utah juniper (*Juniperus osteosperma*) occurs from northern Arizona south to the Mogollon Rim. Rocky Mountain juniper (*J. scopulorum*) occurs in central Arizona, primarily on the Mogollon Plateau, and oneseed juniper (*J. monosperma*) is found in the eastern half of the State, principally in the central and southeast portions. Alligator juniper (*J. deppeana*) ranges from southern Arizona north through the Mogollon Plateau. Most of the larger junipers in the State are alligator juniper.

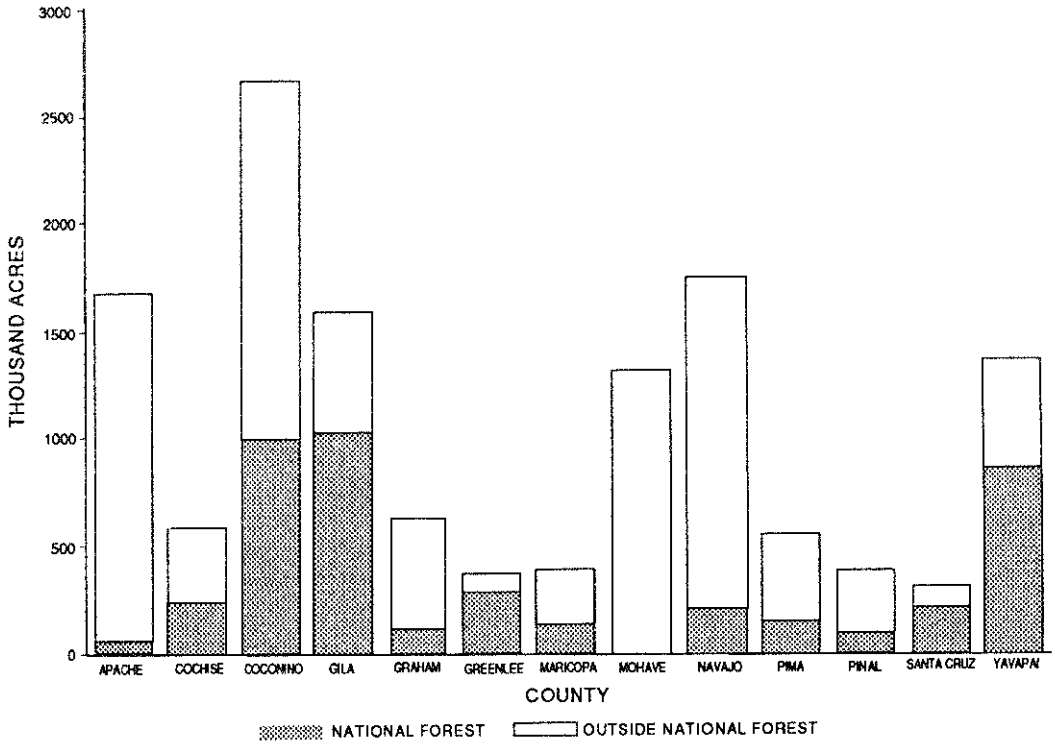


Figure 17—Distribution of woodland area by county and ownership class, Arizona, 1985.

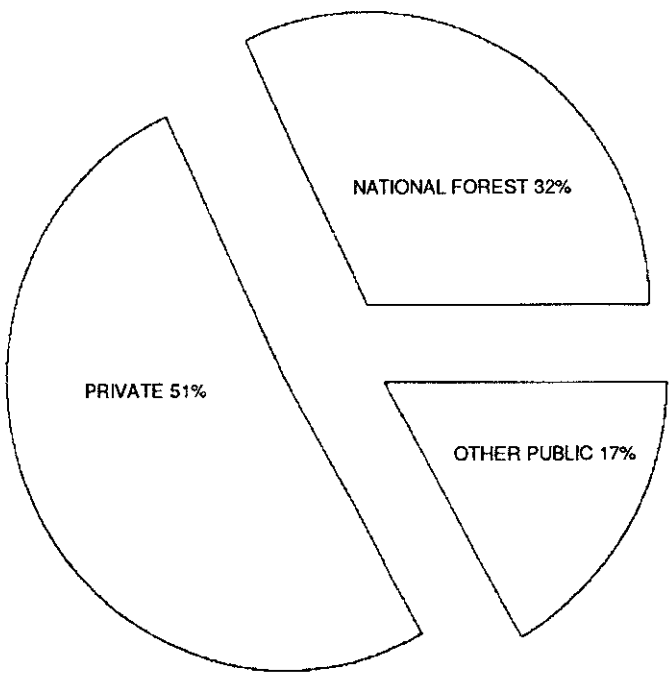


Figure 18—Distribution of nonreserved woodland area by ownership class, Arizona, 1985.

Pinyon-juniper is the dominant forest type and . . .

The P-J type covers more area than any other forest type in Arizona. The 9 million acres of this type account for two-thirds of the woodland and about 46 percent of all forest land in the State. About half of this type is on public lands, including 3.6 million acres within National Forests (fig. 19). The area of P-J found on private lands is mostly on Indian Reservations.

with juniper, accounts for 83 percent of the woodland area.

Juniper—Juniper occurs in pure stands on just over 2 million acres in Arizona. Juniper stands are characteristically found at lower elevations and on drier sites than the P-J type. National Forests account for only 11 percent of this type. About 58 percent of the juniper area is on private lands.

Mesquite, a desert shrub, is also recognized as a forest type on flood plains.

Mesquite—Mesquite is primarily classified as a component of the desert shrub ecosystem but is a recognized forest type on the flood plains of major drainages where it can form dense stands of sizable trees (Eyre 1980). Mesquite trees do reach "product size" (up to 30 feet tall and 12 inches d.b.h.) and, as such, can be a valuable commodity. A recent trend toward increased wood utilization generated the need for more information about this potential, emerging resource (Ffolliott 1989). The reported statistics for the type represent only those areas where the mesquite condition met Forest Survey's definitions for tree form and stocking. Less than 60 percent of the mesquite area outlined on the forest type map met these definitions.

The mesquite type is primarily found in southeastern Arizona and grows in pure stands or mixes with acacia species (*Acacia* sp.) and ironwood (*Olneya tesota*). All three tend to grow in both shrub and tree form, with the latter dependent upon the availability of water. For instance, mesquite (*Prosopis* sp.) found in riparian draws and washes—called bosques—is dramatically different in growth form from that occurring on drier "savannah" sites. Mesquite and its associated species most often reach tree form in the riparian areas. Here, growth is rapid, and a single large tree may contain half a cord of wood or more.

Over half of the 1.3 million acres of mesquite in Arizona is privately owned. Only 7 percent occurs on National Forest land.

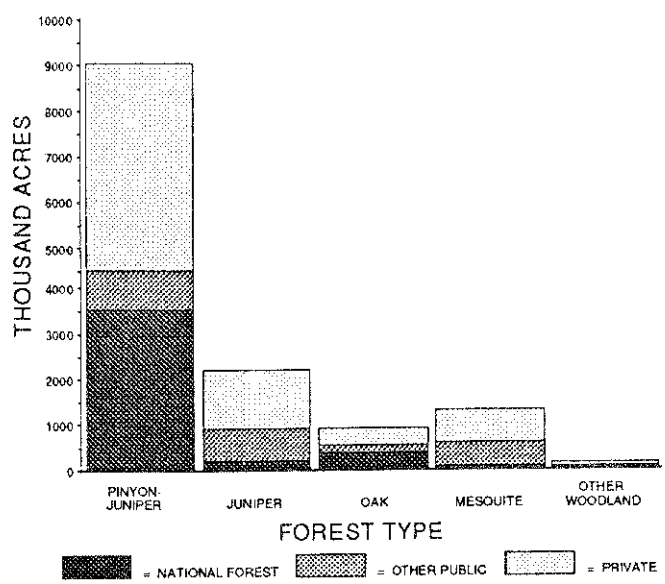


Figure 19—Distribution of woodland ownership within forest types, Arizona, 1985.

Oak and Other Forest Types—Oak and other forest types cover slightly more than a million acres, less than 8 percent of the woodland area. Eighty-five percent of this area is in the oak type. Gambel oak occurs in central and northern Arizona and varies in form from scattered large trees to brushy thickets. In the southern part of the State the oak type is composed of Arizona white oak (*Quercus arizonica*), Emory oak (*Q. emoryi*), Mexican blue oak (*Q. oblongifolia*), silverleaf oak (*Q. hypoleucoides*), and several other minor species. Oak is commonly a component of other forest types, notably ponderosa pine, P-J, and juniper.

A mixed hardwood type, composed of several vegetative associations, is found on riparian sites in the southern portion of the State. Common species are cottonwood (*Populus* sp.), willow (*Salix* sp.), Arizona sycamore (*Platanus wrightii*), boxelder (*Acer negundo*), ash (*Fraxinus* sp.), Arizona walnut (*Juglans major*), and netleaf hackberry (*Celtis reticulata*).

The chaparral classification is a relic.

The chaparral ecosystem—shown as a forest type on the map—is not really considered a forest type because most species associated with it, such as manzanita (*Arctostaphylos pungens*), do not generally reach tree form. However, when pinyon, juniper, or oak species are present in this vegetative association in sufficient size and stocking, these sites are classified into the P-J, juniper, or oak forest type. The previous area estimate for chaparral was 3.7 million acres, but only a small percentage has been classified into associated forest types. Another species common in southwestern Arizona, paloverde (*Cercidium microphyllum*), reaches tree form but is generally not usable for wood material—even fuelwood—and was not included in the inventory.

The Woodland Resource

Dead material is a valuable component of total volume.

Volume—The total wood volume in woodland forest types in 1985 was estimated to be over 7.8 billion cubic feet. About 17 percent of that volume was dead material—mostly on live trees (fig. 20). This total includes 983 million net cubic feet of volume in timber species occurring in woodland stands, of which 88 percent is ponderosa pine within National Forests.

Not included in the woodland tables is an additional 570 million cubic feet of volume in woodland species occurring in timber types. Oak makes up 60 percent of this volume and another 34 percent is in juniper species.

National Forest stands are classified woodland when the plurality of basal area stocking is in woodland species. The average total volume per acre of woodland species within woodland types on National Forests, about 663 cubic feet, is considerably higher than other owner groups. And when the volume in timber species is included, the average total volume increases to 879 cubic feet per acre (fig. 21).

The better sites generally are in the National Forests.

National Forest woodland sites are generally higher in elevation and are more moist than sites in other ownerships and are often interspersed among timber types.

Converting total cubic volume to cords—at 75 cubic feet per cord—translates to an average of almost 12 cords of wood per acre on National Forest woodland. In comparison, the average is only six cords per acre on private land and five cords per acre on other public land. These latter two owner groups also have little timber species interspersed within the woodland because of the drier sites. Over half of the total woodland volume is in juniper species, followed by pinyon with 17 percent and oak with 14 percent. Almost three-fourths of the oak volume is on National Forests.

Pinyon, juniper, and oak species occur in a wide variety of sizes, with many trees attaining diameters of over 30 inches. Except for juniper species, most of the woodland volume is in trees less than 20 inches diameter at root collar (d.r.c.) (fig. 22). Most of the larger trees are found on better sites in the National Forests and Indian reservations. Conversely, most mesquite trees are below 20 inches d.r.c. Over half of the mesquite volume is on private land and occurs at lower elevations.

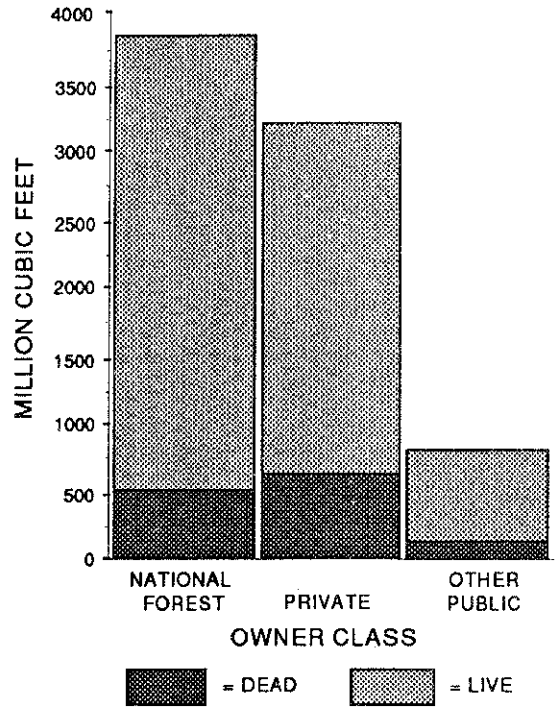


Figure 20—Distribution of total woodland volume by ownership class, Arizona, 1985.

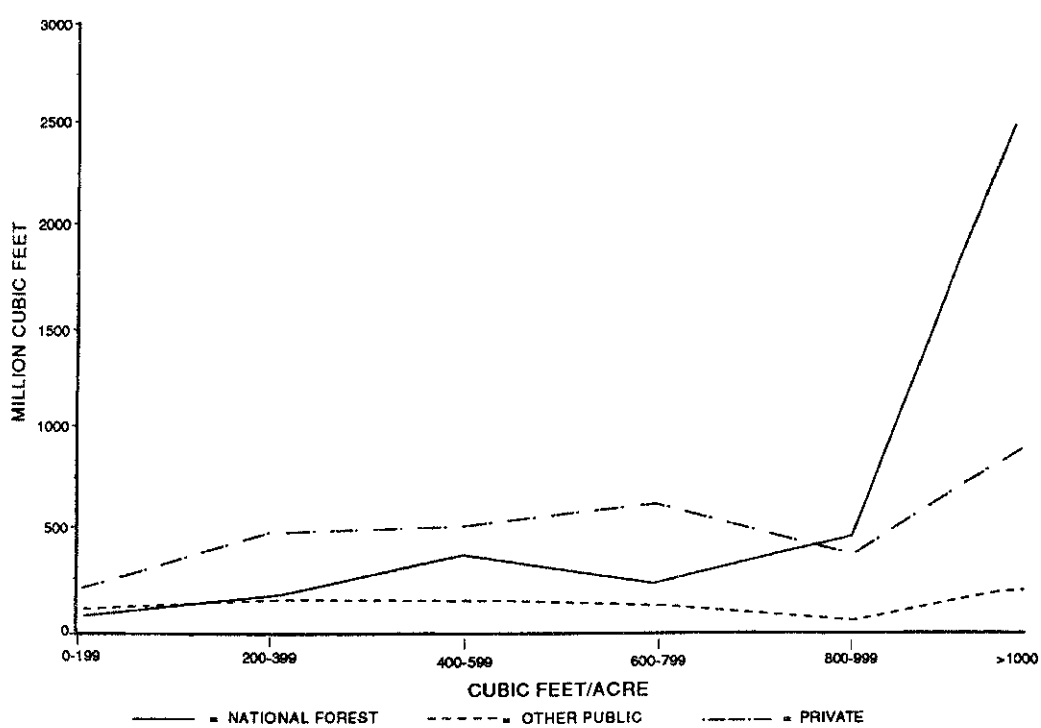


Figure 21—Total woodland volume by volume class and owner, Arizona, 1985.

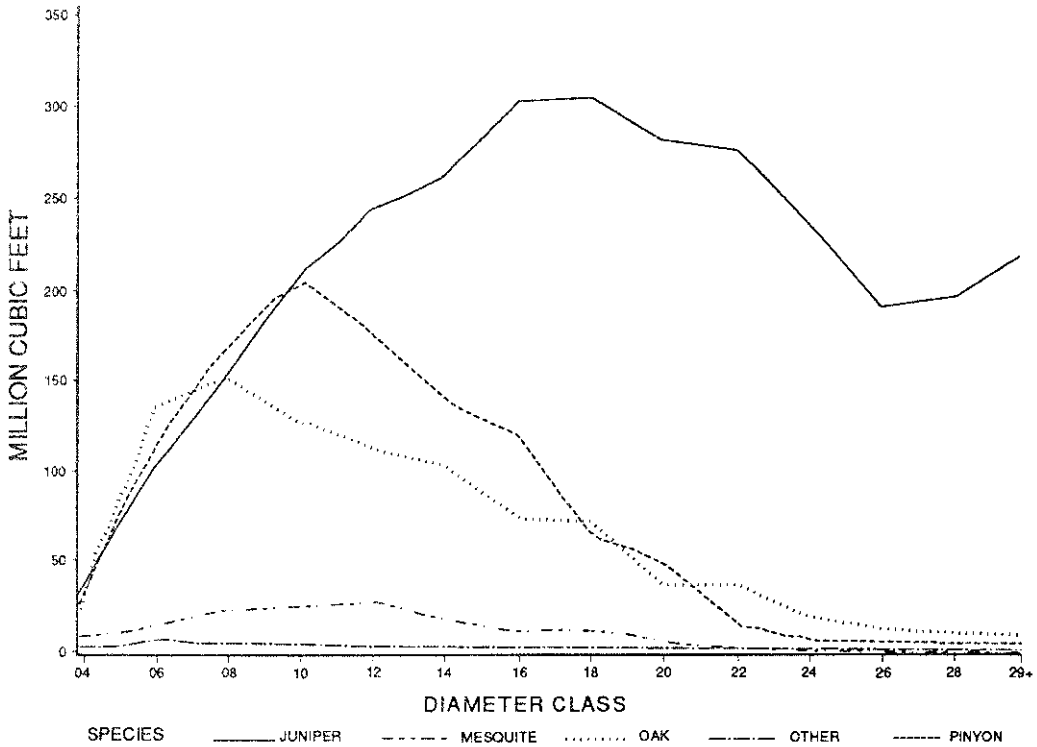


Figure 22—Net volume on woodland by species and diameter class, Arizona, 1985.

Total volume per acre—both live and dead material—in the P-J type averages 698 cubic feet, or over nine cords per acre. However, the range is from about six cords per acre on other public to over 13 cords per acre on National Forest land. The juniper type averages about five cords per acre across all ownerships. Oak averages about seven cords per acre but has a wide range of volume depending upon the site and species mix. Mesquite volume averages less than two cords per acre, but stands with over 10 cords per acre are not uncommon in drainages and infrequently exceed 15 cords per acre.

Net dead volume includes dead trees and dead portions of live trees.

Net dead volume on Arizona's woodlands amounts to about 1.3 billion cubic feet and includes dead trees and the dead portion of live trees. Most of the dead volume is found in stands with an average diameter of less than 14 inches (fig. 23). Dead volume on live trees is important in woodlands because of the amount available and the desirability of the dead material for fuelwood. Native Americans historically have collected much of their fuelwood from dead branches and the practice continues today.

Juniper characteristically has the highest amount of dead material of any woodland species, and the proportion generally increases with the age of the trees. The amount of dead material in juniper usually ranges from 15 to 20 percent, but may go as high as 40 percent in some areas. Pinyon and oak usually have 10 to 15 percent dead volume. The other woodland species have an insignificant amount.

Woodland growth is difficult to measure.

