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The Hardwoods of California's Timberlands, Woodlands, and Savannas

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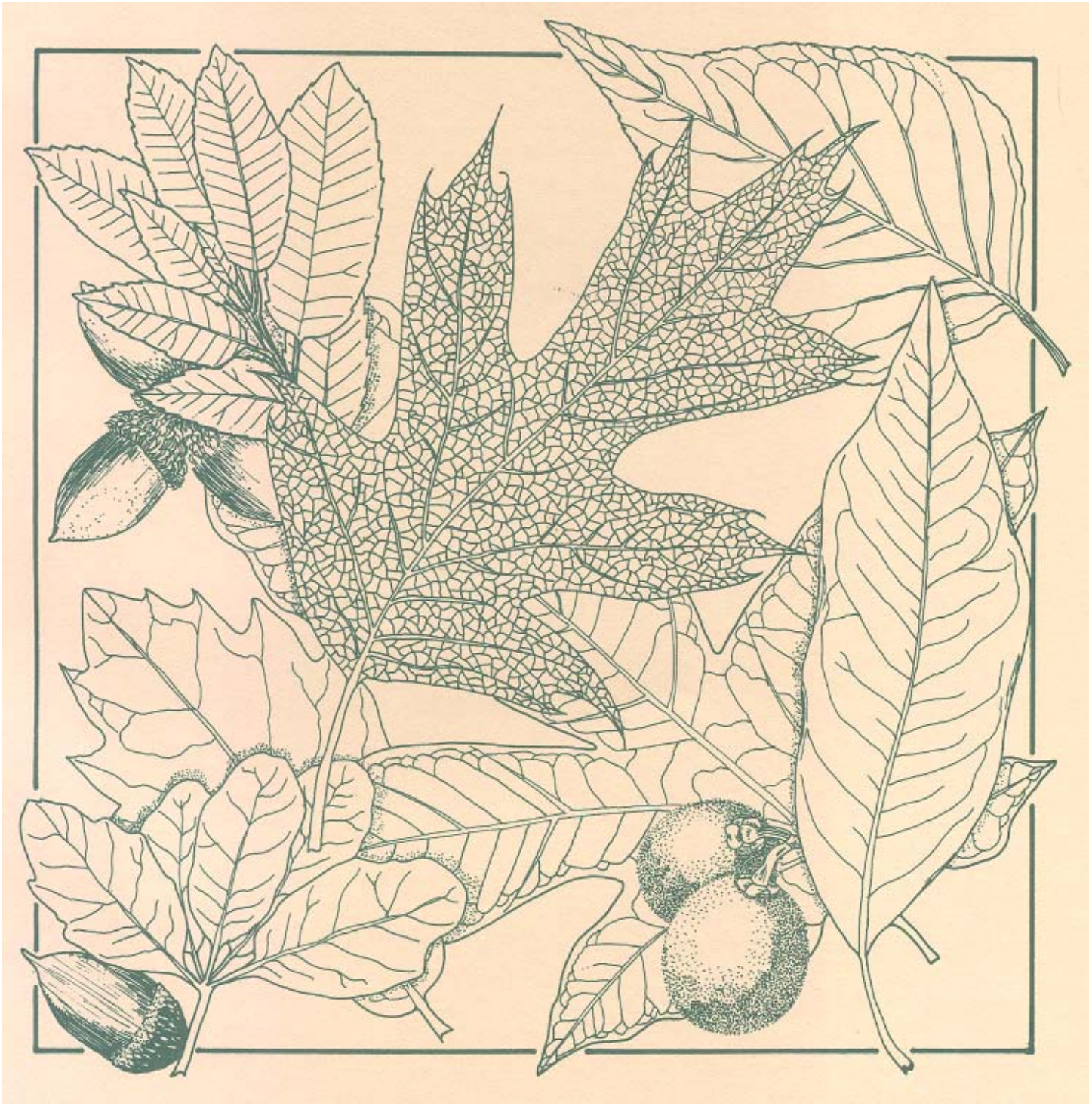

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Abstract

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The results of a statewide inventory of California's hardwood resources are presented. This is the first comprehensive inventory with tree and stand measurements ever conducted in the extensive oak woodlands. In timberland areas where hardwoods had been previously inventoried, improved procedures and volume equations developed specifically for the major California hardwood species were used in the new inventory. Included are details on area and volume of hardwoods by ownership; growth and mortality of hardwoods on timberland; hardwood tree cutting on timberland and woodland; the extent of types and species occurrence; stand characteristics; regeneration; extent of grazing in woodland areas; and changes in hardwood area from 1945 to 1985.

Research Summary

Hardwood forest types occupy 9.6 million acres in California, about 25 percent of the total forest area and 9.5 percent of the State's total land area. Hardwoods also occur as scattered trees, stringers, or clumps on an estimated 8.2 million acres of conifer types, 1.8 million acres of rangeland (savanna), and 1.7 million acres of chaparral. The total area of hardwood occurrence is estimated to exceed 21 million acres.

About 2.2 million acres (23 percent) of the total area in hardwood types are classified as timberland, areas capable of growing industrial wood. Most of the timberland on which hardwoods occur is capable of growing conifer *trees. The* major species of hardwoods on timberland are tanoak, Pacific madrone, California black oak, and canyon live oak.

About 7.4 million acres (77 percent) of hardwood types are classified as woodland. These areas are not capable of growing commercial quantities of industrial wood. They are capable of growing firewood, fenceposts, and small quantities of industrial wood. The majority of the woodland types is grazed by livestock. The major species on woodland are coast live oak, interior live oak, blue oak, valley oak, and Oregon white oak. Canyon live oak, common on timberland, also is found on several hundred thousand acres of woodland.

Seventy-two percent of the hardwood area is in private ownership; 16 percent is in National Forests; and 12 percent is managed by other governmental organizations including the State, counties, Bureau of Land Management (U.S. Department of the Interior), and U.S. Department of Defense. About 577,000 acres of hardwood types are in parks and wilderness.

Total estimated volume of hardwood growing stock in the State is 12.5 billion cubic feet. This includes the sound volume in straight bole sections of *trees above* a 1-foot stump and to the point where the bole is 4 inches in *diameter in* trees 5.0 inches and larger. The total estimated volume in trees 5.0 inches and larger, including all bole sections, stumps, limbs, branches, and tips, is 18.4 billion cubic feet. The estimated volume of hardwoods in saw logs suitable for lumber is 5.3 billion cubic *feet, about* 25 billion board feet.

As with area, private landowners hold the largest portion of the total hardwood timber volume, 67 percent. National Forests contain 26 percent; lands managed by other public agencies, 7 percent.

California's hardwoods are extremely variable in tree quality, stand density, and stand composition. Species such as giant chinkapin, eucalyptus, and tanoak tend 'to be straight and single stemmed with small limbs and gradually tapering boles. At the other extreme are live oaks and Pacific madrone, which often are crooked and multistemmed with large limbs and rapidly tapering boles. Tanoak and madrone stands are typically dense, with many trees per acre. Large specimens are common. Blue oak stands are typically sparse; widespread clearing in blue oak for range improvement and recent cutting of fuelwood have lowered the average density even more. Large blue oak trees are not common.

Regeneration of hardwoods, indicated by seedlings and saplings on sample plats, varies by type. In general, timberland hardwoods are regenerating well. In woodland areas, oak seedlings and saplings were found in great abundance in canyon live oak stands, and in moderate amounts in interior live oak, California black oak, and Oregon white oak stands. Regeneration was relatively sparse in coast live oak and blue oak stands and almost nonexistent in valley oak stands. Some valley oak seedlings and saplings were found in stands of other species.

Since 1945, the total area of hardwood types on timberland is estimated to have increased by about 760,000 acres. Tanoak and madrone are the major types that increased. Over the same period, hardwood woodland area is estimated to have decreased by about 1.2 million acres. Blue oak and valley oak are the major types that have decreased.

The primary cause of the increase in hardwoods on timberland was logging. Conifers were removed, and hardwoods were usually left; in some cases, they rapidly resprouted or seeded in after logging.

Several factors resulted in the decrease in hardwood woodland areas. Between 1945 and the early 1970's, rangeland improvement was the primary cause of woodland conversion. Since the early 1970's, clearings have decreased; urban and suburban expansion has become the main cause of conversion, followed by road construction. The recent increase in fuelwood cutting has reduced the number of trees, but has had little impact per se on the area of woodland. Most permanent clearings apparently are for other purposes, though the wood removed is often used for fuel.

Residential and recreational developments in-process were found on 279,000 acres of woodland. The time frame for these potential conversions was not determined. These developments were in coast live oak, valley oak, blue oak, and eucalyptus stands.

In timberland areas, in hardwood stands as well as in conifer stands, hardwood volume has increased substantially since the early 1950's, a direct result of logging practices and land management activities. Hardwood growth rates have been higher than those for conifers, and mortality rates lower. Hardwood timber cutting has been but a fraction of growth and total inventory volume.

Growth rates were not determined for hardwoods in woodland, but a system of permanent plots was installed from which future growth rates can be determined, along with cutting rates and other changes. The estimated area of woodland in which cutting had taken place, based on a one-time visit to sample plots, is 300,000 acres in the past 5 years or 60,000 acres per year. Intensity of cutting ranged from one tree per acre to 90 percent of the stand. Excluded were areas that had been converted from woodland to nonforest in range clearing; residential developments; and other conversions.

Grazing had occurred within the past year on 55 percent of all woodland plots visited. Grazing intensity varied considerably by type. A larger percentage of the blue oak, coast live oak, interior live oak, and valley oak types had been grazed than of black oak and canyon live oak types,

Contents

Introduction

More than 30 species of hardwoods trees grow in California. Included are widely distributed species such as quaking aspen and black cottonwood, which are found thousands of miles beyond California's borders; and species found only in California, such as blue oak, valley oak, and California buckeye. Hardwoods grow on several million acres of forest in California, in stands of redwood, Douglas-fir, ponderosa pine, and other conifer timber types, and in mixed- and single-species hardwood stands. They also occur as scattered trees in the vast foothill grasslands on both sides of the Sacramento and San Joaquin Valleys and are found in narrow streamside stringers from the Colorado River at the southeast corner of the State to the Oregon border. One or more species of hardwood grow naturally in every county.

Despite the vast acreage and variety of hardwoods in the State, they have not figured greatly in California's forest products industry. In 1982, for example, the total reported log consumption by all categories of forest products (excluding fuelwood) mills was 2,599 million board feet, of which less than 10 million (0.39 percent) was hardwood species (Howard 1984). The largest reported hardwood production was 26 million board feet in 1962, less than one-half of 1 percent of total industrial wood consumption for that year (Bolsinger 1980). For this reason, primarily, statewide forest inventories of the past have concentrated on softwoods. Hardwoods on timberland outside National Forests have been counted in past inventories, but in many cases their volumes were estimated by imprecise methods and volume tables that were developed for other species. On some National Forests, hardwoods on timberland were ignored in past inventories; and the hardwoods on all ownerships in the vast foothill woodland outside the conifer timber zone, although classified into broad ecosystems, had never been inventoried. Not until the late 1970's was any attempt made to inventory hardwoods over extensive areas of woodland, and those attempts were confined to a four-county area (Pillsbury and Brockhaus 1981, Pillsbury and Stephens 1978).

Hardwood Issues

Events since 1978 have brought California hardwoods into public focus. In 1979, a symposium (Plumb 1980) brought together diverse views on the "state-of-science" and the "state-of-practice" relating to California oaks (Callaham 1980). The symposium also served as a "bulletin board" for information gaps. In this respect, the symposium seems to have been successful. Action was taken by many organizations to fill those gaps. By 1983, the number of research and development projects on oak had increased from 25 to 68. More than 20 organizations invested 2.5 million dollars and 26 scientists and professional years (Muick and Bartolome 1985) on hardwood research.

[1] See "Definition of Terms" in the appendix.
[2] Common names are used for trees throughout this text and scientific names for shrubs. See "Names of Woody Plants" for scientific names of all plants.

Several of the concerns aired at the 1979 symposium were reintroduced at planning sessions for the statewide forest inventory, along with some new concerns. Some of these concerns have become major policy issues facing the State. Most of the issues fall into one or more of seven categories:

1. Fuelwood cutting
2. Rangeland clearing
3. Residential and commercial development of woodland
4. Hardwood regeneration
5. Wildlife habitat
6. Underutilized hardwoods
7. Hardwoods as "weeds"

Following is a discussion of these issues, as they relate to the first statewide inventory of hardwoods in California presented here.

Fuelwood Cutting

The increasing cost of energy from fossil fuels and hydroelectricity has caused a tremendous increase in the use of wood for home heating. The 1973-74 oil embargo seems to mark the beginning of the firewood revolution, nationwide. By the winter of 1980-81, 28 percent of U.S. households burned 40.5 million cords of wood as their primary source of heat (Bailey and Skog 1984), an increase of nearly 300 percent. Industrial use of wood energy also increased.
For example: In 1977, 16 percent of the capacity of all industrial boiler starts in the United States was in wood-fueled units; by 1980, it had increased to 49 percent (Hewett and Glidden 1981). In 1980 in California, the State Board of Equalization reported that about 28,000 cords of fuelwood were cut in the State, including more than 12,000 cords of hardwoods. In 1984, the reported amount of fuelwood cut in California was more than 85,000 cords, including 35,000 cords of hardwoods (State of California, Board of Equalization 1981-85). The reported estimates indicate a 292-percent increase in the amount of hardwoods cut for fuel between 1980 and 1984.

Rangeland Clearing

Past increases in demand for beef and the trend toward marketing range animals without feedlot finishing have encouraged land managers to remove trees to improve land forage production. From 1945 to 1974, about 1.9 million acres of hardwoods and chaparral were reported to have been cleared in rangeland improvement projects (State of California 1953-74). Although the acreage of rangeland cleared annually has declined considerably, some clearing is still taking place and was one of 19 concerns identified by the Hardwood Task Force of the California Board of Forestry in its December 1983 draft report (Passof and Bartolome 1985).

Residential-Commercial Development of Oak Woodland

In many parts of the State, residential and recreational developments have usurped hardwood forest and woodland. The actual area occupied by buildings in most developments is not great; however, their dispersion across the landscape and their concomitant networks of roads, pipelines, and transmission lines have destroyed the wild-land character over extensive areas. A major concern relates to these "suburban forests," the remaining enclaves of wild land within developed areas, and the forests adjacent to and beyond development boundaries: What is their resource potential? How should they be taxed? Should they be regulated, and if so, how?

Hardwood Regeneration

In large areas of the oak woodland in the foothills, young oak trees are few. Concern is growing that once the old trees die or are cut, certain species of oaks will disappear. Considerable research has been done, but no universal solutions have been found. Until now, no information on oak regeneration statewide has been available

Wildlife Habitat

The importance of hardwoods to wildlife has been well documented, but only in recent years have wildlife habitat concerns made much difference in land-use plans, forest regulations, or resource allocation. In statewide planning for wildlife, information on hardwoods has been generally lacking. Needed are data on extent of hardwood species, stand characteristics, occurrence of large trees, and stair dynamics, in timber areas as well as in woodlands.

Underutilized Hardwoods

The presence of large quantities of hardwoods in local areas of marginal economic health has prompted many hardwood development efforts over the past several decades. Most of these projects have failed; why is not clear. One contributing factor is thought to be that California hardwoods simply cannot compete with hardwoods of the Eastern United States. California hardwoods are generally believed to be smaller and inferior in quality to eastern hardwoods. Whether or not this has ever been true is not as important as the fact that people believe it. But this may be changing. The growing scarcity of quality hardwoods in the East has caused people to take a closer look at the resource situation, and to look for alternate sources, including the Pacific coast. At the same time, foreign interests have also begun to notice California's hardwoods.

Hardwoods as "Weeds"

In much of the coastal redwood and Douglas-fir zone, and in part of the mixed conifer zone of the interior, there has been little interest in managing timberland for hardwood production. Conifer timber grown in the area is much more valuable. In fact, the hardwoods, especially the lower grade trees, often cannot be sold. Tanoak, Pacific madrone, California-laurel, red alder, bigleaf maple, and occasionally other species often dominate sites within a few years after removal of conifer trees by logging. On these sites, without some kind of "hardwood control," the land's potential to grow large quantities of valuable conifer timber is lost for decades. In the mixed-conifer type of the interior, California black oak and other hardwood species rarely dominate the site, but they often reduce timber yields by simply occupying space where the more productive conifers could grow.

Although listed as separate concerns, the growing pressure from various interest groups has fused several concerns into some common issues. Economic imperatives facing both public and private timberland and rangeland managers necessitate efficient use of land.

On many sites, hardwoods are inimical to landowners' goals, at least within the short-term planning horizon forced on most managers. A dilemma faces policymakers. Scientific evidence seems to indicate that some kind of hardwood stocking control will usually abet conifer production or beef production, but not without some tradeoffs. In many cases, the immediate effect on wildlife will be negative; the mid-term effect on soil pH, fertility, and stability will be negative; and the long-term effect on biological diversity will be negative; in some areas and to some people, the effect on esthetics will be negative.

The Hardwood Inventory

The many "issues" related to hardwoods have created the need for information on which to base policy decisions. This need was translated into an action plan for a statewide hardwood inventory to be conducted by the USDA Forest Service Forest Inventory and Analysis Research Unit. The existing forest inventory system was modified and extended to cover hardwood woodlands; several new hardwood volume equations were developed (Pillsbury and Kirkley 1984); and new procedures and methods pertinent to hardwoods were adopted (see appendix). Fieldwork for the statewide hardwood inventory was begun in March 1981 and was finished in November 1984. Compilation and analysis of the data were done from December 1984 to September 1985. The results, presented in this report, include information on area of hardwoods by type and ownership; extent of species occurrence; stand characteristics including understory vegetation; regeneration; volume by species, ownership, and tree form; growth and mortality of hardwoods on timberland; hardwood removals; and extent of woodland grazing and nonforest development.

Hardwood Area

Hardwood Types on One-Fourth of the Forest Land

The total estimated area of hardwood forest types in California is 9.6 million acres, about 25 percent of the total area classified as forest (table 1). Included are 2.2 million acres classified as timberland (fig. 1) and 7.4 million acres classified as woodland (fig. 2). Twenty-eight thousand acres of hardwood types on timberland and 506,000 acres on woodland are reserved in parks and wilderness (see table 8 in the appendix). About 77 percent of the area of hardwood types on timberland is in the north coast and northern interior resource areas. Woodland hardwood types, although found in the north coast and northern interior, are more extensive in the central coast, Sacramento, San Joaquin, and southern California resource areas (fig. 3).

Table 1—Total area of forest land by forest type group and owner, California, January 1, 1985[1/]

Forest type group	National Forest	Other public	Private	Total	Percent
		Thousand acres			
Hardwoods	1,540	1,146	6,917	9,603	25
Timber conifers and nonstocked	11,841	1,574	5,810	19,225	50
Pinyon juniper and cypress	1,107	862	463	2,432	6
Chaparral	2,651	1,568	3,239	7,458	19
Total	17,139	5,150	16,429	38,718	100

1/ Includes all forest land in the State, inside and outside parks and wilderness, and productive as well as unproductive sites.

Figure 1—Hardwood types occupy 2.2 million acres of conifer timberland in California. This stand of California black oak in Shasta County consists of numerous small trees growing on land that formerly supported large conifers.

Figure 2—Hardwood types occupy 7.4 million acres of woodland. Included in this woodland-grassland mosaic in southern Mendocino County are interior live oak, canyon live oak, California black oak, blue oak, and Oregon white oak.

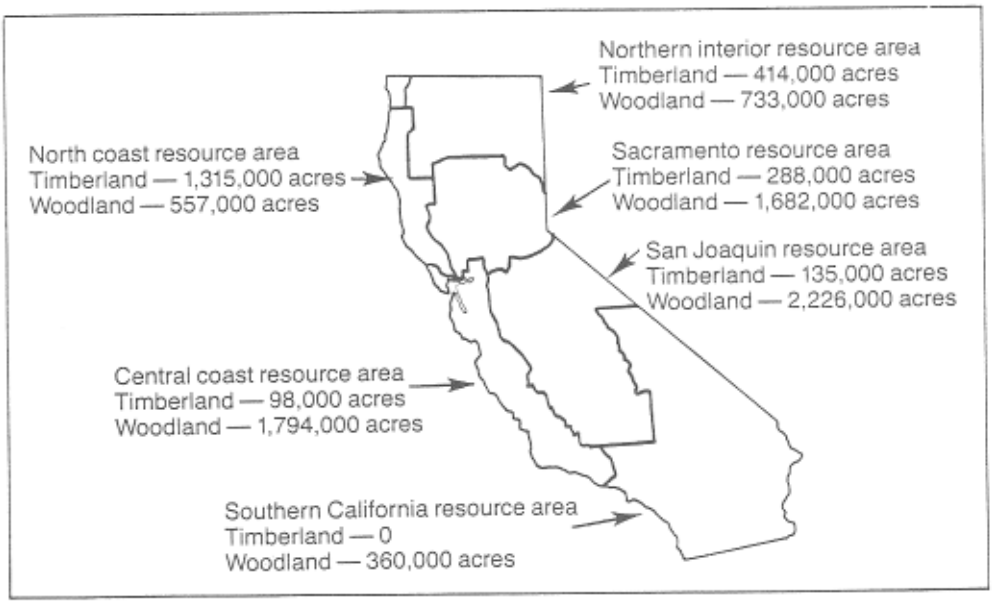


Figure 3—Area of hardwood types on timberland and woodland by resource area, California, 1985.

Most of the Hardwoods on Private Lands

About 6.9 million acres, or 72 percent of the hardwood types, are on privately owned land, a decided contrast with the ownership of other forest types, of which 19.6 million acres or 67 percent are on public lands (fig. 4 and table 1). National Forests contain 44 percent of all forest land in the State (including timberland types, hardwood woodland, pinyon-juniper, cypress, and chaparral), but only 16 percent of the hardwood types. Other public lands contain 13 percent of the forest land and 12 percent of the hardwood types.

	Timberland		Woodland	
Public	395,000 acres	4	2,291,000 acres	24
Private	1,857,000 acres	19	5,060,000 acres	53
	2,252,000 acres	23	7,351,000 acres	77

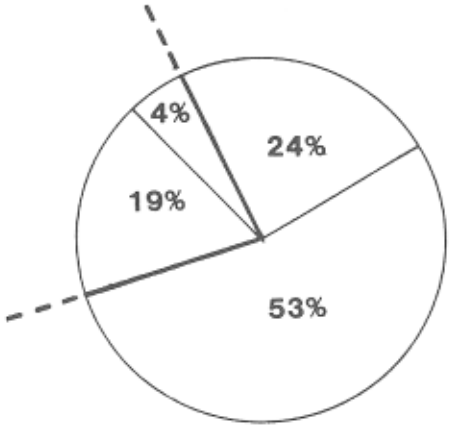


Figure 4—About three-fourths of the area of California-hardwood types is in woodland; private owners hold 72 percent of the hardwood area.

Hardwood types in reserved areas amount to 534,000 acres: 286,000 acres in National Forests (mostly Wilderness Areas), and 248,000 acres in other public ownerships (national, State, county, and regional parks).

Hardwoods in Conifer Types

In addition to the hardwood forest types where one or more species of hardwood predominate, individual hardwood trees, or clumps, groves, or stringers occur in conifer types in many parts of the State. In the forest inventory outside National Forests and Parks, hardwood trees were found on 4,475,000 acres or about 60 percent of the conifer types. Included were 3,915,000 acres of timber conifers-such as Douglas-fir, redwood, mixed conifer, and ponderosa pine-on manageable sites; 383,000 acres of timber conifers on steep and rocky sites classified as unmanageable for timber production; and 177,000 acres of woodland types including pinyon, juniper, cypress, and Digger pine.

Information is not available on the occurrence of hardwood trees in conifer types in National Forests and Parks. Because large areas of the National Forests are at higher elevations where hardwoods are less common, a smaller proportion of the conifer types would be expected to contain hardwoods. Still, hardwoods occur on most of the 1.4 million acres of Douglas-fir type on National Forests, on much of the 5.1 million acres of mixed conifer type, and on a small amount of the 2.2 million acres of ponderosa pine and Jeffrey pine types. Also, some hardwoods occur in the 2.3 million acres of minor conifer types in National Forests, including knobcone pine, lodgepole pine, Coulter pine, western white pine, bigcone Douglas-fir, pinyon, and juniper.

About 1.2 million acres of conifer forest types, many of which contain hardwoods, are in national, State, county, and regional parks. In Redwood National Park and the many State parks in the coastal counties from Monterey to Del Norte, tanoak, live oaks, alder, maple, and laurel are common in the conifer forests. In Yosemite National Park, California black oak is conspicuous in the mixed conifer forest of the valley; white alder trees border the streams; and canyon live oak forms an understory in the hillside conifer stands.

Hardwood trees are thought to occur as scattered individuals, small clumps, or stringers on at least 30 percent or 3.7 million of the 12.2 million acres of conifer types in National Forests and Parks.

Hardwoods in Savannas and Chaparral

The information presented thus far relates to hardwoods on forest land. By definition; forest land has trees, the canopies of which cover at least 10 percent of the ground, or had such cover before disturbance and has not been developed for nonforest use. In California, hardwoods often occur as scattered trees and groves in rangeland and as a scattered overstory in chaparral (Paysen 1980). The oaks in the grasslands of the foothills contribute to the distinctive character of California's scenery (Litton 1980). From a wildlife habitat standpoint, nonforest areas with scattered trees-even very widely spaced trees-are vastly different from treeless areas. Some speakers at the symposium on California oaks (Plumb 1980) addressed the subject of oaks in areas that are not classified as forest land by the Forest Service. Several speakers cited the need for better information on oaks in nonforest and chaparral areas.

The area of scattered hardwoods in the extensive grassland and chaparral areas of California was determined by an aerial photo sample. About 85,000 aerial photo plots were examined outside National Forests (parks were included). Plots were circular, covering 5 acres. Tree cover was classified as follows:

1-4 trees per 5 acres (less than 1 tree per acre) 5-24 trees per 5 acres (1-5 trees per acre) 26 trees per 5 acres-9 percent cover (more than 5 trees per acre)

Plots with 10 percent or more cover were classified as forest and are included in the forest statistics.

Individual species could not be consistently identified on aerial photographs within the time available to do the study, but hardwoods could be identified as a group; Digger pine; pinyon, juniper, and cypress as a group; and all other conifers. The group classification, along with geographic information, is a help in identifying species.

Outside National Forests, hardwoods in densities of at least one tree per 5 acres were found on about 1.6 million acres of grassland in the State (fig. 5), and on 1.2 million acres of chaparral (fig. 6; see table 2). The sparsest class (1-4 trees per 5 acres) accounted for the majority of the grassland and chaparral with trees present. An even greater area could be expected if sparser densities were included.

Within National Forests are some grassland and chaparral areas with scattered hardwoods. The total area of National Forest grassland is about 2.3 million acres, 1.5 million acres or 65 percent of which lies east of the Cascade Range-Sierra Nevada crest in Inyo, Lassen, Modoc, Plumas, Tahoe, and Toiyabe National Forests where hardwoods are uncommon. Of the remaining 0.8 million acres, 0.4 million are in the Los Padres National Forest where some scattered hardwoods grow. The balance is in many small pieces from Cleveland National Forest in the south to Klamath National Forest in the north. At the most, estimates are that there could be about 0.2 million acres of scattered hardwoods on grassland in National Forests.

Figure 5—Oak savanna in the Coast Range foothills in Glenn County. Scattered hardwood trees, groves less than an acre in size, and stringers less than 120 feet wide were found on 1.6 million acres of grassland outside National Forests statewide.

Figure 6—Oak and chaparral intermingle on this hillside in San Luis Obispo County. Statewide, hardwoods were found on 1.2 million acres of chaparral outside National Forests.

Chaparral types cover about 2.6 million acres of National Forest land'. No information is available on the occurrence of hardwood trees in these types. If hardwood occurrence is similar to that outside National Forests-24 percent has at least one tree per 5 acres-then about 0.6 million acres of National Forest chaparral are likely to have scattered hardwood trees.

The total area in California in which hardwoods occur, based on different methods of estimation and approximation, is about 21 million acres:

Category	Thousand acres	Percent
Hardwood forest types, all owners[3]	9,615	45
Hardwood trees in conifer forest types:[3]		
Outside National Forests and Parks[3]	4,475	21
In National Forests and Parks[4]	3,700	17
Hardwood trees in grassland (less than 10-percent tree cover):		
Outside National Forests and Parks[5]	1,598	8
In National Forests[4]	200	1
Hardwood trees in chaparral (less than 10-percent tree cover):		
Outside National Forests and Parks[5]	1,159	5
In National Forests[4]	600	3
Total area of hardwoods	21,347	100

[3] Based on ground plots and/or type mapping.

[4] Approximated; no actual data available.

[5] Based on aerial photo plots without ground checking.

Table 2—Area of grassland and chaparral outside National Forests with scattered hardwood trees, by tree density class and resource area, California, January 1, 1985

Tree density class and resource area	Grassland	Chaparral	Total
	Thousand acres		
1-4 trees/5 acres:			
North coast	105	27	132
Central coast	225	265	490
Northern interior	45	40	85
Sacramento	166	92	258
San Joaquin and southern California	340	181	521
Total	881	605	1,486
5-25 trees/5 acres:			
North coast	31	22	53
Central coast	251	262	513
Northern interior	36	24	60
Sacramento	98	71	169
San Joaquin and southern California	184	87	271
Total	600	466	1,066
26 trees/5 acres--9 percent cover:			
North coast	10	8	18
Central coast	45	49	94
Northern interior	11	7	18
Sacramento	29	12	41
San Joaquin and southern California	21	11	32
Total	116	87	203
All tree densities:			
North coast	146	57	203
Central coast	521	576	1,097
Northern interior	92	71	163
Sacramento	293	175	468
San Joaquin and southern California	545	279	824
All resource areas	1,597	1,158	2,755

Timberland Hardwoods Concentrated on Steep Slopes

Forests in California, as in much of the Pacific coast. are often on rugged terrain where logging is costly and sometimes hazardous, and the risks of damaging soil productivity and water quality are high. About 30 percent of California's timberland outside National Forests is in areas that have special management problems such as steep (more than 45 percent), unstable slopes and stockability problems (Bolsinger 1980). The steep, unstable forested areas are concentrated in the Klamath Mountains and Coast Ranges from the Oregon border to Monterey County, where 5 billion cubic feet or two-thirds of the timberland hardwoods grow. Conifers and some hardwoods have been logged successfully in these mountains for more than a century, although not without affecting soil and water quality in some areas. In many areas, the hardwoods have been left to grow after logging, and no doubt they have helped protect the sites. If the market permits an appreciable increase in hardwood utilization, effects on soil and water, as well as on wildlife and other values, may be deleterious.