Growth and Mortality—Growth rates for woodland species are difficult to measure, but estimates indicate they are not high, averaging overall about 1.3 percent of net (live) volume. However, this amounts to nearly 82 million cubic feet or over a million cords per year statewide. Pinyon and oak species are growing twice as fast as juniper, but timber species on woodland are growing twice as fast as pinyon and oak. The mesquite average growth rate of over 4 percent exceeds all

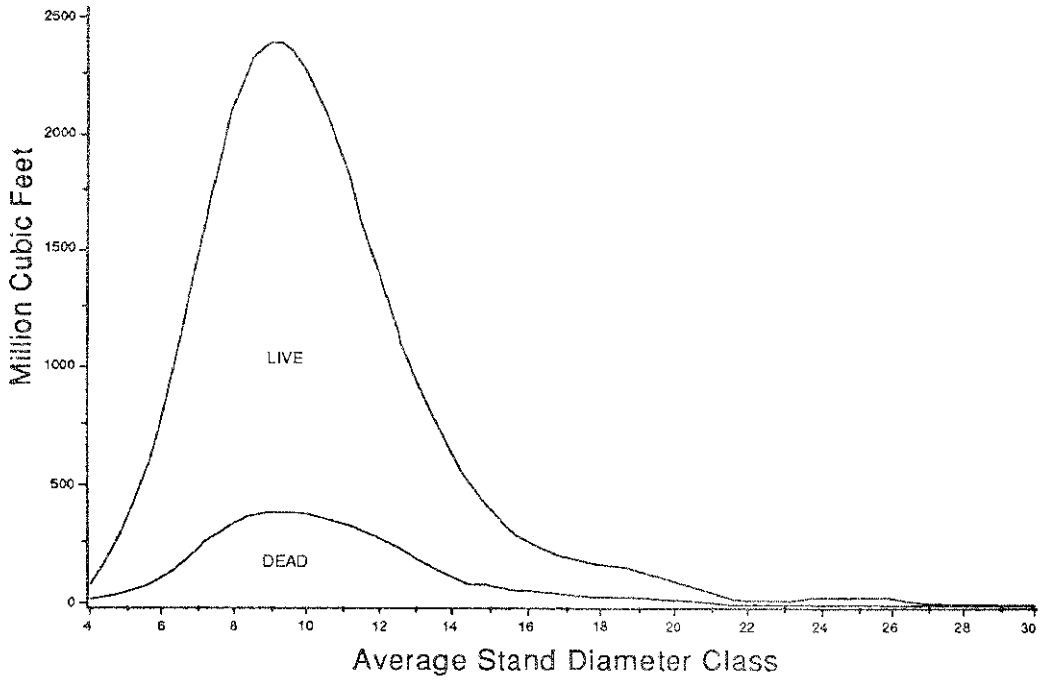


Figure 23—Distribution of total cubic volume on woodland by average stand diameter class, Arizona, 1985.

other species occurring on woodland but varies depending upon the site. On the best and usually moist sites, the mesquite growth rate may exceed 10 percent.

These growth rates translate into 6.1 cubic feet per acre per year over all woodland. However, the growth ranges from 11.7 cubic feet on National Forests to a low of 3.1 cubic feet per acre per year on other public lands.

Mortality is low . . .

The level of mortality on Arizona's woodlands is low. In 1984, annual mortality was estimated to be roughly 949,000 cubic feet, and reduces total annual growth by only 1 percent. Nearly three-fourths of the mortality occurred on private lands.

particularly in juniper.

Mortality is particularly low in juniper species. Although the stems and branches of juniper trees die, and the amount of dead material increases over time, the trees continue to survive, sometimes for several hundred years.

Another possible reason for the low level of woodland mortality may be due to the extent of past disturbance within a stand. In areas of high utilization, few stands are in an overmature condition where volume losses to mortality can be significant.

Inventory Change

Overall, woodland area has remained relatively constant . . .

In 1985 the area of P-J, juniper, and oak types was estimated to be 12.2 million acres, which is virtually the same as estimated in 1962. Any actual change would be difficult to quantify considering sampling error of each of the two surveys and changes in definitions and procedures over the 23 years. And there is little other evidence to suggest any significant overall change in the woodland area. A considerable amount of woodland area previously converted to grassland has restocked, and the amount of land being converted has dropped dramatically in recent years.

but there is more wood volume than previously thought.

Because previous estimates of woodland volume were not based on statistical sampling, no meaningful comparison of volume estimates between the two inventories can be made. However, the 7.8 billion cubic feet of volume estimated from the current inventory is considerably more wood than was previously thought to exist.

Potential Wood Products

The primary wood products available from woodland trees are fuelwood, posts, and Christmas trees. Pinyon has occasionally been used for pulp, and for a variety of products usually made from other pine species. And pinyon nuts are also a

valued commodity. Juniper and mesquite are used for some specialty products, and mesquite and mesquite charcoal are used for barbecuing.

Fuelwood remains the primary product from woodlands.

Fuelwood—Woodlands are important as a source of fuelwood, although residential use has declined somewhat since a peak in the early 1980's. Rural subsistence use appears to remain at a constant level, however. Mesquite use for cooking has increased in recent years, although the supply of this species in Arizona probably would not support extended commercial use.

It is difficult to say how much fuelwood is really used each year in Arizona. Respondents to a telephone survey in 1984 indicated an estimated harvest of some 231,300 cords, of which 169,000 came from woodlands (McLain 1988b). In addition, the annual subsistence use of fuelwood in rural households on the Indian Reservations may be as high as 150,000 cords (Akerson 1988).

Considering the annual net growth of all woodlands of about a million cords, the current fuelwood harvest probably is somewhat below the total annual increase in volume. A large sustained increase in fuelwood demand could cause local shortages in accessible material and might begin to drain the total supply. The Forest Service, U.S. Department of Agriculture, and some Indian tribes have restricted fuelwood permits to personal use in some areas.

"Usable" volume is largely dictated by demand.

An important consideration in relating fuelwood harvest to inventory volume and management planning is the level of utilization, that is, the size of the material harvested. Forest Survey volume tables have been developed to a 1.5-inch minimum diameter representing nearly all the usable volume in a tree. Material approaching this minimum diameter is commonly harvested either by acceptance or preference, especially in locales where fuelwood demand is high.

There are several good reasons to plan for and encourage the use of the smaller size material. First, it extends the utility of the existing resource. Second, it decreases the quantity of debris left on the ground that is slow to decay. This can inhibit tree reproduction, or the establishment of herbaceous vegetation important for forage production or for the reduction of soil erosion.

Posts . . .

Posts—Although sample data were not available for post potential on some National Forests, the available information was prorated to include all woodland in the State. The results indicate that, potentially, over 300 million posts are available from juniper and oak trees, of which over 75 percent are juniper. Juniper posts are extremely durable and are often used for fencing (Barger and Ffolliott 1972). Over a third of the juniper posts available qualify as corner posts due to size.

and Christmas trees are potential woodland products.

Christmas Trees—Pinyon is the only woodland species commonly used for Christmas trees and was the only species assessed for this purpose. As with posts, Christmas tree grades were not recorded on some National Forests. Based on an extension of available data to all woodland in the State, approximately 92 million potential Christmas trees are available from the P-J type in Arizona. Although Christmas trees are not sold by grade directly, higher quality trees—relating to shape and density of the crowns—bring a higher price. Few qualify for premium grade, or near perfect form. However, about a third are in the standard grade, which are marketable. And less than half of the potential Christmas trees are in the popular 5- to 10-foot height range.

Management Considerations

Managing for wood products is a rather recent idea and . . .

It has been only within the last decade or so that interest in the ecology of the woodland forests in the West has been much more than academic. In earlier times wood products were extracted from these forests because it was convenient to do so or they were the only source reasonably available. Later, vast areas of woodlands were stripped bare to help meet the construction and energy needs of railroads and a developing mining industry. "Management" usually meant eradication in favor of improving forage production for livestock grazing (Ffolliott and Clary 1986). The idea of intentionally growing wood products on these lands is a relatively recent one.

while much about the resource remains unknown . . .

Site productivity models for wood production generally have not been available for woodland forest types because of the great diversity in species composition and site conditions under which they grow, and a history of disturbance. The few studies done over the last few decades (Daniel and others 1966; Howell 1940) were seldom applied, but the recent interest in woodlands for wood products has generated more studies (Chojnacky 1987; Chojnacky [In preparation]; Ffolliott and Guertin 1988; Smith and Schuler 1988). Still, the results of these studies offer tools relatively crude in comparison to similar work for timber species because of inherent variability in the data and the lack of remeasurement data.

some practical guides could aid management efforts.

Because woodland types occupy many sites where the combination of tree form, growth rate, stocking, and rates of reproduction are inadequate to support practical management for wood material, a subjective classification of "high site" and "low site" has been used in the inventory. Woodlands considered usable for growing wood products have been called high site. Future research will likely refine our ability to identify such areas, but meanwhile the low site classification can be used to exclude essentially unusable area and volume from calculations of allowable harvest levels. Although some wood material may be used from these lands on a one-time basis, the amount would be insignificant.

Low site woodlands occupy less than 2 million acres, or about 14 percent of the woodland area in Arizona. Due to the relatively lower volumes per acre typically found on low site lands, these areas account for only 5 percent of the net volume of all woodland types.

P-J and juniper types have, respectively, 11 and 18 percent of their area classified as low site. Roughly 29 percent of the area of mesquite also has this classification.

The practical side of managing woodlands for the production of wood fiber dictates that the effort be concentrated on those areas offering the best chance for success—both ecologically and economically. The site quality classification previously described can be used with steepness of slope, volume per acre, and crown cover to rank woodlands as to relative suitability for management and the harvest of wood products. These items have been grouped into 10 classes or "forest profiles":

Forest profile	Site class	Slope class	Volume class	Crown cover
		Percent	*Ft³*	*Percent*
1	High	0-10	501+	55+
2	High	10-30	1,001+	55+
3	High	10-30	501-1,000	55+
4	High	0-30	1,001+	0-54
5	High	0-30	501-1,000	0-54
6	High	30+	all	all
7	High	0-30	0-500	all
8	Low	all	all	all
9	High	all	seed/sap and nonstocked	all
10	Low	all	seed/sap and nonstocked	all

What may be a management "opportunity" for one manager may not be for another, so there is no single answer as to which profiles represent the better areas for managing woodlands for wood products.

However, certain profiles obviously identify woodlands less desirable for wood products and, as an example, can be used as a starting point in identifying the acreage and associated volume of lands of interest to managers (fig. 24). Profiles 8 and 10 identify all low site lands, and profile 6 identifies all woodlands on slopes of 30 percent and over. For example, about 8 percent of the woodland area and 12 percent of the woodland total volume on private lands in Arizona occur on steep slopes.

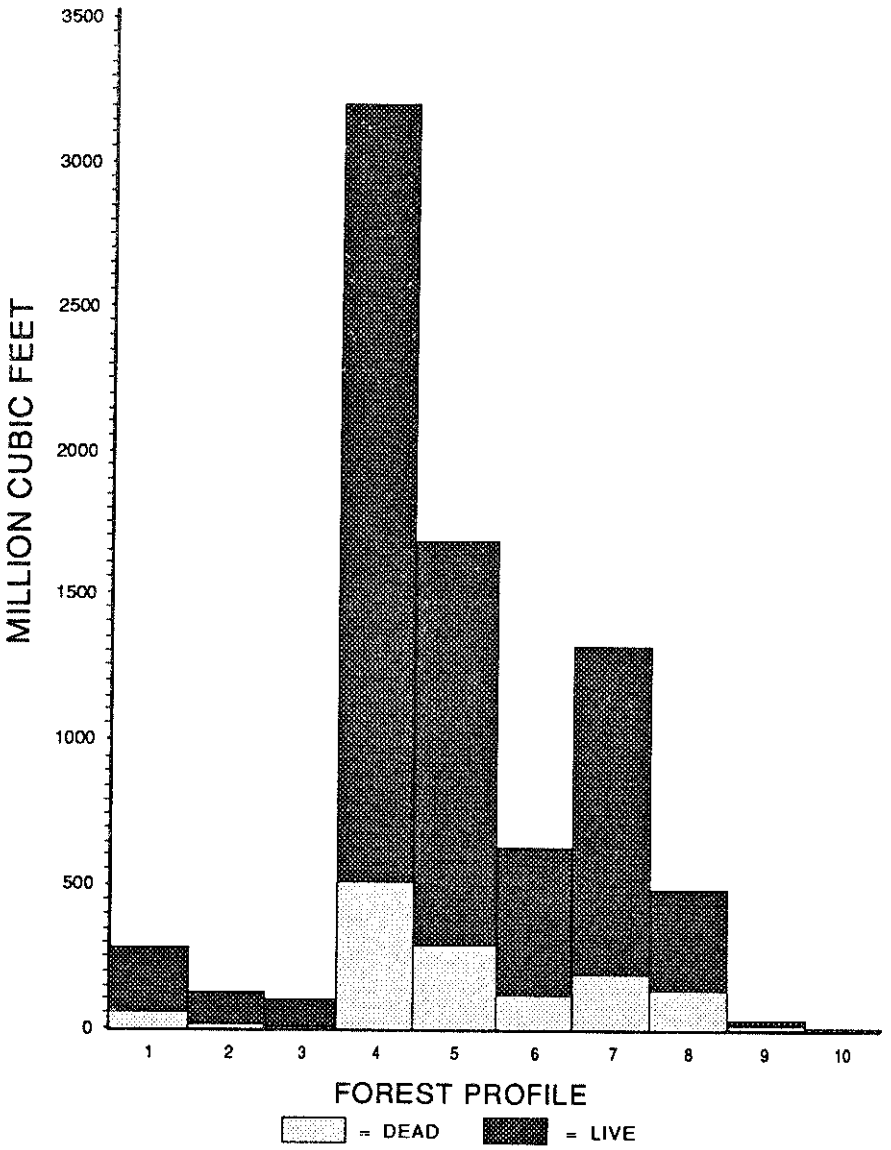


Figure 24—Total woodland volume by type of volume and forest profile, Arizona, 1985.

On the other hand, 41 percent of the total woodland volume in Arizona is in the high volume class on moderate slopes (profile 4), and 76 percent of this volume is within National Forests. The high volume class includes stands with 1,000 or more cubic feet per acre, or over 13 cords of wood.

OTHER USES OF THE FOREST RESOURCES

New demands are influencing management decisions.

Timber production has been, and likely always will be, a primary function and most obvious consumptive use of Arizona's forest land. But recreation and tourism is fast becoming the number one income generator from forest land use in many Western States. This, the increasing demand for water, and ongoing environmental issues have heightened pressures on forest managers to ensure that each potential use of the resource is given equal consideration.

The following is a brief discussion of three nontimber uses of Arizona's forest resources—recreation, grazing, and wildlife habitat. Although comprehensive

recreation and range statistics are available for National Forest lands only, they still provide some indication of the level of use that may occur on private, State, and other forest lands in Arizona. In addition to these, the importance of forest land in the supply of water is recognized and briefly discussed.

Recreation

Arizona's forests provide a variety of recreational opportunities such as hunting, fishing, hiking, sightseeing, and picnicking. For whatever reason, a growing number of people are spending considerable time enjoying the State's forests.

Recreational use of forest land is again on the rise.

An estimate of just how much forest-based recreational activity is taking place is perhaps best gauged by visitor figures for National Forests. In 1988, an estimated 18.8 million recreation visitor-days (RVD's)[1] were spent in the National Forests in Arizona:

Year	Visitor days (millions)
1988	18.8
1987	18.8
1986	17.6
1985	14.7
1984	16.4
1983	16.6
1982	16.9
1981	17.8

This latest RVD figure is an 8 percent increase over the 1986 estimate and represents a continuing trend toward higher levels of use (U.S. Department of Agriculture 1986b, 1987, 1989).

Grazing

The history of Arizona's rangeland in the 19th century is similar to that of other Rocky Mountain States. A booming cattle industry resulted in a rapid increase in stocking that, by the early 1880's, had reached numbers 10 times the carrying capacity of the range. Continued overgrazing of the fragile grasslands reduced forage availability to precariously low levels. Additional pressure from a 2-year drought in the mid-1890's brought about the virtual collapse of an ecosystem already pushed to the edge. The result was the subsequent loss of hundreds of thousands of cattle and other domestic livestock to starvation (Spencer 1966).

Some of that same rangeland is now under management by the Forest Service, U.S. Department of Agriculture. The disastrous grazing practices of the time were replaced by immediate and long-term range improvement programs that included major reductions in livestock.

Today, grazing is closely monitored.

Today, the Forest Service's fee permit system carefully controls the amount and duration of grazing on Agency lands. To mitigate damage, stocking levels are kept at only 45 to 50 percent of the range's carrying capacity (Zarlingo 1988). Statistics for National Forests in Arizona show over 164,000 head of domestic livestock were permitted to graze in 1986 (U.S. Department of Agriculture 1986a):

	Number of animals
Cattle	135,145
Horses and burros	1,086
Sheep and goats	28,306
Total	164,537

[1]One recreation visitor-day (RVD) is the recreation use of National Forest land or water that aggregates 12 visitor-hours. This may entail one person for 12 hours, 12 persons for 1 hour, or any equivalent combination of individual or group use, either continuous or intermittent.

Wildlife Habitat

Maintenance of critical wildlife habitat is a growing issue.

Arizona's forests are a source of critical habitat for the State's diverse wildlife population. Many species require hiding and thermal cover, nesting and perch sites, breeding areas, forage, and other essentials that only a forest environment can provide.

In some instances, a species' existence is virtually dependent upon the availability of a single tree species. The Abert squirrel (*Sciurus aberti*), for example, requires an all-aged ponderosa pine forest to ensure an ample supply of pine seeds and twigs, its primary food source (Ffolliott and Patton 1978; Keith 1978). And the flammulated owl (*Otus flammeolus*) apparently prefers mature—greater than 200 years—ponderosa pine and Douglas-fir forests to forage and nest (Reynolds and others 1989). The ecological needs of these and other wildlife species may provide additional tools to help guide management of Arizona's forest resources in the future.

The economic value of the State's wildlife will continue to be an important consideration in any approach to forest management. Although nongame species are a highly valued nonconsumptive resource, it is the big-game animals that directly generate the greatest dollar revenues. Latest figures show that hunters spent an estimated $46 million in Arizona in the pursuit of javelina, desert bighorn sheep, black bear, mountain lion, deer, elk, and other big-game species (Arizona Game and Fish Department 1986).

It is vital that Arizona's forests be wisely managed if the variety of animal life the State enjoys is to remain for future generations. Continued cooperation among the various Federal, State, local, and private forest land managers is necessary to assure wildlife a place among the other benefits derived from these lands.

Water

The one problem Arizona has had to deal with throughout its history is water. Besides being in short supply, the water that was available never has been quite where humans wanted, needed, or thought it should to be most useful for their purposes. Completion of the Roosevelt Dam on the Salt River in 1911 was the forerunner of many impoundments that today bead the State's major watercourses.

Water—current and future supply . . .

With a resident population of nearly 3 million, a large and increasing number of winter residents in retirement, and expanding industrial and agricultural enterprises, the specter of a water shortage looms larger and larger. Arrangements with neighboring States for diversion of water from the Colorado River notwithstanding, the threat of inadequate future water supplies is real.

is directly tied to forest land.

About half of Arizona's population, some 1.5 million acres of irrigated citrus and other agricultural cropland, and a good share of the industrial activity are concentrated in the same general region of the State where the precipitation is most meager. Most of the precipitation originates in the forested mountains and must be transported to consumers by a complex and often ingenious distribution system. Consequently, how the forest land is used and treated can and does influence the quantity, quality, and timeliness of the available water.

It may well be that in the future watershed protection and increased available water supplies will be the driving force in establishing the kind and extent of forest uses and management practices and attendant activities, rather than a constraint in the pursuit of wood fiber production.

WOODLAND UNDERSTORY VEGETATION AND SOIL SURFACE CONDITIONS

Understory Vegetation Conditions

Nearly all of Arizona's woodland is or has been used for grazing. Pinyon-juniper, juniper, oak, and mesquite woodlands are considered range types as well as forest types. The amount and types of understory vegetation presently occurring on woodland sites can indicate general condition, as well as forage potential and

Understory vegetation can indicate resource condition.

availability. Ocular estimates of cover of the predominant understory plant species occurring on each field location were included in the inventory. Predominant species include those with crown canopy cover of at least 5 percent of the plot area. Also included was an assessment of cover and heights of each of four life forms: seedlings, shrubs, forbs, and graminoids. As a general assessment of ground cover and forage potential, these data were used to compile statistics of both herbaceous and woody cover by overstory canopy cover and owner group.

Understory vegetation data were collected on the Prescott and Coronado National Forests in addition to private and other public lands. Although similar data are not available for other National Forest lands in Arizona, average percentage herbaceous cover by the major owner categories indicate a slight difference in condition:

Ownership class	Average herbaceous cover
	Percent
National Forest	30
Other public	29
Private	23

Percentage tree cover, taken in classes, was cross-tabulated with average percentage herbaceous cover for all woodland types and owners combined. An interesting pattern that is well documented in range literature is illustrated in these data—the decrease in herbaceous understory cover with increasing overstory cover:

Overstory percentage cover class	Average herbaceous cover
	Percent
1 (0-9)	43
2 (10-24)	28
3 (25-54)	23
4 (55-84)	17
5 (85-100)	14

Some interesting statistics about the frequency of occurrence of desirable or undesirable plants were obtained from the data. For example, broom snakeweed (*Gutierrezia sarothrae*) is an undesirable plant that has increased rapidly on Southwestern ranges in the last decade (McDaniel and others 1984). This shrub is poisonous to livestock and competes with desirable forage plants on disturbed sites. Broom snakeweed was found with 5 percent cover or greater on 4 percent of the National Forest field locations, 23 percent of the other public field locations, and 15 percent of the private field locations inventoried.

The single most commonly occurring plant species was a choice forage grass, blue grama (*Bouteloua gracilis*). This species occurred with 5 percent cover or greater on 21 percent of the other public lands, 29 percent of the private lands, and 5 percent of the National Forest lands.

Vegetative associations may be a key to woodland productivity.

Habitat typing per se was not done on woodland field locations. However, some useful information about shrub associations within the P-J resource can be gleaned from the understory vegetation data. In the northern part of the State, 17 percent of other public and 12 percent of private field locations had 5 percent or greater cover of big sagebrush (*Artemisia tridentata*), which would link them closely to the *Pinus edulis/Artemisia tridentata* or *Juniperus osteosperma* or *J. monosperma/Artemisia tridentata* habitat types (Moir and Carleton 1987). Other shrub associations occurred that could also be related to habitat types, or even winter range potential. Additional significant shrubs include shrub live oak (*Quercus turbinella*), cliffrose (*Cowania mexicana*), mountain-mahogany (*Cercocarpus montanus*), and

pointleaf manzanita (*Arctostaphylos pungens*). Relative shrub abundance (percentage of field locations with 5 percent cover or greater) for the three owner groups is presented below:

Ownership group	Shrubs					
	Broom snakeweed	Big sagebrush	Shrub live oak	Cliff-rose	Mountain-mahogany	Pointleaf manzanita
	Percent					
National Forest	4	0	8	12	4	10
Other public	23	17	6	7	1	2
Private	15	12	21	1	6	1

These types of vegetation associations have potential for indicating productivity for several resource values. Ongoing research will provide more information for further classification and interpretation of the woodland resource using this concept.

Soil Surface Conditions

Woodlands are highly susceptible to erosion.

Because of the history of use of woodlands involving the removal of soil-holding plant cover throughout the last century, soil erosion can be a serious problem. Descriptive locational observations on litter depth, percentage bare ground, and degree of soil erosion were made at each field location to get an idea of the general condition and stability of the woodland soil resource in the State.

These data indicate that two-thirds of woodland field locations show some evidence of soil erosion:

Degree of erosion	Percentage of field locations
None	35
Light (evidence of sheet erosion)	48
Medium (both sheet and rill erosion)	13
High (severe rill erosion and gullies)	4

Other statistics indicate that roughly half of woodland sites have more than 10 percent bare ground, with an overall average of 22 percent. On over half of the field locations there was no litter (undecomposed leaves, needles, twigs, bark, and so forth).

Due to low water retention capacities, the occurrence of considerable amounts of bare ground, coupled with the low amounts of protective litter and sparse understory vegetation, indicate potential erosion problems in the woodland resource. The soil erosion observations indicate that a serious erosion situation may exist.

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APPENDIX I: TERMINOLOGY

Acceptable trees—Growing-stock trees meeting specified standards of size and quality but not qualifying as desirable trees.

Area condition class—A classification of timberland reflecting the degree to which the site is being utilized by growing-stock trees and other conditions affecting current and prospective timber growth (see Stocking):

Class 10—Areas fully stocked with desirable trees and not overstocked.

Class 20—Areas fully stocked with desirable trees but overstocked with all live trees.

Class 30—Areas medium to fully stocked with desirable trees and with less than 30 percent of the area controlled by other trees, or inhibiting vegetation or surface conditions that will prevent occupancy by desirable trees, or both.

Class 40—Areas medium to fully stocked with desirable trees and with 30 percent or more of the area controlled by other trees, or conditions that ordinarily prevent occupancy by desirable trees, or both.

Class 50—Areas poorly stocked with desirable trees but fully stocked with growing-stock trees.

Class 60—Areas poorly stocked with desirable trees but with medium to full stocking of growing-stock trees.

Class 70—Areas lacking or poorly stocked with desirable trees and poorly stocked with growing-stock trees.

Class 80—Low-risk old-growth stands.

Class 90—High-risk old-growth stands.

Nonstocked—Areas less than 10 percent stocked with growing-stock trees.

Average stand diameter class—An average woodland stand diameter class, based upon the quadratic mean diameter of the stand (the tree diameter corresponding to the tree of average basal area at diameter at root collar).

Basal area—The cross-sectional area of a tree expressed in square feet. For timber species the calculation is based on diameter at breast height (d.b.h.); for woodland species it is based on diameter at root collar (d.r.c.).

Christmas tree grade—Pinyon species are classified as Christmas trees using the following guidelines:

Premium—Excellent conical form with no gaps in branches and a straight bole.

Standard—Good conical form with small gaps in branches and boles slightly malformed.

Utility—Conical in form with branches missing and bole bent or malformed.

Cull—Not meeting one of the above classifications or over 12 feet in height.

Cord—A pile of stacked wood having standard dimensions of 4 by 4 by 8 feet (128 cubic feet). Actual wood volume is less depending on size and straightness of sticks.

Crown cover—Percentage of the ground covered by a vertical projection of tree crowns.

Cull trees—Live trees that are unmerchantable now or prospectively (see Rough trees and Rotten trees).

Cull volume—Portions of a tree's volume that are not usable for wood products because of rot, missing or dead material, or other cubic-foot defect.

Deferred forest land—Forest lands within the National Forest System that are under study for possible inclusion in the Wilderness System.

Desirable trees—Growing-stock trees (1) having no serious defect in quality to limit present or prospective use for timber products, (2) of relatively high vigor, and (3) containing no pathogens that may result in death or serious deterioration within the next decade.

Diameter at breast height (d.b.h.)—Diameter of the stem measured at 4.5 feet above the ground.

Diameter at root collar (d.r.c.)—Diameter equivalent at the point nearest the ground line that represents the basal area of the tree stem or stems.

Diameter classes—Tree diameters, either d.b.h. or d.r.c., grouped into 2-inch classes labeled by the midpoint of the class.

Farmer/rancher-owned lands—Lands owned by a person who operates a farm or a ranch and who either does the work or directly supervises the work.

Fenceposts—Juniper and oak species are evaluated for post potential using the following criteria:

Line post—A 7-foot minimum length with 5 to 7 inches diameter at the butt, 2.5 inch minimum small end diameter, and reasonably straight and solid.

Corner post—An 8-foot minimum length with 7 to 9 inches diameter at the butt, 2.5 inch minimum small end diameter, and reasonably straight and solid.

Forest industry lands—Lands owned by companies or individuals operating a primary wood-processing plant.

Forest lands—Lands at least 10 percent stocked by forest trees of any size, including lands that formerly had such tree cover and that will be naturally or artificially regenerated. The minimum area for classification of forest land is 1 acre. Roadside, streamside, and shelterbelt strips of timber must have a crown width at least 120 feet wide to qualify as forest land. Unimproved roads and trails, streams, and clearings in forest areas are classified as forest if less than 120 feet wide.

Forest profile—A categorization of woodland that combines slope, volume per acre, site class, and crown density. Ten profiles are possible, 1 through 10.

Forest trees—Woody plants having a well-developed stem or stems, usually more than 12 feet in height at maturity, with a generally well-defined crown.

Forest type—A classification of forest land based upon and named for the tree species presently forming a plurality of live-tree stocking.

Gross annual growth—The average annual increase in the net volume of trees during a specified period.

Growing-stock trees—Live sawtimber trees, poletimber trees, saplings, and seedlings of timber species meeting specified standards of quality and vigor; excludes cull trees.

Growing-stock volume—Net cubic-foot volume in live poletimber-size and sawtimber-size growing-stock trees from a 1-foot stump to a minimum 4-inch top (of central stem) outside bark or to the point where the central stem breaks into limbs.

Growth—See definition for Net annual growth.

Hardwood trees—Dicotyledonous trees, usually broad-leaved and deciduous.

High-risk old-growth stands—Timber stands over 100 years old in which the majority of the trees are not expected to survive more than 10 years.

Indian lands—Indian lands held in trust by the Federal Government.

Industrial wood—All commercial roundwood products except fuelwood.

Land area—The area of dry land and land temporarily or partially covered by water such as marshes, swamps, and river flood plains, streams, sloughs, estuaries, and canals less than 120 feet wide; and lakes, reservoirs, and ponds less than 1 acre in size.

Logging residues—The unused portions of growing-stock trees cut or killed by logging.

Low-risk old-growth stands—Timber stands over 100 years old in which the majority of the trees are expected to survive more than 10 years.

Miscellaneous Federal lands—Lands administered by Federal agencies other than the Forest Service, U.S. Department of Agriculture, or Bureau of Land Management, U.S. Department of the Interior.

Mortality—The net volume of growing-stock trees that have died from natural causes during a specified period.

National Forest lands—Public lands administered by the Forest Service, U.S. Department of Agriculture.

National Resource lands—Public lands administered by the Bureau of Land Management, U.S. Department of the Interior.

Net annual growth—Gross annual growth minus average annual mortality.

Net dead volume—Total net volume of dead trees plus the net volume of dead material in live trees.

Net volume in board feet—The gross board-foot volume in the sawlog portion of growing-stock trees, less deductions for cull volume.

Net volume in cubic feet—Gross cubic-foot volume in the merchantable portion of trees less deductions for cull volume. For timber species, volume is computed for the merchantable stem from a 1-foot stump to a minimum 4-inch top diameter outside bark (d.o.b.), or to the point where the central stem breaks into limbs. For woodland species, volume is computed outside bark (o.b.) for all woody material above d.r.c. that is larger than 1.5 inches d.o.b.

Nonforest lands—Lands that do not currently qualify as forest land.

Nonindustrial private—All private ownerships except forest industry.

Nonstocked areas—Forest land less than 10 percent stocked with live trees.

Old-growth stands—Stands of timber species over 100 years old.

Other private lands—Privately owned lands other than forest industry or farmer owned.

Other public lands—Public lands administered by agencies other than the Forest Service, U.S. Department of Agriculture.

Other removals—The net volume of growing-stock trees removed from the inventory by cultural operations such as timber-stand improvement, by land clearing, and by changes in land use, such as a shift to wilderness.

Poletimber stands—Stands at least 10 percent stocked with growing-stock trees, in which half or more of the stocking is sawtimber or poletimber trees or both, with poletimber stocking exceeding that of sawtimber (see definition for Stocking).

Poletimber trees—Live trees of timber species at least 5 inches d.b.h. but smaller than sawtimber size.

Potential growth—The average net annual cubic-foot growth per acre at culmination of mean annual growth attainable in fully stocked natural stands.

Primary wood-processing plants—Plants using roundwood products such as sawlogs, pulpwood bolts, veneer logs, and so forth.

Productivity class—A classification of forest land that reflects biological potential. For timberlands the index used is the potential net annual growth at culmination of mean annual increment in fully stocked natural stands. For woodland, periodic annual measurement is an indicator of productivity. Furthermore, woodland is classified as high site where sustained wood production is likely, or low site where the continuous production of wood is unlikely, based upon tree form, growth rate, stocking, and presence or absence of reproduction.

Removals—The net volume of growing-stock trees removed from the inventory by harvesting, cultural operations, land clearings, or changes in land use.

Reserved forest land—Forest land withdrawn from tree utilization through statute or administrative designation.

Residues:

Coarse residues—Plant residues suitable for chipping, such as slabs, edgings, and ends.

Fine residues—Plant residues not suitable for chipping, such as sawdust, shavings, and veneer clippings.

Plant residues—Wood materials from primary manufacturing plants that are not used for any product.

Rotten trees—Live poletimber or sawtimber trees with more than 67 percent of their total volume cull (cubic-foot) and with more than half of the cull volume attributable to rotten or missing material.

Rough trees—Live poletimber or sawtimber trees with more than 67 percent of their total volume cull (cubic-foot) and with less than half of the cull volume attributable to rotten or missing material.

Roundwood—Logs, bolts, or other round sections cut from trees.

Salvable dead trees—Standing or down dead trees that are currently merchantable by regional standards.

Saplings—Live trees of timber species 1 to 4.9 inches d.b.h. or woodland species 1 to 2.9 inches d.r.c.

Sapling and seedling stands—Timberland stands at least 10 percent stocked on which more than half of the stocking is saplings or seedlings or both.

Sawlog portion—That part of the bole of sawtimber trees between a 1-foot stump and the sawlog top.

Sawlog top—The point on the bole of sawtimber trees above which a sawlog cannot be produced. The minimum sawlog top is 7 inches d.o.b. for softwoods and 9 inches d.o.b. for hardwoods.

Sawtimber stands—Stands at least 10 percent stocked with growing-stock trees, with half or more of total stocking in sawtimber or poletimber trees, and with sawtimber stocking at least equal to poletimber stocking.

Sawtimber trees—Live trees of timber species meeting regional size and defect specifications. Softwood trees must be at least 9 inches d.b.h. and hardwood trees 11 inches d.b.h.

Sawtimber volume—Net volume in board feet of the sawlog portion of live sawtimber trees.

Seedlings—Established live trees of timber species less than 1 inch d.b.h. or woodland species less than 1 inch d.r.c.

Softwood trees—Monocotyledonous trees, usually evergreen, having needle or scale-like leaves.

Standard error—An expression of the degree of confidence that can be placed on an estimated total or average obtained by statistical sampling methods. Standard errors do not include technique errors that could occur in photo classification of areas, field measurements, or compilation of data.

Stand-size classes—A classification of forest land based on the predominant size of trees present (see Sawtimber stands, Poletimber stands, and Sapling and seedling stands).

State, county, and municipal lands—Lands administered by States, counties, and local public agencies, or lands leased by these governmental units for more than 50 years.

Stocking—An expression of the extent to which growing space is effectively utilized by present or potential growing-stock trees of timber species.

Timberland—Forest land where timber species make up at least 10 percent stocking.

Timber species—Tree species traditionally used for industrial wood products. In the Rocky Mountain States, these include aspen and cottonwood hardwood species and all softwood species except pinyon and juniper.

Timber stand improvement—Treatments such as thinning, pruning, release cutting, girdling, weeding, or poisoning of unwanted trees aimed at improving growing conditions for the remaining trees.

Upper-stem portion—That part of the main stem or fork of sawtimber trees above the sawlog top to a minimum top diameter of 4 inches outside bark or to the point where the main stem or fork breaks into limbs.

Water—Streams, sloughs, estuaries, and canals more than 120 feet wide, and lakes, reservoirs, and ponds more than 1 acre in size at mean high water level.

Wilderness—An area of undeveloped land currently included in the Wilderness System, managed so as to preserve its natural conditions and retain its primeval character and influence.

Woodland—Forest land where timber species make up less than 10 percent stocking.

Woodland species—Tree species not usually converted into industrial wood products. Common uses are fuelwood, fenceposts, and Christmas trees.

APPENDIX II: INVENTORY PROCEDURE

The 1985 forest inventory of Arizona was conducted with considerable assistance from cooperators. The principal cooperator was the Forestry Division of the State Land Department (ASLD), with additional support from the Bureaus of Land Management and Indian Affairs of the U.S. Department of the Interior, and several Indian tribes. Two National Forests were involved directly in the inventory, and data for the others were supplied by the Forest Service's Southwestern Region. Data for a portion of the Fort Apache Indian Reservation were supplied by the Bureau of Indian Affairs. The remaining data needed in the State were collected between 1982 and 1985 by Forest Survey staff and cooperator field crews.

The State was divided into 10 sample areas for which separate information and precision requirements were needed. Two of the sample areas were National Forests and another six were major areas of Indian trust land. The final two sample areas consisted of the remainder of the State divided into northern and southern portions. Each of these sample areas was unique in respect to stratification methods, sample intensity, and some of the data collected. However, the basic inventory design and core data were compatible for summaries at the county, owner group, and State levels.

Inventory Design

The inventory was sample based and used a two-phase statistical design. A primary phase estimated the areas of sampling strata that were then sampled on the ground to obtain detailed classification and measurement data. Three types of primary data were used to obtain stratum areas. National Forests have vegetation maps that were sampled at 1,000-m intervals. Vegetation map summaries were used for the Navajo, Fort Apache, and San Carlos Indian Reservations. Conventional aerial photo interpretation of 1,000-m sample points was used for the Hopi Indian Reservation. Landsat satellite data were used for the remainder of the State, except for La Paz and Yuma Counties, which were excluded as nonforest land.

All data were adjusted to meet Bureau of the Census gross areas by county. All primary and field data were registered to the Universal Transverse Mercator (UTM) map projection, then primary and field sample data were located using the UTM Grid System (U.S. Department of Defense, Army 1973).

Landsat multispectral scanner (MSS) data from the Landsat satellite were used, which covered over 85,000 square miles, or 75 percent of the State. Twenty-two scenes of data, each covering an area of about 115 miles square, were selected from the most recent cloud-free summer satellite passes. Digital terrain data, digitized from 1:250,000 scale Defense Mapping Agency (DMA) maps, were purchased as a source of slope, elevation, and aspect data. A land net database, based upon the Public Land Survey System from the Arizona State Department of Transportation, was used with some updating and modification. Ownership data were digitized and reconciled using maps obtained from the Bureau of Land Management, U.S. Department of the Interior, Forest Service, U.S. Department of Agriculture, State of Arizona, and several other sources.

The raw MSS data were composed of four bands—red, green, and two infrared—of digital spectral reflectance data. Each data element, or pixel, represents about 1.1 acres on the ground. The raw data were registered to U.S. Geological Survey quadrangle maps using about 30 control points per map, and the data were resampled to elements 50 by 50 m in size, or about 0.6 acres. For each scene of data the pixels were grouped into 40 to 50 classes using unsupervised classification of the data, or statistical subdivision of the natural spectral range of a combined value for the four bands. Samples from each class were then field checked to label the classes with actual ground conditions, and the classes were then refined and collapsed as necessary to simulate the land cover classes described in "The Natural Vegetation of Arizona" (Lowe and Brown 1973).