Woodland Areas Mostly Flat to Gently Sloping

Vast areas of the oak woodland are in flat to gently sloping terrain, contrasting with the steep, broken country where much of the timberland hardwoods grow. Interior live oak and blue oak types are usually found on slopes of 35 percent or less canyon live oak and coast live oak types, on steeper ground:

Woodland forest type	Slope (percent) 0-15	16-35	36-55	55+	Total
	(Percent of type)				
Coast live oak	33	13	20	34	100
Canyon live oak	0	31	14	55	100
Interior live oak	15	50	30	5	100
Blue oak	25	50	22	3	100
Oregon white oak	27	45	9	19	100
All other hardwoods	25	46	8	21	100
All forest types	21	44	20	15	100

Hardwood Volume

Volume in Hardwood Growing Stock More Than 12 Billion Cubic Feet

The total estimated volume in hardwood growing-stock trees on timberland and woodland outside parks and wilderness in California is 12.5 billion cubic feet. As with area, private landowners hold the majority of the total hardwood volume-8.4 billion cubic feet, or 67 percent (see "Sources of Information and Inventory Methods" in the appendix for details on volume determination).

Hardwood Volume Greater on Timberland Than on Woodland

Although hardwood types are more extensive on woodland areas than on timberland, the volume of hardwoods is greater on timberland-7.7 billion cubic feet on timberland and 4.8 billion on woodland (fig. 7). On the average, timberland sites are much more productive than woodland sites; they support denser stands of taller trees. Hardwoods are also found in several million acres of conifer types on timberland, as well as in hardwood types.

Collectively, Oaks Predominant Tanoak and Madrone Also Prominent

Oaks (all species of *Quercus*) predominate on both timberland and woodland, but only by a narrow margin on timberland. Species other than oak (nonoak) amount to 48 percent of hardwood volume on timberland, compared with 19 percent on woodland(table 14, fig. 8).

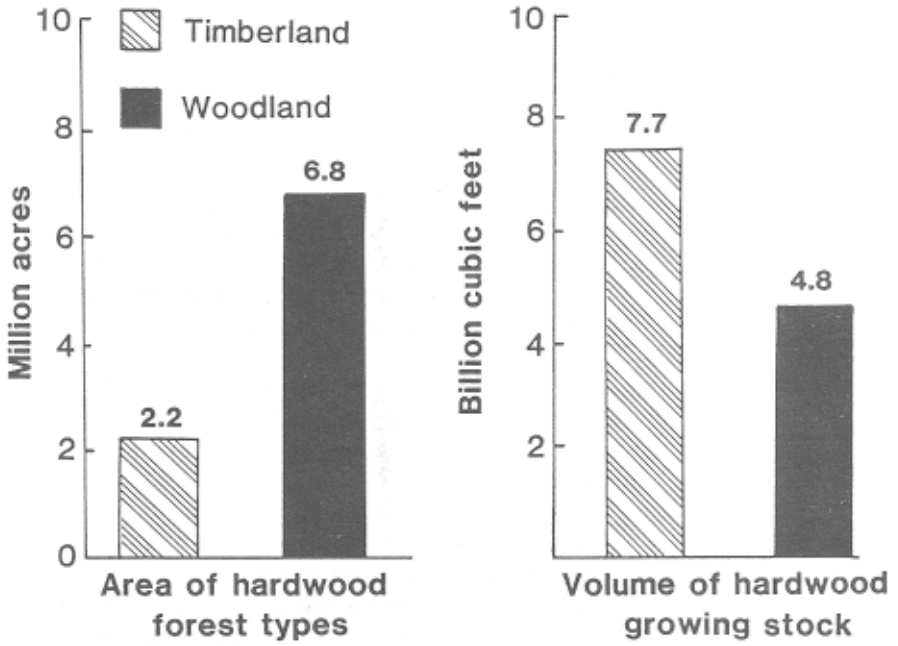


Figure 7—Hardwood types are more extensive on woodland than on timberland, but hardwood volume is greater on timberland; area and volume in parks and wilderness are not included.

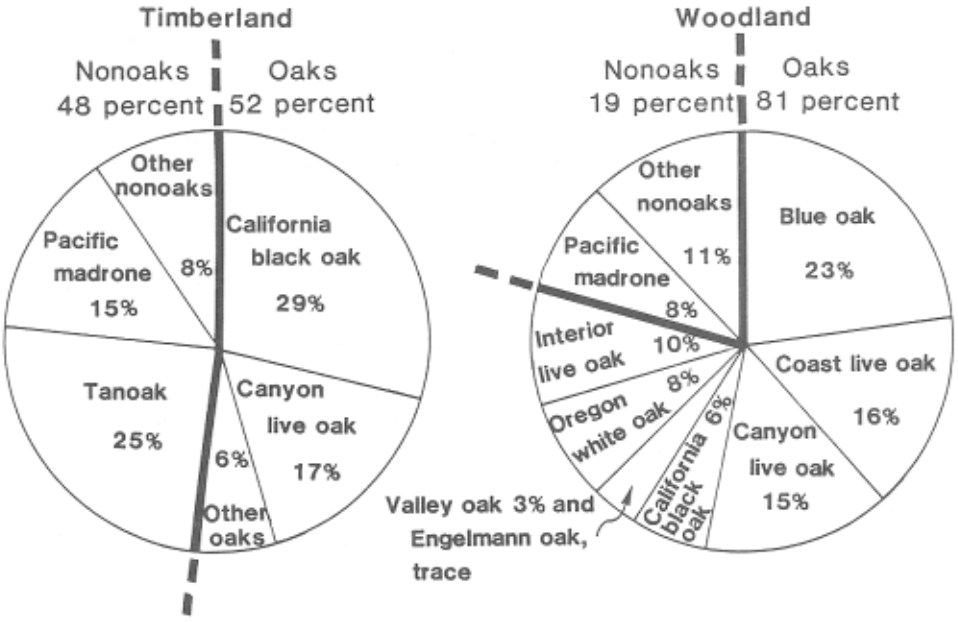


Figure 8—Oaks comprise 52 percent of the hardwood volume on timberland and 81 percent on woodland.

Although more than 30 hardwood tree species grow in the State, 80 percent of the volume is in six species: California black oak, canyon live oak, tanoak, Pacific madrone, blue oak, and coast live oak:

Species	Growing stock volume	
	(Million cubic feet)	*(Percent)*
California black oak	2,531	20.2
Canyon live oak	2,033	16.2
Tanoak	1,938	15.5
Pacific madrone	1,517	12.1
Blue oak	1,113	8.9
Coast live oak	881	7.0
Oregon white oak	600	4.9
Interior live oak	553	4.4
California laurel	427	3.4
Eucalyptus	231	1.8
Valley oak	198	1.6
Alder	167	1.3
Bigleaf maple	156	1.2
Giant chinkapin	50	.4
Cottonwood	42	.3
Aspen	29	.2
California buckeye	25	.2
All other hardwoods	44	.4
Total	12,535	100.0

California black oak is the most abundant oak on timberland, accounting for 29 percent of the hardwood volume; tanoak, the most abundant nonoak, 25 percent. On woodland, blue oak is the predominant tree species, accounting for 23 percent of total volume, but six other oak species (coast live oak, canyon live oak, interior live oak, California black oak, Oregon white oak, and valley oak) collectively constitute 58 percent. Pacific madrone is the most common nonoak species on woodland, with 8 percent of the hardwood volume; eucalyptus amounts to 4.5 percent; of the remaining 6.5 percent, 3 percent is California-laurel, and 3.5 percent is made up of several species including alders, aspen, California buckeye, cottonwoods, maple, and willows (see table 14 in the appendix).

High Wood Density in Most of California's Hardwoods

On California's timberland, 95 percent of the hardwood growing stock volume is in species with high wood density-specific gravity of 0.51 or more based on ovendry weight and green volume (USDA Forest Service, Forest Products Laboratory 1974). On woodland, although the species mix is different, the percentage of high-density species is about the same-96 percent. The predominant woodland species have generally higher specific gravities than the species that are most abundant on timberland. For example, the white oaks, blue oak, and live oaks-the major woodland species-have specific gravities ranging from about 0.65 to 0.75. California black oak, tanoak, and Pacific madrone-three of the major timberland hardwood species have specific gravities of about 0.51 to 0.60.

The high density of California's hardwoods is notable in comparison with hardwoods in other regions. In all Eastern States, hardwoods with specific gravity of 0.51 or more amount to 68 percent of the total. In the Western States other than California, only 17 percent of the hardwoods have wood with specific gravity of 0.51 or more. For several of the traditional uses of hardwoods (fuel, furniture, tool handles, flooring, and cutting boards, for example), species with high wood density have been preferred, although, as discussed below, other factors can determine the usefulness of a particular species.

California's Hardwoods Largest in the United States

Several eastern hardwoods with high specific gravity are valued for products, but factors other than wood density are critical in their usefulness. Wood workability, freedom from defect, and size of material are of prime importance. These characteristics are often related to age and size of trees. The eastern "select" oaks used in furniture and many other products are distinguished from nonselect oaks mainly by their larger size and better form.

Although the volume of hardwoods on California timberland amounts to only 3 percent of the total hardwood volume on timberland in the United States (table 3), the volume of trees more than 29.0 inches in d.b.h. on California's timberland is 19 percent of the total for that diameter class in the Nation. The 702 million cubic feet o` California hardwoods in trees 29.0 inches and larger exceeds that in all the New England, Middle Atlantic, and Lake States combined (USDA Forest Service 1982).

Projections of hardwood supply in the United States (USDA Forest Service 1982) indicate that demands in the next three decades for most hardwood products can be met. The outlook would change if demand for fuelwood increases above expected levels. The projections show a different outlook for the larger sized hardwoods of preferred species, such as "select" oaks, walnut, and black cherry. Removals of these valuable hardwoods in the Eastern United States have exceeded recent renewal rates. California's large hardwoods are not the same species as those that support the hardwood industry in the Eastern United States, but some-California black oak, for example-are suitable for the same products (Hall and Allen 1980). As the supply of quality hardwoods is depleted in the East, hardwoods in California may attract more attention.

Table 3—Net volume of hardwood growing stock on timberland by section and region or State, and diameter class, United States, 1977[1/]

Section and region or State	Diameter at breast height (inches)					
	5.0-10.9	11.0-14.9	15.0-20.9	21.0-28.9	29.0+	Total
	Million cubic feet					
Eastern United States:						
New England	10,569	4,727	2,465	627	77	18,465
Middle Atlantic	24,414	12,936	8,792	2,340	373	48,855
Lake States	19,088	7,930	4,350	1,082	166	32,616
Central States	11,445	7,996	6,578	2,157	459	28,635
South Atlantic	13,326	10,692	9,053	2,993	590	36,654
East Gulf	6,278	4,485	3,118	1,121	277	15,279
Central Gulf	12,602	8,032	5,944	1,569	275	28,422
West Gulf	10,333	6,275	5,337	1,799	323	24,067
Total	108,055	63,073	45,637	13,688	2,540	232,993
Western United States:						
Rocky Mountains	2,981	1,202	548	134	15	4,880
Pacific Northwest	4,268	2,819	2,244	924	267	10,522
Alaska	1,347	537	284	166	119	2,453
California	2,234	1,552	1,821	1,372	702	7,681
Total	10,830	6,110	4,897	2,596	1,103	25,536
Total United States	118,885	69,183	50,534	16,284	3,643	258,529

1/ Data for California as of 1985.

Hardwood Stands Lower in Volume Than Conifer Stands

In the West, more than in the East where terrain is usually gentle, an important factor in determining whether timber is economically available is the value of the timber per unit of land. Most California hardwoods are currently less valuable than conifers on a per-unit basis, and stands of hardwoods typically have less volume than conifers. The average per-acre volume for conifers statewide is about 3,000 cubic feet (about 16,500 board feet). The statewide average per-acre volume for hardwoods on timberland, including hardwood types as well as hardwoods in conifer stands, is less than 500 cubic feet. The board foot-cubic foot ratio for hardwoods is much lower than for conifers. On the average, 500 cubic feet of hardwoods represents no more than 1.200 board feet (500 cubic feet of conifers represents 2,500 to 3,000 board feet).

Hardwood Tree Form Class

A factor in the economic availability of wood is tree form. Conifers typically are tall and straight, single-stemmed with gradually tapering boles and small limbs and branches that grow out of the main bole at a right angle, or close to it. These characteristics are ideal for falling, trimming, bucking, yarding, loading, and hauling to processing facilities; they are also ideal for most industrial processes. Hardwoods vary more in form. The form of giant chinkapin resembles that of the conifers with which it grows; and tanoak, cottonwood, alder, aspen, and eucalyptus are often straight and relatively free of large limbs or forks. In contrast are Pacific madrone, which is usually crooked, and the oaks that vary too much for generalizations. In a given stand of live oak, for example, can be found straight single-stemmed trees, straight but forked trees, and multistemmed, crooked trees. California black oak a[-cl valley oak usually have straight lower boles, but the height at which they start to fork and the straightness of the forks vary.

For every hardwood tree tallied on forest inventory plots outside National Forests, a hardwood tree form class was assigned (fig. 9). The tree form classes are:

Class 1 Entire bole including the first 8-foot log above the stump is straight (fig. 10). Tree has small limbs, and less than 20 percent of volume is 'lost because of roughness, forking, branching, rapid taper, or breakage.

Class 2 The first 8-foot log above the stump is straight; large limbs (more than t;4bole diameter), roughness, crooks, or forks are present, but they affect less than 20 percent of the volume. Included are straight-forking trees with little volume loss. Breakage loss is less than 20 percent.

Class 3 The first 8-foot log above the stump is straight, but large limbs, roughness, crooks, or forks affect at least 20 percent of the volume. Breakage loss is less than 20 percent.

Class 4 The first 8-foot log above the stump is not straight, but the tree must have one or more straight 8-foot logs elsewhere.

Class 5 The tree has no 8-foot logs because of form.

Class 6 Top out-20 percent or more of tree volume is lost because of broken bole.

Hardwood tree form classes 1 through 4 and 6 are growing-stock trees. Class 5 trees are "sound cull" trees-that is, they do not make a minimum log-and are not included in the estimates of growing-stock volume (tables 14-31 in the appendix).

Tree form classes 1 and 2 represent hardwood trees that could be harvested as efficiently and safely as conifer trees, other factors being equal. On timberland, class 1 trees accounted for about 24 percent of hardwood volume and class 2 trees for 29 percent (table 32). The total of classes 1 and 2 is 3.0 billion cubic feet, 53 percent. On woodland, class 1 trees accounted for only 8 percent of hardwood volume and class 2 for 19 percent (table 38). The total in these classes is 1.2 billion cubic feet; 27 percent.

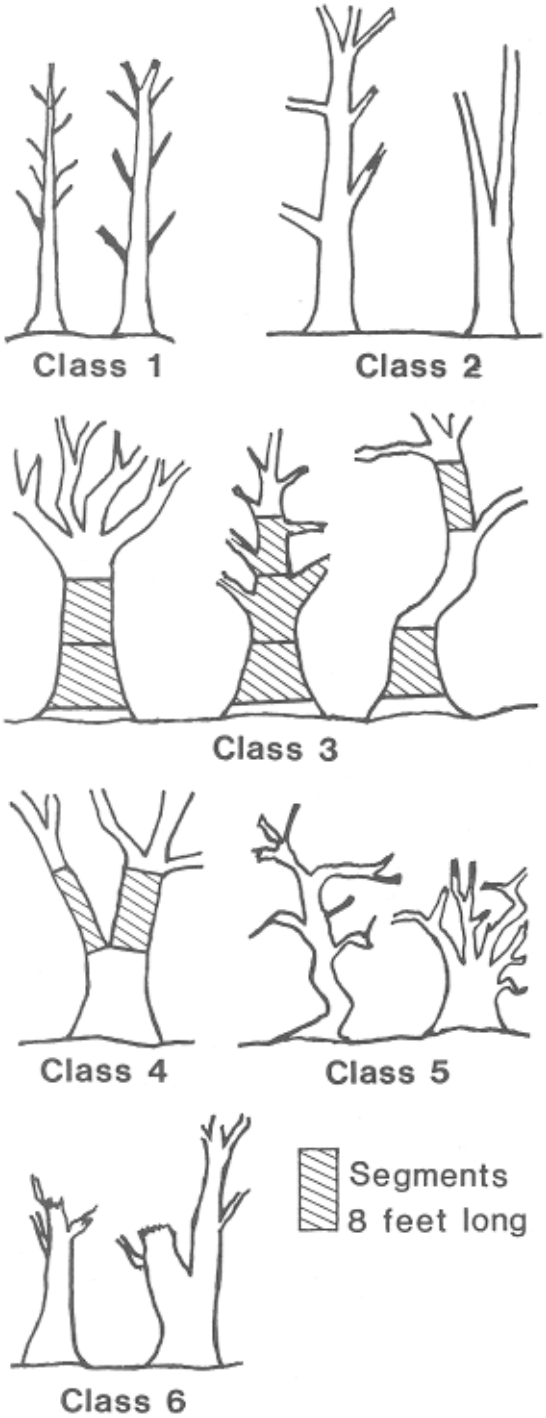


Figure 9—Hardwood tree form classes.

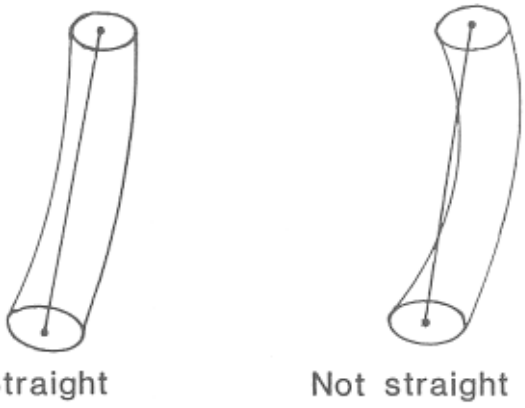


Figure 10—Straight log definition: A line drawn through the centers of both ends of the log does not pass outside the curve of the log.

Tree form classes 3 and 4 represent hardwood trees with straight sections that could be used for industrial purposes, but the trees are rough or forked and therefore more costly to harvest. Some of these trees would be hazardous to log, especially on steep slopes and in stands where the tree crowns interlock. On timberland. class 3 trees accounted for 28 percent and class 4 trees for 10 percent of total hardwood volume. The total volume in these classes is 2.2 billion cubic feet. On woodland, class 3 trees accounted for 36 percent and class 4 trees for 23 percent of total hardwood volume. The total volume in these classes is 2.8 billion cubic feel.

Tree form class 5 represents trees that have no industrial wood volume. Their volume is excluded from the growing stock volume totals in tables 14-31 . They account for 7 percent of the total volume on timberland and 14 percent on woodland Although these trees contain wood suitable for fuel, they are time consuming and o fen dangerous to handle. Fuelwood cutters prefer straighter trees with few forks or large limbs.

Tree form class 6-the broken trees-represents a small part of the total resource These are trees that have lost at least 20 percent of their volume to broken boles and are not form class 5 trees. On timberland, they amount to about 1.6 percent and on woodland 0.6 percent. California black oak and tanoak have a slightly higher breakage rate than that of woodland hardwoods. California black oak has a spreading crown pattern that appears to make it more susceptible to breakage by logging. Much of the mixed conifer forest where black oak grows has been selectively logged one to several times. Some damage also has been caused by snow and wind. Tanoak breakage seems to be closely correlated to logging of the Douglas-firs and redwoods with which it grows, although in some localities snow and wind may also be factors.

Giant chinkapin, eucalyptus (fig. 11), alders, and tanoak are predominantly well formed, with 85 percent or more of their volume in tree form classes 1 and 2. Oaks in general are less well formed. Forty-six percent of the volume in California black oak, the best-formed oak, is in tree form classes 1 and 2; compared with 9 percent for coast live oak, the species with the poorest form (fig. 12).

Figure 11—Blue gum plantation established in the late 1800's or early 1900's. Most eucalyptus trees in California are straight boled with few large limbs. This photo was in a file of material pertaining to the 1945 forest inventory (Wieslander and Jensen 1946).

Total Hardwood Tree Volume More Than 18 Billion Cubic Feet

Equations were developed (Pillsbury and Kirkley 1984) and tree measurements taken on sample plots outside National Forests and Parks for estimating hardwood tree volume to three standards:

1. Total tree volume, including wood and bark from ground level to the tips of all stems and branches for all trees 5.0 inches in d.b.h. and larger. Included were cull trees and cull sections of trees.

2. Growing-stock volume, including only wood above a 1-foot stump to a 4-inch top outside bark, of sound trees 5.0 inches in d.b.h. and larger. Excluded were cull trees and cull sections of trees.

3. Sawtimber volume, including only wood above a 1-foot stump in straight sections at least 8 feet long to a 9-inch top outside bark, of sound trees 11.0 inches in d.b.h. and larger.

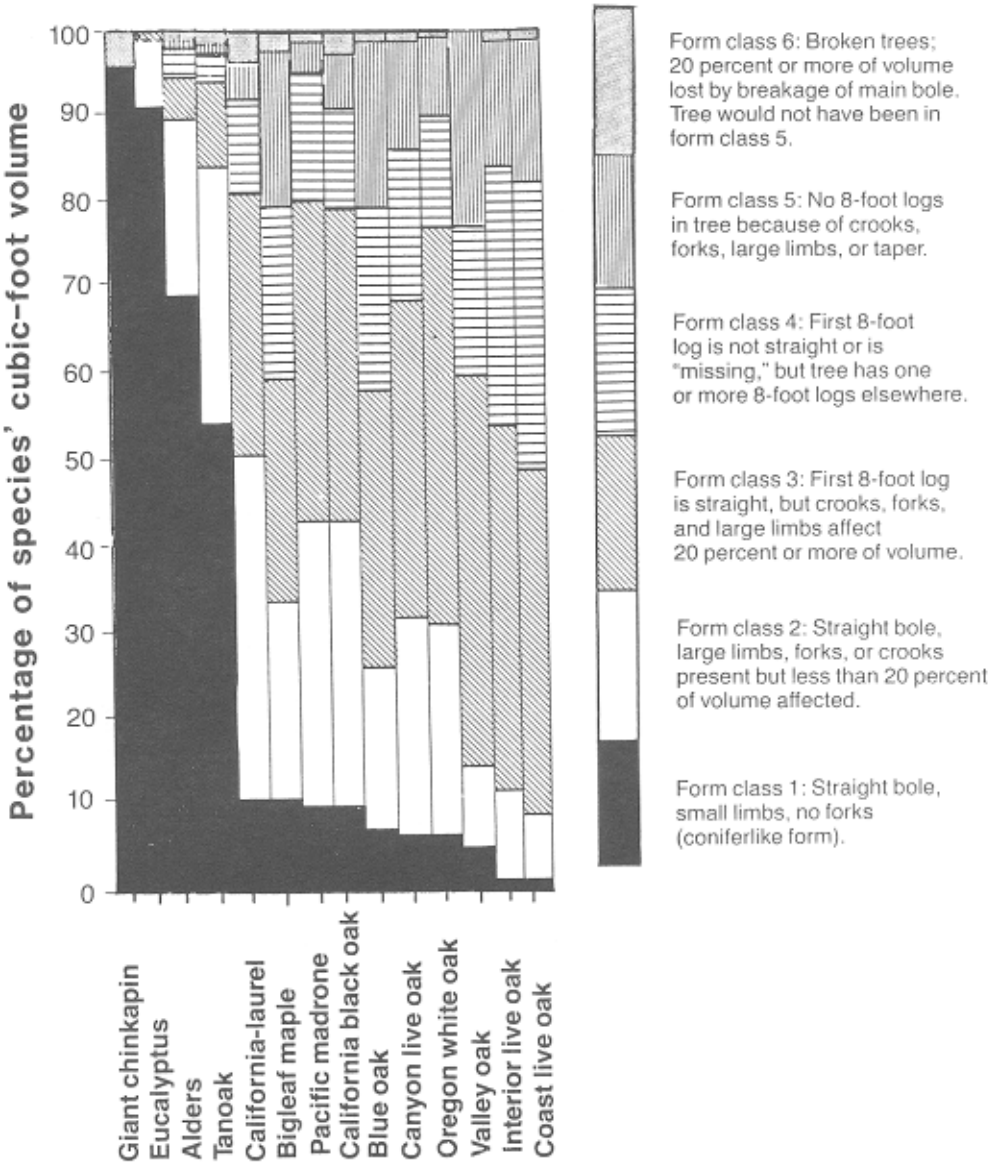


Figure 12—Percentage of volume by hardwood tree form class of major hardwood species on timberland and woodland outside National Forests and Parks, California, January 1, 1985.

Total tree volume is a measure of total hardwood biomass less twigs and leaves. Growing-stock volume is a measure of the total amount of existing wood that could be suitable for fuel, or chips, waferboard, and other reconstituted products. It is not necessarily indicative of the total available volume, which depends on many other factors-tree form, stand characteristics, landform, market value, ownership, zoning restrictions, and harvesting technology. Sawtimber volume is a measure of the existing amount of wood suitable for milling into lumber.

Tne relation of total tree volume and sawtimber volume to growing-stock volume were assumed to be the same for National Forests. Following are the approximate volumes by category for the State (see table 26 for details by species):

	Total tree	Growing stock	Sawtimber
		(Million cubic feet)	
Outside National Forests and Parks	13,638	9,306	3,958
National Forests (excluding wilderness)[6]	4,735	3,230	1,373
Total	18,373	12,536	5,331

Hardwood Volume by Tree Component

Growing-stock volume includes sawtimber volume, and total tree volume includes both growing stock and sawtimber. By subtraction, the total hardwood resource can be categorized by component as shown in figure 13.

[6] For National Forests, total tree and sawtimber volumes were estimated by multiplying the growing-stock volume by factors determined from data collected outside National Forests. total tree volume =3,230 x 1.466 =4,735; sawtimber volume = 3 230 x 0.4253 = 1,373

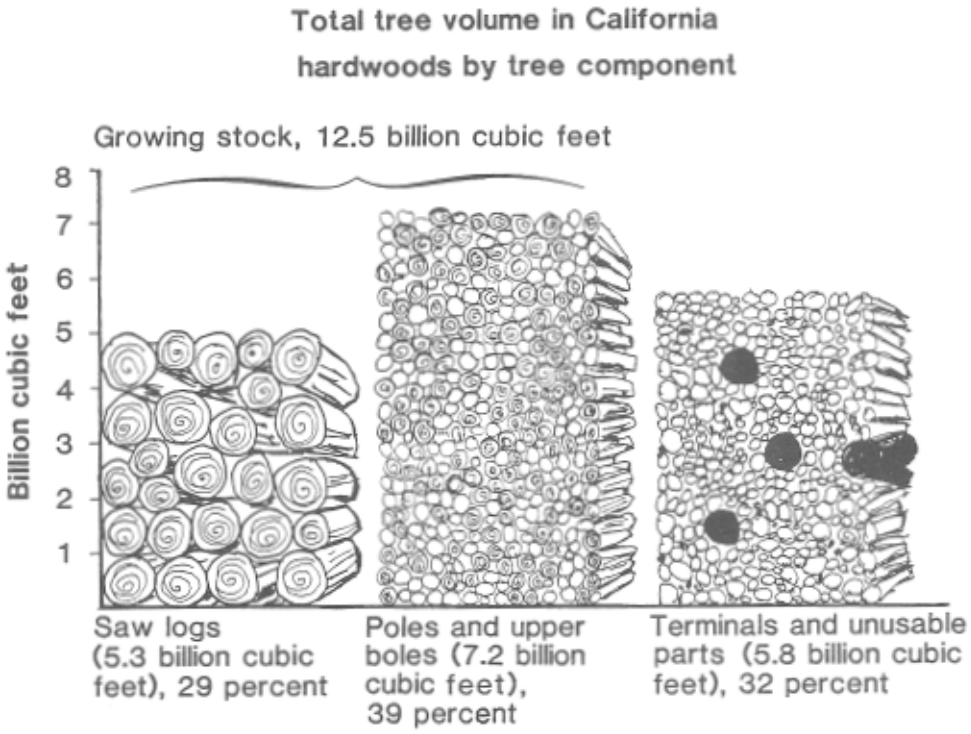


Figure 13—If California hardwoods were sorted and stacked by major tree component, saw logs would make the shortest stack.

The 5.3 billion cubic feet in saw logs (29 percent) represents the most usable portion of the hardwood resource. Saw logs are more economical to handle than the smaller material in the other two categories and are suitable for almost all hardwood products including lumber, veneer, chips, and fuel. Much firewood comes from saw logs. The volume of wood in poletimber trees and sawtimber tops, although the largest component of the hardwood resource (39 percent), is only marginally usable because of limited product potential and the high cost of working it into transportable and usably form. For the most part, the 32 percent in limbs, branches, stumps, and unusable sections is not available although a small amount is used for firewood, especially by cc-,i yourself firewood cutters.

The relations of sawtimber volume to total volume and to growing-stock volume vary by tree diameter, height, and form. For timberland, statewide, the total saw-log volume (in cubic feet) for all hardwood species is 0.49 times the growing-stock volume and 0.33 times the total tree volume. For woodland, where trees are smaller in diameter, shorter, and of poorer form, the factor is 0.34 for growing stock and 0 2^ for total tree volume.

Saw-Log Volume in Oaks Relatively Lower Than in Nonoaks

Generally speaking, trees with a higher saw-log volume in relation to total tree volume are more valuable, other things being equal. They yield more high quality wood, and they are more economical to handle. For the inventory as a whole, including all trees 5.0 inches in d.b.h. and larger, the three species with the highest saw-log volume-total volume ratios are eucalyptus, alder, and giant chinkapin. These three species also have the highest percentage of volume in form class 1 trees. The oaks, as a group or individually, have lower saw-log volume-total volume ratios than the major nonoak hardwoods-tanoak, madrone, laurel, and alder:

Species	Ratio of cubic-foot sawtimber volume to total volume
Oaks:	
Coast live oak	0.29
Canyon live oak	.26
Interior live oak	.21
California black oak	.29
Oregon white oak	.15
Valley oak	.27
Blue oak	.21
Total oaks	.25
Nonoaks:	
Tanoak	.34
Pacific madrone	.36
California laurel	.35
Bigleaf maple	.27
California buckeye	.09
Giant chinkapin	.41
Alder	.44
Eucalyptus	.45
Total nonoaks	.35

Growth, Mortality, and Harvest of Hardwoods

The current inventory shows that the volume of hardwoods on timberland has increased substantially since the previous inventory, a continuation of a long-term trend (Bolsinger 1980). Major causes are:

1. Several hardwood species have high growth potential.
2. Market conditions discourage use of hardwoods.
3. Forest and land management practices have favored hardwoods on many sites, and laws and regulations and lack of economical and socially acceptable methods have thwarted hardwood control efforts on conifer sites (fig. 14).

Figure 14—Douglas-fir and redwood trees were logged from this area in Humboldt County in the late 1960's. The area is now in hardwood type, although Douglas-fir and redwood are present (taller dark crowns). The shorter dark crowns in the background are tanoak. The lighter rounded crowns are red alder and bigleaf maple.

On Timberland, Growth Rates of Hardwoods Higher and Mortality Rates Lower Than Conifers

Growth and mortality rates for hardwoods on timberland outside National Forests were calculated from data taken at revisited plot locations (see "Sources of Information and Inventory Methods" in the appendix). Plots had originally been established in the mid-1960's in the north coast resource area and in the early 1970's elsewhere. For National Forests, hardwood growth was calculated from growth rates determined in previous inventories. No attempt was made to determine growth for hardwoods on woodland, but an extensive permanent plot system established on lands outside National Forests will provide the basis for future growth measurements.