The digital data were combined, or mosaicked, to delineate counties or other areas crossing scene boundaries. For the ASLD and other local use, color quadrangle and county maps with ownership or terrain data overlays were produced. For Forest Survey use and other reporting, tabular statistical summaries of area by vegetation class, owner class, and county were developed. These summaries were the basis for stratum areas for each sample area by grouping vegetation classes as necessary by owner or owner group.

The ASLD computers and software were used to process the Landsat data. The ELAS satellite image processing system was used with the ARC/INFO map geographic information system to analyze the data, and summaries were produced using the INFO tabular database management system. The DTAP (digital terrain applications package) software was developed by ASLD. The inventory and Landsat data analysis are described in more detail by Born and Pearlberg (1987), and further information concerning the availability of map products can be obtained by contacting the Forestry Division of the ASLD in Phoenix, AZ.

Field Sampling

Land classification and estimates for timberland and woodland characteristics and volume were based on observations and measurements of field sample locations. Sample trees for timberland were selected using a five-point cluster (USDA Forest Service 1985). Trees 5.0 inches d.b.h. or larger were selected using a variable radius plot. A 20 basal area factor was used for ponderosa pine locations, and other timberland locations were measured using a 40 basal area factor. Sample trees for woodland were selected using a 1/10- or 1/5-acre fixed radius plot for trees 3.0 inches d.r.c. or larger. Trees less than 3.0 inches d.r.c. were tallied on four 1/300-acre subplots, and understory vegetation was observed using a 1/20-acre subplot.

Data Compilation

Field data were entered into a computer file and edited to assure accuracy and coding consistency and to produce quality control summaries. These data were then compiled using appropriate factors and equations, including those reported by Hann and Bare (1978), Chojnacky and Ott (1986), and Chojnacky (1988a,b). The compiled field data file was then merged with the stratum areas (statistical-weights) files and expanded into statistical summaries, a portion of which is included in this bulletin.

Data Reliability

Standard error percentages calculated at the 67 percent confidence level for major classes of land are shown in table 6, and for volume in table 7. Individual cells in the other tables should be used with caution because some are based on small sample sizes that have high sampling errors. Generally, table cells with small values are based on correspondingly small sample sizes.

Table 6--Area of forest land with percent standard error, Arizona, 1985

Item	Acres	Percent standard error
Timberland	3,914,426	±0.9
Woodland	13,490,027	±1.6
Reserved forest land:[1]		
Timberland	1,630,878	
Woodland	822,839	
Total forest land	19,858,170	

[1]Reserved land areas are estimated from aerial photos without field verification; therefore, standard errors are not calculated.

Table 7--Net volume, net annual growth, and annual mortality on timberland and woodland with percent standard error, Arizona

Forest land	Item	All species	
		Volume	Percent standard error
Timberland:	Net volume, 1985:		
	Growing stock (M cubic feet)	5,557,451	±2.8
	Sawtimber[1] (M board feet)	24,870,296	±3.0
	Sawtimber[2] (M board feet)	21,680,552	±3.0
	Net annual growth, 1984:		
	Growing stock (M cubic feet)	122,845	±5.4
	Sawtimber[1] (M board feet)	593,124	±6.6
	Sawtimber[2] (M board feet)	502,867	±6.3
	Annual mortality, 1984:		
	Growing stock (M cubic feet)	15,160	±17.8
	Sawtimber[1] (M board feet)	73,635	±19.9
	Sawtimber[2] (M board feet)	65,527	±19.2
Woodland:	Net volume, 1985 (M cubic feet)	6,523,793	±3.7
	Growth, 1984 (M cubic feet)	81,762	±5.9
	Mortality, 1984 (M cubic feet)	949	±30.2

[1]International ¼-inch rule.

[2]Scribner rule.

APPENDIX III: FOREST SURVEY TABLES

Timberland Tables

AREA

Table 8--Total land area by major land class and ownership class, Arizona, 1985

Land class	Ownership class			
	National Forests	Other public	Private	Total
	Acres			
Timberland:				
Reserved	1,404,642	214,399	11,837	1,630,878
Nonreserved	2,542,413	54,937	1,317,076	3,914,426
Total	3,947,055	269,336	1,328,913	5,545,304
Woodland:				
Reserved	113,579	709,260	--	822,839
Nonreserved	4,356,430	2,249,633	6,883,964	13,490,027
Total	4,470,009	2,958,893	6,883,964	14,312,866
Total forest land:				
Reserved	1,518,221	923,659	11,837	2,453,717
Nonreserved	6,898,843	2,304,570	8,201,040	17,404,453
Total	8,417,064	3,228,229	8,212,877	19,858,170
Nonforest land	2,818,252	25,380,811	24,724,494	52,923,557
Total land area	11,235,316	28,609,040	32,937,371	72,781,727

Table 9--Area of timberland by forest type, stand-size class, and productivity class, Arizona, 1985

Forest type and stand-size class	Productivity class					Total acres
	120-164	85-119	50-84	20-49	0-19	
	Acres					
Douglas-fir:						
Sawtimber	28,942	41,590	191,772	93,015	--	355,319
Poletimber	--	--	3,967	--	--	3,967
Sapling and seedling	--	--	--	2,287	--	2,287
Nonstocked	--	--	--	7,524	--	7,524
Total	28,942	41,590	195,739	102,826	--	369,097
Ponderosa pine:						
Sawtimber	--	2,573	465,189	2,281,248	2,378	2,751,388
Poletimber	--	--	--	263,693	1,189	264,882
Sapling and seedling	--	--	--	277,749	--	277,749
Nonstocked	--	--	4,268	44,740	16,170	65,178
Total	--	2,573	469,457	2,867,430	19,737	3,359,197
Limber pine:						
Sawtimber	--	--	1,441	--	--	1,441
Poletimber	--	--	--	--	--	--
Sapling and seedling	--	--	--	--	--	--
Nonstocked	--	--	--	--	--	--
Total	--	--	1,441	--	--	1,441
Spruce-fir:						
Sawtimber	3,619	20,875	55,022	11,633	--	91,149
Poletimber	--	--	--	--	--	--
Sapling and seedling	--	--	--	--	--	--
Nonstocked	--	--	6,205	--	--	6,205
Total	3,619	20,875	61,227	11,633	--	97,354

(con.)

Table 9 (Con.)

Forest type and stand-size class	Productivity class					Total acres
	120-164	85-119	50-84	20-49	0-19	
	Acres					
White fir:						
Sawtimber	1,441	6,743	28,665	16,612	--	53,461
Poletimber	--	--	--	--	--	--
Sapling and seedling	--	--	--	--	--	--
Nonstocked	--	--	--	--	--	--
Total	1,441	6,743	28,665	16,612	--	53,461
Other softwoods:						
Sawtimber	--	--	--	4,867	--	4,867
Poletimber	--	--	--	--	--	--
Sapling and seedling	--	--	--	--	--	--
Nonstocked	--	--	--	--	--	--
Total	--	--	--	4,867	--	4,867
Aspen:						
Sawtimber	--	--	6,846	8,943	--	15,789
Poletimber	--	--	2,750	7,463	--	10,213
Sapling and seedling	--	--	--	3,007	--	3,007
Nonstocked	--	--	--	--	--	--
Total	--	--	9,596	19,413	--	29,009
All types:						
Sawtimber	34,002	71,781	748,935	2,416,318	2,378	3,273,414
Poletimber	--	--	6,717	271,156	1,189	279,062
Sapling and seedling	--	--	--	283,043	--	283,043
Nonstocked	--	--	10,473	52,264	16,170	78,907
Total	34,002	71,781	766,125	3,022,781	19,737	3,914,426

Table 10--Area of National Forest timberland by forest type, stand-size class, and productivity class, Arizona, 1985

Forest type and stand-size class	Productivity class					Total acres
	120-164	85-119	50-84	20-49	0-19	
	Acres					
Douglas-fir:						
Sawtimber	28,942	41,590	58,283	30,926	--	159,741
Poletimber	--	--	3,967	--	--	3,967
Sapling and seedling	--	--	--	--	--	--
Nonstocked	--	--	--	7,524	--	7,524
Total	28,942	41,590	62,250	38,450	--	171,232
Ponderosa pine:						
Sawtimber	--	--	280,313	1,446,951	--	1,727,264
Poletimber	--	--	--	221,755	--	221,755
Sapling and seedling	--	--	--	240,968	--	240,968
Nonstocked	--	--	4,268	18,165	--	22,433
Total	--	--	284,581	1,927,839	--	2,212,420
Limber pine:						
Sawtimber	--	--	1,441	--	--	1,441
Poletimber	--	--	--	--	--	--
Sapling and seedling	--	--	--	--	--	--
Nonstocked	--	--	--	--	--	--
Total	--	--	1,441	--	--	1,441
Spruce-fir:						
Sawtimber	3,619	20,875	41,578	10,599	--	76,671
Poletimber	--	--	--	--	--	--
Sapling and seedling	--	--	--	--	--	--
Nonstocked	--	--	--	--	--	--
Total	3,619	20,875	41,578	10,599	--	76,671

(con.)

Table 10 (Con.)

Forest type and stand-size class	Productivity class					Total acres
	120-164	85-119	50-84	20-49	0-19	
	Acres					
White fir:						
Sawtimber	1,441	6,743	28,665	16,612	--	53,461
Poletimber	--	--	--	--	--	--
Sapling and seedling	--	--	--	--	--	--
Nonstocked	--	--	--	--	--	--
Total	1,441	6,743	28,665	16,612	--	53,461
Other softwoods:						
Sawtimber	--	--	--	4,867	--	4,867
Poletimber	--	--	--	--	--	--
Sapling and seedling	--	--	--	--	--	--
Nonstocked	--	--	--	--	--	--
Total	--	--	--	4,867	--	4,867
Aspen:						
Sawtimber	--	--	6,846	4,763	--	11,609
Poletimber	--	--	242	7,463	--	7,705
Sapling and seedling	--	--	--	3,007	--	3,007
Nonstocked	--	--	--	--	--	--
Total	--	--	7,088	15,233	--	22,321
All types:						
Sawtimber	34,002	69,208	417,126	1,514,718	--	2,035,054
Poletimber	--	--	4,209	229,218	--	233,427
Sapling and seedling	--	--	--	243,975	--	243,975
Nonstocked	--	--	4,268	25,689	--	29,957
Total	34,002	69,208	425,603	2,013,600	--	2,542,413

Table 11--Area of other public timberland by forest type, stand-size class, and productivity class, Arizona, 1985

Forest type and stand-size class	Productivity class					Total acres
	120-164	85-119	50-84	20-49	0-19	
	Acres					
Douglas-fir:						
Sawtimber	--	--	--	--	--	--
Poletimber	--	--	--	--	--	--
Sapling and seedling	--	--	--	--	--	--
Nonstocked	--	--	--	--	--	--
Total	--	--	--	--	--	--
Ponderosa pine:						
Sawtimber	--	--	--	54,937	--	54,937
Poletimber	--	--	--	--	--	--
Sapling and seedling	--	--	--	--	--	--
Nonstocked	--	--	--	--	--	--
Total	--	--	--	54,937	--	54,937
Limber pine:						
Sawtimber	--	--	--	--	--	--
Poletimber	--	--	--	--	--	--
Sapling and seedling	--	--	--	--	--	--
Nonstocked	--	--	--	--	--	--
Total	--	--	--	--	--	--
Spruce-fir:						
Sawtimber	--	--	--	--	--	--
Poletimber	--	--	--	--	--	--
Sapling and seedling	--	--	--	--	--	--
Nonstocked	--	--	--	--	--	--
Total	--	--	--	--	--	--

(con.)

Table 11 (Con.)

Forest type and stand-size class	Productivity class					Total acres
	120-164	85-119	50-84	20-49	0-19	
	Acres					
White fir:						
Sawtimber	--	--	--	--	--	--
Poletimber	--	--	--	--	--	--
Sapling and seedling	--	--	--	--	--	--
Nonstocked	--	--	--	--	--	--
Total	--	--	--	--	--	--
Other softwoods:						
Sawtimber	--	--	--	--	--	--
Poletimber	--	--	--	--	--	--
Sapling and seedling	--	--	--	--	--	--
Nonstocked	--	--	--	--	--	--
Total	--	--	--	--	--	--
Aspen:						
Sawtimber	--	--	--	--	--	--
Poletimber	--	--	--	--	--	--
Sapling and seedling	--	--	--	--	--	--
Nonstocked	--	--	--	--	--	--
Total	--	--	--	--	--	--
All types:						
Sawtimber	--	--	--	54,937	--	54,937
Poletimber	--	--	--	--	--	--
Sapling and seedling	--	--	--	--	--	--
Nonstocked	--	--	--	--	--	--
Total	--	--	--	54,937	--	54,937

Table 12--Area of private timberland by forest type, stand-size class, and productivity class, Arizona, 1985

Forest type and stand-size class	Productivity class					Total acres
	120-164	85-119	50-84	20-49	0-19	
	Acres					
Douglas-fir:						
Sawtimber	--	--	133,489	62,089	--	195,578
Poletimber	--	--	--	--	--	--
Sapling and seedling	--	--	--	2,287	--	2,287
Nonstocked	--	--	--	--	--	--
Total	--	--	133,489	64,376	--	197,865
Ponderosa pine:						
Sawtimber	--	2,573	184,876	779,360	2,378	969,187
Poletimber	--	--	--	41,938	1,189	43,127
Sapling and seedling	--	--	--	36,781	--	36,781
Nonstocked	--	--	--	26,575	16,170	42,745
Total	--	2,573	184,876	884,654	19,737	1,091,840
Limber pine:						
Sawtimber	--	--	--	--	--	--
Poletimber	--	--	--	--	--	--
Sapling and seedling	--	--	--	--	--	--
Nonstocked	--	--	--	--	--	--
Total	--	--	--	--	--	--
Spruce-fir:						
Sawtimber	--	--	13,444	1,034	--	14,478
Poletimber	--	--	--	--	--	--
Sapling and seedling	--	--	--	--	--	--
Nonstocked	--	--	6,205	--	--	6,205
Total	--	--	19,649	1,034	--	20,683

(con.)

Table 12 (Con.)

Forest type and stand-size class	Productivity class					Total acres
	120-164	85-119	50-84	20-49	0-19	
	Acres					
White fir:						
Sawtimber	--	--	--	--	--	--
Poletimber	--	--	--	--	--	--
Sapling and seedling	--	--	--	--	--	--
Nonstocked	--	--	--	--	--	--
Total	--	--	--	--	--	--
Other softwoods:						
Sawtimber	--	--	--	--	--	--
Poletimber	--	--	--	--	--	--
Sapling and seedling	--	--	--	--	--	--
Nonstocked	--	--	--	--	--	--
Total	--	--	--	--	--	--
Aspen:						
Sawtimber	--	--	--	4,180	--	4,180
Poletimber	--	--	2,508	--	--	2,508
Sapling and seedling	--	--	--	--	--	--
Nonstocked	--	--	--	--	--	--
Total	--	--	2,508	4,180	--	6,688
All types:						
Sawtimber	--	2,573	331,809	846,663	2,378	1,183,423
Poletimber	--	--	2,508	41,938	1,189	45,635
Sapling and seedling	--	--	--	39,068	--	39,068
Nonstocked	--	--	6,205	26,575	16,170	48,950
Total	--	2,573	340,522	954,244	19,737	1,317,076

Table 13--Area of timberland by forest type and area condition class, Arizona, 1985

Forest type	Area condition class									Nonstocked	All classes
	10	20	30	40	50	60	70	80	90		
	Acres										
Douglas-fir	94,777	44,149	80,386	--	34,707	--	9,679	65,301	32,574	7,524	369,097
Ponderosa pine	445,703	596,899	661,778	66,908	349,703	139,819	793,112	80,705	159,391	65,178	3,359,196
Limber pine	--	1,441	--	--	--	--	--	--	--	--	1,441
Spruce-fir	11,728	36,749	11,797	7,592	11,896	--	--	11,388	--	6,205	97,355
White fir	1,505	11,388	8,772	3,796	--	--	3,007	24,993	--	--	53,461
Other softwoods	--	--	--	--	--	--	--	--	4,867	--	4,867
Aspen	10,664	10,353	484	726	836	--	5,946	--	--	--	29,009
All types	564,377	700,979	763,217	79,022	397,142	139,819	811,744	182,387	196,832	78,907	3,914,426

Table 14--Number of growing-stock trees on timberland by species and diameter class, Arizona, 1985

Species	Diameter class (inches at breast height)															All classes
	1.0-2.9	3.0-4.9	5.0-6.9	7.0-8.9	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-22.9	23.0-24.9	25.0-26.9	27.0-28.9	29.0+	
	Thousand trees															
Douglas-fir	21,251	17,194	14,566	10,297	5,406	2,962	2,630	1,468	951	970	737	811	419	317	500	80,479
Ponderosa pine	214,334	158,043	125,199	88,265	51,039	31,768	20,621	13,418	9,347	6,109	4,657	3,476	2,304	1,267	1,350	731,197
Limber pine	484	6,688	2,914	1,056	613	989	294	206	246	34	95	25	52	18	46	13,760
Subalpine fir	1,141	1,692	1,735	1,912	938	556	337	186	30	19	5	17	--	--	5	8,573
White fir	14,235	5,512	4,699	3,091	1,818	1,023	863	545	348	315	178	185	71	27	139	33,049
Engelmann spruce	15,484	6,404	5,994	3,365	3,424	2,566	1,651	1,045	751	339	222	99	45	6	29	41,424
Total softwoods	266,929	195,533	155,107	107,986	63,238	39,864	26,396	16,868	11,673	7,786	5,894	4,613	2,891	1,635	2,069	908,482
Aspen	4,895	2,332	9,154	7,895	5,549	3,732	2,108	821	384	137	30	13	39	6	([1])	37,095
Cottonwood	--	--	60	36	36	49	25	19	6	6	--	6	--	--	6	249
Total hardwoods	4,895	2,332	9,214	7,931	5,585	3,781	2,133	840	390	143	30	19	39	6	6	37,344
All species	271,824	197,865	164,321	115,917	68,823	43,645	28,529	17,708	12,063	7,929	5,924	4,632	2,930	1,641	2,075	945,826

[1]Less than 500 trees.