Statewide, gross annual growth of hardwoods on timberland is estimated to total 246 million cubic feet (table 47, appendix). Average annual mortality is estimated to total 24 million cubic feet (table 48, appendix), resulting in annual growth of 222 million cubic feet, or 2.9 percent of the hardwood growing-stock volume.

Growth rates of hardwoods were higher than those of all conifers combined, and mortality was slightly lower:

	Hardwoods	Conifers
	(Percent of growing stock inventory)	
Gross growth	3.2	2.0
Mortality	.3	.4
Net growth	2.9	1.6

Tanoak has the highest growth rate of the hardwood species on timberland. Oaks have lower growth rates than nonoak species (table 4).

Table 4—Gross and net annual growth and mortality as a percentage of growing stock volume on timberland, by hardwood species or species group, California, January 1, 1985

Species or species group	Gross growth	Mortality	Net growth
		Percent	
Tanoak	4.04	0.54	3.50
Pacific madrone	3.40	.26	3.14
California-laurel	3.70	.19	3.51
California black oak	2.70	.27	2.43
Canyon live oak	2.69	.19	2.50
Other oaks	2.72	.20	2.52
Other hardwoods	3.38	.24	3.14
All species	3.20	.31	2.89

Hardwood Harvest on Timberland a Small Fraction of Growth

Records of past hardwood harvesting have not been reliable although increased efforts have been made recently to account for the total amount cut for all purposes including fuelwood, lumber, pulp, and veneer. Industrial consumption of California hardwoods since the previous statewide inventory has averaged about 11 million board feet per year (Barrette and others 1970, for 1968; Howard 1974, for 1972; Hiserote and Howard 1978, for 1976; Howard 1984, for 1982):

Year	Mill			Total
	Lumber	Veneer	Pulp and other	
	(Thousand board feet)			
1968	13,345	170	0	13,515
1972	12,781	0	0	12,781
1976	7,609	200	0	7,809
1982	5,452	0	4,152	9,604

The California State Board of Equalization reported about 12,000 cords of hardwoods cut for fuel in 1980 and 35,000 in 1984 (State of California 1981-85). The volume of hardwoods harvested from timberland is not kept separate from the volume harvested from woodland, but most is thought to come from timberland. The reports may not indicate the actual amount of increase because of better accounting in 7984; but they are thought to show direction of change. In addition, a considerable volume of hardwood is known to be cut and not reported.7At the assumed average rate of 25,000 cords for fuelwood and 11 million board feet for industrial purposes, the total annual reported hardwood harvest totals about 6.5 million cubic feet (fig. 15).$
Data from sample plots visited twice indicate that, outside National Forests, hardwoods have been harvested on about 7,100 acres of timberland per year over the past 10 to 15 years. This is about 5 percent of the total area harvested per year (including hardwoods and conifers), and 0.1 percent of the 6.5 million acres of timberland with hardwood present. The hardwood volume removed, as indicated by trees cut on revisited sample plots, averaged about 1,300 cubic feet per acre. Statewide, the total hardwood cut was 9.2 million cubic feet per year, 1.4 times the volume reported (State of California 1981-85) to have been harvested. The two figures (6.5 million cubic feet versus 9.2 million) disagree less than they appear to because reported cut represents volume removed from the woods, whereas the sample-based estimate represents total growing-stock volume in trees that were cut down.

[7] Personal communications with personnel from California Department of Forestry and California State Board of Equalization, Timber Tax Division.
[8] Assumed cubic-foot volume of wood per cord is 85: 85 x 25,000 = 2 1 million cubic feet. The average ratio of board feet to cubic feet for California is 2.5 to 1: 11 million board feet divided by 2.5 = 4.4 million cubic feet. Total hardwood harvest = 2.1 + 4.4 = 6.5.

Figure 15—Truckload of hardwood logs. In 1984, 6.5 million cubic feet of hardwoods were reported to have been harvested in California.

Reports on annual timber harvest as well as sample-based estimates both show that only a fraction of the hardwood resource is being used. Outside National Forests; conifer timber harvest is about equal to the annual growth and represents about 2 percent of the inventory (see tabulation below). This would place the conifer forests on about a 50-year timber rotation, a stated goal of many timber companies. Conversely, hardwood timber harvest is less than one-quarter of 1 percent of the inventory and 4 to 6 percent of the annual growth. At this rate, hardwood volume on timberland will continue to accumulate, as it has in the past quarter of a century

	Annual timber harvest harvest as a percentage of inventory		Annual timber harvest as a percentage of net annual growth	
	Hardwoods	Conifers	Hardwoods	Conifers
Annual harvest based on reports (average of past 7 years—6.5 million cubic feet)	0.12	2.09	4.16	85.40
Annual harvest based on sample plots (average during inventory period—9.2 million cubic feet)	.17	2.34	5.90	95.60

Volume in Culturally Killed Hardwoods on Timberland Nearly as Much as Volume Harvested

On revisited timberland plots outside National Forests, trees that had died between inventories as a direct result of management activities were classified as culturally killed. Included were trees that had been knocked over by other trees felled in logging, trees intentionally or unintentionally pushed over or broken off by machinery, and trees killed by herbicides (fig. 16) or girdling. Trees that had been out down and left wholly at the site were also classified as culturally killed. (Trees that had been cut down and from which one or more logs were removed were classified as harvested This sample indicated that hardwoods had been culturally killed on about 82,000 acres of timberland since the previous inventory. This amounts to 5,500 acres per year, and 77 percent of the total area from which hardwoods were harvested. The volume in culturally killed trees amounted to 8.2 million cubic feet per year, 45 percent of total hardwood mortality, and about 90 percent of the total volume of hardwood harvested. This contrasts sharply with the incidence of culturally killed conifers, which amounted to only 7.5 percent of total conifer mortality and 1.0 percent of conifer harvest.

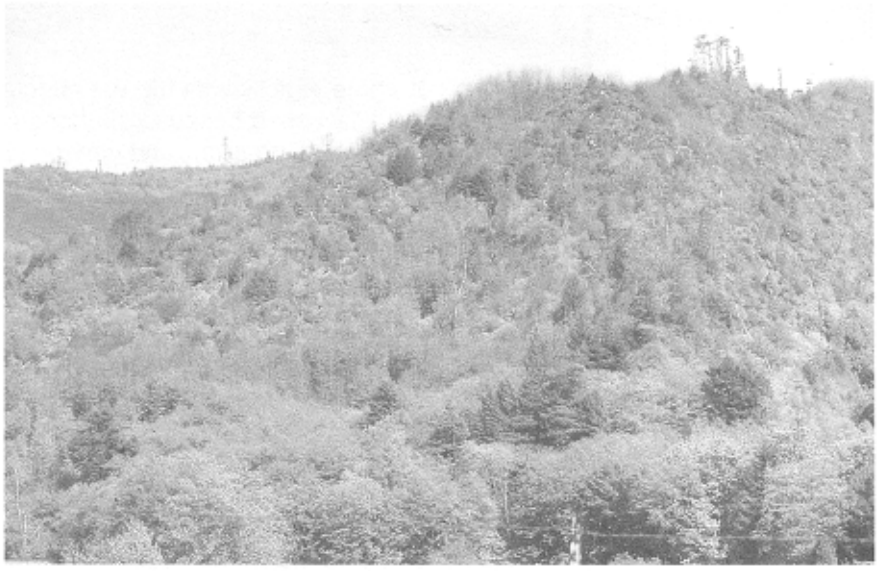


Figure 16—Hardwoods have been killed by aerial spraying of herbicides on these hillsides in Del Norte County to release conifer regeneration.

Nearly 90 percent of the volume of culturally killed hardwoods was in the north coast resource area. It consisted mostly of tanoak, madrone, and bigleaf maple knocked over in logging operations in redwood and Douglas-fir stands. California black oak in the interior made up most of the balance. The relatively large area and volume of culturally killed trees indicate the low value placed on these trees by land managers. They also indicate that some increase in demand for hardwoods could be met simply by using the volume left in the woods to rot.

Hardwoods on Timberland Increasing

The net increase in hardwood volume on timberland between forest inventories outside National Forests, as indicated by revisited plots, is 34 percent. The north coast resource area had the greatest increase-41.0 percent or 2.65 percent annually. Only in the central coast resource area did conifers increase more than hardwoods

Resource area	Remeasurement period	Change in cubic feet per acre	
		Hardwoods	Conifers
	(Number of growing seasons)	*(Percent)*	
North coast	15.5	+41.0	-20.9
Central coast	8.5	+9.2	+11.5
Northern interior	12.5	+23.1	-1.8
Sacramento	11.5	+30.1	+10.5
San Joaquin	11.5	+18.4	+15.8
Statewide	—	+33.9	-7.4

These changes do not agree exactly with the net effects of growth, mortality, and harvest that were previously discussed because of changes in the rates of each factor over the inventory period, sampling error, and varying standards used in reporting.

Tree Cutting in Hardwood Woodland

Some of the volume of hardwoods cut from woodland areas has been included in the timber harvest reports prepared by the California State Board of Equalization (State of California 1981-85). To separate woodland cutting from timberland cutting in the reports is not possible, but woodland cutting is thought to be a small part of the total. Technically, the law requires harvest reports to be filed on all commercial tree harvesting operations (including fuelwood harvesting) and yield taxes to be paid. The list of commercial species varies by region, and some species are excluded entirely. Timber operators in the transition zone between conifer forest and hardwood woodland usually file timber harvest plans and therefore report and pay taxes on hardwoods that are marketed. In the more open oak woodlands, which are at lower elevations and usually physically removed from the conifer forest, hardwoods are often cut, both for fuelwood and for land clearing without being reported. The volume of wood removed in these woodland operations and its value are comparatively low. The tax revenue generated from such operations, which often involve less than 100 cords of wood (about 8,500 cubic feet), would be less than the cost of monitoring them.9

9 Personal communication with Paul Crebbin, California State Board of Equalization, Sacramento, California.

Extent of tree cutting in woodland areas was estimated in the statewide forest inventory, by the following procedures. At each inventory plot location outside National Forests, field crews recorded whether or not tree cutting had occurred as indicated by stumps. The length of time since the cutting was estimated from physical evidence, such as condition of stumps, height of stump sprouts, type and condition of ground vegetation, appearance of skid roads, and degree of erosion. In some cases, the exact date of cutting was provided by the landowner.

Evidence of hardwood cutting was found on plots representing 773,000 acres, or about 14 percent of the existing hardwood woodland. Of this, about 300;000 acres-5 percent of the woodland area-have been cut within the past 5 years (see tabulation below). Not included in these estimates are areas that were completely converted from woodland to nonforest before the inventory.

	Area cut		Woodland cut	
Period cut	Periodic rate	Annual rate	Periodic rate	Annual rate
(Years before inventory)	*(Thousand acres)*		*(Percent)*	
0-5	300	60	5.2	1.0
6-10	221	44	3.8	.8
11 or more	252	—	4.4	—
Total	773	—	13.4	—

The following tabulation shows the total estimated area of woodland cut by forest type:

Forest type	Acres cut	Percent of type
Canyon live oak	36,000	8.8
Interior live oak	161,000	21.9
California black oak	34,000	24.5
Oregon white oak	105,000	32.9
Valley oak	33,000	12.4
Blue oak	336,000	13.6
Pacific madrone	7,000	3.6
Eucalyptus	61,000	63.5
Total	773,000	13.5

The data shown above, like most in this report, were obtained from a light statewide sample. They are presented as the best indication of the amount of woodland cutting taking place but should be tempered with information from other sources. For example, none of the coast live oak sample plots had evidence of cutting, but this species is known to be used for firewood (Pillsbury and Williamson 1980). In some areas, fire, fungi, insects, and vegetation may have eliminated evidence of cutting. To the extent that this has occurred, the estimate of area cut is low.

Intensity of Woodland Cutting Variable

The intensity of cutting observed on woodland inventory pools varied, ranging from r one tree per acre to more than 90 percent of the trees (fig. 17). With only stumps a: evidence (and some of these bulldozed into ravines; covered with debris, vines, and earth; or burned in slash piles), there was no way to estimate the volume of wood that had been cut. If the average volume removed was 1 cord (85 cubic feet) per acre, then the 773,000 acres that were cut would have yielded 773,000 cords, about 66 million cubic feet. This would mean that about 26 million cubic feet were cut within the past 5 years, or 5.2 million cubic feet per year. Excluded from these approximations is the volume of wood removed in permanent clearings.

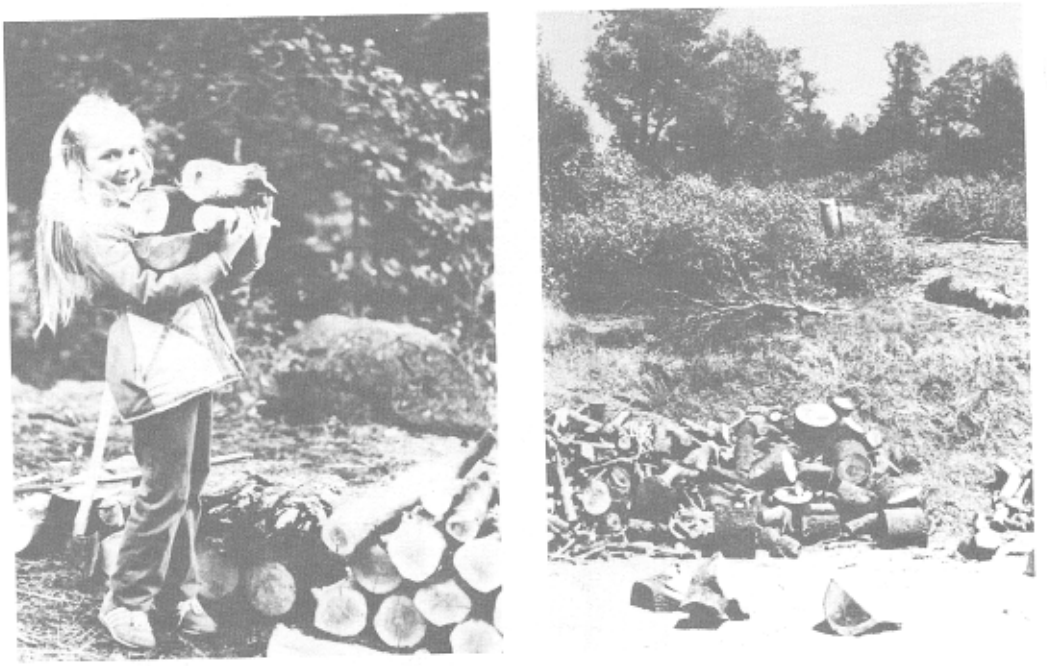


Figure 17—Most cutting on oak woodland is for firewood. Firewood operations range from do-it-yourself family outings requiring a few sticks of wood to commercial operations requiring many cords and covering several acres.

All woodland inventory plots were carefully marked and referenced for future location and measurement; in future inventories, estimates of the amount of woodland tree cutting, including that in permanent clearings, should be more reliable.

Area of Hardwood Types, Occurrence by Species, arid Stand Characteristics

Forest types were classified for lands outside National Forests based on the plurality of basal area of dominant tree species. For example, a stand classified as interior live oak type has a plurality of interior live oak trees in the dominant crown classes. The total estimated area of interior live oak type is determined by adding up the area of all stands classified as interior live oak-884,000 acres for all ownerships. Included are stands of various sizes and densities and with composition varying from pure interior live oak to mixtures of several tree species. In some stands, the removal of one or two trees or a slight change in plot boundary could change the type classification to blue oak, canyon live oak, or one of a dozen other types including both hardwood and conifer.

For some purposes, area by forest type is less useful than area of species occurrence. Several tree species of economic importance are seldom concentrated as types but typically occur as scattered trees or clumps and stringers in other types. Outside National Forests, for example, California black oak type covers an estimated 614,000 acres, but its total area of occurrence is 4,313,000 acres, seven times the type area (fig. 18).

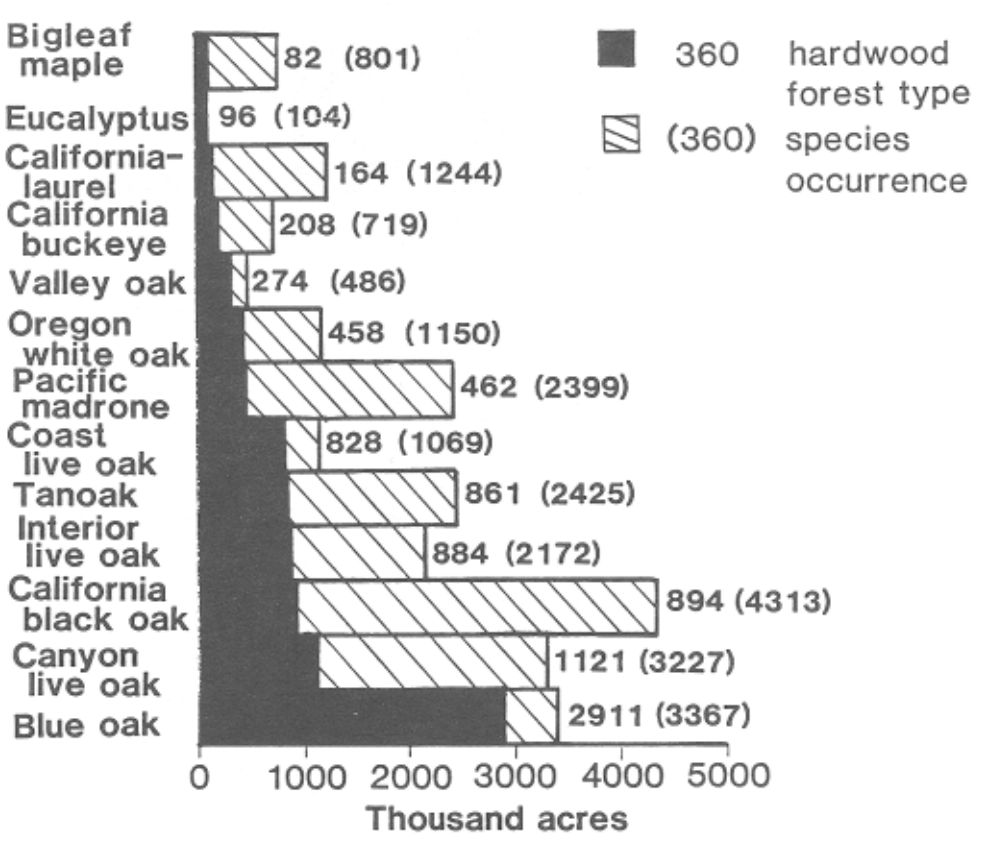


Figure 18—Total area of hardwood forest types, all ownerships, and area of species occurrence of major hardwoods outside National Forests and Parks, California, 1985.

Stand density for hardwood stands in this study is expressed in basal area of trees 1.0 inch in d.b.h. and larger. Hardwood and conifer basal areas are shown separately (tables 56-58). Averages for each plot were calculated by summing the values of the three to five subplots distributed over 5 acres and dividing by the number of subplots. Percentage of area in each hardwood type by basal area class was developed (fig. 19). Stand volume is expressed in net cubic feet per acre, averaged over three to five subplots (table 59).

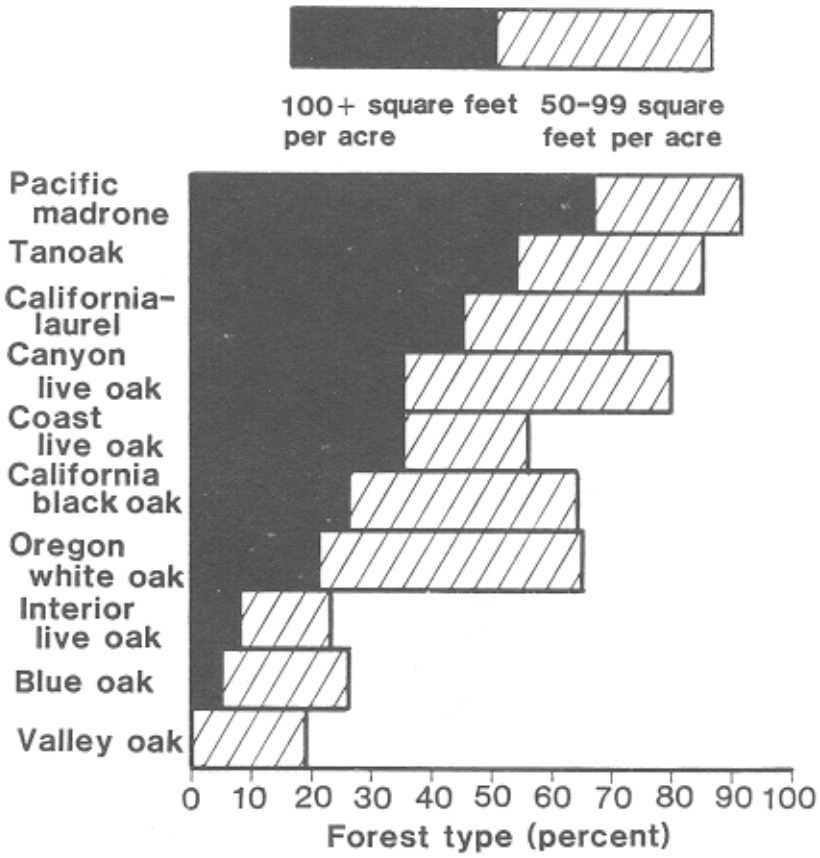


Figure 19—Percentage of area in major hardwood forest types by basal area density class, California, January 1, 1985.

Understory vegetation is generalized by type, based on the vegetation profile recorded at each subplot (procedure described in appendix). Shrubs were recorded by species, height, stage of development, and percent cover; grasses and forbs were recorded by height and percent cover, but not consistently by species because of the difficulty of identifying species during much of the field season.

The following section summarizes the area of hardwood types; species occurrence; stand density; stand size; stand volume; volume by tree size; maximum tree size by species; and shrub and grass understory.

Oaks

Sixteen species of *Quercus* and numerous subspecies and varieties are native to California (Munz and Keck 1970). Ten species normally attain tree size. Two of the tree-size oaks, McDonald oak and island live oak, grow only on islands in California. Of the remaining eight species, seven are widespread in the State: coast live oak, canyon live oak, interior live oak, California black oak, valley oak, Oregon white oak, and blue oak (Griffin and Critchfield 1972). Engelmann oak, a minor species; grows only in southern California.

The total estimated area in all tree-size oak types in California is 7.6 million acres (table 8), 79 percent of the total area in hardwood types. In addition, oaks occur in several million acres of other types, including conifer. Following are summaries by species.

Coast live oak

Area of type and species occurrence-The total estimated area of coast live oak type is 828,000 acres-39,000 acres of timberland and 789,000 acres of woodland. Seventy-nine percent is in private ownership. National Forests contain 9 percent; State, county, and miscellaneous Federal agencies hold 12 percent. Outside National Forests and Parks, the total area in which coast live oak trees occur, as represented by sample plots, is 1,069,000 acres (fig. 20)-752,000 acres of coast live oak type and 317,000 acres of several other types:

Forest type with coast live oak trees	Acres	Percent
Coast live oak	752,000	70.3
Pacific madrone	107,000	10.0
Redwood-Douglas-fir	72,000	6.7
Valley oak	33,000	3.1
Blue oak	33,000	3.1
California-laurel	24,000	2.2
California black oak	16,000	1.5
Tanoak	16,000	1.5
Oregon white oak	8,000	.8
Interior live oak	8,000	.8
Total	1,069,000	100.0

A shrubby form of coast live oak was also found on plots in chaparral but is not included in the above estimates.

Figure 20—Coast live oak stands are often dense. This stand is in San Luis Obispo County.

Stand density-Coast live oak stands are, on the average, the densest of the predominantly woodland hardwood types (canyon live oak stands are denser, but many are on timberland). Inventory plot data show that 34 percent of the stands have more than 100 square feet of basal area per acre.

Although conifer species often grow in coast live oak stands, only 4 percent of the type sampled had more than 25 square feet of conifers (table 49). The maximum density found in a coast live oak stand was 228 square feet-197 square feet of hardwoods and 31 of conifers.

Hardwood basal area	Coast live oak type
(Square feet per acre)	*(Percent)*
0-24	19
25-49	25
50-74	8
75-100	14
More than 100	34
Total	100

Stand size-Seventy-five percent of the coast live oak stands sampled were sawtimber size. Poletimber stands accounted for 11 percent of the type. Nonstocked areas and areas with only seedlings and saplings amounted to 15 percent (nonstocked areas were judged capable of supporting coast live oak stands).

Stand volume-Growing-stock volume in coast live oak stands ranged from zero to 4,038 cubic feet per acre (including all trees 5.0 inches in d.b.h. and larger) and averaged 1,300 cubic feet. Some individual subplots, about one-fifth acre in size, had much higher volumes (the maximum was more than 7,000 cubic feet, expressed as a per-acre value), but the density found in these "clumps" was never sustained over the entire plot area.

Volume by tree size-About 85 percent of the total volume in coast live oak ouiside National Forests is in sawtimber trees. Large sawtimber trees (21.0 inches and larger) account for 28 percent; trees larger than 29 inches, for 12 percent.

Maximum tree size-The largest coast live oak tallied on an inventory plot was 30.6 inches in diameter, 5th largest among the oaks and 10th among all California hardwood species sampled. r° The American Forestry Association (1986) has registered a coast live oak near Gilroy that is 111.4 inches in diameter, tying with a valley oak of the same diameter found near Gridley. Those trees share second place among oaks, and third among all hardwoods shown on the register to be in California.

Understory vegetation-Shrub cover on plots in coast live oak stands was extremely variable, from dense thickets of *Rhus diversiloba, Baccharis pilularis* spp. *consanguinea*, and *Rhamnus californica* to no cover. On moister sites, *Ceanothus thyrsiflorus, Holodiscus discolor, Symphoricarpos mollis,* and *Salix* spp. were found. On drier sites, many shrub species common to the blue oak and interior live oak types east of coast live oak's range were found: *Arctostaphylos* spp., *Ceanothus s*pp., *Cercocarpus betuloides, Heteromeles arbutifolia*, *Prunus ilicifolia*, and *Phamnus crocea* ssp. *ilicifolia*. In southern California, *Arctostaphylos glandulosa, Quercus dumosa,* and *Rhus laurina* were found, along with several shrub species common in the north The most common shrub species in the type was *Rhus diversiloba* (poison oak), found on 77 percent of the plots, and from Sonoma County to San Diego County.

Grass cover-In coast live oak stands, grass cover, although variable, was generally sparse:

Grass cover	Coast live oak type
(Percent)	*(Percent)*
0-24	47
25-49	20
50-74	20
75+	13
Total	100

[10] Trees were tallied in a random sample. Although larger trees may be found, the range of tree sizes found in the inventory is considered indicative of the general relative size by species.

Canyon live oak

Area of type and species occurrence-The total estimated area of canyon live oak type in California is 1,121,000 acres-344,000 acres of timberland and 777,000 acres of woodland; 54 percent in private ownership, 38 percent in National Forest, and 8 percent on other public land. Although the area of canyon live oak type is less than that of blue oak, its total geographic distribution is greater. It may have the widest range of any hardwood in the State. Canyon live oak trees were tallied on plots in Del Norte County near the Oregon border and in San Diego County near Baja California.

Canyon live oak grows in an extremely broad range of forest conditions. Although absent from pine forest of northeastern California and rare in the higher elevations of the Cascade Range and the Sierra Nevada, it was found somewhere in the State in almost every forest type. Outside National Forests and Parks, it was found in 698,000 acres of canyon live oak type and 2,529,000 acres of other types. These estimates exclude chaparral areas, in which canyon live oak occurs as a shrub or as an occasional tree.

Stand density-Stands with more than 100 square feet of basal area per acre amounted to 34 percent of the canyon live oak type outside National Forests and Parks:

Hardwood basal area	Canyon live oak type
(Square feet per acre)	*(Percent)*
0-24	11
25-49	11
50-74	24
75-99	20
100+	34
Total	100

Unlike coast live oak, which grows predominantly in woodland areas and rarely has a significant component of conifer trees, canyon live oak type often grows near conifer stands and often has a conifer component (fig. 21). Seventeen percent of the plots in canyon live oak type had more than 25 square feet in conifer basal area, and 8 percent had more than 50 square feet. The maximum hardwood density found on a canyon live oak plot was 252 square feet. Total stand density, including conifers, was even greater on several other plots, including one with basal area of 353 square feet.

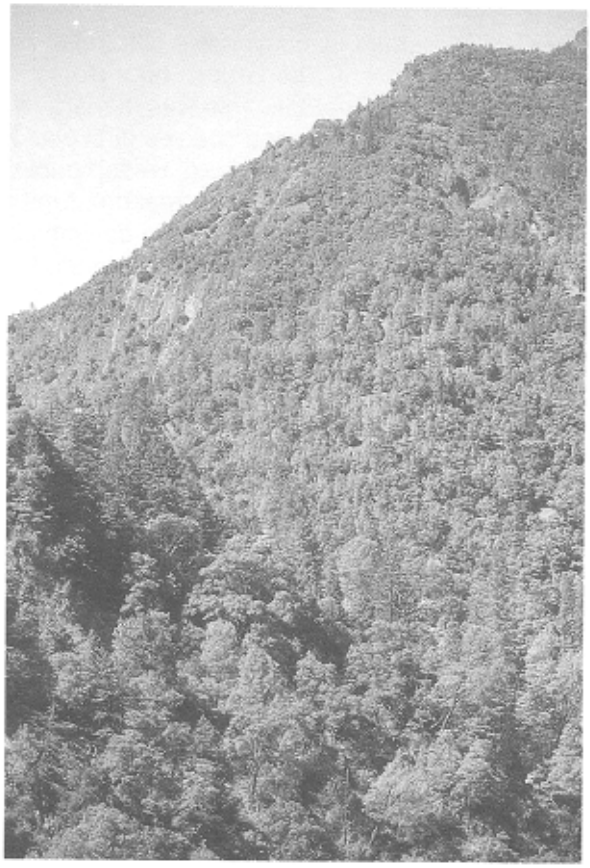


Figure 21—Canyon live oak, the predominant cover on these steep hillsides in Trinity County, is intermingled with Digger pine, ponderosa pine, Douglas-fir, Pacific madrone, California black oak, and Oregon white oak.

Stand size-About 41 percent of the canyon live oak stands outside National Forests and Parks were sawtimber size. Poletimber stands accounted for another 41 percent and seedling-sapling stands for 18 percent. The growth form of canyon live oak varies. Sawtimber-size trees dominate in some stands, whereas other stands consist mainly of smaller specimens. Size at maturity seems to depend on site, density, and stand history. Some canyon live oak stands consist mainly of clumps of trees-often several from one rootstock. Individual stems in such stands are usually small.