Table 15--Number of cull and salvable dead trees on timberland by ownership class, and softwoods and hardwoods, Arizona, 1985

Ownership class and species group	Cull trees			Salvable dead trees	Total
	Rough	Rotten	Total		
	Thousand trees				
National Forest:					
Softwoods	2,557	1,631	4,188	790	4,978
Hardwoods	--	6,040	6,040	83	6,123
Total	2,557	7,671	10,228	873	11,101
Other public:					
Softwoods	--	--	--	181	181
Hardwoods	--	--	--	--	--
Total	--	--	--	181	181
Private:					
Softwoods	19	--	19	8,436	8,455
Hardwoods	--	87	87	3,410	3,497
Total	19	87	106	11,846	11,952
Total:					
Softwoods	2,576	1,631	4,207	9,407	13,614
Hardwoods	--	6,127	6,127	3,493	9,620
Total	2,576	7,758	10,334	12,900	23,234

Table 16--Net volume of growing stock on timberland by ownership class, forest type, and stand-size class, Arizona, 1985

Ownership class	Forest type	Stand-size class: Sawtimber	Poletimber	Sapling/ seedling	Nonstocked	All classes
		Thousand cubic feet				
National Forest:						
	Douglas-fir	460,764	4,243	--	666	465,673
	Ponderosa pine	2,540,401	220,447	17,016	3,063	2,780,927
	Limber pine	5,741	--	--	--	5,741
	Spruce-fir	247,722	--	--	--	247,722
	White fir	132,524	--	--	--	132,524
	Other softwoods	2,439	--	--	--	2,439
	Aspen	19,733	17,868	616	--	38,217
	All types	3,409,324	242,558	17,632	3,729	3,673,243
Other public:						
	Douglas-fir	--	--	--	--	--
	Ponderosa pine	46,975	--	--	--	46,975
	Limber pine	--	--	--	--	--
	Spruce-fir	--	--	--	--	--
	White fir	--	--	--	--	--
	Other softwoods	--	--	--	--	--
	Aspen	--	--	--	--	--
	All types	46,975	--	--	--	46,975
Private:						
	Douglas-fir	582,927	--	576	--	583,503
	Ponderosa pine	1,112,488	22,830	11,495	3,894	1,150,707
	Limber pine	--	--	--	--	--
	Spruce-fir	58,493	--	--	10,707	69,200
	White fir	--	--	--	--	--
	Other softwoods	--	--	--	--	--
	Aspen	19,524	14,299	--	--	33,823
	All types	1,773,432	37,129	12,071	14,601	1,837,233
Total:						
	Douglas-fir	1,043,691	4,243	576	666	1,049,176
	Ponderosa pine	3,699,864	243,277	28,511	6,957	3,978,609
	Limber pine	5,741	--	--	--	5,741
	Spruce-fir	306,215	--	--	10,707	316,922
	White fir	132,524	--	--	--	132,524
	Other softwoods	2,439	--	--	--	2,439
	Aspen	39,257	32,167	616	--	72,040
	All types	5,229,731	279,687	29,703	18,330	5,557,451

Table 17--Net volume of sawtimber (International ¼-inch rule) on timberland by ownership class, forest type, and stand-size class, Arizona, 1985

Ownership class	Forest type	Stand-size class: Sawtimber	Poletimber	Sapling/ seedling	Nonstocked	All classes
		Thousand board feet, International ¼-inch rule				
National Forest:						
	Douglas-fir	2,233,143	14,803	--	3,874	2,251,820
	Ponderosa pine	11,319,463	638,598	97,933	16,590	12,072,584
	Limber pine	23,367	--	--	--	23,367
	Spruce-fir	1,015,320	--	--	--	1,015,320
	White fir	546,967	--	--	--	546,967
	Other softwoods	11,209	--	--	--	11,209
	Aspen	79,778	33,509	2,983	--	116,270
	All types	15,229,247	686,910	100,916	20,464	16,037,537
Other public:						
	Douglas-fir	--	--	--	--	--
	Ponderosa pine	231,137	--	--	--	231,137
	Limber pine	--	--	--	--	--
	Spruce-fir	--	--	--	--	--
	White fir	--	--	--	--	--
	Other softwoods	--	--	--	--	--
	Aspen	--	--	--	--	--
	All types	231,137	--	--	--	231,137
Private:						
	Douglas-fir	2,844,210	--	2,683	--	2,846,893
	Ponderosa pine	5,204,434	52,725	50,776	19,429	5,327,364
	Limber pine	--	--	--	--	--
	Spruce-fir	302,999	--	--	55,076	358,075
	White fir	--	--	--	--	--
	Other softwoods	--	--	--	--	--
	Aspen	22,595	46,695	--	--	69,290
	All types	8,374,238	99,420	53,459	74,505	8,601,622
Total:						
	Douglas-fir	5,077,353	14,803	2,683	3,874	5,098,713
	Ponderosa pine	16,755,034	691,323	148,709	36,019	17,631,085
	Limber pine	23,367	--	--	--	23,367
	Spruce-fir	1,318,319	--	--	55,076	1,373,395
	White fir	546,967	--	--	--	546,967
	Other softwoods	11,209	--	--	--	11,209
	Aspen	102,373	80,204	2,983	--	185,560
	All types	23,834,622	786,330	154,375	94,969	24,870,296

Table 18--Net volume of sawtimber (Scribner rule) on timberland by ownership class, forest type, and stand-size class, Arizona, 1985

Ownership class	Forest type	Stand-size class: Sawtimber	Poletimber	Sapling/ seedling	Nonstocked	All classes
		Thousand board feet, Scribner rule				
National Forest:						
	Douglas-fir	1,924,492	12,825	--	3,447	1,940,764
	Ponderosa pine	9,785,526	550,052	86,560	14,580	10,436,718
	Limber pine	20,239	--	--	--	20,239
	Spruce-fir	833,568	--	--	--	833,568
	White fir	463,774	--	--	--	463,774
	Other softwoods	9,621	--	--	--	9,621
	Aspen	65,228	27,227	2,563	--	95,018
	All types	13,102,448	590,104	89,123	18,027	13,799,702
Other public:						
	Douglas-fir	--	--	--	--	--
	Ponderosa pine	201,584	--	--	--	201,584
	Limber pine	--	--	--	--	--
	Spruce-fir	--	--	--	--	--
	White fir	--	--	--	--	--
	Other softwoods	--	--	--	--	--
	Aspen	--	--	--	--	--
	All types	201,584	--	--	--	201,584
Private:						
	Douglas-fir	2,553,892	--	2,239	--	2,556,131
	Ponderosa pine	4,632,978	44,205	43,849	17,089	4,738,121
	Limber pine	--	--	--	--	--
	Spruce-fir	272,972	--	--	49,618	322,590
	White fir	--	--	--	--	--
	Other softwoods	--	--	--	--	--
	Aspen	20,356	42,068	--	--	62,424
	All types	7,480,198	86,273	46,088	66,707	7,679,266
Total:						
	Douglas-fir	4,478,384	12,825	2,239	3,447	4,496,895
	Ponderosa pine	14,620,088	594,257	130,409	31,669	15,376,423
	Limber pine	20,239	--	--	--	20,239
	Spruce-fir	1,106,540	--	--	49,618	1,156,158
	White fir	463,774	--	--	--	463,774
	Other softwoods	9,621	--	--	--	9,621
	Aspen	85,584	69,295	2,563	--	157,442
	All types	20,784,230	676,377	135,211	84,734	21,680,552

Table 19--Net volume of growing stock on timberland by species and ownership class, Arizona, 1985

Species	Ownership class			
	National Forest	Other public	Private	Total
	Thousand cubic feet			
Douglas-fir	440,417	--	204,448	644,865
Ponderosa pine	2,692,104	46,975	1,217,154	3,956,233
Limber pine	44,109	--	26,216	70,325
Subalpine fir	35,201	--	16,367	51,568
White fir	132,137	--	35,899	168,036
Engelmann spruce	168,349	--	132,740	301,089
Total softwoods	3,512,317	46,975	1,632,824	5,192,116
Aspen	160,926	--	201,529	362,455
Cottonwood	--	--	2,880	2,880
Total hardwoods	160,926	--	204,409	365,335
All species	3,673,243	46,975	1,837,233	5,557,451

Table 20--Net volume of sawtimber (International ¼-inch rule) on timberland by species and ownership class, Arizona, 1985

Species	Ownership class			
	National Forest	Other public	Private	Total
	Thousand board feet, International ¼-inch rule			
Douglas-fir	2,107,161	--	952,589	3,059,750
Ponderosa pine	11,929,043	231,137	5,929,910	18,090,090
Limber pine	183,412	--	122,612	306,024
Subalpine fir	111,443	--	72,480	183,923
White fir	484,773	--	159,050	643,823
Engelmann spruce	744,437	--	653,896	1,398,333
Total softwoods	15,560,269	231,137	7,890,537	23,681,943
Aspen	477,268	--	698,104	1,175,372
Cottonwood	--	--	12,981	12,981
Total hardwoods	477,268	--	711,085	1,188,353
All species	16,037,537	231,137	8,601,622	24,870,296

Table 21--Net volume of sawtimber (Scribner rule) on timberland by species and ownership class, Arizona, 1985

Species	Ownership class			
	National Forest	Other public	Private	Total
	- - - - - - - Thousand board feet, Scribner rule - - - - - - -			
Douglas-fir	1,816,899	--	843,320	2,660,219
Ponderosa pine	10,342,148	201,584	5,293,124	15,836,856
Limber pine	155,405	--	110,461	265,866
Subalpine fir	88,392	--	65,297	153,689
White fir	416,610	--	143,289	559,899
Engelmann spruce	602,526	--	589,096	1,191,622
Total softwoods	13,421,980	201,584	7,044,587	20,668,151
Aspen	377,722	--	622,984	1,000,706
Cottonwood	--	--	11,695	11,695
Total hardwoods	377,722	--	634,679	1,012,401
All species	13,799,702	201,584	7,679,266	21,680,552

Species	Diameter class (inches at breast height)													
	5.0-6.9	7.0-8.9	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-22.9	23.0-24.9	25.0-26.9	27.0-28.9	29.0+	All classes
	Thousand cubic feet													
Douglas-fir	29,428	44,783	42,468	40,747	56,877	43,500	37,594	53,481	52,058	64,839	42,150	37,705	99,235	644,865
Ponderosa pine	191,680	325,520	368,400	394,913	396,998	378,831	372,419	315,618	300,955	289,942	230,324	159,406	231,227	3,956,233
Limber pine	4,392	4,069	5,314	11,449	5,519	6,895	10,608	1,751	5,562	1,597	4,876	1,514	6,779	70,325
Subalpine fir	4,231	9,233	8,381	8,571	8,683	5,741	1,806	1,156	555	2,183	--	--	1,027	51,567
White fir	7,757	13,224	14,419	13,995	18,088	15,175	13,832	15,613	11,078	13,954	6,540	3,138	21,223	168,036
Engelmann spruce	11,292	15,288	33,598	43,125	44,078	42,077	39,141	25,065	21,014	10,594	6,876	852	8,090	301,090
Total softwoods	248,780	412,117	472,580	512,800	530,243	492,219	475,400	412,684	391,222	383,109	290,766	202,615	367,581	5,192,116
Aspen	23,578	57,213	69,069	77,224	64,087	32,856	19,311	9,673	2,770	1,385	4,348	922	19	362,455
Cottonwood	42	98	197	433	347	367	159	195	--	357	--	--	685	2,880
Total hardwoods	23,620	57,311	69,266	77,657	64,434	33,223	19,470	9,868	2,770	1,742	4,348	922	704	365,335
All species	272,400	469,428	541,846	590,457	594,677	525,442	494,870	422,552	393,992	384,851	295,114	203,537	368,285	5,557,451

Table 23--Net volume of sawtimber (International ¼-inch rule) on timberland by species and diameter class, Arizona, 1985

Species	Diameter class (inches at breast height)											
	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-22.9	23.0-24.9	25.0-26.9	27.0-28.9	29.0+	All classes
	Thousand board feet, International ¼-inch rule											
Douglas-fir	128,958	160,229	271,084	222,476	203,935	300,123	298,354	379,191	250,670	224,737	619,993	3,059,750
Ponderosa pine	1,179,147	1,651,361	1,928,596	2,010,505	2,080,282	1,837,626	1,789,568	1,750,455	1,410,900	989,751	1,461,899	18,090,090
Limber pine	16,895	45,012	25,349	34,269	54,153	9,596	30,845	9,038	29,873	8,973	42,021	306,024
Subalpine fir	28,158	40,268	43,337	30,120	10,087	6,710	3,589	14,481	--	--	7,173	183,923
White fir	46,743	57,377	80,306	68,326	61,470	67,998	49,972	56,404	29,787	14,129	111,311	643,823
Engelmann spruce	109,633	189,766	219,228	222,162	215,926	145,943	124,047	63,875	45,521	4,499	57,733	1,398,333
Total softwoods	1,509,534	2,144,013	2,567,900	2,587,858	2,625,853	2,367,996	2,296,375	2,273,444	1,766,751	1,242,089	2,300,130	23,681,943
Aspen	XXXXX	400,732	357,081	189,069	113,958	59,009	17,326	8,767	23,428	5,902	100	1,175,372
Cottonwood	XXXXX	1,804	1,633	1,841	827	1,028	--	1,855	--	--	3,993	12,981
Total hardwoods	XXXXX	402,536	358,714	190,910	114,785	60,037	17,326	10,622	23,428	5,902	4,093	1,188,353
All species	1,509,534	2,546,549	2,926,614	2,778,768	2,740,638	2,428,033	2,313,701	2,284,066	1,790,179	1,247,991	2,304,223	24,870,296

Table 24--Net volume of sawtimber (Scribner rule) on timberland by species and diameter class, Arizona, 1985

Species	Diameter class (inches at breast height)											All classes
	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-22.9	23.0-24.9	25.0-26.9	27.0-28.9	29.0+	
	Thousand board feet, Scribner rule											
Douglas-fir	105,860	127,502	223,540	188,384	175,876	262,389	263,675	337,614	222,072	199,548	553,759	2,660,219
Ponderosa pine	972,581	1,356,526	1,647,349	1,758,666	1,849,440	1,639,270	1,598,565	1,563,465	1,260,561	884,322	1,306,110	15,836,855
Limber pine	13,759	36,540	21,581	29,609	47,421	8,606	27,591	8,080	26,911	8,035	37,734	265,867
Subalpine fir	23,460	31,356	36,064	25,323	8,803	5,942	3,233	13,046	--	--	6,462	153,689
White fir	38,338	46,568	67,291	59,105	54,289	60,317	44,664	50,234	26,636	12,628	99,828	559,898
Engelmann spruce	92,631	151,346	182,288	188,465	186,949	128,315	108,974	56,266	40,691	3,856	51,841	1,191,622
Total softwoods	1,246,629	1,749,838	2,178,113	2,249,552	2,322,778	2,104,839	2,046,702	2,028,705	1,576,871	1,108,389	2,055,734	20,668,150
Aspen	XXXXX	331,832	301,919	164,143	100,734	52,853	15,604	7,898	20,323	5,314	87	1,000,707
Cottonwood	XXXXX	1,626	1,471	1,658	745	926	--	1,671	--	--	3,598	11,695
Total hardwoods	XXXXX	333,458	303,390	165,801	101,479	53,779	15,604	9,569	20,323	5,314	3,685	1,012,402
All species	1,246,629	2,083,296	2,481,503	2,415,353	2,424,257	2,158,618	2,062,306	2,038,274	1,597,194	1,113,703	2,059,419	21,680,552

Table 25--Net volume on timberland by class of material, and softwoods and hardwoods, Arizona, 1985

Class of material	Softwoods	Hardwoods	Total
	- - - - - -	Thousand cubic feet	- - - - - -
Sawtimber trees:			
Sawlog portion	3,318,284	94,381	3,412,665
Upper-stem portion	1,212,933	120,758	1,333,691
Total	4,531,217	215,139	4,746,356
Poletimber trees	660,898	150,197	811,095
All growing-stock trees	5,192,115	365,336	5,557,451
Rough cull trees	5,081	--	5,081
Rotten cull trees	10,002	23,711	33,713
Salvable dead trees	121,487	26,413	147,900
All timber	5,328,685	415,460	5,744,145
Woodland	220,367	349,632	569,999
Total material	5,549,052	765,092	6,314,144

Table 26--Net volume of growing stock on timberland by forest type and species, Arizona, 1985

Forest type	Species										All species
	Douglas-fir	Ponderosa pine	Limber pine	Subalpine fir	White fir	Engelmann spruce	Total softwoods	Aspen	Cottonwood	Total hardwoods	
	Thousand cubic feet										
Douglas-fir	434,346	220,795	40,162	7,632	61,667	103,800	868,402	180,337	439	180,776	1,049,178
Ponderosa pine	134,936	3,688,407	23,759	795	34,588	23,671	3,906,156	70,011	2,442	72,453	3,978,609
Limber pine	1,690	540	1,791	--	--	--	4,021	1,720	--	1,720	5,741
Spruce-fir	44,467	11,417	3,509	40,809	12,147	161,325	273,674	43,247	--	43,247	316,921
White fir	25,108	26,548	--	1,876	59,385	8,959	121,876	10,648	--	10,648	132,524
Other softwoods	267	2,171	--	--	--	--	2,438	--	--	--	2,438
Aspen	4,051	6,355	1,103	454	250	3,335	15,548	56,492	--	56,492	72,040
All types	644,865	3,956,233	70,324	51,566	168,037	301,090	5,192,115	362,455	2,881	365,336	5,557,451

Table 27--Net volume of sawtimber (International ¼-inch rule) on timberland by forest type and species, Arizona, 1985

Forest type	Species										All species
	Douglas-fir	Ponderosa pine	Limber pine	Subalpine fir	White fir	Engelmann spruce	Total softwoods	Aspen	Cottonwood	Total hardwoods	
	Thousand board feet, International ¼-inch rule										
Douglas-fir	2,197,482	1,228,273	182,773	27,947	253,160	485,589	4,375,224	721,470	2,017	723,487	5,098,711
Ponderosa pine	494,008	16,602,967	95,778	2,881	115,861	103,569	17,415,064	205,056	10,965	216,021	17,631,085
Limber pine	9,424	2,881	8,299	--	--	--	20,604	2,764	--	2,764	23,368
Spruce-fir	228,035	65,192	14,815	143,785	48,485	755,106	1,255,418	117,977	--	117,977	1,373,395
White fir	116,199	149,724	--	8,971	225,400	41,498	541,792	5,175	--	5,175	546,967
Other softwoods	994	10,215	--	--	--	--	11,209	--	--	--	11,209
Aspen	13,608	30,839	4,360	339	915	12,571	62,632	122,929	--	122,929	185,561
All types	3,059,750	18,090,091	306,025	183,923	643,821	1,398,333	23,681,943	1,175,371	12,982	1,188,353	24,870,296

Table 28--Net volume of sawtimber (Scribner rule) on timberland by forest type and species, Arizona, 1985

Forest type	Species										All species
	Douglas-fir	Ponderosa pine	Limber pine	Subalpine fir	White fir	Engelmann spruce	Total softwoods	Aspen	Cottonwood	Total hardwoods	
	Thousand board feet, Scribner rule										
Douglas-fir	1,931,523	1,100,343	159,656	24,902	224,477	426,916	3,867,817	627,262	1,817	629,079	4,496,896
Ponderosa pine	418,729	14,509,638	82,913	2,275	99,423	84,459	15,197,437	169,108	9,878	178,986	15,376,423
Limber pine	8,271	2,529	7,332	--	--	--	18,132	2,107	--	2,107	20,239
Spruce-fir	195,087	56,985	12,183	119,095	42,198	636,640	1,062,188	93,968	--	93,968	1,156,156
White fir	94,688	131,526	--	7,112	193,048	33,252	459,626	4,149	--	4,149	463,775
Other softwoods	734	8,887	--	--	--	--	9,621	--	--	--	9,621
Aspen	11,188	26,946	3,783	305	753	10,355	53,330	104,112	--	104,112	157,442
All types	2,660,220	15,836,854	265,867	153,689	559,899	1,191,622	20,668,151	1,000,706	11,695	1,012,401	21,680,552

Table 29--Net annual growth of growing stock on timberland by species and ownership class, Arizona, 1984

Species	Ownership class			Total
	National Forest	Other public	Private	
	Thousand cubic feet			
Douglas-fir	9,446	--	4,385	13,831
Ponderosa pine	69,391	830	21,895	92,116
Limber pine	1,302	--	348	1,650
Subalpine fir	900	--	172	1,072
White fir	3,480	--	842	4,322
Engelmann spruce	2,671	--	-96	2,575
Total softwoods	87,190	830	27,546	115,566
Aspen	4,328	--	2,663	6,991
Cottonwood	--	--	288	288
Total hardwoods	4,328	--	2,951	7,279
All species	91,518	830	30,497	122,845

Table 30--Net annual growth of sawtimber (International ¼-inch rule) on timberland by species and ownership class, Arizona, 1984

Species	Ownership class			Total
	National Forest	Other public	Private	
	Thousand board feet, International ¼-inch rule			
Douglas-fir	53,294	--	19,683	72,977
Ponderosa pine	306,826	3,668	106,462	416,956
Limber pine	5,302	--	2,162	7,464
Subalpine fir	6,532	--	1,039	7,571
White fir	10,922	--	2,637	13,559
Engelmann spruce	13,073	--	-2,410	10,663
Total softwoods	395,949	3,668	129,573	529,190
Aspen	43,738	--	18,671	62,409
Cottonwood	--	--	1,525	1,525
Total hardwoods	43,738	--	20,196	63,934
All species	439,687	3,668	149,769	593,124

Table 31--Net annual growth of sawtimber (Scribner rule) on timberland by species and ownership class, Arizona, 1984

Species	Ownership class			Total
	National Forest	Other public	Private	
	Thousand board feet, Scribner rule			
Douglas-fir	44,397	--	17,529	61,926
Ponderosa pine	258,504	3,250	93,496	355,250
Limber pine	4,248	--	1,948	6,196
Subalpine fir	5,675	--	936	6,611
White fir	9,615	--	2,375	11,990
Engelmann spruce	11,348	--	-2,171	9,177
Total softwoods	333,787	3,250	114,113	451,150
Aspen	33,565	--	16,778	50,343
Cottonwood	--	--	1,374	1,374
Total hardwoods	33,565	--	18,152	51,717
All species	367,352	3,250	132,265	502,867

Table 32--Net annual growth of growing stock on timberland by species and diameter class, Arizona, 1984

Species	Diameter class (inches at breast height)													All classes
	5.0-6.9	7.0-8.9	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-22.9	23.0-24.9	25.0-26.9	27.0-28.9	29.0+	
	Thousand cubic feet													
Douglas-fir	3,452	1,894	1,442	1,339	1,476	911	559	810	501	340	280	371	455	13,830
Ponderosa pine	20,829	12,975	12,857	10,940	9,404	6,915	5,132	3,771	2,785	2,551	2,103	954	901	92,117
Limber pine	468	140	171	339	115	78	169	19	47	13	53	9	28	1,649
Subalpine fir	275	292	52	192	140	73	([1])	11	5	19	--	--	13	1,072
White fir	1,159	557	465	407	431	330	252	295	171	173	84	-45	44	4,323
Engelmann spruce	1,306	518	1,184	1,406	843	607	273	-157	-1,561	11	-1,279	-291	-285	2,575
Total softwoods	27,489	16,376	16,171	14,623	12,409	8,914	6,385	4,749	1,948	3,107	1,241	998	1,156	115,566
Aspen	1,347	1,617	1,392	1,231	688	317	254	43	28	9	52	13	([1])	6,991
Cottonwood	4	10	20	43	35	37	16	19	--	36	--	--	68	288
Total hardwoods	1,351	1,627	1,412	1,274	723	354	270	62	28	45	52	13	68	7,279
All species	28,840	18,003	17,583	15,897	13,132	9,268	6,655	4,811	1,976	3,152	1,293	1,011	1,224	122,845

[1]Less than 500 cubic feet.

Table 33--Net annual growth of sawtimber (International ¼-inch rule) on timberland by species and diameter class, Arizona, 1984

Species	Diameter class (inches at breast height)											All classes
	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-22.9	23.0-24.9	25.0-26.9	27.0-28.9	29.0+	
	Thousand board feet, International ¼-inch rule											
Douglas-fir	31,317	6,401	8,735	5,606	3,437	5,080	3,130	2,270	1,779	2,287	2,934	72,976
Ponderosa pine	138,749	60,704	57,492	43,521	32,727	24,196	17,910	16,095	13,605	6,283	5,675	416,957
Limber pine	2,384	1,889	692	478	928	113	298	84	360	58	182	7,466
Subalpine fir	4,799	1,119	888	420	-3	71	34	147	--	--	96	7,571
White fir	4,154	1,760	2,097	1,555	1,095	1,205	795	686	401	-310	119	13,557
Engelmann spruce	12,302	7,599	5,269	3,653	1,697	-866	-8,427	57	-6,579	-2,070	-1,972	10,663
Total softwoods	193,705	79,472	75,173	55,233	39,881	29,799	13,740	19,339	9,566	6,248	7,034	529,190
Aspen	XXXXX	53,395	4,542	2,015	1,541	298	183	61	285	87	1	62,408
Cottonwood	XXXXX	1,190	49	55	25	31	--	56	--	--	120	1,526
Total hardwoods	XXXXX	54,585	4,591	2,070	1,566	329	183	117	285	87	121	63,934
All species	193,705	134,057	79,764	57,303	41,447	30,128	13,923	19,456	9,851	6,335	7,155	593,124

Table 34--Net annual growth of sawtimber (Scribner rule) on timberland by species and diameter class, Arizona, 1984

Species	Diameter class (inches at breast height)											All classes
	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-22.9	23.0-24.9	25.0-26.9	27.0-28.9	29.0+	
	Thousand board feet, Scribner rule											
Douglas-fir	25,027	5,415	7,645	5,005	3,109	4,648	2,817	2,028	1,580	2,039	2,613	61,926
Ponderosa pine	104,426	53,720	52,189	40,082	29,930	21,763	15,988	14,358	12,155	5,605	5,034	355,250
Limber pine	1,698	1,616	613	434	853	103	266	75	324	51	163	6,196
Subalpine fir	4,242	933	768	363	-6	63	30	132	--	--	86	6,611
White fir	3,481	1,549	1,897	1,434	1,011	1,108	717	611	359	-280	103	11,990
Engelmann spruce	10,881	6,373	4,571	3,150	1,446	-804	-7,239	44	-5,602	-1,866	-1,777	9,177
Total softwoods	149,755	69,606	67,683	50,468	36,343	26,881	12,579	17,248	8,816	5,549	6,222	451,150
Aspen	XXXXX	42,350	3,994	1,797	1,381	268	165	55	254	78	1	50,343
Cottonwood	XXXXX	1,072	44	50	22	28	--	50	--	--	108	1,374
Total hardwoods	XXXXX	43,422	4,038	1,847	1,403	296	165	105	254	78	109	51,717
All species	149,755	113,028	71,721	52,315	37,746	27,177	12,744	17,353	9,070	5,627	6,331	502,867

Table 35--Annual mortality of sawtimber (International ¼-inch rule) on timberland by species and ownership class, Arizona, 1984

Species	Ownership class			
	National Forest	Other public	Private	Total
	- - Thousand board feet, International ¼-inch rule - - -			
Douglas-fir	948	--	3,026	3,974
Ponderosa pine	2,301	895	24,159	27,355
Limber pine	--	--	506	506
Subalpine fir	480	--	682	1,162
White fir	--	--	1,500	1,500
Engelmann spruce	13,767	--	19,838	33,605
Total softwoods	17,496	895	49,711	68,102
Aspen	--	--	5,533	5,533
Cottonwood	--	--	--	--
Total hardwoods	--	--	5,533	5,533
All species	17,496	895	55,244	73,635

Table 36--Annual mortality of sawtimber (Scribner rule) on timberland by species and ownership class, Arizona, 1984

Species	Ownership class			
	National Forest	Other public	Private	Total
	- - - - - - Thousand board feet, Scribner rule - - - - -			
Douglas-fir	843	--	2,726	3,569
Ponderosa pine	2,027	796	21,723	24,546
Limber pine	--	--	456	456
Subalpine fir	428	--	615	1,043
White fir	--	--	1,351	1,351
Engelmann spruce	11,705	--	17,872	29,577
Total softwoods	15,003	796	44,743	60,542
Aspen	--	--	4,985	4,985
Cottonwood	--	--	--	--
Total hardwoods	--	--	4,985	4,985
All species	15,003	796	49,728	65,527

Table 37--Annual mortality of growing stock on timberland by species and diameter class, Arizona, 1984

Species	Diameter class (inches at breast height)													
	5.0-6.9	7.0-8.9	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-22.9	23.0-24.9	25.0-26.9	27.0-28.9	29.0+	All classes
	Thousand cubic feet													
Douglas-fir	80	46	42	35	22	--	22	82	--	165	55	--	265	814
Ponderosa pine	715	335	175	161	181	346	810	495	645	635	132	348	705	5,683
Limber pine	21	26	13	8	26	62	--	--	--	--	--	--	--	156
Subalpine fir	16	92	191	20	50	21	33	--	--	--	--	--	--	423
White fir	31	14	16	8	--	17	--	--	--	--	--	74	138	298
Engelmann spruce	51	86	85	121	247	406	548	567	1,820	108	1,357	300	377	6,073
Total softwoods	914	599	522	353	526	852	1,413	1,144	2,465	908	1,544	722	1,485	13,447
Aspen	229	224	261	323	399	165	32	80	--	--	--	--	--	1,713
Cottonwood	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total hardwoods	229	224	261	323	399	165	32	80	--	--	--	--	--	1,713
All species	1,143	823	783	676	925	1,017	1,445	1,224	2,465	908	1,544	722	1,485	15,160

Table 38--Annual mortality of sawtimber (International ¼-inch rule) on timberland by species and diameter class, Arizona, 1984

Species	Diameter class (inches at breast height)											All classes
	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-22.9	23.0-24.9	25.0-26.9	27.0-28.9	29.0+	
	Thousand board feet, International ¼-inch rule											
Douglas-fir	122	95	93	--	119	476	--	947	321	--	1,800	3,973
Ponderosa pine	506	566	805	1,779	4,493	2,991	3,965	4,130	832	2,244	5,045	27,356
Limber pine	36	33	118	319	--	--	--	--	--	--	--	506
Subalpine fir	557	68	236	111	191	--	--	--	--	--	--	1,163
White fir	46	21	--	79	--	--	--	--	--	453	901	1,500
Engelmann spruce	246	432	1,139	2,196	3,221	3,559	10,135	747	7,124	2,119	2,686	33,604
Total softwoods	1,513	1,215	2,391	4,484	8,024	7,026	14,100	5,824	8,277	4,816	10,432	68,102
Aspen	XXXXX	1,652	2,226	965	197	493	--	--	--	--	--	5,533
Cottonwood	XXXXX	--	--	--	--	--	--	--	--	--	--	--
Total hardwoods	XXXXX	1,652	2,226	965	197	493	--	--	--	--	--	5,533
All species	1,513	2,867	4,617	5,449	8,221	7,519	14,100	5,824	8,277	4,816	10,432	73,635

Table 39--Annual mortality of sawtimber (Scribner rule) on timberland by species and diameter class, Arizona, 1984

Species	Diameter class (inches at breast height)											All classes
	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-22.9	23.0-24.9	25.0-26.9	27.0-28.9	29.0+	
	Thousand board feet, Scribner rule											
Douglas-fir	109	85	84	--	108	429	--	843	289	--	1,622	3,569
Ponderosa pine	455	496	725	1,588	4,006	2,695	3,563	3,716	746	2,012	4,545	24,547
Limber pine	33	29	107	287	--	--	--	--	--	--	--	456
Subalpine fir	497	61	212	100	172	--	--	--	--	--	--	1,042
White fir	42	19	--	71	--	--	--	--	--	408	811	1,351
Engelmann spruce	221	389	1,026	1,978	2,902	3,207	8,762	673	6,090	1,909	2,420	29,577
Total softwoods	1,357	1,079	2,154	4,024	7,188	6,331	12,325	5,232	7,125	4,329	9,398	60,542
Aspen	XXXXX	1,489	2,005	869	177	445	--	--	--	--	--	4,985
Cottonwood	XXXXX	--	--	--	--	--	--	--	--	--	--	--
Total hardwoods	XXXXX	1,489	2,005	869	177	445	--	--	--	--	--	4,985
All species	1,357	2,568	4,159	4,893	7,365	6,776	12,325	5,232	7,125	4,329	9,398	65,527

Table 40--Annual mortality of growing stock on timberland by species and cause of death, Arizona, 1984

Species	Cause of death								
	Insects	Disease	Fire	Animal	Weather	Suppression	Logging	Unknown[1]	Total
	Thousand cubic feet								
Douglas-fir	1	119	28	1	352	2	66	245	814
Ponderosa pine	660	339	485	16	1,637	43	1,421	1,083	5,684
Limber pine	--	--	67	23	3	25	38	--	156
Subalpine fir	9	164	--	26	58	69	11	86	423
White fir	3	--	1	14	99	--	8	173	298
Engelmann spruce	2,987	120	--	69	779	3	263	1,851	6,072
Total softwoods	3,660	742	581	149	2,928	142	1,807	3,438	13,447
Aspen	--	741	34	20	426	35	277	180	1,713
Cottonwood	--	--	--	--	--	--	--	--	--
Total hardwoods	--	741	34	20	426	35	277	180	1,713
All species	3,660	1,483	615	169	3,354	177	2,084	3,618	15,160

[1]Because many destructive agents often attack trees in concert or in succession, it is often difficult to identify the actual causal agent. When the primary cause of death cannot be precisely determined, it is listed as unknown.

Table 41--Annual mortality of sawtimber (International ¼-inch rule) on timberland by species and cause of death, Arizona, 1984

Species	Cause of death								
	Insects	Disease	Fire	Animal	Weather	Suppression	Logging	Unknown	Total
	Thousand board feet, International ¼-inch rule								
Douglas-fir	--	554	26	--	2,033	--	62	1,297	3,972
Ponderosa pine	3,683	1,168	1,675	9	7,889	101	6,533	6,298	27,356
Limber pine	--	--	296	26	--	123	62	--	507
Subalpine fir	17	480	--	72	292	--	--	302	1,163
White fir	--	--	--	18	469	--	--	1,013	1,500
Engelmann spruce	17,084	543	--	160	4,480	--	1,411	9,926	33,604
Total softwoods	20,784	2,745	1,997	285	15,163	224	8,068	18,836	68,102
Aspen	--	2,345	79	78	1,655	--	780	596	5,533
Cottonwood	--	--	--	--	--	--	--	--	--
Total hardwoods	--	2,345	79	78	1,655	--	780	596	5,533
All species	20,784	5,090	2,076	363	16,818	224	8,848	19,432	73,635

Table 42--Annual mortality of sawtimber (Scribner rule) on timberland by species and cause of death, Arizona, 1984

Species	Cause of death								Total
	Insects	Disease	Fire	Animal	Weather	Suppression	Logging	Unknown	
	Thousand board feet, Scribner rule								
Douglas-fir	--	499	24	--	1,832	--	56	1,158	3,569
Ponderosa pine	3,280	1,052	1,509	8	7,060	91	5,886	5,661	24,547
Limber pine	--	--	267	23	--	111	55	--	456
Subalpine fir	15	427	--	65	263	--	--	272	1,042
White fir	--	--	--	16	422	--	--	913	1,351
Engelmann spruce	15,063	489	--	144	4,037	--	1,271	8,573	29,577
Total softwoods	18,358	2,467	1,800	256	13,614	202	7,268	16,577	60,542
Aspen	--	2,113	71	70	1,491	--	703	537	4,985
Cottonwood	--	--	--	--	--	--	--	--	--
Total hardwoods	--	2,113	71	70	1,491	--	703	537	4,985
All species	18,358	4,580	1,871	326	15,105	202	7,971	17,114	65,527

Table 43--Area of woodland by ownership class, forest type, and site class, Arizona, 1985

Ownership class	Forest type	Site class: High	Site class: Low	All classes
		Acres		
National Forest:	Pinyon-juniper	3,566,054	34,568	3,600,622
	Juniper	221,432	14,718	236,150
	Oak	387,830	35,934	423,764
	Mesquite	88,824	--	88,824
	Other woodland	7,070	--	7,070
	Total	4,271,210	85,220	4,356,430
Other public:	Pinyon-juniper	895,454	59,061	954,515
	Juniper	546,988	98,895	645,883
	Oak	104,976	--	104,976
	Mesquite	378,059	101,727	479,786
	Other woodland	24,706	39,767	64,473
	Total	1,950,183	299,450	2,249,633
Private:	Pinyon-juniper	3,578,607	936,485	4,515,092
	Juniper	968,401	258,313	1,226,714
	Oak	326,674	33,342	360,016
	Mesquite	436,223	262,944	699,167
	Other woodland	44,651	38,324	82,975
	Total	5,354,556	1,529,408	6,883,964
Total:	Pinyon-juniper	8,040,115	1,030,114	9,070,229
	Juniper	1,736,821	371,926	2,108,747
	Oak	819,480	69,276	888,756
	Mesquite	903,106	364,671	1,267,777
	Other woodland	76,427	78,091	154,518
	Total	11,575,949	1,914,078	13,490,027

Table 44--Area of woodland by ownership class, forest type, and volume class, Arizona, 1985

Ownership class	Forest type	Volume class: 0 - 199 ft³/acre	200 - 399 ft³/acre	400 - 599 ft³/acre	600 - 799 ft³/acre	800 - 999 ft³/acre	1,000+ ft³/acre	All classes
		Acres						
National Forest:	Pinyon-juniper	253,427	339,286	601,481	303,585	455,344	1,647,499	3,600,622
	Juniper	93,631	65,196	39,684	20,246	10,619	6,774	236,150
	Oak	140,647	92,248	97,092	17,418	23,035	53,324	423,764
	Mesquite	61,550	16,015	--	4,314	--	6,945	88,824
	Other woodland	--	7,070	--	--	--	--	7,070
	Total	549,255	519,815	738,257	345,563	488,998	1,714,542	4,356,430
Other public:	Pinyon-juniper	299,715	238,527	152,831	97,947	64,979	100,516	954,515
	Juniper	234,419	166,319	117,987	85,923	--	41,236	645,884
	Oak	69,985	17,328	17,663	--	--	--	104,976
	Mesquite	409,370	58,258	12,157	--	--	--	479,785
	Other woodland	64,473	--	--	--	--	--	64,473
	Total	1,077,962	480,432	300,638	183,870	64,979	141,752	2,249,633
Private:	Pinyon-juniper	1,016,351	1,146,080	820,783	756,350	304,676	470,851	4,515,091
	Juniper	511,038	264,241	187,564	130,381	54,771	78,719	1,226,714
	Oak	110,353	99,453	13,348	27,326	43,024	66,512	360,016
	Mesquite	568,584	63,404	31,007	4,325	31,848	--	699,168
	Other woodland	64,604	6,584	2,928	--	--	8,859	82,975
	Total	2,270,930	1,579,762	1,055,630	918,382	434,319	624,941	6,883,964
Total:	Pinyon-juniper	1,569,493	1,723,893	1,575,095	1,157,882	824,999	2,218,866	9,070,228
	Juniper	839,088	495,756	345,235	236,550	65,390	126,729	2,108,748
	Oak	320,985	209,029	128,103	44,744	66,059	119,836	888,756
	Mesquite	1,039,504	137,677	43,164	8,639	31,848	6,945	1,267,777
	Other woodland	129,077	13,654	2,928	--	--	8,859	154,518
	Total	3,898,147	2,580,009	2,094,525	1,447,815	988,296	2,481,235	13,490,027

Table 45--Area of woodland by ownership class, forest type, and forest profile, Arizona, 1985