Stand volume-Despite the large number of stands that were smaller than sawtimber size, canyon live oak plots had the highest average cubic-foot volume of any of the oaks, including California black oak, which grows mainly on timberland. The maximum volume per acre found in canyon live oak type was 4,128 cubic feet, and the average was 1,503 cubic feet (table 59).

Volume by tree size-About 72 percent of the volume in canyon live oak outside National Forests and parks is in sawtimber-size trees. Large sawtimber trees (21.0 inches and larger) account for 33 percent; trees larger than 29 inches, for 8 percent.

Maximum tree size-Numerous canyon live oak trees more than 40 inches in d.b.h, were tallied on inventory plots. The largest, on a plot in Tulare County, was 58.3 inches in diameter and 106 feet tall. This was the largest oak tallied in the inventor;, and the third largest of any hardwood species (first was Pacific madrone and second was tanoak). The "National Register of Big Trees," published by the American Forestry Association (1986), shows the largest oak (and the second-largest hardwood of any species in California) to be a canyon live oak. The record tree s 128.5 inches in diameter and 72 feet tall. It was found in the Cleveland National Forest in southern California.

Understory vegetation-Shrub cover on most plots in canyon live oak type was sparse, but over its broad range, the variety of shrub species found was as great as any type in the State. Included were most species found in other woodland types well as species frequently associated with timberland, such as *Acer circinatum*, *Amelanchier* spp., *Arctostaphylos* spp., *Berberis spp*., *Ceanothus* spp., *Corylus cc*nuta van. *californica, Philadelphus lewisii* spp. *californicus*, *Physocarpus* spp., *Ribes* spp., Rosa spp., *Rubus spp*., and *Symphoricarpos mollis*.

Several woody or semiwoody plants that are generally limited to canyons and streaimside areas were found in the canyon live oak type, including: *Aralia californica*, *Calycanthus occidentalis, Clematis ligusticifolia*, *Cornus* spp., *Mimulus* spp., *Viburnum ellipticum*, and *Vitis californica*.

Grass cover in canyon live oak stands was the sparsest of the woodland types. Most of the type had less than 25 percent grass cover:

Grass cover	Canyon live oak type
(Percent)	*(Percent)*
0-24	89
25-49	5
50-74	3
75+	3
Total	100

Interior live oak

Area of type and species occurrence-The total estimated area of interior live oak type is 884,000 acres-63,000 acres of timberland and 821,000 acres of woodland. About 82 percent of the interior live oak type is in private ownership, 10 percent in National Forests, and 8 percent on other public land.

Outside National Forests and Parks, the total estimated area in which interior live oak trees occur is 2,172.000 acres. Interior live oak is common in much of the foothill woodland from Shasta County to Kern County, where it often grows with blue oak. Interior live oak is also occasionally found in the humid conifer forests of the central coast and the arid pinyon woodland of the southern Sierra Nevada and Tehachapi Mountains. Types other than interior live oak accounted for 63 percent of the species occurrence outside National Forests:

Forest type with interior live oak trees	Acres	Percent
Interior live oak	796,000	36.6
Blue oak	534,000	24.6
Conifer timber types	275,000	12.7
Canyon live oak	124,000	5.7
California buckeye	100,000	4.6
California black oak	97,000	4.5
California-laurel	74,000	3.4
Pacific madrone	49,000	2.3
Valley oak	33,000	1.5
Cottonwood (riparian)	33,000	1.5
Singleleaf pinyon	33,000	1.5
Tanoak	24,000	1.1
Total	2,172,000	100.0

Stand density-Plot data indicate that interior live oak stands are typically sparse; only 6 percent of the stands sampled had more than 100 square feet of basal area. and 44 percent had less than 25 square feet:

Hardwood basal area *(Square feet per acre)*	Interior live oak type *(Percent)*
0-24	44
25-49	34
50-74	5
75-99	11
100+	6
Total	100

In some cases, the low density is a result of tree cutting. The sample indicated that about 22 percent of the interior live oak type had been partially cut (see "Tree Cutting in Hardwood Woodland").

Stand size-About 30 percent of interior live oak stands sampled were sawtimber size, 25 percent were poletimber, and 45 percent were seedling-sapling. Like canyon live oak, interior live oak stands often consist of clumps of many small trees growing from common rootstocks. Some of the seedling-sapling and poletimber stands occupied sites that had been cut and were stocked with vigorous sprouts at the time of the inventory.

Stand volume-Growing-stock volume in interior live oak stands ranged from zero to 3,779 cubic feet per acre and averaged 612 cubic feet. Of the major hardwood types, only blue oak stands had lower average volume.

Volume by tree size-About 64 percent of the total volume in interior live oak stands is in sawtimber trees. Large sawtimber trees (21 .0 inches in d.b.h. and larger) account for 12 percent; trees larger than 29.0 inches, for only 3 percent.

Maximum tree size-Interior live oak ranked third in size among oaks tallied on inventory plots. The largest interior live oak, in trunk diameter, was on a plot in Contra Costa County. The tree was 42.6 inches in d.b.h., but only 32 feet tall, short even for interior live oak. Seven interior live oaks in the same stand were more than 50 feet tall. The American Forestry Association (1986) has registered an interior live oak tree near Stockton that is 85.3 inches in diameter and 90 feet tall.

Understory vegetation-Shrubs found on plots in interior live oak stands include several species of *Arctostaphylos* (most common were *A*. *manzanita* and *A*. *viscida*), *Ceanothus spp*. (most common were *C*. *cuneatus* and *C*. *leucodermis*), *Cercis occidentalis, Cercocarpus betuloides, Corylus cornuta* var. *californica, Fraxinus dipetala, Heteromeles arbutifolia, Rhamnus crocea* var. *ilicifolia,* and *Rhus diversiloba.* In transition areas, plants were found that are more commonly associated with chaparral-for example, *Adenostoma fasciculatum, Chrysothamnus* spp.; *Haplopappus* spp., and *Artemisia* spp.; or with timberland-*Amelanchier* spp„ *Symphoricarpos* spp., *Rubus* spp.; and *Holodiscus discolor*.

Grass cover in most inferior live oak stands was relatively dense.

Grass cover *(Percent)*	Interior live oak type *(Percent)*
0-24	24
25-45	20
50-74	20
75+	36
Total	100

California black oak

Area of type and species occurrence-The total estimated area of California black oak type is 894,000 acres, 591,000 acres of timberland and 303;000 acres of woodland. About 60 percent is in private ownerships; 31 percent is in National Forests; and 9 percent is on other public lands, including those managed by State, county; and miscellaneous Federal agencies.

Although the total acreage of California black oak type is less than that of canyon live oak and also that of blue oak, the total area of occurrence of black oak in the State exceeds that of any other hardwood. Outside National Forests, it was found on 4,313,000 acres-614,000 acres of black oak type and 3,699,000 acres of other types. Most common as an associate of mixed conifer stands, it is also found in stands of coastal Douglas-fir and redwood, and tanoak and madrone; on moist microsites in foothill woodland types; and in ponderosa and Jeffrey pine stands on the eastern slopes of the Cascade Range and Sierra Nevada (fig. 22). It is also found in Coulter pine and bigcone Douglas-fir stands in southern California, and in western juniper stands in Siskiyou, Lassen, and Modoc Counties.

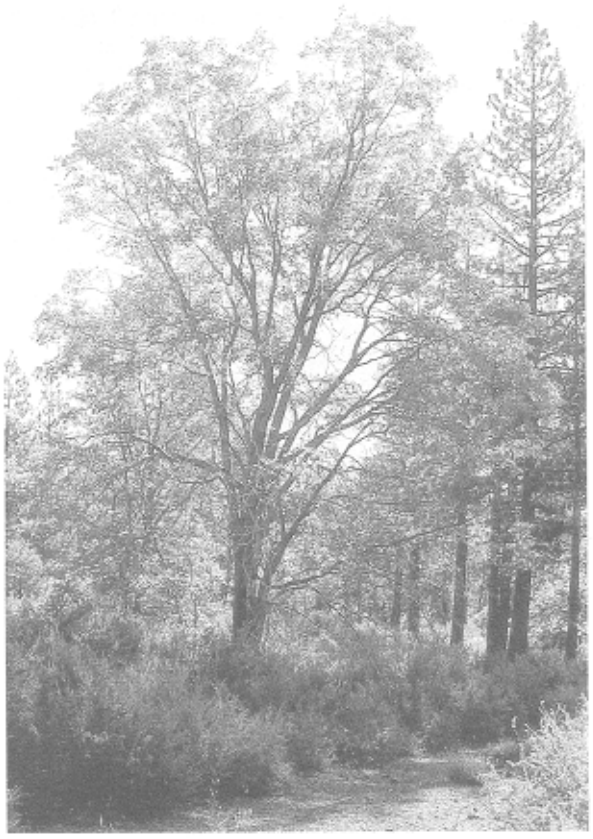


Figure 22—California black oak near Susanville associated with Jeffrey pine and bitterbrush.

Stand density-California black oak does best on conifer sites. On such sites, it usually shares space with pines, firs, and other conifers, which are frequently harvested. Where California black oak occurs in the absence of conifers, the sites are often poor and the density of black oak is relatively low. Outside National Forests and Parks, only 27 percent of the black oak stands have 100 square feet of basal area per acre:

Hardwood basal area *(Square feet per acre)*	California black oak type *(Percent)*
0-24	20
25-49	17
50-74	22
75-100	14
100+	27
Total	100

The maximum total density of all black oak stands sampled was 218 square feet of basal area, 139 square feet of hardwoods and 79 square feet of conifers. The maximum hardwood density was 168 square feet. Several undisturbed black oak stands had about 130 square feet of hardwoods per acre.

Stand size-About 40 percent of the California black oak stands outside National Forests and Parks were sawtimber size. Poletimber stands accounted for 33 percent; seedling and sapling stands, 27 percent.

Stand volume-Growing-stock volume in California black oak stands ranged from zero to 4,000 cubic feet per acre. The overall average volume was 1,213 cubic feet per acre. California black oak is the major California hardwood sawn into lumber. The average growing-stock volume of 1,213 cubic feet translates to about 500 cubic feet in saw logs, or roughly 2,500 to 3,000 board feet, local scale. The maximum volume-4,000 cubic feet-represents about 8,500 to 10,000 board feet of saw logs.

Volume by tree size-Of the growing-stock volume of California black oak, 75 percent is in sawtimber trees. Large sawtimber trees (21.0 inches in d.b.h. and larger) account for 29 percent; trees 29.0 inches and larger, for 10 percent.

Maximum tree size-Large black oaks are fairly common. Many trees with diameters exceeding 40 inches were tallied on inventory plots. The largest was in Kern County. It was 53.6 inches in d.b.h., a "wolf tree" growing in a poletimber stand of black oak with scattered Jeffrey pine, sugar pine, and white fir. This tree ranked second in size of the oaks tallied in the State, and fourth of all hardwoods.

Understory vegetation-Shrub cover in California black oak stands includes most of the species found in the mixed conifer forests of the mountains and the oak woodland of the higher foothills. More than 40 shrub species were found on sample plots. Some of the common ones are: *Amelanchierspp., Arctostaphylos canescens* (Coast Range only), *A*. *glandulosa, A*. patula, *A*. viscida, Castanopsis *sempervirens*, *Ceanothus integerrimus, C*. *palmeri* (southern California), *C*. *prostratus*, *C*. *velutinus*, *Chamaebatia foliolosa, Corylus cornuta* var. *californica*, *Holodiscus discolor, Rhus diversiloba, Ribes roezlii*, *Rubus leucodermis, R. ursinus, Rosa* spp., *Salix* spp., and *Symphoricarpos* spp.

Grass cover in California black oak stands is usually sparse because of the prevalence of woody plants. Eighty-four percent of the sample plots in the type had less than 25 percent grass cover:

Grass cover *(Percent)*	California black oak type *(Percent)*
0-24	84
25-49	12
50-74	4
75+	0
Total	100

Oregon white oak

Area of type and species occurrence-The total estimated area of Oregon white oak type in California is 458,000 acres-97,000 acres of timberland and 361,000 acres of woodland. Seventy-eight percent is in private ownership; 10 percent is in National Forests; and 12 percent is on land managed by State, county, and miscellaneous Federal agencies.

Two shrubby varieties of Oregon white oak are recognized (*Ouercus garryana* var, *brewerii* and var. *semota*). They were not counted as trees in the inventory but were recorded in a vegetation tally.

Tree-form Oregon white oak occurs mainly in northern California, in an extremely broad range of environmental conditions. It is common near the coast in transitional belts between redwood and Douglas-fir stands and grassy glades, on dry ridges and south-facing slopes in the interior Coast Range, and on volcanic soils in the mixed conifer and pine types in the northern interior (fig. 23). It is also found in western juniper stands in Siskiyou, Shasta, and Lassen Counties (;:g. Biz),

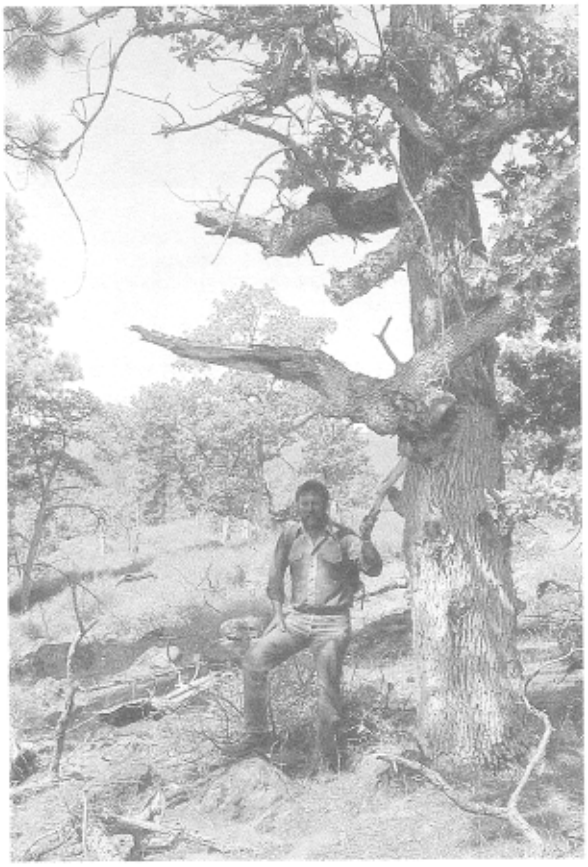


Figure 23—Oregon white oak grows on shallow soils on volcanic parent material within and bordering mixed conifer and ponderosa pine stands in northeastern California.

The total area outside National Forests and Parks in which Oregon white oak trees were found is 1,150,000 acres-411,000 acres of Oregon white oak type, 275,000 acres of other hardwood types, 377,000 acres of conifer timber types, and 87,000 acres of western juniper type.

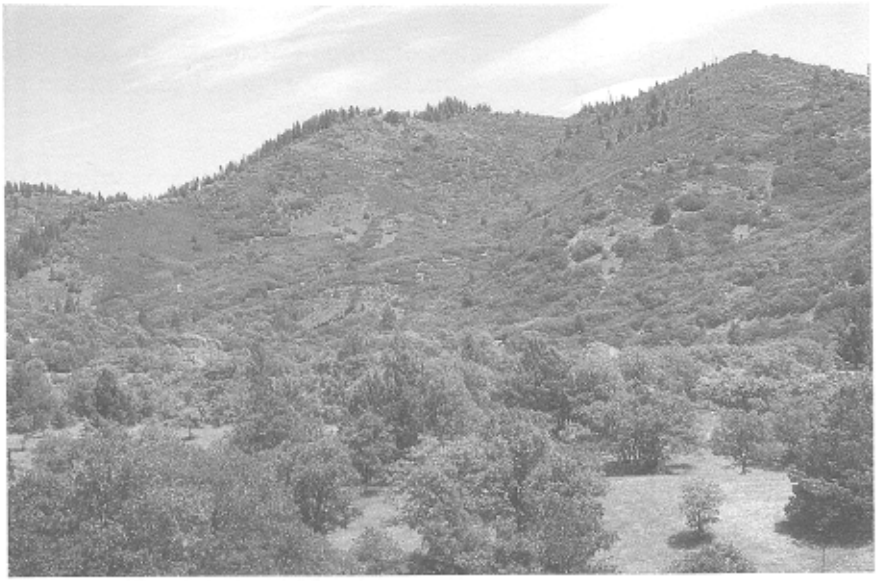


Figure 24—Oregon white oak mixed with California black oak, ponderosa pine, western juniper, and enclaves of chaparral (*Ceanothus cuneatus* and *Cercocarpus betuloides*) in Siskiyou County.

Stand density-About 21 percent of Oregon white oak type is in steeds with 100 square feet or more of hardwood basal area; very sparse stands (less than 25 square feet) amounted to 16 percent:

Hardwood basal area *(Square feet per acre)*	Oregon white oak type *(Percent)*
0-24	16
25-49	20
50-74	41
75-99	2
100+	21
Total	100

The maximum hardwood density found in Oregon white oak type was 177 square feet, in a pure hardwood stand. Total density in several Oregon white oak stands with conifers present did not exceed this.

Stand size-About 26 percent of the Oregon white oak type is sawtimber size, 51 percent is poletimber, and 23 percent is seedling and sapling.

Stand volume-Volume per acre in Oregon white oak type ranged from zero to 4,498 cubic feet, which was the highest volume on any plot in all the oak types (but not the highest for all hardwoods). Average volume of Oregon white oak per acre was only 1,099 cubic feet, fourth among oak types.

Volume by tree size-Only 41 percent of the growing-stock volume in Oregon white oak is in sawtimber trees, and large sawtimber trees account for only 9 percent of the volume. The large percentage of volume in small trees is thought to be more a reflection of the species potential than current stage of development. Many stands, appear to be physiologically mature even though trees are small in diameter and short.

Maximum tree size-Although many large Oregon white oak trees are found farther north in Oregon and Washington, few large trees were tallied on forest inventory plots in California. The largest, in Humboldt County, was 37.0 inches in d.b.h. and 50 feet tall. This makes Oregon white oak the smallest of the California tree-size oaks sampled, with the exception of Engelmann oak, a small tree with restricted distribution in southern California. As with valley oak, the largest specimens of Oregon while oak are often isolated trees in pastures, cultivated valleys, and narrow riparian stringers. Such areas usually do not qualify as forest so were rarely sampled in the forest inventory,

Understory vegetation-Shrub species In the eastern part of Oregon white oaks range include plants found on the dry interior plateaus, such as *Artemisia tridentata, Cercocarpus ledifolius, Purshia tridentata*, and *Ribes cereum*. In the Coast Range, plants such as *Arctostaphylos canescens, A. columbiana, Ceanothus thyrsiflorus, Holodiscus discolor*, and *Rhamnus purshiana* are common. Other shrubs include *Amelanchier* spp., *Berberis spp*., *Ceanothus cuneatus*, *C. integerrimus, Cercocarpus betuloides*, *Philadelphus lewisii, Prunus emarginata*, *P. subcordata, Rhus diversiloba*, *Rosa* spp., and *Symphoricarpos mollis*.

Grass cover-Total cover in woody plants is often sparse in Oregon white oak stands, allowing fairly heavy grass cover, as shown below:

Grass cover *(Percent)*	Oregon white oak type *(Percent)*
0-24	19
25-49	43
50-74	24
75+	14
Total	100

Valley oak

Area of type and species occurrence-Although the range of valley oak is more than 500 miles long and 100 miles wide, the acreage in valley oak type is small. The total estimated area is 274,000 acres. Of the eight tree-size oak species in California, only Engelmann oak type occupies a smaller area.

About 86 percent of the valley oak type is in private ownership. State, county, and miscellaneous Federal agencies manage land containing the other 14 percent. National Forests reported only a trace.

Outside National Forests, valley oak trees were found on 486,000 acres-274,000 acres of valley oak type and 212,000 acres of other types:

Forest type with valley oak trees	Acres	Percent
Valley oak	274,000	56
Interior live oak	45,000	9
Cottonwood (riparian)	33,000	7
Bigleaf maple	33,000	7
Conifer timber types	32,000	7
Canyon live oak	28,000	6
Coast live oak	25,000	5
California black oak	16,000	3
Total	486,000	100

Valley oak is often seen as a lone tree in grassland, or in small groves and streamside stringers, or in open savannas (fig. 25). None of these areas would be classified as forest; hence, they were not sampled on the ground in the statewide forest inventory. Valley oak is also found in many parks, cities, and suburban residential developments. Numerous ranches and farmsteads are sheltered by magnificent valley oak trees. The extent of valley oak in these unsampled settings is not known.

Stand density-Because of the small area of valley oak type, the plot sample s weak. Still, the data give some indication of valley oak stand characteristics They show that none of the stands sampled had a density of 100 square feet of basal area per acre. Most stands had 25 to 50 square feet:

Hardwood basal area *(Square feet per acre)*	Valley oak type *(Percent)*
0-24	0
25-49	81
50-74	3
75-99	16
Total	100

Stand size-Of the valley oak type, 52 percent is in sawtimber stands, 48 percent is in poletimber and sapling stands.

Stand volume-The highest volume measured in a valley oak stand was 2,180 cubic feet per acre, and the mean volume of all stands was 994 cubic feet.

Volume by tree size-Eighty-four percent of the growing-stock volume of valley oak is in sawtimber trees. Large sawtimber trees (21 .0 inches in d.b.h. and larger) account for 60 percent of the volume; trees 29.0 inches in d.b.h. and larger, for 40 percent.

Figure 25—Valley oak is one of the species found on an estimated 1.6 million acres of rangeland with scattered trees and groves. Such areas, also called savannas, are not classified as forest or woodland. This scene is in El Dorado County.

Maximum tree size-Valley oak is considered by many to be the largest of California's oaks, if not all of California's hardwoods. In the American Forestry Association (1986) "National Register of Big Trees," the record valley oak is 111 4 inches in diameter. This tree, growing near Gridley, ties with coast live oak for second place among oaks in California, and third of all hardwoods registered within the State. The largest, tallied on an inventory plot in Napa County, was 42.5 inches in d.b.h. and 66 feet tall, ranking valley oak fourth in size of oaks measured in the inventory. The largest valley oaks probably grow in nonforest areas not sampled in the forest inventory.

Understory vegetation-Shrub cover was absent on more than half the plots in valley oak type. At the other extreme, one stand sampled had an understory of *Phus diver*siloba covering 70 percent of the ground and averaging more than 6 feet high. *Rhus diversiloba was* common in some stands, both as a shrub and a tree-climbing vine. Both tree and shrub-size *Aesculus californica, Cercocarpus betuloides,* and *Heteromeles arbutifolia* were also tallied.

Grass cover- Grass cover was typically heavy in valley oak stands because of the sparse tree and shrub cover and the fertile soil on which the species grows:

Grass cover *(Percent)*	Valley oak type *(Percent)*
0-24	14
25-49	14
50-74	29
75+	43
Total	100

Blue oak

Area of type and species occurrence-The most extensive hardwood type in California is blue oak, covering an estimated 2,911,000 acres. Almost all of this is in woodland (4,000 acres of blue oak type on timberland are reported by National Forest Systems). About 75 percent is in private ownership; 14 percent is in National Forests; and the remaining 11 percent is on land managed by State, county, and miscellaneous Federal agencies.

In addition to the blue oak type and Digger pine-blue oak type, blue oak trees were found on 925,000 acres of other types outside National Forests and Parks, as shown in the tabulation below.

As used here, blue oak type consists of two broad plant associations: pure blue oak stands, consisting of blue oak with a dense ground cover of grass; and blue oak stands with one or more other tree species present. The other species usually include Digger pine or interior live oak or both, but may also include several others. Outside National Forests, 52 percent of the blue oak type was "pure" blue oak, with no other trees present (fig. 26).

Forest type with blue oak trees	Acres	Percent
Blue oak	2,473,000	72.8
Interior live oak	371,000	10.9
Coast live oak	135,000	4.0
California buckeye	132,000	3.9
Canyon live oak	66,000	1.9
Valley oak	65,000	1.9
California black oak	57,000	1.7
California juniper	34,000	1.0
Cottonwood (riparian)	33,000	1.0
Conifer timber types	32,000	.9
Total	3,398,000	100.0

Stand density-Blue oak stands are usually open with relatively few trees and low basal area per unit of area (fig. 26). Activities by people and animals over the past several decades have made many blue oak stands even more open (about 14 percent of the type has evidence of partial cutting, and 65 percent is currently being grazed by livestock). Forty-seven percent of the type has less than 25 square feet of basal area, and only 4 percent has more than 100 square feet.

Hardwood basal area *(Square feet per acre)*	Blue oak type *(Percent)*
0-24	47
25-49	28
50-74	20
75-99	1
100+	4
Total	100

Figure 26—Pure blue oak stands in Calaveras County. More than half the blue oak stands sampled had no other trees present, and 36 percent had no shrubs.

Although Digger pine is fairly common in blue oak stands and other conifers are occasionally present, none of the blue oak stands sampled had more than 49 square feet of basal area in conifers; 93 percent had less than 25 square feet (see table 55).

Stand size-Of the blue oak type, 43 percent is in sawtimber stands; 26 percent in poletimber, and 17 percent in sapling- and seedling-size trees. About 14 percent is nonstocked. As with other woodland species, sapling and poletimber trees are no; necessarily young. Small trees often indicate a harsh site rather than stage of development. Unlike the live oaks and California black oak, few blue oak sprouts were tallied on plots. When trees are cut down, the rootstocks apparently often die Multiple-stemmed trees and dense clumps of small boles are rare.

Stand volume-Blue oak type has the lowest maximum and mean volumes of any oak type, except Engelmann oak. The maximum, 1,767 cubic feet per acre, is about half that of interior live oak type which overlaps the blue oak type. The mean volume is only 381 cubic feet per acre, less than 5 cords.

Volume by tree size-Of the growing-stock volume of blue oak, 65 percent is in sawtimber trees. Large sawtimber trees (21.0 inches and larger) account for 20 percent of the volume; trees 29.0 inches and larger, for only 3 percent.

Maximum tree size-Blue oak ranks sixth in size of the seven major tree-size oaks tallied in the statewide inventory. The largest blue oak tallied was 39.3 inches in d.b.h. and 63 feet tall. This tree was in Napa County, on the same plot as the largest valley oak tallied in the inventory. The American Forestry Association (1986) also shows blue oak to be sixth in size among California oaks. The record tree, in Alameda County, is listed as 77.3 inches in d.b.h. and 94 feet tall.

Understory vegetation-Of the blue oak stands sampled, 36 percent had no shrubs. For the most part, these were "pure" blue oak stands on arid sites at the lower elevational limit of the type. In blue oak stands at higher elevations, and on moist sites at lower elevations, several shrub species were found. The presence of shrubs often indicated the presence of other tree species. Shrubs included Adenostoma fasciculatum, Arctostaphylos manzanita, A. viscida, Ceanothus cuneatus, C. leucodermis, Cercis occidentalis, Cercocarpus *betuloides, Chrysothamnus s*pp., Fraxinus dipetala, Haplopappus spp., Heteromeles arbutifolia, Lonicera *hispidula, Prunus* ilicifolia, *Rhamnus californica, R.* crocea ssp. ilicifolia, *Rhus diversiloba, and R.* trilobata.

Grass cover-Grass cover in blue oak type is typically dense (see fig. 26;, as shown below:

Grass cover *(Percent)*	Blue oak type *(Percent)*
0-24	3
25-49	4
50-74	22
75+	71
Total	100

Engelmann oak

Area of type and species occurrence-Engelmann oak occurs s curly it southern California and Baja California. In California, its range is very limited. The estimated area of Engelmann oak type is 39,600 acres-4,ODd aces in National Forests and 35,000 acres in private ownership.

Outside National Forests, Engelmann oak was tallied on two woodland inventory plots and one chaparral plot, all in San Diego County. On one of the woodland plots, Engelmann oak trees occupied an area that would have been classified as chaparral had the tree stocking been less than 10 percent. A rich mixture of shrub species was growing on the site. Included were *Adenostoma fasciculatum, Arctostaphylos glandulosa, Cercocarpus betuloides, Comarostaphylis diversifolia, Heteromeles arbutifolia*, three species of *Rhus,* and *Ouercus dumosa*. The other woodland plot was a mixture of coast live oak and Engelmann oak.

The largest Engelmann oak tallied in the inventory, a tree in San Diego County, was 24.4 inches in d.b.h. and 43 feet tall. The largest on record (American Forestry Association 1986), found at Pasadena, is 41.1 inches in d.b.h. and 78 feet tall.

Hardwoods Other Than Oak

Several species of hardwoods other than those in the genus *Ouercus* grow in the timberland and woodland areas of California. The three major nonoak hardwoods are the evergreens tanoak, Pacific madrone, and California-laurel. Tanoak is closely related (taxonomically) to the oaks. It grows primarily on highly productive timberland. Pacific madrone and California-laurel often grow with tanoak on timberland, but they also grow on the less productive woodland sites.

Hardwood basal area (Square feet per acre)	Tanoak type (Percent)
0-24	7
25-49	10
50-74	9
75-99	20
100+	54
Total	100

Many of the stands classified as tanoak type based on the current tree stocking had been redwood, Douglas-fir, or other conifer types before the conifers were removed by timber operators. Many stands still have a sizable conifer component 43 percent of the sampled stands had at least 25 square feet of conifer basal area, and 25 percent had 50 or more square feet.

Stand size-Of the tanoak type, 51 percent is in sawtimber stands; 37 percent in poletimber, and 12 percent in sapling- and seedling-size trees.

Stand volume-Average growing-stock volume per acre in tanoak type is 1,679 cubic feet per acre, almost identical to that of Pacific madrone (1,705) and California-laurel (1,677), the two hardwood species most commonly associated with tanoak. Tanoak however, has the greatest maximum volume-6,900 cubic feet. This was the highest volume by a wide margin found in any hardwood type in California. Some individual subplots had more than 10,000 cubic feet per acre. As in most hardwood stands, such densities are rarely sustained over a large area.

Volume by tree size-Of the growing-stock volume of tanoak, 74 percent is in sawtimber trees. Sawtimber trees 21.0 inches and larger account for 25 percent of volume; and trees 29.0 inches and larger, for 9 percent.

Maximum tree size-The largest tanoak tree tallied on forest inventory plots was 59.2 inches in diameter. This tree, in Mendocino County, had a broken top, so total height could not be measured. Undamaged trees in the same stand were about 90 feet tall, Tanoak was the second largest hardwood species measured in the inventory (Pacific madrone was the largest). The largest on record (American Forestry /association 1982), in Humboldt County, is 109.5 inches in d.b.h. and 100 feet fall.

Understory vegetation-More than 35 shrub species were tallied on plots in tanoak stands, including *Arctostaphylos canescens, A. columbiana, Berberis* spp., *Ceanothus foliosus, C. incanus, C. integerrimus, C. sorediatus, C. thyrsiflorus, Gaultheria shallon, Corylus cornuta* ssp. *californica*, *Heteromeles arbutifolia, Holodiscus discolor*, *Lonicera* involucrata, *L. ciliosa, L. interrupta*, *Osmaronia cerasiformis, Prunus emarginata*, *Rhamnus californica, R. purshiana, Rhododendron macrophyllum R. occidentale, Rhus diversiloba, Ribes* spp., *Rosa* spp., *Rubus leucodermis. R. parviflorus, R. spectabilis*, *R. ursinus, Salix* spp., *Sambucus* spp., *Symphoricarpos mollis, Vaccinium ovatum*, and *V. parvifolium*.