Ownership class and forest type	Forest profile 1	2	3	4	5	6	7	8	9	10	Total
	Acres										
National Forest:											
Pinyon-juniper	14,140	6,725	6,178	1,620,455	862,425	197,530	851,531	34,568	7,070	--	3,600,622
Juniper	--	--	--	3,224	37,936	32,223	130,919	14,718	17,130	--	236,150
Oak	5,030	6,178	10,513	6,999	6,344	210,014	134,015	35,934	8,737	--	423,764
Mesquite	11,259	--	--	--	--	11,421	66,144	--	--	--	88,824
Other woodland	--	--	--	--	--	--	7,070	--	--	--	7,070
Total	30,429	12,903	16,691	1,630,678	906,705	451,188	1,189,679	85,220	32,937	--	4,356,430
Other public:											
Pinyon-juniper	47,040	--	11,278	66,770	183,119	88,644	454,243	47,782	44,360	11,278	954,514
Juniper	--	--	--	41,236	145,203	49,632	285,509	98,895	25,408	--	645,883
Oak	--	--	--	--	--	69,279	35,698	--	--	--	104,977
Mesquite	--	--	--	--	--	24,315	341,586	89,569	12,158	12,158	479,786
Other woodland	--	--	--	--	--	--	24,706	39,767	--	--	64,473
Total	47,040	--	11,278	108,006	328,322	231,870	1,141,742	276,013	81,926	23,436	2,249,633
Private:											
Pinyon-juniper	47,533	32,131	74,806	315,490	799,838	370,427	1,733,384	905,505	204,997	30,980	4,515,091
Juniper	21,158	13,245	16,751	38,383	212,762	65,482	570,824	218,730	29,796	39,583	1,226,714
Oak	27,081	12,314	3,700	22,292	42,991	54,252	158,994	20,978	5,050	12,364	360,016
Mesquite	23,580	--	--	--	12,593	12,593	363,047	226,534	24,411	36,410	699,168
Other woodland	--	3,701	--	--	--	9,499	22,037	16,911	9,414	21,413	82,975
Total	119,352	61,391	95,257	376,165	1,068,184	512,253	2,848,286	1,388,658	273,668	140,750	6,883,964
Total:											
Pinyon-juniper	108,713	38,856	92,262	2,002,715	1,845,382	656,601	3,039,158	987,855	256,427	42,258	9,070,227
Juniper	21,158	13,245	16,751	82,843	395,901	147,337	987,252	332,343	72,334	39,583	2,108,747
Oak	32,111	18,492	14,213	29,291	49,335	333,545	328,707	56,912	13,787	12,364	888,757
Mesquite	34,839	--	--	--	12,593	48,329	770,777	316,103	36,569	48,568	1,267,778
Other woodland	--	3,701	--	--	--	9,499	53,813	56,678	9,414	21,413	154,518
Total	196,821	74,294	123,226	2,114,849	2,303,211	1,195,311	5,179,707	1,749,891	388,531	164,186	13,490,027

Table 46--Number of trees of woodland species on woodland by ownership class, species, and diameter class, Arizona, 1985

Ownership class and species	Diameter class (inches at root collar)															All classes
	1.0-2.9	3.0-4.9	5.0-6.9	7.0-8.9	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-22.9	23.0-24.9	25.0-26.9	27.0-28.9	29.0+	
	Thousand trees															
National Forest:																
Pinyon	46,849	28,819	38,384	24,640	13,696	7,125	4,083	2,074	1,456	637	196	8	--	--	47	168,014
Juniper	71,079	60,807	65,874	41,758	26,505	13,508	9,153	6,532	5,311	2,943	2,914	2,396	1,608	1,472	4,690	316,550
Oak	59,929	62,413	95,286	50,382	24,056	14,274	6,965	4,226	2,874	1,475	1,170	335	240	298	82	324,005
Cercocarpus	325	255	446	273	254	124	67	--	--	--	--	--	--	--	--	1,744
Mesquite	3,280	2,951	2,028	1,533	905	669	448	118	111	--	--	--	--	--	69	12,112
Other woodland	2,956	--	2,937	409	408	180	202	--	--	124	--	--	--	--	--	7,216
Total	184,418	155,245	204,955	118,995	65,824	35,880	20,918	12,950	9,752	5,179	4,280	2,739	1,848	1,770	4,888	829,641
Other public:																
Pinyon	26,277	14,501	8,594	5,619	3,695	2,257	1,225	413	--	107	53	64	66	--	--	62,871
Juniper	36,871	19,160	21,746	15,003	14,593	11,191	6,394	6,860	4,566	3,905	2,122	1,720	1,005	1,154	1,510	147,800
Oak	--	4,104	3,757	1,642	1,001	557	793	--	114	--	--	--	--	--	--	11,968
Cercocarpus	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Mesquite	15,615	5,190	5,622	4,708	2,837	1,429	949	446	182	170	--	--	--	--	--	37,148
Other woodland	3,123	1,866	1,100	498	601	182	61	306	61	--	63	--	--	63	--	7,924
Total	81,886	44,821	40,819	27,470	22,727	15,616	9,422	8,025	4,923	4,182	2,238	1,784	1,071	1,217	1,510	267,711
Private:																
Pinyon	141,512	65,622	58,897	36,821	27,164	14,191	6,726	5,107	1,516	1,131	165	137	29	53	--	359,071
Juniper	96,353	43,002	48,700	39,644	34,279	33,251	27,395	21,932	16,857	13,559	10,565	6,925	4,748	3,927	5,162	406,299
Oak	24,148	24,397	26,294	17,347	9,016	5,046	3,945	1,850	1,819	400	358	377	193	16	88	115,294
Cercocarpus	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Mesquite	37,951	15,680	11,466	6,384	4,563	2,385	1,017	773	448	72	87	--	--	--	--	80,826
Other woodland	8,681	2,321	1,471	697	457	58	236	43	127	38	29	--	--	--	23	14,181
Total	308,645	151,022	146,828	100,893	75,479	54,931	39,319	29,705	20,767	15,200	11,204	7,439	4,970	3,996	5,273	975,671
Total:																
Pinyon	214,638	108,942	105,875	67,080	44,555	23,573	12,034	7,594	2,972	1,875	414	209	95	53	47	589,956
Juniper	204,303	122,969	136,320	96,405	75,377	57,950	42,942	35,324	26,734	20,407	15,601	11,041	7,361	6,553	11,362	870,649
Oak	84,077	90,914	125,337	69,371	34,073	19,877	11,703	6,076	4,807	1,875	1,528	712	433	314	170	451,267
Cercocarpus	325	255	446	273	254	124	67	--	--	--	--	--	--	--	--	1,744
Mesquite	56,846	23,821	19,116	12,625	8,305	4,483	2,414	1,337	741	242	87	--	--	--	69	130,086
Other woodland	14,760	4,187	5,508	1,604	1,466	420	499	349	188	162	92	--	--	63	23	29,321
Total	574,949	351,088	392,602	247,358	164,030	106,427	69,659	50,680	35,442	24,561	17,722	11,962	7,889	6,983	11,671	2,073,023

Table 47--Net volume on woodland by species and ownership class, Arizona, 1985

Species	Ownership class			Total
	National Forest	Other public	Private	
	Thousand cubic feet			
Douglas-fir	21,303	--	1,178	22,481
Ponderosa pine	870,803	--	42,913	913,716
White fir	47,284	--	--	47,284
Cottonwood	--	--	276	276
Pinyon	409,042	94,161	600,208	1,103,411
Juniper	1,241,375	511,023	1,604,546	3,356,944
Oak	670,462	17,839	223,321	911,622
Cercocarpus	1,252	--	--	1,252
Mesquite	25,935	40,734	76,491	143,160
Other woodland	8,764	6,769	8,114	23,647
All species	3,296,220	670,526	2,557,047	6,523,793

Table 48--Net volume of woodland species on woodland by ownership class, species, and diameter class, Arizona, 1985

Ownership class and species	Diameter class (inches at root collar)														All classes
	3.0-4.9	5.0-6.9	7.0-8.9	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-22.9	23.0-24.9	25.0-26.9	27.0-28.9	29.0+	
	Thousand cubic feet														
National Forest:															
Pinyon	10,134	43,927	67,771	68,753	62,566	55,791	37,318	33,655	17,573	7,442	390	--	--	3,723	409,043
Juniper	12,977	51,973	72,451	82,967	68,518	77,498	82,907	87,179	64,780	82,135	78,235	63,230	65,991	350,534	1,241,375
Oak	15,831	104,518	114,774	96,354	86,663	65,488	53,718	44,097	29,482	29,495	10,124	7,393	8,713	3,812	670,462
Cercocarpus	46	162	156	288	428	172	--	--	--	--	--	--	--	--	1,252
Mesquite	1,019	1,983	3,931	2,985	4,756	3,571	1,472	1,761	--	--	--	--	--	4,457	25,935
Other woodland	--	3,947	904	1,331	605	821	--	--	1,156	--	--	--	--	--	8,764
Total	40,007	206,510	259,987	252,678	223,536	203,341	175,415	166,692	112,991	119,072	88,749	70,623	74,704	362,526	2,356,831
Other public:															
Pinyon	4,710	9,216	15,315	16,994	17,273	14,353	5,189	--	3,450	1,469	2,113	4,079	--	--	94,161
Juniper	4,624	14,801	22,592	39,098	47,193	38,573	58,387	55,472	52,891	40,812	27,567	22,323	39,687	47,003	511,023
Oak	668	2,330	2,043	2,601	1,293	7,159	--	1,745	--	--	--	--	--	--	17,839
Cercocarpus	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Mesquite	1,601	4,224	7,469	6,842	6,950	5,835	2,467	2,773	2,573	--	--	--	--	--	40,734
Other woodland	225	380	338	803	525	298	1,803	385	--	748	--	--	1,264	--	6,769
Total	11,828	30,951	47,757	66,338	73,234	66,218	67,846	60,375	58,914	43,029	29,680	26,402	40,951	47,003	670,526
Private:															
Pinyon	20,841	60,747	86,104	118,898	96,557	68,441	75,475	30,336	27,704	6,234	3,345	2,234	3,292	--	600,208
Juniper	11,391	34,414	56,585	85,129	127,916	144,564	160,690	161,509	164,022	153,844	132,474	104,785	89,926	177,297	1,604,546
Oak	8,819	28,647	32,933	26,876	22,990	29,250	18,450	24,211	7,109	5,670	8,497	5,288	241	4,340	223,321
Cercocarpus	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Mesquite	4,475	7,730	10,637	14,285	14,224	8,570	7,063	7,004	931	1,572	--	--	--	--	76,491
Other woodland	631	769	1,306	228	168	755	153	1,357	549	854	--	--	--	1,344	8,114
Total	46,157	132,307	187,565	245,416	261,855	251,580	261,831	224,417	200,315	168,174	144,316	112,307	93,459	182,981	2,512,680
Total:															
Pinyon	35,685	113,890	169,190	204,645	176,396	138,585	117,982	63,991	48,727	15,145	5,848	6,313	3,292	3,723	1,103,412
Juniper	28,992	101,188	151,628	207,194	243,627	260,635	301,984	304,160	281,693	276,791	238,276	190,338	195,604	574,834	3,356,944
Oak	25,318	135,495	149,750	125,831	110,946	101,897	72,168	70,053	36,591	35,165	18,621	12,681	8,954	8,152	911,622
Cercocarpus	46	162	156	288	428	172	--	--	--	--	--	--	--	--	1,252
Mesquite	7,095	13,937	22,037	24,112	25,930	17,976	11,002	11,538	3,504	1,572	--	--	--	4,457	143,160
Other woodland	856	5,096	2,548	2,362	1,298	1,874	1,956	1,742	1,705	1,602	--	--	1,264	1,344	23,647
Total	97,992	369,768	495,309	564,432	558,625	521,139	505,092	451,484	372,220	330,275	262,745	209,332	209,114	592,510	5,540,037

Table 49--Net volume on woodland by ownership class, forest type, and site class, Arizona, 1985

Ownership class	Forest type	Site class: High	Site class: Low	All classes
		- - - - - Thousand cubic feet	- - - - -	
National Forest:	Pinyon-juniper	3,011,595	5,353	3,016,948
	Juniper	68,484	898	69,382
	Oak	177,175	6,750	183,925
	Mesquite	23,889	--	23,889
	Other woodland	2,076	--	2,076
	Total	3,283,219	13,001	3,296,220
Other public:	Pinyon-juniper	371,418	8,485	379,903
	Juniper	218,517	10,109	228,626
	Oak	14,902	--	14,902
	Mesquite	40,782	4,122	44,904
	Other woodland	1,745	446	2,191
	Total	647,364	23,162	670,526
Private:	Pinyon-juniper	1,627,383	248,975	1,876,358
	Juniper	340,898	49,239	390,137
	Oak	195,358	3,015	198,373
	Mesquite	72,138	8,553	80,691
	Other woodland	9,338	2,150	11,488
	Total	2,245,115	311,932	2,557,047
Total:	Pinyon-juniper	5,010,396	262,813	5,273,209
	Juniper	627,899	60,246	688,145
	Oak	387,435	9,765	397,200
	Mesquite	136,809	12,675	149,484
	Other woodland	13,159	2,596	15,755
	Total	6,175,698	348,095	6,523,793

Table 50--Net volume on woodland by ownership class, forest type, and volume class, Arizona, 1985

Ownership class	Forest type	Volume class: 0 - 199 ft³/acre	200 - 399 ft³/acre	400 - 599 ft³/acre	600 - 799 ft³/acre	800 - 999 ft³/acre	1,000+ ft³/acre	All classes
		Thousand cubic feet						
National Forest:	Pinyon-juniper	29,647	92,673	257,439	176,048	354,570	2,106,571	3,016,948
	Juniper	8,399	15,099	18,287	10,742	7,519	9,336	69,382
	Oak	14,699	24,624	42,232	9,682	18,419	74,269	183,925
	Mesquite	6,121	4,059	--	1,793	--	11,916	23,889
	Other woodland	--	2,076	--	--	--	--	2,076
	Total	58,866	138,531	317,958	198,265	380,508	2,202,092	3,296,220
Other public:	Pinyon-juniper	24,998	70,661	62,649	52,172	52,128	117,295	379,903
	Juniper	18,043	45,708	48,610	51,736	--	64,529	228,626
	Oak	5,285	2,749	6,868	--	--	--	14,902
	Mesquite	25,247	15,158	4,499	--	--	--	44,904
	Other woodland	2,191	--	--	--	--	--	2,191
	Total	75,764	134,276	122,626	103,908	52,128	181,824	670,526
Private:	Pinyon-juniper	95,569	278,216	317,563	399,207	209,381	576,423	1,876,359
	Juniper	40,353	68,045	75,565	72,305	39,626	94,242	390,136
	Oak	5,233	27,845	5,941	15,428	29,026	114,900	198,373
	Mesquite	28,433	14,594	10,936	3,228	23,500	--	80,691
	Other woodland	1,146	1,319	1,561	--	--	7,462	11,488
	Total	170,734	390,019	411,566	490,168	301,533	793,027	2,557,047
Total:	Pinyon-juniper	150,214	441,550	637,651	627,427	616,079	2,800,289	5,273,210
	Juniper	66,795	128,852	142,462	134,783	47,145	168,107	688,144
	Oak	25,217	55,218	55,041	25,110	47,445	189,169	397,200
	Mesquite	59,801	33,811	15,435	5,021	23,500	11,916	149,484
	Other woodland	3,337	3,395	1,561	--	--	7,462	15,755
	Total	305,364	662,826	852,150	792,341	734,169	3,176,943	6,523,793

Table 51--Net volume on woodland by ownership class, forest type, and forest profile, Arizona, 1985

Ownership class and forest type	Forest profile 1	2	3	4	5	6	7	8	9	10	Total
	Thousand cubic feet										
National Forest:											
Pinyon-juniper	18,892	11,426	3,293	2,066,020	577,900	63,793	270,137	5,353	134	--	3,016,948
Juniper	--	--	--	2,772	22,441	13,036	30,008	897	228	--	69,382
Oak	9,598	15,550	8,809	8,119	3,008	97,346	34,109	6,750	636	--	183,925
Mesquite	13,709	--	--	--	--	1,439	8,741	--	--	--	23,889
Other woodland	--	--	--	--	--	--	2,076	--	--	--	2,076
Total	42,199	26,976	12,102	2,076,911	603,349	175,614	345,071	13,000	998	--	3,296,220
Other public:											
Pinyon-juniper	35,658	--	7,954	84,487	109,086	25,015	105,205	8,339	4,013	146	379,903
Juniper	--	--	--	64,529	80,079	6,014	67,864	10,109	31	--	228,626
Oak	--	--	--	--	--	10,956	3,946	--	--	--	14,902
Mesquite	--	--	--	--	--	3,563	37,190	4,005	29	117	44,904
Other woodland	--	--	--	--	--	--	1,745	446	--	--	2,191
Total	35,658	--	7,954	149,016	189,165	45,548	215,950	22,899	4,073	263	670,526
Private:											
Pinyon-juniper	48,145	45,959	48,404	382,948	454,517	230,851	405,677	247,586	10,881	1,389	1,876,357
Juniper	26,071	14,001	10,476	46,346	116,053	25,142	102,372	47,627	437	1,613	390,138
Oak	46,940	14,736	2,448	39,428	25,597	38,911	25,930	2,274	1,367	741	198,372
Mesquite	18,162	--	--	--	8,566	1,907	39,867	7,914	3,636	639	80,691
Other woodland	--	2,797	--	--	--	4,711	1,696	2,150	135	--	11,489
Total	139,318	77,493	61,328	468,722	604,733	301,522	575,542	307,551	16,456	4,382	2,557,047
Total:											
Pinyon-juniper	102,695	57,385	59,651	2,533,455	1,141,503	319,659	781,019	261,278	15,028	1,535	5,273,208
Juniper	26,071	14,001	10,476	113,647	218,573	44,192	200,244	58,633	696	1,613	688,146
Oak	56,538	30,286	11,257	47,547	28,605	147,213	63,985	9,024	2,003	741	397,199
Mesquite	31,871	--	--	--	8,566	6,909	85,798	11,919	3,665	756	149,484
Other woodland	--	2,797	--	--	--	4,711	5,517	2,596	135	--	15,756
Total	217,175	104,469	81,384	2,694,649	1,397,247	522,684	1,136,563	343,450	21,527	4,645	6,523,793

Table 52--Net dead volume of woodland species on woodland by ownership class, species, and diameter class, Arizona, 1985