Grass cover-In tanoak stands, grass cover was usually very sparse because of the dense overstory of trees and shrubs.

Pacific madrone

Area of type and species occurrence-The total area of Pacific madrone type in California is 462,000 acres: 57 percent is in private ownership; 26 percent is in National Forests; and 17 percent is on lands managed by State, county, and miscellaneous Federal agencies. Although often associated with conifers on highly productive timberland, madrone also grows on harsh sites that are incapable of supporting timber conifers. On these sites, madrone's associates include coast live oak, interior live oak, Oregon white oak, California-laurel, and other hardwoods. Such sites, classified as woodland, amount to 244,000 acres, or 53 percent of the total area of madrone type.

The total estimated area outside National Forests and Parks in which Pacific madrone trees occur is 2,399,000 acres-344,000 acres in madrone type and 2,055,000 acres in other types.

Stand density--Madrone stands sampled in the forest inventory had higher average density than any other hardwood type: 67 percent had 100 or more square feet of hardwood basal area per acre; only 2 percent had less than 25 square feet. The greater stand densities probably result from madrone's ability to "grow toward" light More than most species, madrone trees lean, bend, crook, and fork as they seek light.

Hardwood basal area *(Square feet per acre)*	Pacific madrone type *(Percent)*
0-24	2
25-49	7
50-74	7
75-99	17
100+	67
Total	100

Madrone, unlike many of the hardwoods, rarely grows in monotypic stands. None was found in the statewide inventory. In most madrone stands, a considerable portion of the basal area is in other hardwoods.

Conifers are often present in madrone stands, usually in small to moderate amounts. Twenty-five percent of the madrone stands had at least 25 square feet of conifer basal area; 18 percent had 50 or more square feet.

Stand size-Of the Pacific madrone type, about 48 percent is in sawtimber stands, 43 percent in poletimber, and 9 percent in seedling- and sapling-size trees.

Stand volume-Average growing-stock volume in Pacific madrone stands is 1,706 cubic feet, similar to that of tanoak and California-laurel. The greatest volume in all stands sampled was 4,519 cubic feet per acre.

Volume by tree size-Of the growing-stock volume of madrone, 67 percent is in sawtimber trees. Large sawtimber trees (21.0 inches and larger) account for 25 percent of the volume; trees 29.0 inches and larger account for 9 percent.

Maximum tree size-The largest hardwood tree tallied on a forest inventory plot in California was a Pacific madrone. The tree (in Mendocino County) was 73.3 inches in d.b.h. and 98 feet tall. The second largest hardwood tree tallied (62.7 inches in d.b.h. and 75 feet tall) was also a madrone, on a plot in Humboldt County. Although madrone amounts to only 7 percent of the total area in hardwood types on timberland outside National Forests and Parks, it was the largest hardwood tallied on 18 percent of the plots. The American Forestry Association (1986) also recognizes Pacific madrone as a champion among hardwoods: The largest hardwood listed in California is a madrone-129.9 inches in d.b.h. and 96 feet tall. It was found in Humboldt County. Larger specimens of three of California's hardwood species were found in other States-California-laurel, bigleaf maple, and Fremont cottonwood.

Understory vegetation-Shrubs present in madrone stands include those found in tanoak stands on drier sites. Not found in madrone stands were moist-site specie such as *Gaultheria shallon*, *Osmaronia cerasiformis*, *Rhododendron s*pp., *Rubus spectabilis*, and *Vaccinium parvifolium*. Some shrub species found in the drier oak, woodlands were also found in madrone stands on dry sites; for example: *Arctostaphylos manzanita, A. viscida*, and *Lonicera hispidula.*

Grass cover-In madrone stands, grass cover was usually sparse.

California-laurel

Area of type and species occurrence-California-laurel seldom forms a type over a very large area. Statewide, only 164,000 acres were classified as California-laurel type (fig. 28). Sixty-three percent is in private ownership; 37 percent is on lands managed by State, county, and miscellaneous Federal agencies. National Forests report a trace (less than 500 acres).

Outside National Forests and Parks, California-laurel trees were found on 1,244,000 acres-164,000 acres of laurel type, 514,000 acres of other hardwood types, and 566,000 acres of conifer timber types.

Stand density-Forty-five percent of the California-laurel stands sampled had 100 square feet or more of basal area per acre, and none had less than 25 square foe;. Although laurel often grows in conifer stands, in the laurel type conifers were ere; only 4 percent of the type had more than 24 square feet of conifer basal area.

Hardwood basal area *(Square feet per acre)*	California-laurel type *(Percent)*
0-24	0
25-49	29
50-74	17
75-99	9
100+	45
Total	100

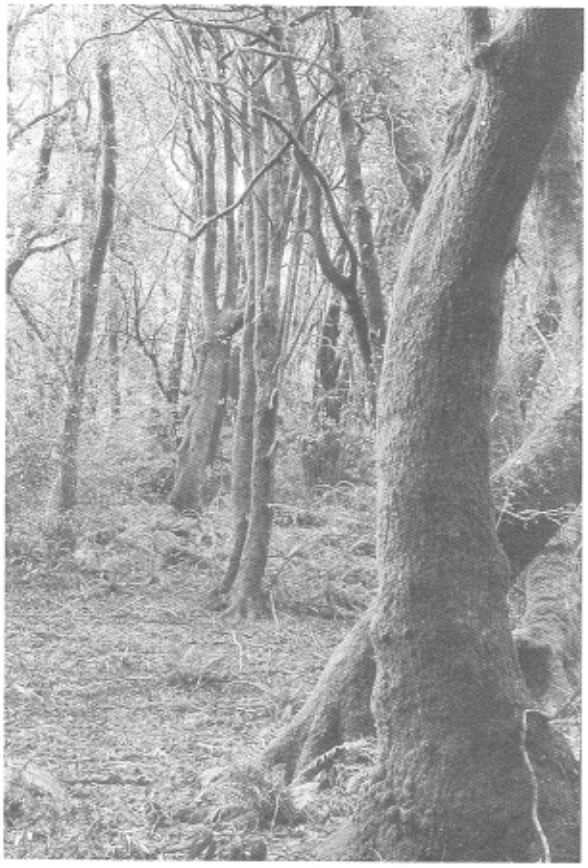


Figure 28—California-laurel stand in Del Norte County. Also called Oregon-myrtle, bay, and pepperwood, California-laurel is widespread in the State but seldom forms a pure type.

Stand size-Of the laurel type, 30 percent is in sawtimber stands, 41 percent in poletimber, and 28 percent in seedling-sapling stands. Although California-laurel can grow into a large tree, on some harsh sites where it forms a type it is small ante almost shrubby. The large area in trees smaller than sawtimber size does not necessarily indicate a young forest resource, but a combination of young trees and small but old trees on harsh sites.

Stand volume-Mean stand growing-stock volume in California-laurel type is 1,677 cubic feet per acre, similar to that of tanoak and Pacific madrone. The maximum volume found in a laurel stand was 3,125 cubic feet.

Volume by tree size-Of the growing-stock volume of California-laurel, 69 percent is in sawtimber trees. Large sawtimber trees (21 inches and larger) account for 14 percent; trees 29.0 inches, for only 3 percent.

Maximum tree size-The largest California-laurel tree tallied in the statewide forest inventory was 45.2 inches in diameter and 84 feet tall. The tree, on a plot in Mendocino County, was growing in a mixed stand containing Douglas-fir, madrone, California black oak, and Oregon white oak. The national champion California-laurel (American Forestry Association 1986) is in Oregon (where it is usually called Oregon-myrtle). The record tree is 159.5 inches in diameter and 88 feet tall.

Understory vegetation-Shrubs present in California-laurel stands include most of those found in tanoak and madrone stands. Occasionally, California-laurel grows in moist microsites within the woodland-chaparral zone, where it is associated with dry site plants such as *Adenostoma fasciculatum*, *Ceanothus cuneatus, Cercis Occidentalis, Fraxinus dipetala, Fremontia spp., Garrya* spp., and *Guercus dumosa.*

Grass cover-Grass cover is usually sparse in California-laurel stands.

Minor Hardwoods

Several species of hardwoods occur in limited amounts in the State. Some are locally common but are found in a restricted area of the State Others are widely distributed but never abundant. Following is a discussion of the occurrence of these minor species, as indicated by the statewide forest inventory.

Red alder

Red alder is found in the moist coastal belt from Del Norte County to Monterey County (fig. 29). In the north coast area, it occasionally grows as a hillside forest tree as well as a riparian tree. In the southern part of its range, it is confined to riparian strips and canyon bottoms. The total estimated area of red alder type in California is 20,000 acres, all but a few hundred of which are in private ownership,

Figure 29—Red alder is a bottomland species in the moist coastal belt; it also grows on logged-over hillsides in Del Norte and Humboldt Counties.

In the forest inventory, red alder was found on 388,000 acres outside National Forests, including the 20,000 acres of red alder type. Red alder is considered a small-to-medium-size tree and often appears dwarfed by the large redwood, Douglas-fir, and Sitka spruce trees with which it grows. Red alder trees in the sawtimber-size class (11.0 inches in d.b.h. and larger) are not uncommon. A red alder tallied on a plot in Humboldt County places the species sixth in size of all California hardwood species measured in the inventory. The tree was 47.0 inches in d.b.h. and 102 feet tall.

White alder

White alder is a riparian tree found throughout most of the forested part of California outside the moist coastal belt where red alder grows. The total estimated area of white alder type is 22,000 acres. A few hundred acres are in public ownership (other than National Forest); the rest of the area is privately owned.

In the forest inventory outside National Forests, white alder was found on 201,000 acres, including the 22,000 acres classified as white alder type. Similar in size and appearance to red alder, white alder is usually a smaller tree than its common riparian associates (cottonwood, sycamore, and walnut) or its nonriparian neighbors (including Douglas-fir, ponderosa pine, sugar pine, white fir, and incense-cedar).

Like red alder, sawtimber-size white alder trees (11.0 inches in d.b.h.) are fairly common. Trees in the large sawtimber class (21.0 inches in d.b.h. and larger) were found on several plots. The largest white alder measured in the inventory (in Napa County), was 38.6 inches in d.b.h. and 112 feet tall, and a close runner-up was a tree 36.0 inches in d.b.h. and 93 feet tall in Calaveras County, The record white alder, 43.6 inches in d.b.h. and 93 feel: tall, was found in the Angeles National Forest (American Forestry Association 1982).

Quaking aspen

A tree widely distributed in North America, quaking aspen in California is generally limited to the higher elevations in California-the Sierra Nevada, Cascade Range, and Klamath Mountains-and the area east of these mountains (fig. 30). Forty thousand acres were classified as aspen type; all but a few hundred acres were in National Forests.

Outside National Forests, quaking aspen trees were found on 54,000 acres, including mixed conifer type, white fir, California red fir, Jeffrey pine, and western juniper (on moist microsites).

The largest aspen tallied on an inventory plot, 22.8 inches in d.b.h. and 72 feet tall, was in eastern Amador County.

Figure 30—Quaking aspen fringe between a hillside ponderosa pine stand and a mountain meadow, Lassen County. Aspen is one of the most widely distributed trees in North America, found from Newfoundland to Alaska and from The Yukon to central Mexico.

Black cottonwood and Fremont cottonwood

Two species of cottonwood are widely distributed in California. Black cottonwood is a riparian tree in coastal areas and in the conifer forest zone in the higher mountains. Fremont cottonwood is a riparian tree of the interior valley, foothills, and lower mountains. Both species occur as occasional trees, groves or stringers, often in areas too small or strips too narrow to qualify as forest. They were tallied one fear forest Inventory plots.

The total estimated area of black cottonwood type is 19,000 acres-7 000 acres in private ownership, 11,000 acres in National Forests, and 1,000 acres on other public land. The total estimated area outside National Forests and Parks n which black cottonwood was found in the inventory is 23,000 acres, 7,000 acres of black cottonwood type and 16,000 acres of conifer timber types.

The largest black cottonwood tallied on an inventory plot was 30 9 Inches in d.b.h, and 91 feet tall. The tree was by a stream in a ponderosa pine type in Plumas County. The largest tree on record is in Oregon and is 101.2 inches in d.b.h. and 148 feet tall (American Forestry Association 1986).

The total estimated area of Fremont cottonwood type is 39,000 acres, 33,000 acres in private ownership and 6,000 acres on public land other than National Forest. Outside National Forests, Fremont cottonwood trees were found only in Fremont cottonwood type.

The largest Fremont cottonwood tallied was 48.6 inches in d.b.h. and 112 feet tall; it was in Placer County. The record Fremont cottonwood is in Arizona-133.0 inches in d.b.h. and 94 feet tall (American Forestry Association 1986).

BIgleaf maple

Bigleaf maple is a common forest tree in northwestern California, found along streams, in canyons and other moist sites in the central coast area, and in scattered localities in the Sierra Nevada and southern California. The total estimated area of bigleaf maple type is 82,000 acres; all but a few acres are privately owned.

Outside National Forests and Parks, bigleaf maple trees were found on a fairly large area-801,000 acres. The data suggest that bigleaf maple rarely forms a type but typically occurs as scattered trees or clumps in stands of other species.

The largest bigleaf maple tallied on an inventory plot was 40.7 inches in d.b.h. and 82 feet tall; the tree was in Shasta County. The record bigleaf maple (American Forestry Association 1986) is in Oregon, a multiple-stemmed tree 133.4 inches in d.b.h. and 101 feet tall.

California buckeye

California buckeye is a small tree of the valleys, foothills, and canyons. It is found in a broad range of forest types, including Douglas-fir and redwood forests from Humboldt County to Santa Cruz County, ponderosa pine and mixed conifer forests in the Coast Range and Sierra Nevada, and in the oak woodlands from Shasta County to Kern County. It is also found as a shrub on moist sites in chaparral types; it occasionally appears in riparian strips in grassland areas outside the forest zone.

Although not usually considered a woodland type in itself but lumped with various oak types, buckeye was the dominant tree on woodland plots representing 208,000 acres. The entire area is privately owned.

Outside National Forests, California buckeye trees were found on 719,000 acres. Not included are areas of buckeye shrubs in chaparral or mature shrub-size buckeye in nonforest areas.

The largest California buckeye tallied on a forest inventory plot was 15.7 inches in d.b.h. and 29 feet tall. It was in Amador County. Buckeye trees as tall as 35 feet were tallied on other plots. The record California buckeye, 55.4 inches in d.b.h. and 48 feet tall (American Forestry Association 1986), was found near Walnut Creek.

Giant chinkapin

Giant chinkapin, also known as golden chinkapin, is an evergreen hardwood found in California from San Luis Obispo County to the Oregon border, almost entirely in the Coast Range and Klamath Mountains. It rarely forms a type. No chinkapin type was found outside National Forests, and only 1,000 acres were reported inside National Forests.

Chinkapin trees were found on plots representing 115,000 acres outside National Forests, in Del Norte, Humboldt, Mendocino, Sonoma, Santa Cruz, and Trinity Counties. The types in which chinkapin trees were found include Douglas-fir, redwood, tanoak, and mixed conifer.

Giant chinkapin, despite its name, is a small-to-medium-size tree. It is unique among Pacific coast hardwoods in that it typically has an excurrent form-straight without forks. In dense young-growth stands, its straight trunk, with furrowed bark and small branches departing at right angles from the bole, gives it the appearance of Douglas-fir or white fir. The largest diameter recorded for a giant chinkapin tree on a forest inventory plot was 30 inches in d.b.h. The tallest, another tree, was 75 feet high. Both trees were in Humboldt County. The record tree is in Oregon-45.2 inches in d.b.h. and 75 feet tall (American Forestry Association 1982).

Eucalyptus

Eucalyptus is not native to North America but has been widely planted in California mostly on nonforest land (see fig. 11). Few forest inventory plots had eucalyptus trees. No attempt was made to identify the species, but most eucalyptus tallied arc thought to be bluegum.

The total estimated area of eucalyptus type is 96,000 acres. Almost all is private land, but a few hundred acres are in public parks. In addition to the 96,000 acres of eucalyptus type, eucalyptus *trees were* found on 8,000 acres of conifer types on the north coast.

The largest eucalyptus tree tallied on an inventory plot was 34.2 inches in d.b.h and 125 feet tall. This tree was in San Luis Obispo County.

Miscellaneous hardwoods

Several species of hardwoods that grow in California are so limited in occurrence that they were seldom encountered on forest inventory plots. Pacific dogwood trees were tallied on 15 plots, but no tree was larger than 4 inches in d.b.h. Oregon asp saplings were found on a few plots. Other species tallied in very minor amounts include western water birch, cherry, walnut, and willow.

California sycamore and California boxelder were observed in the vicinity of forest inventory plots but were not tallied. These two species usually grow along streams, often in stringers of trees too narrow to be classified as forest.

Arborescent Shrubs

A number of angiospermous shrubs sometimes attain tree size and form. Such shrubs were tallied in a vegetation profile on forest inventory plots but were not counted as trees. Among these are mountain-mahogany (*Cercocarpus* spp.), buckthorn *(Rhamnus* spp.), scrub oak (*Quercus dumosa*), blue blossom ceanothus *(Ceanothus thyrsiflorus*), wax myrtle (*Myrica californica*), sumac (*Rhus* spp.), manzanita (*Arctostaphylos* spp.), red shank *(Adenostoma sparsifolium*), mountain-ash (*Sorbus* spp.), toyon *(Heteromeles arbutifolia),* vine maple (*Acer circinatum*), mountain maple (*A. glabrum*), and redbud (*Cercis occicentalis).*

Regeneration of Hardwoods

One of the major concerns related to California hardwoods is that the oaks of the foothills and valleys may not be regenerating. A general opinion held by many is that valley oak and blue oak, especially, are slowly disappearing; old trees are dying and being cut for fuel and in land clearing, but very few young trees are replacing them. Other hardwood species are thought to be also declining. Data gathered in the forest inventory indicate that hardwood regeneration varies markedly by species (fig. 31). The information does seem to confirm the suspicion that valley oak and blue oak are not regenerating well. Results from a one-time field survey cannot be conclusive about how hardwoods are regenerating. The mere presence of seedlings on sample plots is not proof that tree replacement is occurring, nor does their absence in hardwood stands necessarily indicate a problem. Seedlings of intolerant tree species are rarely found in stands of older trees; for example, in the moist coastal belt Douglas-fir seedlings are seldom found under a Douglas-fir overstory, yet natural seedling establishment by the species is common.

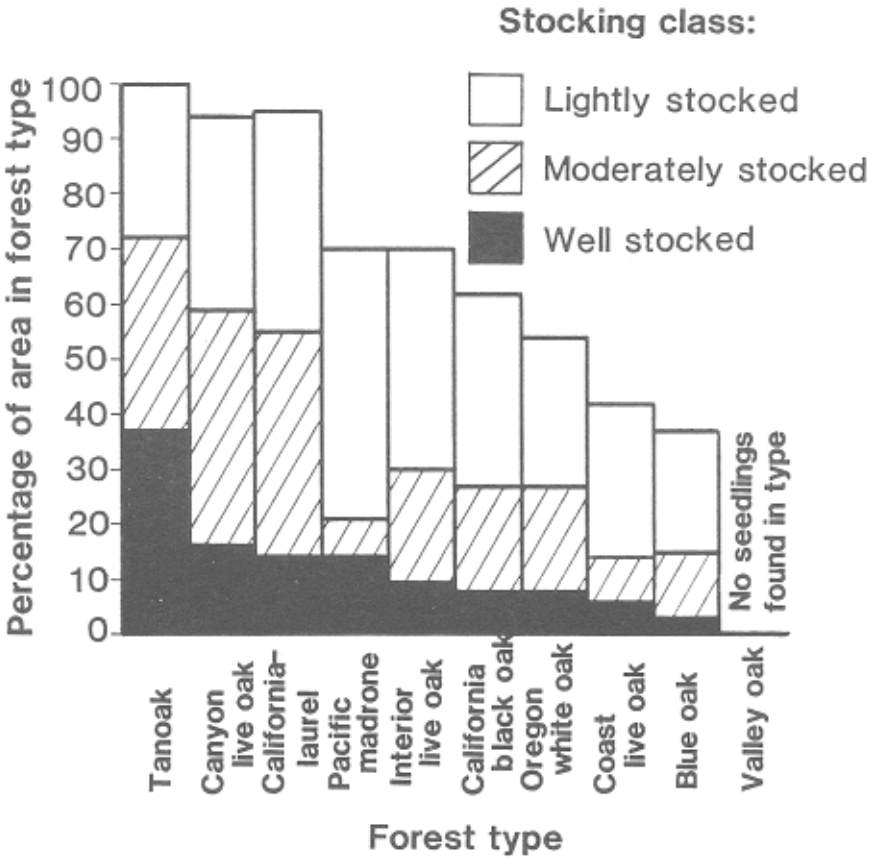


Figure 31—Percentage of area in major hardwood forest types outside National Forests by seedling stocking class, California, 1985.

Data are presented here only to indicate the current presence of seedling- and sapling-size hardwood trees as found on plots established systematically across the State (see "Sources of Information and Inventory Methods" and "Definition of Terms"). Additional studies and revisits to the plot locations will be necessary to quantify status of regeneration and stand dynamics of California hardwoods. Considerable research is needed before their ecological relations can be understood (Muick and Bartolome 1985).

Coast Live Oak

Outside National Forests and Parks, coast live oak seedlings were found on 307.000 acres of coast live oak type (41 percent) and saplings on 331,000 acres (44 percent). Coast live oak seedlings were also found on 171,000 acres of other types, and saplings on 138,000 acres:

Forest type	Area with coast live oak seedlings	Area with coast live oak saplings
	(Thousand acres)	
Coast live oak	307	331
Pacific madrone	65	65
Blue oak	33	—
Tanoak	16	8
Valley oak	—	33
California black oak	16	8
Oregon white oak	8	—
California-laurel	9	—
Redwood—Douglas-fir	24	24
Total	478	469

Only 6 percent of the coast live oak type was well stocked with seedlings. Most plots with seedlings or saplings were lightly stocked:

Regeneration category	Seedling stocking		Sapling stocking	
	(Thousand acres)	*(Percent)*	*(Thousand acres)*	*(Percent)*
Nonstocked	445	59	421	56
Lightly stocked	215	29	278	37
Moderately stocked	46	6	53	7
Well stocked	46	6	—	—
Total	752	100	752	100

Canyon Live Oak

Plot data indicate that canyon live oak does not have a regeneration problem. Outside National Forests and Parks, canyon live oak seedlings were found on 656,000 acres of canyon live oak type (94 percent) and saplings on 568,000 acres (81 percent). Canyon live oak seedlings were found on 1,460,000 acres of other type and saplings on 980,000 acres.

About 58 percent of canyon live oak type was moderately stocked to well stocked with seedlings, and 29 percent was moderately to well stocked with saplings (see following tabulation):

Regeneration category	Seedling stocking		Sapling stocking	
	(Thousand acres)	*(Percent)*	*(Thousand acres)*	*(Percent)*
Nonstocked	44	6	133	19
Lightly stocked	249	36	365	52
Moderately stocked	288	41	193	28
Well stocked	117	17	7	1
Total	698	100	698	100

Interior Live Oak

Plot gala show that there is no scarcity of interior live oak seedlings or saplings, though most of those tallied were slump sprouts, Of the sample plots it interior live oak type, 70 percent had seedling-size trees on them, ant 81 percent had saplings. Seedling- or sapling-size interior live oak trees were found on more than 700,000 acres of other types:

Forest type	Area with interior live oak seedlings	Area with interior live oak saplings
	(Thousand acres)	
Interior live oak	561	643
Blue oak	234	167
Conifer timber types	162	155
Canyon live oak	108	82
California black oak	65	16
California-laurel	67	—
Pacific madrone	41	41
Tanoak	24	8
California buckeye	33	65
Singleleaf pinyon	33	33
Cottonwood (riparian)	—	33
Total	1,328	1,243

Although seedling- and sapling-size interior live oak trees were found in a large percentage of the stands, most interior live oak stands were not well stocked with seedlings or saplings:

Regeneration category	Seedling stocking		Sapling stocking	
	(Thousand acres)	*(Percent)*	*(Thousand acres)*	*(Percent)*
Nonstocked	235	30	153	19
Lightly stocked	318	40	472	59
Moderately stocked	170	21	171	22
Well stocked	73	9	—	—
Total	796	100	796	100

California Black Oak

California black oak seedlings were found on 381,000 acres, or 62 percent of the plots in black oak type; and saplings on 268,000 acres, or 44 percent.

Regeneration category	Seedling stocking		Sapling stocking	
	(Thousand acres)	*(Percent)*	*(Thousand acres)*	*(Percent)*
Nonstocked	233	38	346	56
Lightly stocked	230	37	188	31
Moderately stocked	110	18	63	10
Well stocked	41	7	17	3
Total	614	100	614	100

Acorn-originated California black oak seedlings were common, but stump sprouts often dominated in logged areas (fig. 32). In addition, black oak seedlings or saplings, or both, were found on 2.0 million acres of other forest types.

Oregon White Oak

Oregon white oak seedlings were found on 55 percent of the Oregon white oak type and saplings on 62 percent. Oregon white oak seedlings and saplings were also found on more than 200,000 acres of other types, as follows:

Forest type	Area with Oregon white oak seedlings	Area with Oregon white oak saplings
	(Thousand acres)	
Oregon white oak	226	255
Conifer timber types	120	97
California black oak	31	46
Blue oak	29	29
Western juniper	29	29
Canyon live oak	15	15
Pacific madrone	8	23
Total	458	494

Figure 32—California black oak stump sprout, two and a half growing seasons after the tree was cut down, Amador County.

Areas of Oregon white oak type by regeneration categories are shown below:

Regeneration category	Seedling stocking		Sapling stocking	
	(Thousand acres)	*(Percent)*	*(Thousand acres)*	*(Percent)*
Nonstocked	185	45	156	38
Lightly stocked	124	30	197	48
Moderately stocked	73	18	29	7
Well stocked	29	7	29	7
Total	411	100	411	100

Valley Oak

The forest inventory seems to confirm the general opinion that valley oak is not regenerating well. No valley oak seedlings were found on plots in valley oak type. Saplings were found on 30,000 acres (11 percent) of the type. Although no valley oak seedlings were found in the type, some were found in conifer timber types (7,000 acres) and interior live oak type (32,000 acres). Also, valley oak saplings occurred more often in types other than valley oak: black oak, 8,000 acres; riparian cottonwood, 33;000 acres; and, conifer timber types, 15,000 acres.

On a few occasions, valley oak seedlings and saplings were observed outside plot boundaries by field crews. Young trees can sometimes be seen within road rights-of-way and in fence rows. I have seen young valley oaks both under slash and emerging from dense streamside brush. The question arises about the adequacy of the statewide sample to describe the condition of valley oak.

Of the 1,033 ground plots on which hardwoods were tallied in the statewide inventory, well over 200 were within the general zone occupied by valley oak. The species was found on only 20 plots (each plot consisted of three to five 1/4-acre subplots distributed over about 5 acres) and seedlings and saplings on only 7 plots. Although the light sample may not very well describe the characteristics of valley oak stands, there is no reason to suspect that it does not adequately represent the extent of the species on forest land and the occurrence of seedlings and saplings. It does not represent nonforest areas, such as widely scattered trees in grassland, streamside stringers less than 120 feet wide, and small groves or clumps less than an acre in size. Some of the most visible valley oaks are in these nonforest areas that were not sampled.

Blue Oak

Blue oak is one of the woodland species generally considered to be declining because regeneration is not keeping up with removal and natural mortality. The inventory seems to confirm this, although blue oak seedlings were found on 37 percent of the type. Blue oak seedlings or saplings, or both, were also found on more than 200,000 acres of other types:

Forest type	Area with blue oak seedlings	Area with blue oak saplings
	(Thousand acres)	
Blue oak	915	1,237
Interior live oak	173	132
California live oak	33	66
Canyon live oak	33	33
California black oak	—	8
Conifer timber types	24	—
Total	1,178	1,476

As shown in the following tabulation; seedling and sapling stocking in blue oak type was usually sparse. Many saplings were fairly old trees and probably should not be considered as regeneration.

Regeneration category	Seedling stocking		Sapling stocking	
	(Thousand acres)	*(Percent)*	*(Thousand acres)*	*(Percent)*
Nonstocked	1,558	63	1,236	50
Lightly stocked	593	24	1,039	42
Moderately stocked	273	11	198	8
Well stocked	49	2	—	—
Total	2,473	100	2,473	100

The occurrence of blue oak seedlings in blue oak type was positively correlated with the number of woody plant species found in the stand:

Plants present	Percentage of type with blue oak seedlings
No other trees, no shrubs	24
No other trees, 1 or 2 shrub species	27
1 or 2 other tree species, no shrubs	56
4 or more woody plants, trees, or shrubs	68
5 or more woody plants, trees, or shrubs	78

In general, blue oak stands with several woody plant species are on moister sites than those with few species. The plant found most often on plots with blue oak seedlings present was *Rhus diversiloba* (poison-oak). It was present on 32 percent of the plots with seedlings, but only on 11 percent of those without seedlings.

Engelmann Oak

Engelmann oak was tallied on two oak woodland plots and one chaparral plot. Seedlings and saplings were found on one of these plots. The saplings appeared to be old trees.

Tanoak

Many timberland managers would agree that there is a tanoak regeneration problem. The problem is that tanoak regenerates too well-by sprouting from stumps and from germinating seed. On most sites where it grows, more valuable conifers can grow. Tanoak can inhibit conifer regeneration and compete with larger conifer trees, which reduces timber yields.

Inventory plot data, as well as silvicultural literature (McDonald and others 1983), indicate that tanoak has the ability to germinate and survive in forest stands, but it can also grow vigorously in full sunlight. Tanoak's persistence, tolerance, and vigor make it a difficult tree to deal with on the many sites where it is not wanted. Adding to the list of reasons foresters often hate tanoak is its fuzzy foliage, which irritates the eyes and skin and causes sneezing and coughing.

Tanoak seed lings-including stump sprouts-were found on 100 percent of the plots in tanoak type. They were also found on about 1.5 million acres of other types, including more than 1.2 million acres of conifer types. (A shrubby form of tanoak-*Lithocarpus densiflorus* var. *echinoides*-occurs in the mountains of northern California. It was not tallied as tanoak regeneration but was recorded in a "vegetation profile" on each subplot.)

Evidence shows that the area of tanoak type has increased by several hundred thousand acres since the beginning of large-scale harvesting of conifers in the north coast counties (see "Change in Hardwood Area"). Within a few years after logging; many sites become tanoak thickets with tens of thousands of stems per acre. Stump sprouts quickly grow from "seedling size" to saplings and poles in a few years (McDonald and others 1983).

Seventy-one percent of the tanoak type was moderately stocked to well stocked with tanoak seedlings:

Regeneration category	Seedling stocking	
	(Thousand acres)	*(Percent)*
Nonstocked	—	—
Lightly stocked	227	29
Moderately stocked	266	34
Well stocked	293	37
Total	786	100

Pacific Madrone

Pacific madrone seedlings (including stump sprouts) were found 0n 24 :.'00 *acres* or 70 percent of the madrone type outside National Forests and Parks. Madrone seedlings were also found on about 1.7 million acres of other types-446,000 acres of hardwood types and 1.2 million acres of conifer types. Madrone appears to be less tolerant than tanoak, but in full and partial sunlight madrone stump sprouts grow faster than tanoak (McDonald and others 1983). Like tanoak, madrone regeneration is rarely sought by timber managers, many of whom consider it a. weed tree.

Regeneration category	Seedling stocking	
	(Thousand acres)	(Percent)
Nonstocked	103	30
Lightly stocked	168	49
Moderately stocked	23	7
Well stocked	50	14
Total	344	100

California-Laurel

California-laurel seedlings were found on 95 percent of the plots in California-laurel type. In addition, laurel seedlings were found on 514,000 acres of other hardwood types and about 586,000 acres of conifer timber types.

Regeneration category	Seedling stocking	
	(Thousand acres)	*(Percent)*
Nonstocked	9	5
Lightly stocked	67	41
Moderately stocked	65	40
Well stocked	23	14
Total	164	100

Regeneration of Minor Native Hardwoods

Minor hardwoods were sampled very lightly in the statewide inventory. Because there are no known issues related to these minor species, the sparse sample seems justified.

As shown in the tabulation below, the sample indicated that most species are regenerating fairly well:

	Types with species occurrence	
	Seedlings	Saplings
	(Percent)	
Red alder	31	39
White alder	8	23
Quaking aspen	28	28
Black cottonwood	35	35
Fremont cottonwood	—	—
Big leaf maple	53	40
California buckeye	27	43
Giant chinkapin	70	35

As with some oak species, sapling-size aspen and California buckeye are otter old trees; their presence is not always an indication of recent regeneration success.

Grazing of Woodlands

The primary use of much of California's oak woodland is livestock grazing. Nearly all woodland areas that are not too steep and rocky, or brushy, have been grazed at some time in the past. Grazing was first begun in 1769 in the vicinity of the Spanish missions. Soon, cattle, sheep, and sometimes hogs, roamed the oak woodlands over much of the central and southern Coast Range and the oak-dotted central valley By 1860, stock raising had spread throughout the State. Many areas have been grazed more or less continuously since (Rossi 1980).

Grazing is believed by many to be one of the major factors in the historic decline of oaks in California, although scientific studies do not consistently prove this (Plumb 1980). As early as the 1860's, oak trees were felled to provide foliage for animals that were starving because of the combined effects of drought and overgrazing. Grazing has been blamed for reducing the number of viable acorns available to reseed the woodlands, for destroying seedlings and saplings, and for compacting soil, which further limits the chance of seedlings becoming established. Extensive areas of oak stands have been cleared with the purpose of improving forage production (see "Change in Hardwood Area").

Clearing oak stands does not always improve forage production or increase the nutritional quality of forage; but where stands are dense, especially on certain soils, removal of oak trees can substantially increase the range value (Duncan and Clawson 1980, Holland 1980, Holland and Morton 1980, Kay and Leonard 1980, Murphy 1980). Whether livestock grazing per se is always detrimental to oak regeneration and growth is not clear. Sometimes disturbance such as grazing, if carefully timed, can favor oak regeneration and growth.

Just how much of the woodland is being grazed and in what forest types is grazing concentrated? Data gathered in the statewide forest inventory were used to estimate the extent of grazing. At each woodland plot location, field crews estimated whether or not grazing had taken place in the past year from evidence of grazing within the boundaries of sample plots. Sometimes, conversation with landowners was helpful, but it was not accepted as final proof. Some plots were in areas that were physically inaccessible to livestock, even though the property was being grazed.

The sample indicated that 55 percent of the woodland area had been grazed within the past year, including all forest types. The statistical reliability of this estimate is high (at the 68-percent probability level, the confidence level is about 5 percent). The soundness of the field crew's judgment about whether or not grazing had occurred within 1 year is difficult to evaluate. The tendency would be to underestimate the incidence of grazing, especially where it had been very light. Also where disturbance such as fuelwood cutting, water development. or road or residential construction was recent, evidence of grazing may have been overlooked.

As expected, there were some marked differences in grazing intensity by type. Oak types in general were more heavily grazed than nonoaks, but canyon live oak was hardly grazed at all. Canyon live oak typically grows in steep rocky terrain (see fig. 21), difficult ground for hooved animals; and herbaceous vegetation in the type is usually very sparse (fig. 33). The following tabulation shows percentage of grazing by type as determined from plots in woodland:

Forest type and group	Area grazed within past year		Mean grass cover
	(Thousand acres)	*(Percent)*	*(Percent)*
Oak group:			
Coast live oak	396	56	37
Canyon live oak	34	8	18
Interior live oak	532	72	54
California black oak	39	28	18
Oregon white oak	198	62	45
Valley oak	193	73	62
Blue oak	1,582	64	77
Engelmann oak	35	100	50
All oaks	3,009	60	
Nonoak group:			
California-laurel	33	35	10
California buckeye	136	65	75
All nonoaks	169	25	
All types	3,178	55	

Figure 33—Grass cover is often sparse in the canyon live oak type.

Change in Hardwood Area

Hardwood Types on Timberland Increasing

A comparison of estimates of hardwood area made in 1945 (Wieslander and Jensen 1946) with those in this report (1985) indicates a net decline of 425,000 acres, statewide-from 10,027,000 acres to 9,602,000 acres.[11] The 1945 estimates included hardwoods on timberland as well as on woodland. The comparative statistics indicate that hardwood area increased in several counties where hardwoods occurred primarily on timberland. This generally agrees with Bolsinger's (1980) timber-investment-opportunity study, and his 1986 analysis of change in forest condition in the Del Norte, Humboldt, Mendocino, and Sonoma Counties.[12] All three of these studies indicate that .hardwood area in the four counties increased by about 700,000 acres between 1945 and 1985, primarily as a result of logging. After conifers were removed hardwoods that were left dominated the site, or naturally seeded in. In some cases; hardwoods were cut along with conifers, but they sprouted and gained control of the site before young conifers could develop. Several species of hardwoods are included, but the major one is tanoak. Ironically, 80 years ago George Sudworth (1908) expressed concern for the future of "tanbark oak" after observing the "extensive practice of destroying this oak for its bark alone."

The statistics indicate that hardwoods on timberland also increased in Shasta and Trinity Counties by about 60,000 acres. The total hardwood type on timberland, then, increased an estimated 760,000 acres from 1945 to 1985.

[11] The figures for 1945 and 1985 are both subject to error. In 1945, in addition to errors related to the poor quality of photographs there were probably errors in type line placement, type identification, and determination of area within types. The 1985 estimate is subject to sampling error as well as mistakes in judgment. Also, the minimum area recognized was different in the two projects, which could also result in some unaccountable differences in results.

[12] Presentation titled, "Trends in California's Forest Resource Base, With Emphasis on the North Coast," given at a hearing on the future or California's forest resources held by the California Assembly's Natural Resources Subcommittee on Timber May 13. 1986.

Oak Woodland Conversion Between 1945 and 1973

If the net decline in all hardwood types was 425,000 acres, as indicated by the comparison of 1945 and 1985 area estimates, and hardwoods on timberland increased by 760,000 acres, then hardwood types on woodland must have decreased by 1,185,000 acres. Other information, as discussed below, generally confirm this.

The major cause of the decline in woodland area before the early 1970's was rangeland clearing (fig. 34). The California Division of Forestry (now Department of Forestry and Fire Protection) reported that between 1945 and 1973, 1,940,122 acres were cleared in "brushland range improvements" (fig. 35). Most of the clearings were accomplished by burning, with or without mechanical treatment. Herbicides were also used to kill hardwood sprouts that emerged one or more years after burning (annual reports by State of California, 1953 to 1974). The range improvement reports did net show acreages cleared by vegetation type; however, in each report a brief text summarized activities of the past year and described a few featured projects. For example, the 1971 report features a clearing project on the Wilbur Ranch in San Benito County in "a mixture of chaparral, hardwoods, woodland grass, and conifer." These featured projects were used as a sample to estimate that 36 percent of the clearings were in hardwood types and 64 percent were in chaparral types. About 68 percent of the chaparral cleared had inclusions of hardwoods. An aerial photo sample indicated that such hardwood inclusions averaged 25 percent of these areas. This approximation method indicated that rangeland improvement projects between 1945 and 1973 reduced the area of oak woodland by about 893 CU acres or about 32 000 acres

Figure 34—This pasture in blue oak-interior live oak type was cleared so long ago that stumps and logs are not evident. The straight boundary at the fenceline indicates that the clearing is not natural.

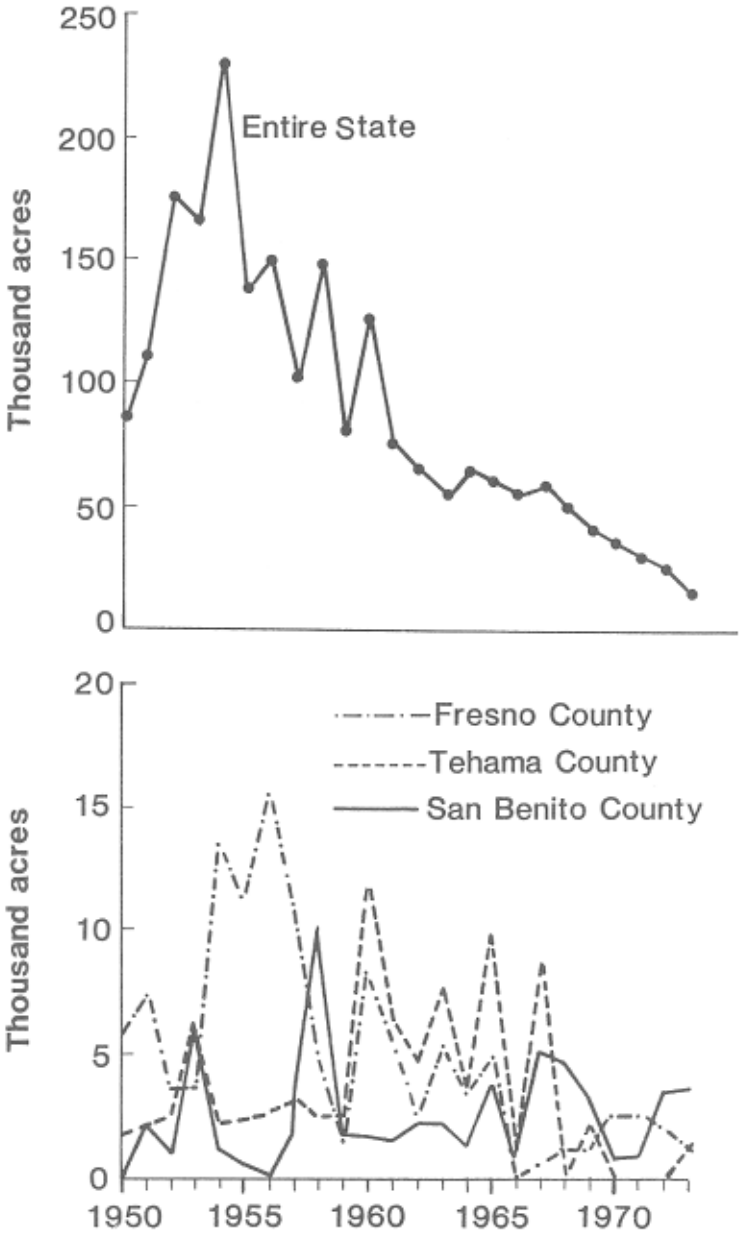


Figure 35—Annual acreage of rangeland clearing in selected counties and entire State, California, 1950-73.

per year. This is a rough indication, but it seems to check with other indicators. When added to the 100,000 acres estimated to have been cleared for reservoirs (fig. 36), roads, powerlines, and residential development between 1953 and 1975 (Bolsinger 1980), the total estimated area of woodland conversions (990,000 acres) is only 195,000 acres less than the adjusted difference between the 1945 and 1985 inventories (1,185,000 acres). Estimates of conversions between 1966-72 and 1981-84 (see the next section) account for most of the remaining difference.

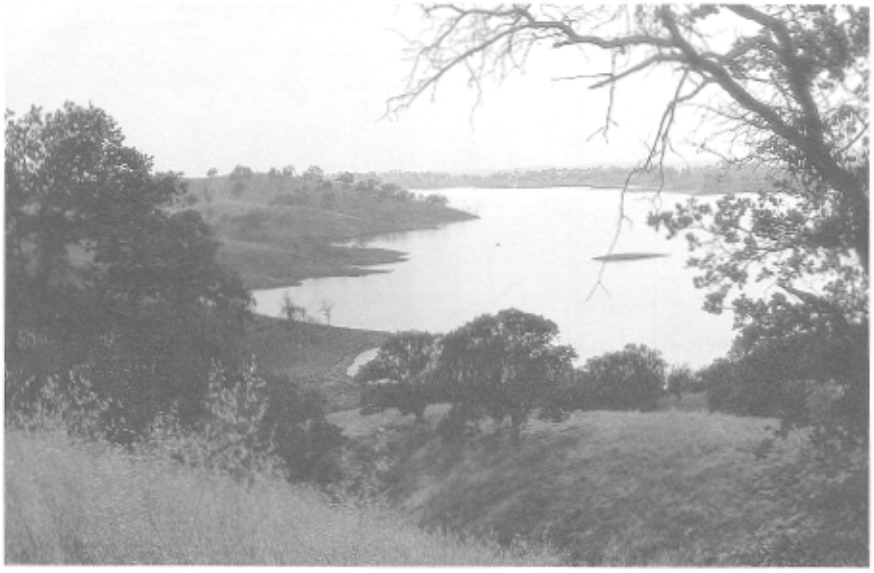


Figure 36—Reservoir construction has obliterated tens of thousands of acres of oak woodland. This reservoir is in Madera County in blue oak type.

Rangeland clearings were reported in 42 of the State's 58 counties, but of the total area cleared (1.9 million acres), more than half (1.0 million acres, including chaparral) was in 11 counties (Amador, Calaveras, Fresno, Madera, Mariposa, Napa, San Benito, San Luis Obispo, Santa Barbara, Tehama, and Tuolumne). The current inventory shows 881,000 fewer acres of hardwood types in these 11 counties than was reported for 1945 (see table 7 and fig. 37).

Blue oak was the tree species mentioned most often in the rangeland improvement reports, followed by "live" oak (presumed to be primarily interior live oak, with small amounts of coast live oak and canyon live oak).

Oak Woodland Conversion, 1966-72 to 1981-84

On lands outside National Forests and Parks in 1966-72, plots were established in oak woodland and chaparral, and in grassland within the woodland and chaparral zones. These plots were located randomly in all counties except Inyo, Los Angeles, Orange, Riverside, San Bernadine, San Diego, San Luis Obispo, Santa Barbara, and Ventura. Most of these plots were not marked on the ground but were carefully marked on aerial photographs. In 1981-84, these plots were relocated. A total of 379 plots classified as oak woodland in 1966-72 were examined, as well as several hundred classified as grassland and chaparral. No plots classified as grassland o, chaparral in 1966-72 were found to be oak woodland in 1981-84, but 11 of the oak woodland plots had been converted to nonforest. These 11 plots represent about 3 percent of the total, which indicates a decline in area of oak woodland between 196672 and 1981-84 of 199,000 acres in the State outside the southern California counties mentioned above.

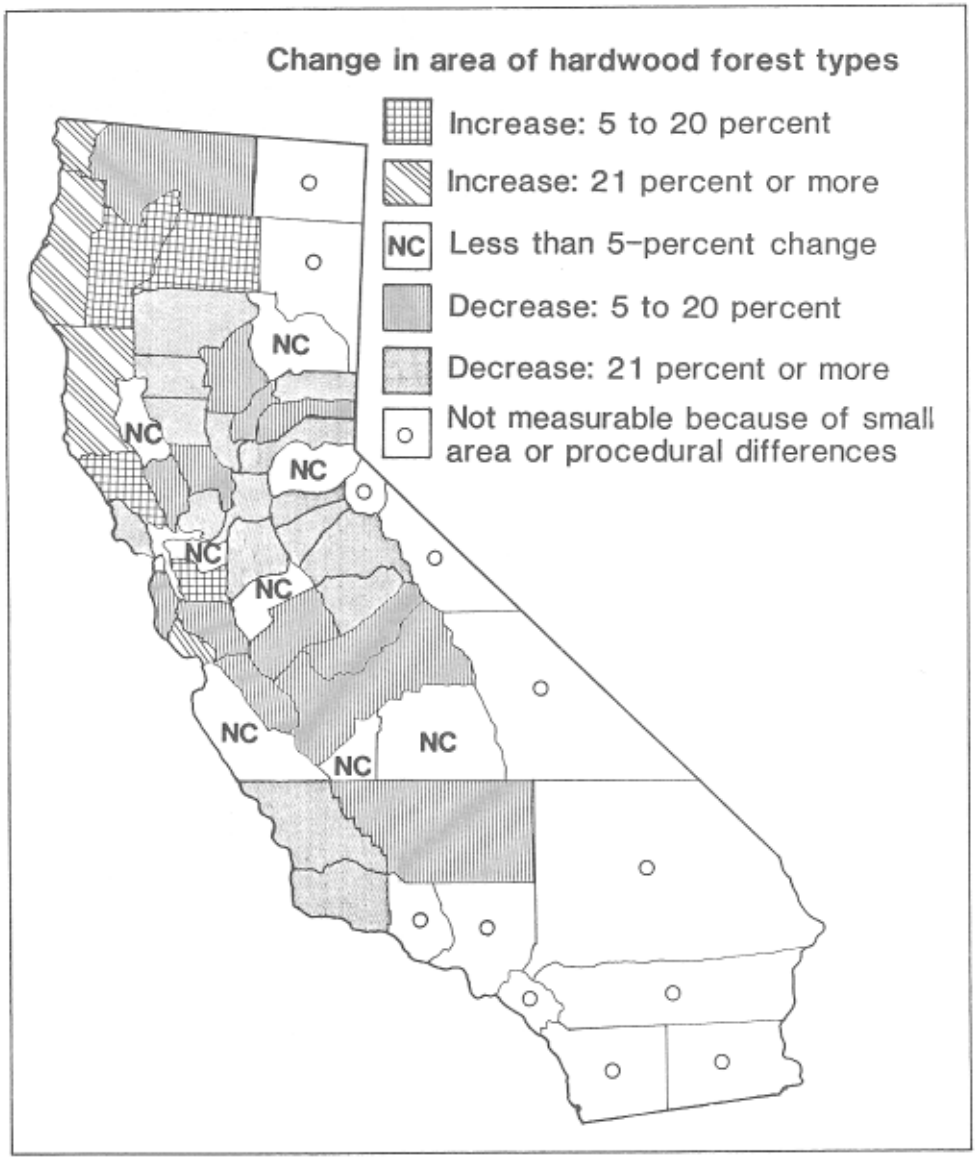


Figure 37—Change in area of hardwood types in California as indicated by comparison of the 1945 and 1985 inventories.

Figure 38—Residential development in interior live oak type in Placer County. Since about 1970, residential and commercial development has been the major cause of the decline in area of oak woodland.

Although rangeland improvement was the major cause of oak woodland decline between 1945 and 1973-about 32,000 acres per year-the relocated plots indicate that between 1966-72 and 1981-84, rangeland clearing amounted to only 2,400 acres per year. Residential-commercial development (fig. 38) was the leading cause:

Cause of oak woodland conversion	Percent	Acres per year
Residential-commercial development	46	7,400
Road and freeway construction	39	6,300
Rangeland clearing	15	2,400

Firewood cutting was not determined to be a cause of woodland conversion on any of the plats. The existence of a firewood market was a motivating factor in some cases, and the wood removed in land clearing was often used for firewood.

As was the case in rangeland clearing, blue oak was the major type converted. Valley oak type, not mentioned in the rangeland improvement reports, was second in importance, attesting to the desirability of valley oak sites for residential development. Clearings in live oak types were also found:

Woodland type converted to nonforest, 1966-72 to 1981-84	Acres	Percent
Blue oak	107,000	54
Valley oak	39,000	20
Interior live oak	30,000	15
Canyon live oak	23,000	11

The plot sample indicates that some geographic shifting has occurred in oak woodland clearing. Although some clearing was still taking place in remote areas-western Tehama County, for example-clearings were concentrated in areas of residential-commercial development, mostly in the foothills of the Sierra Nevada from Nevada and Yuba Counties south to Fresno County:

Resource area	Average number of years in classification period	Acres converted to nonforest	Annual rate
			(Acres per year)
North coast	15	None found	0
Central coast[13]	9	None found	0
Northern interior	13	14,000	1,077
Sacramento	12	90,000	7,500
San Joaquin	12	95,000	7,917

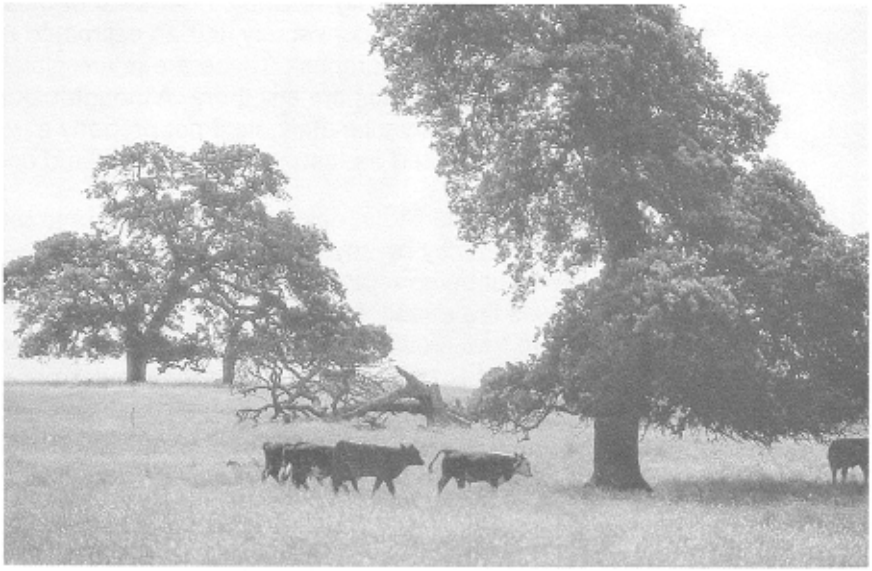
Of the three major categories of oak woodland conversion, two (roadbuilding a rangeland clearing) generally resulted in removal of most of the trees on the site. . Residential development, conversely, left an estimated 80 percent of the trees (estimated from aerial photographs). These areas are effectively removed from a wild land status, but many trees are still there. Although oak trees in urban developments often decline and many ultimately die if not properly cared for (Rogers 1980), they are not being eliminated as fast as the oak woodland conversion data would indicate.

"Natural" Attrition of Woodland

In many areas of the State, oak woodland appears to be declining of natural causes. or at least not directly by any physical action by people. Stands slowly thin out as trees die without being replaced by regeneration. At some point, the density of these stands passes the threshold from forest to nonforest-that is, from 10 percent or more cover in tree crowns to less than 10 percent (fig. 39). Direct measurement of this slow process is not possible now, although the results are implicit in the trends indicated by the 1945 and 1985 estimates of woodland areas. In the future, the loss of woodland to this form of attrition can be quantified by monitoring the permanent plots established across the State.

[13] Excludes San Luis Obispo, Santa Barbara and Ventura Counties

A



B

Figure 39—Oak woodland appears to be slowly phasing into non-forest in many parts of the State as old trees die without being replaced by young trees. A. Valley oak in El Dorado County. B. Blue oak in San Joaquin County.

Woodland Conversions-in-Process

An estimated 279,000 acres of woodland are in areas being developed for residential commercial, and industrial use. This estimate is based on the percentage of plots that were in tracts where development had been started, but on land that was still woodland by definition. Plots that were within areas that had been cleared or built up were classified as nonforest (they were used to estimate changes between 1966-72 and 1981-84). The 279,000 acres in ongoing developments represent about 5 percent of the total woodland area. The following tabulation shows the distribution of these developments by type:

Forest type	Thousand acres	Type
		(Percent)
Blue oak	160	6
Coast live oak	50	7
Eucalyptus	35	36
Valley oak	34	13
Total	279	5

Conclusions

This assessment has confirmed some of the general impressions of many people about the status of California's hardwoods. In a few cases, the findings were the opposite of what was expected. The statistics in this report quantify the hardwood resource base as of 1985; and, along with the system of permanently referenced aerial photo and ground plots, provide a basis for periodically monitoring change in the future. Some shortcomings in addressing all of the State's hardwood issues are apparent. Funds were not available to deal with every concern, or to intensify the sample; and some issues did not surface until the project was nearly completed. For some issues-hardwood regeneration, for example-considerable research is needed.

In summary, the findings of this study, as related to the seven issues identified in the introduction, show that:

1. *Fuelwood cutting* of hardwoods has increased in recent years, but the volume cut is a minute fraction of the total wood volume on both woodland and timberland. In woodland areas, hardwoods are being cut on about 60,000 acres per year, or 1 percent of the total woodland area in the State. This excludes hardwood removals made in woodland conversions. Fuelwood cutting per se was not determined to be a cause of woodland conversions (see point 2, below).

2. *Rangeland clearings* in oak woodland between 1945 and 1975 amounted to about 32,000 acres per year. Since the early 1970's, they have averaged less than 2,500 acres per year. Oak stand thinning is more prevalent than clearing now. Clearing operations usually involve fuelwood removal and, in some cases, may be encouraged by the increase in demand for firewood.

3. *Residential-commercial developments* of oak woodland since the early 1970's have taken place on an estimated 92,000 acres, an average of about 7,400 acres per year. Developments in-process were found on an additional 279,000 acres. These areas, still woodland by definition, will probably be converted within the next few years. Other oak woodland conversions, both completed and in-process, were related to construction of roads, reservoirs, and power transmission lines. Residential developments, unlike other causes of conversion, resulted in removal of only a portion of the trees. In some developments, considerable effort had apparently been made to save as many trees as possible.

4. *Hardwood regeneration* is extremely variable. Several species are regenerating faster than they are being removed. Blue oak regeneration is not keeping up with removals in some parts of the State. Valley oak regeneration seems even sparser than blue oak. Whether or not regeneration of the species is actually being hindered by natural or human-caused factors is not clear. Blue oak seedlings were rare in the pure blue oak stands at the species lower elevational range but fairly common at higher elevations on sites occupied by several other woody plant species. This suggests gests that the range of blue oak may be receding. If so, whether the cause is natural or related to action by people is not clear.

5. *Wildlife habitat* relations were not analyzed in this report, but much of the information on area and stand characteristics relates to the subject. For example, stand density is important to many animals, and this is the first statewide assessment ever made of density of oak stands. Tree size is also important to many species of animals; this assessment shows that large hardwood trees are abundant in California. Problems may be on the horizon, however, if woodland conversions continue 01 accelerate. Increased utilization of hardwoods, seen as a boon to the economy of several depressed counties, could also cause some problems for wildlife by reducing the area and density of hardwood stands, and eliminating some of the larger trees.

6. *Underutilized hardwoods* are abundant on timberland in the north coast counties, and to a lesser degree in other parts of the State. Tanoak, madrone, California-lour e. bigleaf maple, and in some areas, California black oak, have increased in area and volume as a result of conifer logging. In several rural counties, considerable effort has been made to develop industries based on hardwoods. This assessment shows that California's hardwood trees on the average are larger than the hardwoods that support several industries in the Eastern United States, but that much of the volume in California hardwoods is in poorly formed trees. Still, the inventory indicates a sizable potential resource for many products and industries.

7. *Hardwoods as "weeds"* have increased considerably on timberland in the north coast counties and, to some extent, in other areas. This assessment shows that the State's timberland now supports the greatest volume of hardwoods since forest inventories were begun in the 1930's. Considerable effort has been made to control these hardwoods, but at the same time logging practices have encouraged them. Although these hardwoods are desirable in that they provide valuable wildlife habitat, help stabilize steep slopes, and are pleasant to look at; they are undesirable in that they have indirectly resulted in an economic loss in the form *of* reduced conifer timber production on many sites.

Some of the findings of this assessment point to additional work that is needed, if the results are to be meaningful. For example, the relatively high volume in large hardwood trees suggests that a considerable resource of high quality material is available. Further research would be needed to determine the cost of extraction and processing, the actual recovery of products by grade or value, and the effects on other resources of increased utilization.

The vast majority of the hardwood forest is in private ownership, and only a minute fraction is in parks and other reservations. Many of the privately owned hardwood stands are in areas of rapid urban and suburban expansion. Although only 279,000 acres of hardwood were found in areas being developed, the potential for hardwood conversion is many times greater. Much more so than with conifer forests, California's hardwoods are in the hands of many people with diverse interests. Their decisions could have a profound effect on the future of the State's hardwood forests.

Metric Equivalents

1,000 acres = 404.7 hectares
1,000 cubic feet = 28.3 cubic meters
1 cubic foot per acre = 0.07 cubic meter per hectare
1 foot = 0.3048 meter
1 inch = 2.54 centimeters
9 mile = 1.609 kilometers

Names of Woody Plants [14]

Scientific name	Common name
Softwood trees:	
Abies concolor (Gord. & Glend.) Lindl. ex Hildebr.	White fir
Abies grandis (Dougl. ex D. Don) Lind).	Grand fir
Abies magnifica A. Murr.	California red fir
Abies magnifica var. *shastensis* Lemm.	Shasta red fir
Chamaecyparis lawsoniana (A. Murr.) Parl.	Port-Ortord-cedar
Cupressus L. spp.	Cypress
Juniperus californica Carr.	California juniper
Juniperus occidentalis Hook.	Western juniper
Juniperus osteosperma (Torr.) Little	Utah juniper
Libocedrus decurrens Torr.	Incense-cedar
Picea sitchensis (Bong.) Carr.	Sitka spruce
Pinus albicaulis Engelm.	Whitebark pine
Pinus aristata Engelm.	Bristlecone pine
Pinus attenuata Lemm.	Knobcone pine
Pinus balfouriana Grev. & Balf.	Foxtail pine
Pinus contorta Dougl. ex Loud.	Lodgepole pine
Pinus coulteri D. Don	Coulter pine
Pinus jeffreyi Grev. & Balf.	Jeffrey pine
Pinus lambertiana Dougl.	Sugar pine
Pinus monophylla Torr. & From.	Singleleaf pinyon
Pinus monticola Dougl. ex D. Don	Western white pine
Pinus muricata D. Don	Bishop pine
Pinus ponderosa Dougl. ex Laws.	Ponderosa pine
Pinus radiata D. Don	Monterey pine
Pinus sabiniana Doug.	Digger pine
Pseudotsuga macrocarpa (Vasey) Mayr	Bigcone Douglas-fir
Pseudotsuga menziesii (Mirb.) Franco	Douglas-fir
Sequoia sempervirens (D. Don) Endl.	Coastal redwood
Sequoiadendron giganteum (Lindl.) Buchholz	Giant sequoia
Taxus brevifolia Nutt.	Pacific yew
Thuja plicata Donn ex D. Don	Western redcedar
Torreya californica Torr.	California torreya
Tsuga heterophylla (Raf.) Sang.	Western hemlock
Tsuga mertensiana (Bong.) Carr.	Mountain hemlock
Hardwood trees:	
Acer macrophyllum Pursh	Bigleaf maple
Acer negundo spp. *californicum* (Torr. & Gray)	California boxelder
Aesculus californica (Spach) Nutt.	California buckeye
Alnus rhombifolia Nutt.	White alder
Alnus rubra Bong.	Red alder
Arbutus menziesii Pursh	Pacific madrone
Betula occidentalis Hook.	Water birch
*Castanopsis chrysophylla (*Dougl.) A. DC.	Giant chinkapin

[14]Trees follow Little (1979), other plants follow Munz and Keck (1970).