Ownership class and species	Diameter class (inches at root collar)														All classes
	3.0-4.9	5.0-6.9	7.0-8.9	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-22.9	23.0-24.9	25.0-26.9	27.0-28.9	29.0+	
	Thousand cubic feet														
National Forest:															
Pinyon	1,796	9,071	14,857	15,086	11,821	12,262	8,232	7,529	4,178	1,746	92	--	--	873	87,543
Juniper	2,322	10,774	15,909	18,113	12,655	16,101	19,745	19,114	13,681	20,293	19,901	22,991	16,332	94,262	302,193
Oak	3,147	21,746	21,500	18,948	17,884	12,151	10,697	8,889	6,267	5,820	2,262	1,722	2,773	894	134,700
Cercocarpus	4	56	156	58	66	57	--	--	--	--	--	--	--	--	397
Mesquite	76	151	380	743	434	538	12	152	--	--	--	--	--	810	3,296
Other woodland	--	797	421	185	37	808	--	--	1,652	--	--	--	--	--	3,900
Total	7,345	42,595	53,223	53,133	42,897	41,917	38,686	35,684	25,778	27,859	22,255	24,713	19,105	96,839	532,029
Other public:															
Pinyon	93	373	918	2,283	2,529	566	--	--	--	77	564	--	--	--	7,403
Juniper	163	1,147	1,735	3,023	6,954	10,524	13,148	7,614	13,661	16,248	9,782	6,859	3,669	26,095	120,622
Oak	118	751	412	378	698	211	--	205	677	--	--	--	--	--	3,450
Cercocarpus	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Mesquite	176	633	562	730	930	1,604	797	800	686	--	--	--	--	--	6,918
Other woodland	103	163	163	261	111	40	848	118	--	200	--	1,292	195	--	3,494
Total	653	3,067	3,790	6,675	11,222	12,945	14,793	8,737	15,024	16,525	10,346	8,151	3,864	26,095	141,887
Private:															
Pinyon	723	4,510	10,070	19,764	16,001	11,292	9,208	5,566	4,166	385	2,851	394	173	--	85,103
Juniper	274	1,994	5,292	12,589	25,016	41,543	44,965	50,259	51,423	47,368	51,916	41,311	36,238	79,400	489,588
Oak	1,531	2,286	3,393	2,706	3,227	3,501	4,461	7,117	1,540	2,692	1,849	696	1,127	933	37,059
Cercocarpus	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Mesquite	680	1,887	2,408	2,273	2,485	1,762	1,517	102	215	77	--	--	--	--	13,406
Other woodland	86	359	124	669	97	353	41	181	461	--	--	--	--	978	3,349
Total	3,294	11,036	21,287	38,001	46,826	58,451	60,192	63,225	57,805	50,522	56,616	42,401	37,538	81,311	628,505
Total:															
Pinyon	2,612	13,954	25,845	37,133	30,351	24,120	17,440	13,095	8,344	2,208	3,507	394	173	873	180,049
Juniper	2,759	13,915	22,936	33,725	44,625	68,168	77,858	76,987	78,765	83,909	81,599	71,161	56,239	199,757	912,403
Oak	4,796	24,783	25,305	22,032	21,809	15,863	15,158	16,211	8,484	8,512	4,111	2,418	3,900	1,827	175,209
Cercocarpus	4	56	156	58	66	57	--	--	--	--	--	--	--	--	397
Mesquite	932	2,671	3,350	3,746	3,849	3,904	2,326	1,054	901	77	--	--	--	810	23,620
Other woodland	189	1,319	708	1,115	245	1,201	889	299	2,113	200	--	1,292	195	978	10,743
Total	11,292	56,698	78,300	97,809	100,945	113,313	113,671	107,646	98,607	94,906	89,217	75,265	60,507	204,245	1,302,421

Table 53--Net dead volume of woodland species on woodland by ownership class, forest type, and site class, Arizona, 1985

Ownership class	Forest type	Site class: High	Site class: Low	All classes
		- - - - - Thousand cubic feet - - - - -		
National Forest:	Pinyon-juniper	493,852	599	494,451
	Juniper	6,651	5	6,656
	Oak	26,955	343	27,298
	Mesquite	3,532	--	3,532
	Other woodland	92	--	92
	Total	531,082	947	532,029
Other public:	Pinyon-juniper	84,273	3,390	87,663
	Juniper	38,021	3,599	41,620
	Oak	2,274	--	2,274
	Mesquite	8,843	983	9,826
	Other woodland	342	162	504
	Total	133,753	8,134	141,887
Private:	Pinyon-juniper	366,316	114,425	480,741
	Juniper	90,628	10,044	100,672
	Oak	28,005	687	28,692
	Mesquite	12,853	2,024	14,877
	Other woodland	2,070	1,453	3,523
	Total	499,872	128,633	628,505
Total:	Pinyon-juniper	944,441	118,414	1,062,855
	Juniper	135,300	13,648	148,948
	Oak	57,234	1,030	58,264
	Mesquite	25,228	3,007	28,235
	Other woodland	2,504	1,615	4,119
	Total	1,164,707	137,714	1,302,421

Table 54--Net dead volume of woodland species on woodland by ownership class, forest type, and volume class, Arizona, 1985

Ownership class	Forest type	Volume class						All classes
		0 - 199 ft³/acre	200 - 399 ft³/acre	400 - 599 ft³/acre	600 - 799 ft³/acre	800 - 999 ft³/acre	1,000+ ft³/acre	
		Thousand cubic feet						
National Forest:	Pinyon-juniper	3,666	16,412	44,418	32,666	53,354	343,935	494,451
	Juniper	452	1,637	219	1,637	1,302	1,409	6,656
	Oak	1,420	3,036	4,250	1,427	2,223	14,942	27,298
	Mesquite	812	166	--	1,493	--	1,061	3,532
	Other woodland	--	92	--	--	--	--	92
	Total	6,350	21,343	48,887	37,223	56,879	361,347	532,029
Other public:	Pinyon-juniper	4,231	2,616	13,526	14,015	9,082	44,193	87,663
	Juniper	4,489	4,651	9,323	6,529	--	16,628	41,620
	Oak	888	1,175	211	--	--	--	2,274
	Mesquite	6,278	2,383	1,165	--	--	--	9,826
	Other woodland	504	--	--	--	--	--	504
	Total	16,390	10,825	24,225	20,544	9,082	60,821	141,887
Private:	Pinyon-juniper	13,871	62,687	79,811	126,236	61,863	136,273	480,741
	Juniper	6,166	13,013	15,322	19,735	12,336	34,100	100,672
	Oak	1,375	3,840	958	4,306	7,918	10,295	28,692
	Mesquite	6,193	4,052	1,619	224	2,789	--	14,877
	Other woodland	97	138	88	--	--	3,200	3,523
	Total	27,702	83,730	97,798	150,501	84,906	183,868	628,505
Total:	Pinyon-juniper	21,768	81,715	137,755	172,917	124,299	524,401	1,062,855
	Juniper	11,107	19,301	24,864	27,901	13,638	52,137	148,948
	Oak	3,683	8,051	5,419	5,733	10,141	25,237	58,264
	Mesquite	13,283	6,601	2,784	1,717	2,789	1,061	28,235
	Other woodland	601	230	88	--	--	3,200	4,119
	Total	50,442	115,898	170,910	208,268	150,867	606,036	1,302,421

Table 55--Net dead volume of woodland species on woodland by ownership class, forest type, and forest profile, Arizona, 1985

Ownership class and forest type	Forest profile 1	2	3	4	5	6	7	8	9	10	Total
	Thousand cubic feet										
National Forest:											
Pinyon-juniper	2,582	372	102	340,915	92,389	9,550	47,942	599	--	--	494,451
Juniper	--	--	--	1,151	2,954	339	424	5	1,783	--	6,656
Oak	286	339	544	385	581	20,219	4,274	343	327	--	27,298
Mesquite	2,554	--	--	--	--	186	792	--	--	--	3,532
Other woodland	--	--	--	--	--	--	92	--	--	--	92
Total	5,422	711	646	342,451	95,924	30,294	53,524	947	2,110	--	532,029
Other public:											
Pinyon-juniper	18,770	--	2,579	22,251	23,331	8,187	6,976	2,981	2,178	409	87,662
Juniper	--	--	--	16,628	10,766	472	8,013	3,599	2,142	--	41,620
Oak	--	--	--	--	--	2,060	214	--	--	--	2,274
Mesquite	--	--	--	--	--	186	8,657	965	--	18	9,826
Other woodland	--	--	--	--	--	--	343	162	--	--	505
Total	18,770	--	2,579	38,879	34,097	10,905	24,203	7,707	4,320	427	141,887
Private:											
Pinyon-juniper	10,651	6,173	7,333	102,025	109,886	48,307	78,911	114,410	3,029	16	480,741
Juniper	12,591	3,896	530	16,577	31,672	8,861	15,122	9,915	1,379	129	100,672
Oak	5,443	1,521	100	4,585	8,991	3,266	4,032	687	67	--	28,692
Mesquite	1,138	--	--	--	1,875	1,438	6,719	1,940	1,683	84	14,877
Other woodland	--	1,341	--	--	--	526	203	1,453	--	--	3,523
Total	29,823	12,931	7,963	123,187	152,424	62,398	104,987	128,405	6,158	229	628,505
Total:											
Pinyon-juniper	32,003	6,545	10,014	465,191	225,606	66,044	133,829	117,990	5,207	425	1,062,854
Juniper	12,591	3,896	530	34,356	45,392	9,672	23,559	13,519	5,304	129	148,948
Oak	5,729	1,860	644	4,970	9,572	25,545	8,520	1,030	394	--	58,264
Mesquite	3,692	--	--	--	1,875	1,810	16,168	2,905	1,683	102	28,235
Other woodland	--	1,341	--	--	--	526	638	1,615	--	--	4,120
Total	54,015	13,642	11,188	504,517	282,445	103,597	182,714	137,059	12,588	656	1,302,421

Table 56--Area, net volume, and dead volume on woodland by average stand diameter class, Arizona, 1985

Average stand diameter class	Area	Net volume	Dead volume	Total volume
- - Inches - -	- - Acres - -	- - - - - - Thousand cubic feet - - - - - -		
0.0	206,687	275	3,936	4,211
1.0 - 2.9	2,255	3	1	4
3.0 - 4.9	783,162	59,338	12,283	71,621
5.0 - 6.9	2,805,603	674,059	101,923	775,982
7.0 - 8.9	3,689,154	1,805,157	330,389	2,135,546
9.0 - 10.9	2,874,650	1,885,140	363,548	2,248,688
11.0 - 12.9	1,666,596	1,100,521	275,028	1,375,549
13.0 - 14.9	694,140	498,480	113,574	612,054
15.0 - 16.9	410,869	216,488	47,195	263,683
17.0 - 18.9	162,193	141,030	32,116	173,146
19.0 - 20.9	105,338	88,004	17,710	105,714
21.0 - 22.9	14,632	12,747	895	13,642
23.0 - 24.9	31,418	23,955	--	23,955
25.0 - 26.9	43,330	18,596	3,823	22,419
27.0 - 28.9	--	--	--	--
29.0+	--	--	--	--
Total	13,490,027	6,523,793	1,302,421	7,826,214

Table 57--Net volume of woodland species on timberland by diameter class and species, Arizona, 1985

Diameter class[1]	Species						Total
	Pinyon	Juniper	Oak	Cercocarpus	Mesquite	Other woodland	
	Thousand cubic feet						
1.0 - 2.9	--	--	--	--	--	--	--
3.0 - 4.9	2,370	3,263	12,523	--	--	89	18,245
5.0 - 6.9	2,715	10,634	42,685	--	22	559	56,615
7.0 - 8.9	4,028	12,889	41,531	--	32	679	59,159
9.0 - 10.9	4,006	12,077	31,807	--	99	614	48,603
11.0 - 12.9	2,536	10,711	42,274	--	63	442	56,026
13.0 - 14.9	3,640	11,043	29,030	--	28	975	44,716
15.0 - 16.9	3,125	14,307	29,757	--	39	497	47,725
17.0 - 18.9	2,588	11,379	23,620	--	25	818	38,430
19.0 - 20.9	1,912	10,329	21,843	--	109	830	35,023
21.0 - 22.9	766	11,411	16,342	--	--	652	29,171
23.0 - 24.9	847	11,190	15,726	--	--	55	27,818
25.0 - 26.9	--	9,456	9,209	--	--	1,089	19,754
27.0 - 28.9	--	10,926	4,998	--	--	331	16,255
29.0+	--	52,219	17,028	--	103	3,108	72,458
Total	28,533	191,834	338,373	--	520	10,738	569,998

[1]Measured in inches at root collar.

Table 58--Net annual growth on woodland by species and ownership class, Arizona, 1984

Species	Ownership class			Total
	National Forest	Other public	Private	
	Thousand cubic feet			
Douglas-fir	773	--	65	838
Ponderosa pine	24,962	--	1,076	26,038
White fir	981	--	--	981
Cottonwood	--	--	8	8
Pinyon	5,027	1,389	7,672	14,088
Juniper	9,950	3,426	9,414	22,790
Oak	8,207	215	2,063	10,485
Cercocarpus	37	--	--	37
Mesquite	992	1,825	3,367	6,184
Other woodland	117	82	114	313
All species	51,046	6,937	23,779	81,762

Table 59--Net annual growth on woodland by ownership class, forest type, and site class, Arizona, 1984

Ownership class	Forest type	Site class: High	Site class: Low	All classes
		- - - - - Thousand cubic feet - - - -		
National Forest:	Pinyon-juniper	47,193	103	47,296
	Juniper	751	15	766
	Oak	1,888	77	1,965
	Mesquite	972	--	972
	Other woodland	47	--	47
	Total	50,851	195	51,046
Other public:	Pinyon-juniper	3,293	80	3,373
	Juniper	1,379	90	1,469
	Oak	195	--	195
	Mesquite	1,665	212	1,877
	Other woodland	10	13	23
	Total	6,542	395	6,937
Private:	Pinyon-juniper	13,449	2,015	15,464
	Juniper	2,434	296	2,730
	Oak	2,035	-26	2,009
	Mesquite	2,953	496	3,449
	Other woodland	117	10	127
	Total	20,988	2,791	23,779
Total:	Pinyon-juniper	63,935	2,198	66,133
	Juniper	4,564	401	4,965
	Oak	4,118	51	4,169
	Mesquite	5,590	708	6,298
	Other woodland	174	23	197
	Total	78,381	3,381	81,762

MORTALITY

Table 60--Annual mortality on woodland by species and ownership class, Arizona, 1984

Species	Ownership class			
	National Forest	Other public	Private	Total
	Thousand cubic feet			
Douglas-fir	--	--	--	--
Ponderosa pine	--	--	168	168
White fir	--	--	--	--
Cottonwood	--	--	--	--
Pinyon	209	--	220	429
Juniper	--	--	140	140
Oak	21	26	97	144
Cercocarpus	--	--	--	--
Mesquite	--	--	68	68
Other woodland	--	--	--	--
All species	230	26	693	949

COUNTY TABLE

Table 61--Area and volume on timberland and woodland by county, Arizona, 1985

County	Timberland		Woodland	
	Area	Volume	Area	Volume
	Acres	Thousand cubic feet	Acres	Thousand cubic feet
Apache	892,195	1,326,908	1,670,052	698,241
Cochise	11,081	23,939	574,649	124,903
Coconino	1,581,266	2,156,823	2,653,963	1,481,791
Gila	235,524	297,807	1,583,885	1,340,617
Graham	96,498	90,042	622,259	212,671
Greenlee	203,953	459,013	354,048	248,290
La Paz	--	--	--	--
Maricopa	--	--	378,948	185,458
Mohave	27,861	22,023	1,314,215	543,400
Navajo	689,546	943,926	1,753,344	747,397
Pima	13,767	27,854	546,432	99,398
Pinal	166	223	374,765	129,626
Santa Cruz	6,291	14,569	293,676	92,784
Yavapai	156,278	194,324	1,369,791	619,217
Yuma	--	--	--	--
Total	3,914,426	5,557,451	13,490,027	6,523,793

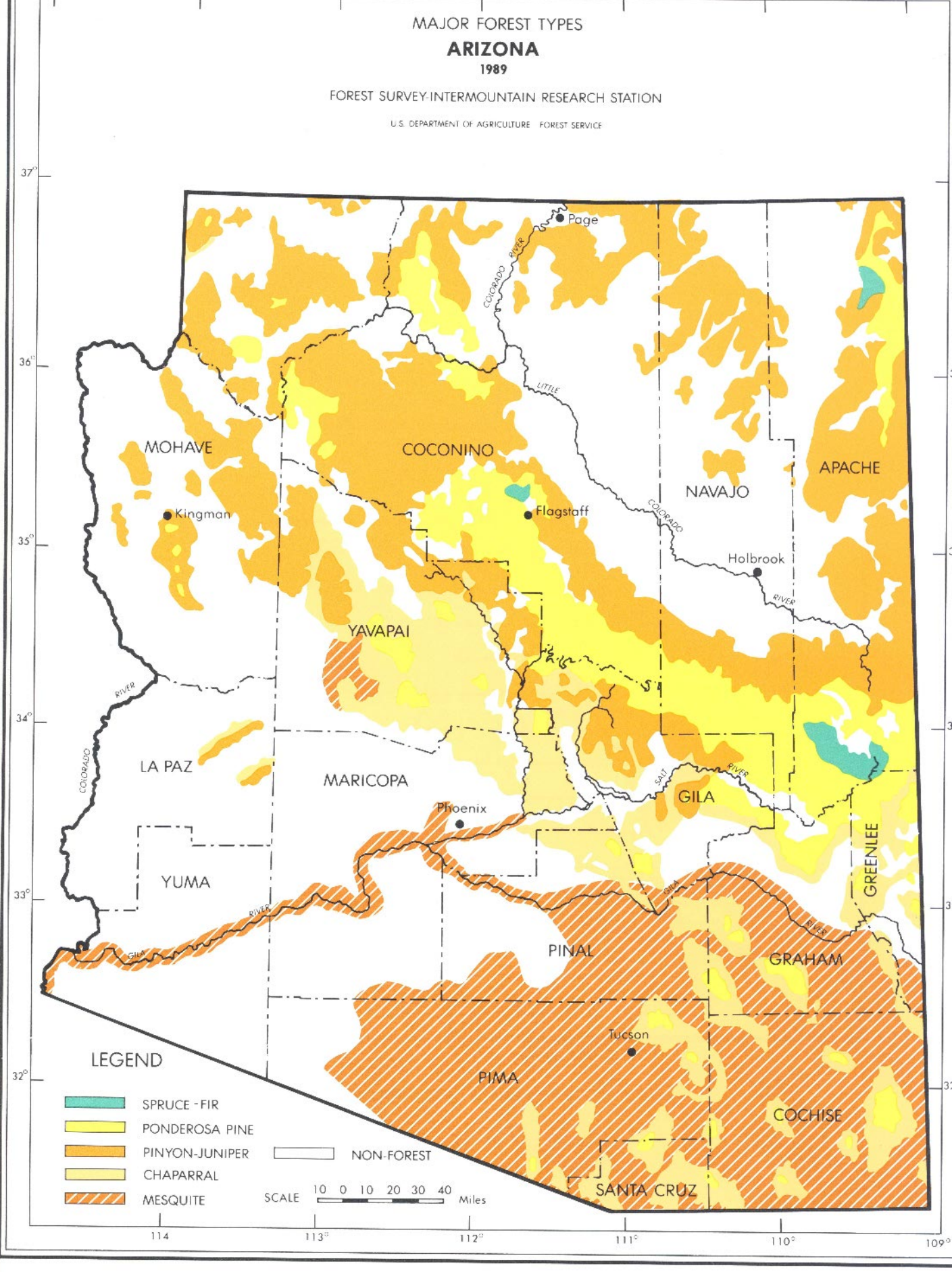

Figure 6—Major forest types in Arizona.

Conner, Roger C.; Born, J. David; Green, Alan W.; O'Brien, Renee A. 1990. Forest Resources of Arizona. Res. Bull. INT-69. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Research Station. 92 p.

Presents highlights of Arizona's forest resources as of 1985. Describes the extent, condition, and location of the State's timberlands and woodlands and briefly discusses levels of some nontimber use of forest land. Includes statistical tables: area by land classes, ownership, wood volumes, growth, mortality, and product removals.

KEYWORDS: timberland, woodland, timber mortality, timber removals, woodland products

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