Corpus nuttalli Audubon	Pacific dogwood
Eucalyptus L'Her. spp.	Eucalyptus
Eucalyptus globulus Labill.	Bluegum eucalyptus
Fraxinus latifolia Benth.	Oregon ash
Juglans L. spp.	Walnut
Lithocarpus densiflorus (Hook. & Am.) Rehd.	Tanoak
Platanus racemosa Nutt.	California sycamore
Populus fremontii Wats.	Fremont cottonwood
Populus tremuloides Michx.	Quaking aspen
Populus trichocarpa Torr. & Gray	Black cottonwood
Prunus L. spp.	Cherry
Quercus agrifolia Nee	Coast live calk
Quercus chrysolepis Liebm.	Canyon live oak
Quercus douglasii Hook. & Arn.	Blue oak
Quercus engelmannii Greene	Engelmann oak
Quercus garryana Dougl. ex Hook.	Oregon white oak
Quercus kelloggii Newb.	California black oak
Quercus lobata Nee	Valley oak
Quercus macdonaldii Greene	McDonald oak
Quercus tomentella Engelm.	Island live oak
Quercus wislizenii A. DC.	Interior live oak
Salix L. spp.	Willow
Umbellularia californica (Hook. & Am.) Nutt.	California-laurel, bay
Shrubs and vines:	
Acer circinatum Pursh	Vine maple
Acer glabrum Torr. var. torreyi (Greene) Smiley	Mountain maple
Adenostoma fasciculatum H. & A.	Chemise
Adenostoma sparsifolium Torr.	Red shank
Amelanchier Medic. spp.	Service-berry
Aralia californica Wats.	Spikenard
Arctostaphylos Adans spp.	Manzanita
Arctostaphylos canescens Eastw.	Hoary manzanita
Arctostaphylos columbiana Piper	Hairy manzanita
Arctostaphylos glandulosa Eastw.	Eastwood manzanita
Arctostaphylos manzanita Parry	Parry manzanita
Arctostaphylos patula Greene	Greenleaf manzanita
Arctostaphylos viscida Parry	Whiteleaf manzanita
Artemisia L. spp.	Sagebrush
Artemisia californica Less.	California sagebrush
Artemisia tridentata Nutt.	Basin sagebrush
Baccharis pilularis ssp. *consanguinea* (DC.) C.B. Wolf	Coyote bush
Berberis L. spp.	Oregon grape, barberry
Calycanthus occidentalis H. & A.	Spice-bush
Castanopsis sempervirens (Kell.) Dudl.	Bush chinkapin, Sierra chinkapin
Ceanothus L. spp.	Ceanothus, California-lilac
Ceanothus cuneatus (Hook.) Nutt.	Buck brush, wedgeleaf ceanothus
Ceanothus foliosus Parry	Ceanothus

Ceanothus incanus T. & G.	Coast whitethorn
Ceanothus integerrimus H. & A.	Deer brush
Ceanothus leucodermis Greene	Chaparral whitethorn
Ceanothus palmeri Trel.	Ceanothus
Ceanothus prostratus Benth.	Squaw carpet
Ceanothus sorediatus H. & A.	Deer brush
Ceanothus thyrsiflorus Esch.	Blue blossom
Ceanothus velutinus Dougl. ex Hook.	Tobacco brush shinyleaf ceanothus
Cercis occidentalis Torr. ex Gray.	California redbud
Cercocarpus betuloides Nutt. ex T. & G.	Birchleaf mountain-mahogany
Cercocarpus ledifolius Nutt.	Curlleaf mountain-mahogany
Chamaebatia foliolosa Benth.	Mountain misery, bear clover
Chrysothamnus Nutt. spp.	Rabbit-brush
Clematis ligusticifolia Nutt, in T. & G.	Clematis
Comarostaphylis diversifolia (Parry) Greene	Summer-holly
Cornus L. spp.	Dogwood
Corylus cornuta Marsh var. *californica* (A.DC.) Sharp	Hazel
Fraxinus dipetala H. & A.	Chaparral ash, flowering ash
Fremontia Torr. spp.	Flannel bush, fremontia
Gaultheria shallon Pursh	Salal
Garrva Doug. spp.	Silk-tassel bush
Hapiopappus Cass. spp.	Golden fleece, haplopappus
Heteromeles arbutifolia M. Room	Toyon
Holodiscus discolor (Pursh) Maxim.	Ocean spray, rock spirea
Lithocarpus densiflorus var. *echinoides* (R. Br.) Abrams	Dwarf tanoak, shrub tanoak
Lonicera ciliosa (Pursh) Poir.	Honeysuckle
Lonicera hispidula Dougl.	Hairy honeysuckle
Lonicera interrupta Benth.	Honeysuckle
Lonicera involucrata (Richards.) Banks	Twinberry
Mimulus L. spp.	Bush monkey-flower
Myrica californica Cham. and Schlecht.	Wax-myrtle
Osmaronia cerasiformis (T. & G.) Greene	Osoberry, Indian plum
Philadelphus lewisii Pursh ssp, *cafifornicus* (Benth.) Munz	Mock-orange
Physocarpus Maxim, spp.	Ninebark
Prunus emarginata (Dougl.) Walp.	Bitter cherry
Prunus ilicifolia (Nutt.) Walp.	Holly-leaved cherry
Prunus subcordata Benth.	Sierra plum
Purshia tridentata (Pursh) DC.	Antelope bush, bitterbrush
Quercus agrifolia Nee var. *frutescens* Engelm.	Shrubby coast live oak
Quercus dumosa Nutt.	Scrub oak
Quercus garryana Doug]. var. *breweri* (Engelm. in Wats.)	Brewer oak
Quercus garryana Dougl. var. *semota* Jeps.	Shin oak, Kaweah oak
Rhamnus californica Esch.	Coffeeberry
Rhamnus crocea Nutt. in T. & G. ssp. *ilicifolia* (Kell) C. B. Wolf	Holly leaf buckthorn
Rhamnus purshiana DC.	Cascara
Rhododendron macrophyllum D. Don	Rhododendron

Rhododendron occidentale (T. & G.) Gray	Western azalea
Rhus diversiloba T. &. G.	Poison-oak
Rhus trilobata Nutt. ex T. & G.	Squaw bush
Rhus laurina Nutt. in T. & G.	Laurel sumac
Ribes L. spp.	Currant, gooseberry
Ribes cereum Dougl.	Squaw currant
Ribes roezlii Regel	Sierra gooseberry
Rosa L. spp.	Rose
Rubus L. spp.	Blackberry, raspberry, etc.
Rubus leucodermis Dougl. ex. T. & G.	Blackcap raspberry, western raspberry,
Rubus ursinus Cham. & Schlecht.	Mountain blackberry, creeping blackberry
Rubus parviflorus Nutt.	Thimbleberry
Rubus spectabilis Pursh	Salmonberry
Sambucus L. spp.	Elderberry
Sorbus L. spp.	Mountain-ash
Symphoricarpos Duhamel spp.	Snowberry
Symphoricarpos mollis Nutt. in T. & G.	Snowberry
Vaccinium ovatum Pursh	Evergreen huckleberry
Vaccinium parvifolium Sm. in Rees.	Red huckleberry
Viburnum ellipticum Hook.	Viburnum
Vitis californica Benth.	California grape

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Appendix
Sources of Information and Inventory Methods

Most of the information in this report came from two major sources:

1. For National Forest lands, National Forest Systems (NFS) personnel at the USDA Forest Service Regional Offices (in San Francisco, California; Portland, Oregon; and Ogden, Utah) provided basic area, volume, and growth statistics from their forest resource inventories. Additional information on hardwood types and stand characteristics were obtained directly from various people on the 21 National Forests through interviews and by mail.
2. For all lands other than National Forests, statistics were collected by the Forest Inventory and Analysis (FIA) Research Work Unit at the Pacific Northwest Research Station. Forest Inventory and Analysis collected available information on hardwood-type area for national, State, county, municipal, and regional parks through interviews with people responsible for management and planning in these parks. For all other lands, FIA obtained information directly from its extensive forest inventory system.

National Forests

National Forest Inventories involved two steps: (1) From aerial photographs, the area of each National Forest was classified into land classes, broad forest types, stand size, and tree density classes. (2) The second step, applied only to timberland, was a ground sample used to determine volumes per acre within forest type, stand size, and tree density classes in timberland. The ground sample consisted of five points, 2 chains (132 feet) apart, arranged in an L shape. At each of the five points, tree attributes were collected on a variable-radius plot, and a seedling count was made on a fixed-radius plot.

The information collected at each plot provided the basis for developing per-acre volumes by species and size class. These values were averaged within each type and used to determine totals for each National Forest.

Hardwoods make up a small portion of the wood volume on National Forests and have proved even less significant in timber sales (hardwoods on National Forests have been virtually unmarketable). For these reasons, plus tight budgets for resource inventories, hardwood data for National Forests in the most recent forest inventory were sketchy: Hardwood stands usually were not identified by specific type. Broad group names, such as oak woodland, montane hardwoods, or simply "hardwoods," were used in the area classification phase of forest inventories. Furthermore, ground plots were not established in woodland areas in National Forests, but only on timberland. On timberland, although hardwoods were measured on ground plots, no attempt was made to determine their growth or mortality rates.

For this report, data deficiencies for National Forests were handled as follows:

Hardwood types *on National Forest land.*

The hardwood area classification done by National Forest Systems is thought to be good. Ground verification showed that types as identified on aerial photographs were correct 85 percent of the time, and this included some specific types separated within the conifer group. Hardwoods as a group are generally easily separated from conifers.

For each National Forest, the total reported area in hardwood types was accepted as correct. Then personnel from each National Forest were contacted, and information was obtained to provide a breakdown of the total hardwood area into specific types such as canyon live oak, blue oak, and so forth. The reliability of this process, unlike that of a statistical sample, cannot be quantified. No other information is available, however. A wealth of unconsolidated information from the National Forests was tapped. Included were stand examination records, fire management plans, soil-vegetation maps, special study data, and the knowledge of many people who are familiar with the vegetation in their area. For these reasons, the information is thought to be reliable.

Volume of hardwoods on National Forest woodland.

To approximate the volume of hardwoods in woodland areas, the acreage of each type (determined as described in the previous paragraph) was multiplied by an average volume per acre. The average volume per acre by type was calculated from FIA plots outside National Forests. Where possible, average volumes were developed by geographic area within type. Volume by species was assumed to equal volume by type; for example, the volume for interior live oak (species) on National Forest woodland shown in table 14-37 million cubic feet-is the same as the volume shown for interior live oak (type) in table 25.

Hardwood growth and mortality on National Forest timberland.

In the most recent National Forest inventories, although hardwood trees on timberland were tallied and their volumes calculated, hardwood growth and mortality were riot estimated. Growth data were available for many National Forests, based on trees remeasured at successive intervals several years ago, or increment cores taken on sample plots. Mortality rates for hardwoods had also been made several years ago. These growth and mortality rates were applied to the current inventory by National Forest to approximate the current rates of hardwood growth and mortality on timberland. Where no growth or mortality measurements had been taken, approximations were based on available data from other National Forests, or from FIA's inventory outside National Forests.

Outside National Forest

For all lands except National Forests and national, State, county, and regional parks, forest statistics were obtained by sampling. Cochran's (1963) double sampling for stratification was used. The primary sample consisted of aerial photo points located as follows: A computer-generated grid was projected over the State, dividing the area into squares 0.85 mile on a side. Within each square, a random-generator program located one point and plotted its location on a U.S. Geological Survey quadrangle map. Each point was the center of an aerial photo sample plot classified by owner group and major land class (timberland, unproductive forest, and nonforest). Timberland points were further stratified into stand-volume classes, and unproductive forest plots were classified into broad types, including oak woodland, chaparral, pinyon-juniper, and others.

For the secondary sample, a fraction of the aerial photo plots was selected on a systematic grid and visited on the ground to determine the accuracy of the aerial photo classification and to obtain detailed information on trees, other vegetation, and various environmental features. For land class checking, the grid interval was 3.4 miles, resulting in a theoretical ratio of 1 ground plot to 16 photo plots. Ground plots in timberland were established on the 3.4-mile grid. In unproductive forest including oak woodland, ground plots on every other grid location (6.8 miles) were established.

Access was denied crews by landowners on about 2 percent of the plots on the grid substitute plots were then selected from nearby photo plots.

Plots consisted of five (in a few cases, three) subplots distributed over a 5-acre area. At each subplot, trees 7 inches and larger were tallied on a variable-radius plot with an outer fixed limit of 55.8 feet (0.22 acre). Trees smaller than 7 inches were tallied on a 10.8-foot-radius plot (0.0084 acre). Ground vegetation was tallied on a 16.4-foot-radius plot (0.019 acre). Detailed measurements were taken on all trees and used along with volume equations developed for California hardwoods to calculate tree and stand volume. Shrubs and woody vines were recorded by species, height, stage of development, and percent cover. Herbaceous plants were recorded by group (forts, grasses, ferns, and mosslike plants), height, and percent cover. The major (most abundant) herbaceous plants were also recorded by species. Ground vegetation information was used in stand descriptions and will be used in wildlife habitat analyses.

Some of the plot locations in timberland had been established in previous inventories and were remeasured to determine growth and mortality rates. Regression estimators of growth and mortality developed from these plots were applied to all trees tallied in the inventory to estimate total growth and mortality. Tree and stand characteristics and environmental factors were used as variables in the growth and mortality estimators.

The following tabulation shows the total number of photo plots and ground plots outside National Forests by category, in the statewide forest inventory:

	Number
Aerial photo sample points:	
Total aerial photo sample points	85,174
Aerial photo sample points in forest (excluding chaparral)	37,799
Aerial photo sample points in chaparral	10,215
Aerial photo sample points in chaparral with scattered hardwood trees	2,169
Nonforest aerial photo sample points with scattered hardwood trees	3,455
Ground plots:	
Total plots examined to verify land class	5,048
Plots in forest examined to verify land class	2,832
Plots with tree and vegetation tally	1,457
Plots with hardwoods present	1,033
Remeasured or reclassified plots (originally established or classified in previous inventory):	
Remeasured plots in timberland	557
Reclassified plots in oak woodland	379
Reclassified plots in chaparral, pinyon-juniper, and other types, including nonforest	841
Total remeasured and reclassified plots	1,777

Reliability of Hardwood Area and Volume Data

Data From National Forests

Area of forest land by broad type was determined by mapping technique and, hence, has no sampling error. A check of the classification for two National Forests determined that the strata were accurately defined for type 85 percent of the time (see "Sources of Information and Inventory Methods").

Timber inventories in National Forests were designed to estimate total growing stock volume within a ±10-percent confidence band at the 68-percent probability level. The confidence band for components of the inventory-hardwoods, for example-would be wider. Confidence bands were not determined for the total hardwood volume on National Forests but are assumed to be comparable, on a statewide basis, with those for lands outside National Forest (see next section). 15

Data From Outside National Forests

For lands outside National Forests, hardwood area and volume statistics are based on sampling and are subject to sampling error. Tables 60 and 61 show the total area of hardwood types and total volume of hardwood growing stock with their associated confidence intervals (68-percent probability).

[15] For more information, contact USDA Forest Service; Pacific Southwest Region, 630 Sansome Street, San Francisco, CA 94111; Intermountain Region, 324 25th Street, Ogden, UT 84401 or Pacific Northwest Region, 319 SW Pine Street, P.O. Box 3623, Portland OR 97208

Confidence intervals vary with both size of the estimate and variance of the item being estimated. Total hardwood area is based on the aerial photo sample as adjusted by field checking. Statistics on hardwood types, stand density, and volume are based on the double sample of photo and field plots.

The confidence intervals for subsets of data are usually broader than those for totals, as can be seen in tables 60 and 61. For example, the statewide estimate of area in hardwood types on woodland has a 2.0-percent confidence interval, whereas the resource area estimates have confidence intervals that range from 3.3 to 8.9 percent. Confidence intervals for individual cells in resource tables may be as high as 100 percent. This is demonstrated in the following list of selected volume estimates taken from table 46 (confidence intervals for detailed statistics are not included in this report but are available on request).

Item	Volume	Confidence interval	
	(Million cubic feet)	*(Million cubic feet)*	*(Percent)*
All species, total volume	4,019	± 421	10.5
Blue oak, total volume	1,000	± 131	13.1
Coast live oak, total volume	702	± 213	30.3
Canyon live oak, total volume	385	± 145	37.7
Oregon white oak, volume in 9.0- to 10.9-inch trees	110	± 55	50.0
Pacific madrone, volume in 11.0- to 12.9-inch trees	61	± 33	54.0
Interior live oak, volume in 13.0- to 14.9-inch trees	60	± 30	50.0
California black oak, volume in 13.0- to 14.9-inch trees	26	± 12	30.0
Valley oak, volume in 21.0- to 28.9-inch trees	30	± 22	73.0
Eucalyptus, volume in 21.0- to 28.9-inch trees	8	± 8	100.0

Definition of Terms

Basal area-The cross-sectional area of a tree stem, measured at breast height.

Chaparral-Areas covered with heavily branched dwarf trees or shrubs, usually evergreen, the crown canopy of which at maturity usually covers more than 50 percent of the ground. The principal genera are *Adenostoma*, *Arctostaphylos*, *Ceanothus*, *Cercocarpus*, *Garrya*, and *Quercus*. Areas in which the predominant cover is *Artemisia*, *Gutierrezia*, *Opuntia*, *Salvia*, or semidesert species are considered nonforest.

Cull trees-Live trees that are more than 75 percent defective and are unlikely to become growing stock.

Cull trees, rotten-Culi trees with defect caused primarily by rot.

Cull trees, sound-Trees with defect caused primarily by poor form.

Diameter class-A classification of trees based on diameter outside the bark measured at breast height, 4-1/2 feet above the ground. D.b.h. is the common abbreviation for "diameter at breast height."

Forest land-Land at least 10 percent covered by crowns of live trees, or land formerly having such tree cover and not currently developed for nonforest use. The minimum area of forest recognized is 1 acre. Strips of forest must be at least 120 feet wide to qualify as forest land.

Forest land, administratively withdrawn-National Forest lands withdrawn from resource management and utilization by local administrative order (but not by statute or ordinance).

Forest land, deferred-National Forest land that was under study for wilderness designation at the time the information for this report was collected. Most of this land was in fact dedicated as wilderness in the October 1984 California Wilderness Bill.

Forest land, reserved-Forest land withdrawn from forest management through statute or ordinance. Included are National Forest wilderness; National, State, and county parks; and other reservations.

Forest types-Types are based on the present cover of live trees, regardless of the site's potential. Stands in which 50 percent or more of the cover is in live conifer trees are classed as softwood types. Stands with a majority of the cover in live hardwood trees are classed as hardwood types. Within these two groups, the individual forest type is determined by plurality of species, with the exception of the mixed-conifer type. Mixed conifer includes stands containing two or more of the following species when no single species makes up 80 percent of the cover: Douglas-fir, white fir, red fir, ponderosa pine, Jeffrey pine, sugar pine, and incense-cedar.

Gross annual growth-The increase in volume of trees during a specified year. Components of gross annual growth of trees: (1) the increment in sound volume of trees alive at the beginning of the specified year and surviving to the year's end, plus (2) the sound volume of trees becoming sawtimber or poletimber size during the year.

Growing-stock trees-All live trees with the exception of cull trees.

Growing-stock volume-Net volume in cubic feet of live sawtimber and poletimber growing-stock trees from a 1-foot stump to a minimum 4-inch top (of central stem) outside the bark. Net volume equals gross volume less deduction for rot and missing bole sections.

Hardwoods-Trees that are angiosperms, usually broad leaved.

Industrial wood-All commercial roundwood products except fuelwood. Roundwood includes logs or bolts that are in straight sections at least 8 feet long in hardwoods and 12 feet long in softwoods.

Land class-A classification of land by major use. The minimum area for classification is 1 acre.

Mortality-Volume of sound wood in growing-stock trees that died from natural causes during a specified period.

National Forest lands-Federal lands that have been designated by Executive order or statute as National Forest or purchase units and other lands under the administration of the Forest Service, including experimental areas and Bankhead-Jones Title III lands.

Nonforest land-Land that has never supported forests or was formerly forested and is currently developed for nonforest use. Included are lands used for agricultural crops, Christmas tree farms, pasture, residential areas, improved roads, operating railroads and their right-of-way clearings, powerline and pipeline clearings, streams more than 30 feet wide, and 1- to 40-acre areas of water classified by the Bureau of the Census as land. If intermingled in forest areas, unimproved roads and other nonforest strips must be more than 120 feet wide, and clearings or other areas must be 1 acre or larger to qualify as nonforest land.

Nonstocked areas-In mapped areas, timberland with less than 10-percent crown cover; in sampled areas, forest land with no tally trees on four or five of five subplots or three of three subplots.

Other public lands-Lands administered by public agencies other than the USDA Forest Service.

Poletimber stands-In National Forests, stands with less than 10-percent crown cover in sawtimber-size trees and more than 10-percent crown cover in smaller trees, the predominance of which have crowns 6 to 12 feet in diameter. Outside National Forests, stands with a mean diameter (weighted by basal area) from 5.0 to 9.0 inches, if softwood, and from 5.0 to 11.0 inches, if hardwood.

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

Productive forest-Forest land capable of producing 20 cubic feet or more per acre per year in continuous crops of industrial wood.

Regeneration categories-

Nonstocked: forest land with no seedling- or sapling-size trees onfive of five subplots, or three of three subplots.

Lightly stocked: forest land with one or more seedling- or sapling-size trees on one or two of five subplots or one of three subplots.

Moderately stocked: forest land with one or more seedling- or sapling-size trees on three or four of five subplots or two of three subplots.

Well stocked: forest land with one or more seedling- or sapling-size trees on all subplots.

Seedling stocking was rated independently from sapling stocking, mainly because hardwood saplings in California are often several decades older than seedlings. The presence of saplings indicates past success in regeneration and is some assurance of continuity in forest cover. The presence of seedlings is evidence that the reforestation process has begun but does not always mean that the area has been regenerated. Many seedlings do not survive.

Sapling and seedling stands-In National Forests, stands with less than 10-percent crown cover in sawtimber-size trees and more than 10-percent crown cover in smaller trees, the predominance of which have crowns less than 5 fee; in diameter. Outside National Forests, stands with a mean diameter (weighted by basal area) less than 5.0 inches.

Sapling- and seedling-size trees-Live trees less than 5.0 Inches in d.b.h, Saplings are 1.0 inch to 4.9 inches in d.b.h., and seedlings are less than 1.0 inch in d.b h. bin at least 6.0 inches tall. No attempt was made to determine whether a sapling- or seedling-size tree had originated from a seed or was a sprout.

Saw-log portion-The bole of sawtimber trees between the stump and the saw-log top. For hardwoods, the saw-log top is at the point where the stem diameter is 8 inches inside bark.

Sawtimber stands-In National Forests, stands with 10-percent or more crown cover, and most trees have crowns 13 or more feet in diameter. Outside National Forests, stands with a mean diameter (weighted by basal area) a, leas; 9.0 inches in d.b.h., if softwood, and at least 11.0 inches in d.b.h., if hardwood.

Sawtimber trees-Live softwood trees at least 9.0 inches in d.b.h. and hardwood trees at least 11.0 inches in d.b.h. At least 25 percent of the board-foot volume in a sawtimber tree must be free from defect. Softwood trees must contain at least one 12-foot saw log with a top diameter of not less than 6 inches inside basic; hardwood trees must contain at least one 8-foot saw log with a top diameter of not less than 8 inches inside bark. Small sawtimber trees are less than 20.9 inches in d.b.h., and large sawtimber trees are 21.0 inches and larger.

Softwoods-Coniferous trees, usually evergreen, with needles or scalelike leaves. Also referred to as conifers.

Timber harvest-Volume of roundwood removed from forest land for products.

Timberland (productive forest)-Forest land capable of producing 20 cubic feet or more per acre (productive forest) per year of industrial wood, and not withdrawn by statute, ordinance, or administrative order from timber utilization.

Unproductive forest-Forest land incapable of producing 20 cubic feet per acre per year of industrial wood. Included are woodland and chaparral.

Upper-stem portion-The bole of sawtimber trees above the saw-log top-7.0 inches outside bark for softwoods and 9.0 inches outside bark for hardwoods-to a minimum top diameter of 4.0 inches outside bark, or to the point where the central stem breaks into limbs.

Woodland-Forest land incapable of producing 20 cubic feet per acre per year of industrial wood because of adverse site conditions such as sterile soils, dry climate, poor drainage, high elevation, steepness, or rockiness. Included are some oak woodlands with relatively high productivity of total biomass, which will not produce 20 cubic feet of industrial wood because of the shape and size of the trees.

Table 5—Area of hardwood forest types on timberland and woodland by resource area and county, California, January 1, 1985[1/]

Resource area and county	Area of hardwood types on timberland	Area of hardwood types on woodland	Total area of hardwood types
		Thousand acres	
North coast:			
Del Norte	46	7	53
Humboldt	570	93	663
Mendocino	536	280	816
Sonoma	163	177	340
Total	1,315	557	1,872
Central coast:			
Alameda	--	82	82
Contra Costa	2/	55	55
Marin	--	36	36
Monterey	10	545	555
San Benito	9	189	198
San Luis Obispo	--	329	329
San Mateo	19	9	28
Santa Barbara	--	164	164
Santa Clara	19	242	261
Santa Cruz	41	4	45
Solano	--	29	29
Ventura	-	110	110
Total	98	1,794	1,892
Northern interior:			
Lassen	11	8	19
Modoc	--	11	11
Shasta	212	351	563
Siskiyou	55	203	258
Trinity	136	160	296
Total	414	733	1,147
Sacramento:			
Butte	67	137	204
Colusa	--	111	111
Eldorado	58	154	212
Glenn	--	82	82
Lake	23	138	161
Napa	23	141	164
Nevada	15	85	100
Placer	25	101	126
Plumas	43	18	61
Sacramento	--	13	13
Sierra	2/	9	9
Sutter	--	13	13
Tehama	10	535	545
Yolo	--	80	80
Yuba	24	65	89
Total	288	1,682	1,970
San Joaquin and southern California:			
Alpine	--	1	1
Amador	12	76	88
Calaveras	25	168	193
Fresno	4	292	296
Inyo	--	3	3
Kern	19	500	519
Kings	--	6	6
Los Angeles	2/	57	57
Madera	7	229	236
Mariposa	4	215	219
Merced	--	50	50
Mono	--	13	13
Orange	--	12	12
Riverside	--	78	78
San Bernardino	--	104	104
San Diego	--	106	106
San Joaquin	--	22	22
Stanislaus	--	122	122
Tulare	39	398	437
Tuolumne	25	134	159
Total	135	2,586	2,721
All resource areas	2,250	7,352	9,602

-- = none found.

1/ Totals may disagree with other tables because of rounding.

2/ Less than 500 acres.

Table 6—Area of hardwood forest types by county, land class, and owner, California, January 1, 1985[1/]

County	Timberland					Woodland					
	Unreserved		Reserved			Unreserved		Reserved			
	National Forest	Outside National Forest	National Forest	Outside National Forest	Total timberland	National Forest	Outside National Forest	National Forest	Outside National Forest	Total woodland	Total timberland and woodland
Alameda	--	--	--	--	--	--	69	--	13	82	82
Alpine	--	--	--	--	--	1	--	2/	--	1	1
Amador	2/	12	--	--	12	2	71	2	1	76	88
Butte	7	60	2/	--	67	5	130	1	1	137	204
Calaveras	2	23	2/	--	25	2	166	2/	--	168	193
Colusa	--	--	--	--	--	9	101	1	--	111	111
Contra Costa	--	--	--	2/	2/	--	41	--	14	55	55
Del Norte	6	39	1	--	46	6	--	1	--	7	53
El Dorado	4	53	1	2/	58	12	124	2	16	154	212
Fresno	4	--	--	--	4	55	211	4	22	292	296
Glenn	--	--	--	--	--	23	57	2	--	82	82
Humboldt	7	552	2/	11	570	8	84	2/	1	93	663
Inyo	--	--	--	--	--	2	--	1	--	3	3
Kern	7	12	--	--	19	90	409	1	--	500	519
Kings	--	--	--	--	--	--	6	--	--	6	6
Lake	--	23	--	--	23	33	102	3	--	138	161
Lassen	3	8	--	--	11	5	2	--	1	8	19
Los Angeles	--	--	--	2/	2/	14	22	11	10	57	57
Madera	1	6	--	--	7	27	202	2/	--	229	236
Marin	--	--	--	--	--	--	30	--	6	36	36
Mariposa	4	--	--	--	4	15	200	--	--	215	219
Mendocino	--	536	--	2/	536	26	253	1	--	280	816
Merced	--	--	--	--	--	--	47	--	3	50	50
Modoc	--	--	--	--	--	7	2/	4	--	11	11
Mono	--	--	--	--	--	11	2/	2	--	13	13
Monterey	--	9	--	1	10	57	369	111	8	545	555
Napa	--	23	--	2/	23	--	140	--	1	141	164
Nevada	--	15	--	--	15	4	81	--	--	85	100
Orange	--	--	--	--	--	3	8	--	1	12	12
Placer	1	23	1	--	25	21	60	6	14	101	126
Plumas	12	30	1	--	43	14	3	1	--	18	61
Riverside	--	--	--	--	--	37	19	21	1	78	78
Sacramento	--	--	--	--	--	--	13	--	--	13	13
San Benito	--	9	--	--	9	--	185	--	4	189	198
San Bernardino	--	--	--	--	--	85	11	7	1	104	104
San Diego	--	--	--	--	--	13	83	3	7	106	106
San Joaquin	--	--	--	--	--	--	21	--	1	22	22
San Luis Obispo	--	--	--	--	--	28	296	--	5	329	329
San Mateo	--	19	--	--	19	--	2	--	7	9	28
Santa Barbara	--	--	--	--	--	12	131	19	2	164	164
Santa Clara	--	19	--	--	19	--	209	--	33	242	261
Santa Cruz	--	38	--	3	41	--	2	--	2	4	45
Shasta	42	170	--	2/	212	57	285	2/	9	351	563
Sierra	2/	--	--	--	2/	8	1	--	--	9	9
Siskiyou	17	34	4	--	55	97	103	3	--	203	258
Solano	--	--	--	--	--	--	29	--	2/	29	29
Sonoma	--	163	--	--	163	--	168	--	9	177	340
Stanislaus	--	--	--	--	--	--	103	--	19	122	122
Sutter	--	--	--	--	--	--	13	--	--	13	13
Tehama	1	7	2	--	10	42	467	26	2/	535	545
Trinity	25	110	1	--	136	60	71	29	--	160	296
Tulare	21	18	2/	--	39	67	300	11	20	398	437
Tuolumne	19	6	2/	--	25	27	107	2/	2/	134	159
Ventura	--	--	--	--	--	82	26	--	2	110	110
Yolo	--	--	--	--	--	--	79	--	1	80	80
Yuba	1	23	2/	--	24	1	64	--	--	65	89
All counties	104	2,040	11	15	2,250	1,060	5,776	273	235	7,352	9,602

-- = none found.

1/ Totals may disagree with other tables because of rounding.

2/ Less than 500 acres.

Table 7—Area of hardwood forest types by county, as estimated in 1985 and 1945, California[1/ 2/]

County	1985	1945	Difference
Alameda	82	77	+5
Alpine	1	1	0
Amador	88	122	-34
Butte	204	225	-21
Calaveras	193	272	-79
Colusa	111	147	-36
Contra Costa	55	54	+1
Del Norte	53	37	+16
El Dorado	212	208	+4
Fresno	296	365	-69
Glenn	82	147	-65
Humboldt	663	216	+447
Inyo	3	trace	+3
Kern	519	612	-93
Kings	6	7	-1
Lake	161	161	0
Lassen	19	2	+17
Los Angeles	57	93	-36
Madera	236	271	-35
Marin	36	57	-21
Mariposa	219	278	-59
Mendocino	816	596	+220
Merced	50	61	-11
Modoc	11	2	+9
Mono	13	1	+12
Monterey	555	566	-11
Napa	164	205	-41
Nevada	100	122	-22
Orange	12	17	-5
Placer	126	186	-60
Plumas	61	62	-1
Riverside	78	31	3/ +47
Sacramento	13	35	-22
San Benito	198	238	-40
San Bernardino	104	35	3/ +69
San Diego	106	109	3/ -3
San Joaquin	22	30	-8
San Luis Obispo	329	448	-119
San Mateo	28	33	-5
Santa Barbara	164	286	-122
Santa Clara	261	276	-15
Santa Cruz	45	35	+10
Shasta	563	528	+35
Sierra	9	27	-18
Siskiyou	258	275	-17
Solano	29	37	-8
Sonoma	340	315	+25
Stanislaus	122	118	+4
Sutter	13	21	-8
Tehama	545	712	-167
Trinity	296	269	+27
Tulare	437	444	-7
Tuolumne	159	275	-116
Ventura	110	82	3/ +28
Yolo	80	90	-10
Yuba	89	109	-20
All counties	9,602	10,027	-425

1/ 1945 estimates from Wieslander and Jensen (1946).

2/ Totals may disagree with other tables because of rounding.

3/ Real change in hardwood area in these counties is masked by definitional and procedural changes in National Forest inventories between 1945 and 1985.

Table 8—Area of hardwood forest by forest type, land class, and owner, California, January 1, 1985[1/]

Forest type	Timberland								Woodland								Total			
	Unreserved				Reserved[2/]				Unreserved				Reserved[2/]							
	National Forest	Other public	Private	Total	National Forest	Other public	Private	Total	National Forest	Other public	Private	Total	National Forest	Other public	Private	Total	National Forest	Other public	Private	Total
	Thousand acres																			
Oak group:																				
Coast live oak	--	--	39	39	--	--	--	--	57	196	617	770	19	--	--	19	76	196	656	828
Canyon live oak	52	57	233	342	2	--	--	2	301	33	375	709	68	--	--	68	423	90	608	1,121
Interior live oak	1	--	62	63	--	--	--	--	70	68	666	804	17	--	--	17	88	68	728	884
California black oak	108	48	427	583	8	--	--	8	146	27	112	285	18	--	--	18	280	75	539	894
Oregon white oak	4	16	76	96	1	--	--	1	37	39	280	356	5	--	--	5	47	55	356	458
Valley oak	3/	--	8	8	--	--	--	--	3/	39	227	266	--	--	--	--	3/	39	235	274
Blue oak 4/	--	--	--	4	--	--	--	--	348	293	2,180	2,821	41	45	--	85	393	338	2,180	2,911
Engelmann oak	--	--	--	--	--	--	--	--	4	--	35	39	--	--	--	--	4	--	35	39
Unclassified	--	--	--	--	--	--	--	--	--	--	--	--	--	180	3/	180	0	180	3/	180
Total	169	121	845	1,135	11	--	--	11	963	595	4,492	6,050	168	225	3/	393	1,211	941	5,337	7,589
Nonoak group:																				
Alder	3/	--	42	42	3/	3/	--	3/	--	--	--	--	--	--	--	--	3/	3/	42	42
Aspen	3/	--	--	3/	--	--	--	--	32	--	--	32	8	3/	--	8	40	3/	--	40
Cottonwood 5/	2	--	7	9	3/	3/	--	3/	4	--	33	37	5	7	3/	12	11	7	40	58
Bigleaf maple	3/	--	22	22	3/	--	--	3/	3/	--	60	60	3/	--	--	3/	3/	--	82	82
California buckeye	--	--	--	--	--	--	--	--	--	--	208	208	--	--	--	--	--	--	208	208
Giant chinkapin	1	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	1
Pacific madrone	6	19	127	151	3/	--	--	3/	46	60	138	244	67	--	--	67	118	79	265	462
California-laurel	3/	--	71	71	3/	3/	--	3/	--	60	33	93	--	--	--	--	3/	60	104	164
Tanoak	7	43	743	793	1	16	--	17	25	--	--	25	26	--	--	26	59	59	743	861
Eucalyptus	--	--	--	--	--	3/	--	3/	--	--	96	96	--	--	--	--	--	3/	96	96
Total	15	62	1,012	1,089	1	16	--	17	107	120	568	795	106	7	3/	113	229	205	1,580	2,014
All classes	184	183	1,857	2,224	12	16	--	28	1,070	715	5,060	6,845	274	232	3/	506	1,540	1,146	6,917	9,603

-- = none found.

1/ Totals may be off or disagree with other tables because of rounding.

2/ Reserved includes National Forest deferred and administratively withdrawn.

3/ Less than 500 acres.

4/ Includes 457,000 acres of Digger pine type with blue oak present on other public and private owners.

5/ Includes riparian forest types.

Table 9—Area of hardwood forest by forest type, land class, and owner, north coast resource area, California, January 1, 1985[1/]

Forest type	Timberland								Woodland								Total			
	Unreserved				Reserved[2/]				Unreserved				Reserved[2/]							
	National Forest	Other public	Private	Total	National Forest	Other public	Private	Total	National Forest	Other public	Private	Total	National Forest	Other public	Private	Total	National Forest	Other public	Private	Total
	Thousand acres																			
Oak group:																				
Coast live oak	--	--	14	14	--	--	--	--	--	--	39	39	--	--	--	--	--	--	53	53
Canyon live oak	2	20	72	94	3/	--	--	3/	13	--	39	52	1	--	--	1	16	20	111	147
Interior live oak	--	--	25	25	--	--	--	--	--	--	39	39	--	--	--	--	--	--	64	64
California black oak	1	13	112	126	3/	--	--	3/	11	--	39	50	1	--	--	1	13	13	151	177
Oregon white oak	1	16	55	72	3/	--	--	3/	5	39	116	160	3/	--	--	3/	6	55	171	232
Valley oak	--	--	8	8	--	--	--	--	--	39	39	78	--	--	--	--	--	39	47	86
Blue oak 4/	--	--	--	--	--	--	--	--	2	--	--	2	3/	--	--	3/	2	--	--	2
Unclassified oaks	--	--	--	--	--	--	--	--	--	--	--	--	--	9	3/	9	--	9	3/	9
Total	4	49	286	339	3/	--	--	3/	31	78	311	420	2	9	3/	11	37	136	597	770
Nonoak group:																				
Alder	3/	--	20	20	3/	3/	--	3/	--	--	--	--	--	--	--	--	3/	3/	20	20
Cottonwood 4/	--	--	7	7	--	--	--	--	--	--	--	--	--	1	--	1	--	1	7	8
Bigleaf maple	3/	--	22	22	3/	--	--	3/	3/	--	--	3/	3/	--	--	3/	3/	--	22	22
California buckeye	--	--	--	--	--	--	--	--	--	--	39	39	--	--	--	--	--	--	39	39
Pacific madrone	2	19	101	122	3/	--	--	3/	4	--	77	81	3/	--	--	3/	6	19	178	203
California-laurel	3/	--	61	61	3/	--	--	3/	--	--	--	--	--	--	--	--	3/	--	61	61
Tanoak	7	43	682	732	1	12	--	13	5	--	--	5	3/	--	--	3/	13	55	682	750
Total	9	62	893	964	1	12	--	13	9	--	116	125	3/	1	--	1	19	75	1,009	1,103
All species	13	111	1,179	1,303	1	12	--	13	40	78	427	545	2	10	3/	12	56	211	1,606	1,873

-- = none found.

1/ Totals may be off or disagree with other tables because of rounding.

2/ Reserved includes National Forest deferred and administratively withdrawn.

3/ Less than 500 acres.

4/ Includes riparian forest types.

Table 10—Area of hardwood forest by forest type, land class, and owner, central coast resource area, California, January 1, 1985[1/]

Forest type	Timberland								Woodland								Total			
	Unreserved				Reserved[2/]				Unreserved				Reserved[2/]							
	National Forest	Other public	Private	Total	National Forest	Other public	Private	Total	National Forest	Other public	Private	Total	National Forest	Other public	Private	Total	National Forest	Other public	Private	Total
	Thousand acres																			
Oak group:																				
Coast live oak	--	--	25	25	--	--	--	--	39	61	544	644	10	--	--	18	57	61	569	687
Canyon live oak	--	--	15	15	--	--	--	--	9	--	--	9	15	--	--	15	24	--	15	39
Interior live oak	--	--	--	--	--	--	--	--	--	--	60	60	--	--	*	--	--	--	60	60
Valley oak	--	--	--	--	--	--	--	--	--	--	121	121	--	--	--	--	--	--	121	121
Blue oak 3/	--	--	--	--	--	--	--	--	85	60	303	448	6	45	--	51	91	105	303	499
Unclassified oaks	--	--	--	--	--	--	--	--	--	--	--	--	--	49	--	49	--	49	--	49
Total	--	--	40	40	--	--	--	--	133	121	1,028	1,282	39	94	--	133	172	215	1,068	1,455
Nonoak group:																				
Cottonwood	--	--	--	--	--	--	--	--	--	--	--	--	--	2	--	2	--	2	--	2
Pacific madrone	--	--	19	19	--	--	--	--	34	60	61	155	66	--	--	66	100	60	80	240
California-laurel	--	--	10	10	*	4/	--	4/	--	60	--	60	--	--	--	--	--	60	10	70
Tanoak	--	--	25	25	--	4	--	4	12	--	--	12	25	--	--	25	37	4	25	66
Eucalyptus	--	--	--	--	--	--	--	--	--	--	61	61	--	--	--	--	--	--	61	61
Total	--	--	54	54	--	4	--	4	46	120	122	288	91	2	--	93	137	126	176	439
All species	--	--	94	94	--	4	--	4	179	241	1,150	1,570	130	96	--	226	309	341	1,244	1,894

-- = none found.

1/ Totals may be off or disagree with other tables because of rounding.

2/ Reserved includes National Forest deferred and administratively withdrawn.

3/ Includes 122,000 acres of Digger pine type in other public and private owners with blue oak present.

4/ Less than 500 acres.

Table 11—Area of hardwood forest by forest type, land class, and owner, northern interior resource area, California, January 1, 1985[1/]

Forest type	Timberland								Woodland								Total			
	Unreserved				Reserved[2/]				Unreserved				Reserved[2/]							
	National Forest	Other public	Private	Total	National Forest	Other public	Private	Total	National Forest	Other public	Private	Total	National Forest	Other public	Private	Total	National Forest	Other public	Private	Total
	Thousand acres																			
Oak group:																				
Canyon live oak	32	18	86	136	1	--	--	1	127	--	27	154	23	--	--	23	183	18	113	314
Interior live oak	1	--	--	1	--	--	--	--	3/	--	27	27	--	--	--	--	1	--	27	28
California black oak	42	18	152	212	4	--	--	4	37	27	--	64	2	--	--	2	85	45	152	282
Oregon white oak	3	--	21	24	3/	--	--	3/	24	--	164	188	2	--	--	2	29	--	185	214
Valley oak	3/	--	--	3/	--	--	--	--	3/	--	--	3/	--	--	--	--	3/	--	--	3/
Blue oak 4/	3	--	--	3	--	--	--	--	74	--	189	203	3/	--	--	3/	77	--	189	206
Unclassified oaks	--	--	--	--	--	--	--	--	--	--	--	--	--	9	--	9	--	9	--	9
Total	81	36	259	376	5	--	--	5	202	27	407	636	27	9	--	36	315	72	666	1,053
Nonoak group:																				
Alder	--	--	6	6	--	3/	--	3/	--	--	--	--	--	--	--	--	--	3/	6	6
Aspen	--	--	--	--	--	--	--	--	18	--	--	18	4	--	--	4	22	--	--	22
Cottonwood	2	--	--	2	3/	--	--	3/	2	--	--	2	5	3/	--	5	9	3/	--	9
Bigleaf maple	3/	--	--	3/	--	--	--	--	3/	--	27	27	--	--	--	--	3/	--	27	27
Giant chinkapin	1	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	1
Pacific madrone	3	--	--	3	--	--	--	--	2	--	--	2	3/	--	--	3/	5	--	--	5
Tanoak	3/	--	21	21	--	--	--	--	2	--	--	2	3/	--	--	3/	2	--	21	23
Total	6	--	27	33	3/	3/	--	3/	24	--	27	51	9	3/	--	9	39	3/	54	93
All species	87	36	286	409	5	3/	--	5	226	27	434	687	36	9	--	45	354	72	720	1,146

-- = none found.

1/ Totals may be off or disagree with other tables because of rounding.

2/ Reserved includes National Forest deferred and administratively withdrawn.

3/ Less than 500 acres.

4/ Includes 25,000 acres of Digger pine type in other public and private owners with blue oak present.

Table 12—Area of hardwood forest by forest type, land class, and owner, Sacramento resource area, California, January 1, 1985[1/]

Forest type	Timberland								Woodland								Total			
	Unreserved				Reserved[2/]				Unreserved				Reserved[2/]							
	National Forest	Other public	Private	Total	National Forest	Other public	Private	Total	National Forest	Other public	Private	Total	National Forest	Other public	Private	Total	National Forest	Other public	Private	Total
	Thousand acres																			
Oak group:																				
Canyon live oak	1	12	33	46	1	--	--	1	44	33	139	216	7	--	--	7	53	45	172	270
Interior live oak	--	--	24	24	--	--	--	--	--	--	98	98	--	--	--	--	--	--	122	122
California black oak	25	12	138	175	4	--	--	4	65	--	--	65	11	--	--	11	105	12	138	255
Oregon white oak	3/	--	--	3/	1	--	--	1	8	--	--	8	3	--	--	3	12	--	--	12
Valley oak	--	--	--	--	--	--	--	--	--	--	33	33	--	--	--	--	--	--	33	33
Blue oak 4/	3/	--	--	3/	--	--	--	--	42	131	868	1,041	19	--	--	19	61	131	868	1,060
Unclassified oaks	--	--	--	--	--	--	--	--	--	--	--	--	--	31	--	31	--	31	--	31
Total	26	24	195	245	6	--	--	6	159	164	1,138	1,461	40	31	--	71	231	219	1,333	1,783
Nonoak group:																				
Alder	--	--	16	16	--	3/	--	3/	--	--	--	--	--	--	--	--	--	3/	16	16
Aspen	--	--	--	--	--	--	--	--	1	--	--	1	--	3/	--	3/	1	3/	--	1
Cottonwood 5/	--	--	--	--	--	3/	--	3/	2	--	33	35	3/	2	3/	2	2	2	33	37
Bigleaf maple	--	--	--	--	--	--	--	--	--	--	33	33	--	--	--	--	--	--	33	33
California buckeye	--	--	--	--	--	--	--	--	--	--	33	33	--	--	--	--	--	--	33	33
Pacific madrone	--	--	7	7	--	--	--	--	6	--	--	6	1	--	--	1	7	--	7	14
California-laurel	--	--	--	--	--	--	--	--	-	---	33	33	--	--	--	--	--	--	33	33
Tanoak	--	--	15	15	--	3/	--	3/	6	--	--	6	1	--	--	1	7	3/	15	22
Total	--	--	38	38	--	3/	--	3/	15	--	132	147	2	2	3/	4	17	2	170	189
All species	26	24	233	283	6	3/	--	6	174	164	1,270	1,608	42	33	3/	75	248	221	1,503	1,972

-- = none found.

1/ Totals may be off or disagree with other tables because of rounding.

2/ Reserved includes National Forest deferred and administratively withdrawn.

3/ Less than 500 acres.

4/ Includes 106,000 acres of Digger pine type in other public and private owners with blue oak present.

5/ Includes riparian forest types.

Table 13—Area of hardwood forest by forest type, land class, and owner, San Joaquin and southern California resource areas, January 1, 1985[1/]

Forest type	Timberland								Woodland								Total			
	Unreserved				Reserved[2/]				Unreserved				Reserved[2/]							
	National Forest	Other public	Private	Total	National Forest	Other public	Private	Total	National Forest	Other public	Private	Total	National Forest	Other public	Private	Total	National Forest	Other Public	Private	Total
	Thousand acres																			
Oak group:																				
Coast live oak	--	--	--	--	--	--	--	--	18	35	34	87	1	--	--	1	19	35	34	88
Canyon live oak	17	7	27	51	3/	--	--	3/	108	--	170	278	22	--	--	22	147	7	197	351
Interior live oak	--	--	13	13	--	--	--	--	70	68	442	580	17	--	--	17	87	68	455	610
California black oak	40	5	25	70	3/	--	--	3/	33	--	73	106	4	--	--	4	77	5	98	180
Valley oak	--	--	--	--	--	--	--	--	--	--	34	34	--	--	--	--	--	--	34	34
Blue oak 4/	1	--	--	1	--	--	--	--	205	102	820	1,127	16	--	--	16	222	102	820	1,144
Engelmann oak	--	--	--	--	--	--	--	--	4	--	35	39	--	--	--	--	4	--	35	39
Unclassified oaks	--	--	--	--	--	--	--	--	--	--	--	--	--	82	3/	82	--	82	2/	82
Total	58	12	65	135	3/	--	--	3/	438	205	1,608	2,251	60	82	3/	142	556	299	1,673	2,528
Nonoak group:																				
Aspen	3/	--	--	3/	--	--	--	--	13	--	--	13	4	--	--	4	17	--	--	17
Cottonwood	--	--	--	--	--	--	--	--	--	--	--	--	--	2	--	2	--	2	--	2
California buckeye	--	--	--	--	--	--	--				136	136	--	--	--	--	--	--	136	136
Eucalyptus	--	--	--	--	--	3/	--	3/	--	--	35	35	--	--	--	--	--	3/	35	35
Total	3/	--	--	3/	--	3/	--	3/	13	-	171	184	4	2	--	6	17	2	171	190
All species	58	12	65	135	3/	3/	--	3/	451	205	1,779	2,435	64	84	3/	148	573	301	1,844	2,718

-- = none found.

1/ Totals may be off or disagree with other tables because of rounding.

2/ Reserved includes National Forest deferred and administratively withdrawn.

3/ Less than 500 acres.

4/ Includes 204,000 acres of Digger pine type in other public and private owners with blue oak present.

Table 14—Volume of hardwood growing stock on unreserved timberland and unreserved woodland, by species and owner, California, January 1, 1985[1/]

Species	National Forest			Other public			Private			All ownerships		
	Timberland	Woodland	Total	Timberland	Woodland	Total	Timberland	Woodland	Total	Timberland	Woodland	Total
	Million cubic feet											
Oak group:												
Coast live oak	--	53	53	2	55	57	124	647	771	126	755	881
Canyon live oak	662	346	1,008	86	27	113	554	358	912	1,302	731	2,033
Interior live oak	1	37	38	--	10	10	44	461	505	45	508	553
California black oak	1,018	97	1,115	119	--	119	1,117	180	1,297	2,254	277	2,531
Oregon white oak	26	22	48	13	56	69	172	311	483	211	389	600
Valley oak	2	2/	2	2/	31	31	32	133	165	34	164	198
Blue oak	--	111	111	--	142	142	1	859	860	1	1,112	1,113
Engelmann oak	--	1	1	--	9	9	--	--	--	--	10	10
Total	1,709	667	2,376	220	330	550	2,044	2,949	4,993	3,973	3,946	7,919
Nonoak group:												
Tanoak	332	51	383	154	--	154	1,401	--	1,401	1,887	51	1,938
Pacific madrone	232	97	329	143	53	196	741	251	992	1,116	401	1,517
California-laurel	--	--	--	20	4	24	253	150	403	273	154	427
Bigleaf maple	48	2/	48	6	--	6	96	6	102	150	6	156
California buckeye	--	--	--	--	--	--	1	24	25	1	24	25
Giant chinkapin	25	--	25	2	--	2	23	--	23	50	--	50
Alder 3/	10	--	10	6	--	6	147	4	151	163	4	167
Aspen	16	9	25	--	--	--	4	--	4	20	9	29
Cottonwood 4/	3	8	11	--	--	--	7	24	31	10	32	42
Walnut	--	--	--	--	--	--	1	--	1	1	--	1
Willow	--	--	--	--	--	--	7	6	13	7	6	13
Eucalyptus 5/	4	--	4	--	--	--	6	221	227	10	221	231
Unclassified	19	--	19	--	--	--	1	--	1	20	--	20
Total	689	165	854	331	57	388	2,688	686	3,374	3,708	908	4,616
All species	2,398	832	3,230	551	387	938	4,732	3,635	8,367	7,681	4,854	12,535

-- = none found.

1/ Totals may be off or disagree with other tables because of rounding.

2/ Less than 500,000 cubic feet.

3/ Includes red alder and white alder.

4/ Includes black cottonwood and Fremont cottonwood.

5/ Includes all species of eucalyptus that were found.

Table 15—Volume of hardwood growing stock on unreserved timberland and unreserved woodland, by species and owner, north coast resource area, California, January 1, 1985[1/]

Species	National Forest			Other public			Private			All ownerships		
	Timberland	Woodland	Total	Timberland	Woodland	Total	Timberland	Woodland	Total	Timberland	Woodland	Total
	Million cubic feet											
Oak group:												
Coast live oak	--	--	--	--	--	--	14	86	100	14	86	100
Canyon live oak	43	15	58	33	--	33	191	41	232	267	56	323
Interior live oak	--	--	--	--	--	--	31	18	49	31	18	49
California black oak	74	7	81	48	--	48	223	60	283	345	67	412
Oregon white oak	11	6	17	10	55	65	127	233	360	148	294	442
Valley oak	--	--	--	2/	31	31	26	21	47	26	52	78
Blue oak	--	2/	2/	--	2/	2/	2/	2/	2/	2/	2/	2/
Total	128	28	156	91	86	177	612	459	1,071	831	573	1,404
Nonoak group:												
Tanoak	127	10	137	154	--	154	1,156	--	1,156	1,437	10	1,447
Pacific madrone	71	8	79	131	--	131	513	223	736	715	231	946
California-laurel	--	--	--	8	--	8	197	12	209	205	12	217
Bigleaf maple	13	2/	13	2	--	2	56	--	56	71	2/	71
California buckeye	--	--	--	--	--	--	2/	--	2/	2/	--	2/
Giant chinkapin	4	--	4	2	--	2	15	--	15	21	--	21
Alder 3/	3	--	3	3	--	3	118	--	118	124	--	124
Cottonwood 4/	--	--	--	--	--	--	2	--	2	2	--	2
Willow	--	--	--	--	--	--	7	--	7	7	--	7
Eucalyptus 5/	3	--	3	--	--	--	6	--	6	9	--	9
Unclassified	--	--	--	--	--	--	1	--	1	1	--	1
Total	221	18	239	300	--	300	2,071	235	2,306	2,592	253	2,845
All species	349	46	395	391	86	477	2,683	694	3,377	3,423	826	4,249

-- = none found.

1/ Totals may be off or disagree with other tables because of rounding.

2/ Less than 500,000 cubic feet.

3/ Includes red alder and white alder.

4/ Includes black cottonwood and Fremont cottonwood.

5/ Includes all species of eucalyptus that were found.

Table 16—Volume of hardwood growing stock on unreserved timberland and unreserved woodland, by species and owner, central coast resource area, California, January 1, 1985[1/]

Species	National Forest			Other public			Private			All ownerships		
	Timberland	Woodland	Total	Timberland	Woodland	Total	Timberland	Woodland	Total	Timberland	Woodland	Total
	Million cubic feet											
Oak group:												
Coast live oak	--	41	41	--	41	41	110	553	663	110	635	745
Canyon live oak	1	10	11	--	--	--	30	--	30	31	10	41
Interior live oak	--	--	--	--	--	--	--	206	206	--	206	206
California black oak	1	--	1	--	--	--	6	24	30	7	24	31
Oregon white oak	--	--	--	--	--	--	4	--	4	4	--	4
Valley oak	1	--	1	--	--	--	--	61	61	1	61	62
Blue oak	--	28	28	--	62	62	--	142	142	--	232	232
Total	3	79	82	--	103	103	150	986	1,136	153	1,168	1,321
Woodoak group:												
Tanoak	8	25	33	--	--	--	195	--	195	203	25	228
Pacific madrone	--	72	72	9	53	62	133	28	161	142	153	295
California-laurel	--	--	--	12	4	16	45	138	183	57	142	199
Bigleaf maple	2/	--	2/	--	--	--	--	--	--	2/	--	2/
California buckeye	--	--	--	--	--	--	--	9	9	--	9	9
Giant chinkapin	--	--	--	--	--	--	2	--	2	2	--	2
Alder 3/	2/	--	2/	--	--	--	--	--	--	2/	--	2/
Eucalyptus 4/	--	--	--	--	--	--	--	193	193	--	193	193
Total	8	97	105	21	57	78	375	368	743	404	522	926
All species	11	176	187	21	160	181	525	1,354	1,879	557	1,690	2,247

-- = none found.

1/ Totals may be off or disagree with other tables because of rounding.

2/ Less than 500,000 cubic feet.

3/ Includes red alder and white alder.

4/ Includes all species of eucalyptus that were found.

Table 17—Volume of hardwood growing stock on unreserved timberland and unreserved woodland, by species and owner, northern interior resource area, California, January 1, 1985[1/]

Species	National Forest			Other public			Private			All ownerships		
	Timberland	Woodland	Total	Timberland	Woodland	Total	Timberland	Woodland	Total	Timberland	Woodland	Total
	Million cubic feet											
Oak group:												
Canyon live oak	467	146	613	20	--	20	152	6	158	639	152	791
Interior live oak	--	2/	2/	--	--	--	--	6	6	--	6	6
California black oak	363	24	387	18	--	18	343	22	365	724	46	770
Oregon white oak	10	12	22	3	1	4	43	67	110	56	80	136
Valley oak	--	2/	2/	--	--	--	1	--	1	1	2/	1
Blue oak	--	3	3	--	--	--	--	37	37	--	40	40
Total	841	185	1,025	41	1	42	539	138	677	1,420	324	1,744
Nonoak group:												
Tanoak	191	4	195	--	--	--	16	--	16	207	4	211
Pacific madrone	154	4	158	3	--	3	45	--	45	202	4	206
California-laurel	--	--	--	--	--	--	3	--	3	3	--	3
Bigleaf maple	30	2/	30	4	--	4	21	6	27	55	6	61
California buckeye	--	--	--	--	--	--	1	--	1	1	--	1
Giant chinkapin	21	--	21	--	--	--	6	--	6	27	--	27
White alder	2/	--	2/	1	--	1	6	--	6	7	--	7
Aspen	11	5	16	--	--	--	--	--	--	11	5	16
Cottonwood 3/	--	4	4	--	--	--	--	--	--	--	4	4
Eucalyptus 4/	1	--	1	--	--	--	--	--	--	1	--	1
Unclassified	3	--	3	--	--	--	--	--	--	3	--	3
Total	411	17	428	8	--	8	98	6	104	517	23	540
All species	1,251	202	1,453	49	1	50	637	144	781	1,937	347	2,284

-- = none found.

1/ Totals may be off or disagree with other tables because of rounding.

2/ Less than 500,000 cubic feet.

3/ Includes black cottonwood and Fremont cottonwood.

4/ Includes all species of eucalyptus that were found.

Table 18—Volume of hardwood growing stock on unreserved timberland and unreserved woodland, by species and owner, Sacramento resource area, California, January 1, 1985[1/]

Species	National Forest			Other public			Private			All ownerships		
	Timberland	Woodland	Total	Timberland	Woodland	Total	Timberland	Woodland	Total	Timberland	Woodland	Total
	Million cubic feet											
Oak group:												
Coast live oak	--	--	--	2	--	2	--	--	--	2	--	2
Canyon live oak	123	51	174	22	11	33	111	79	190	256	141	397
Interior live oak	--	--	--	--	2	2	10	79	89	10	81	91
California black oak	293	44	337	37	--	37	373	35	408	703	79	782
Oregon white oak	5	4	9	--	--	--	--	11	11	5	15	20
Valley oak	--	--	--	--	--	--	--	31	31	--	31	31
Blue oak	--	14	14	--	17	17	1	346	347	1	377	378
Total	421	113	534	61	30	91	495	581	1,076	977	724	1,701
Nonoak group:												
Tanoak	6	12	18	--	--	--	34	--	34	40	12	52
Pacific madrone	7	13	20	--	--	--	48	--	48	55	13	68
California-laurel	--	--	--	--	--	--	7	--	7	7	--	7
Bigleaf maple	5	--	5	--	--	--	19	--	19	24	--	24
Giant chinkapin	2/	--	2/	--	--	--	--	--	--	2/	--	2/
White alder	7	--	7	--	--	--	13	--	13	20	--	20
Aspen	2	2/	2	--	--	--	2	--	2	4	2/	4
Cottonwood 3/	3	4	7	--	--	--	5	20	25	8	24	32
Willow	--	--	--	--	--	--	--	6	6	--	6	6
Unclassified	11	--	11	--	--	--	--	--	--	11	--	11
Total	41	29	70	--	--	--	128	26	154	169	55	224
All species	462	142	604	61	30	91	623	607	1,230	1,146	779	1,925

-- = none found.

1/ Totals may be off or disagree with other tables because of rounding.

2/ Less than 500,000 cubic feet.

3/ Includes black cottonwood and Fremont cottonwood.

Table 19—Volume of hardwood growing stock on unreserved timberland and unreserved woodland, by species and owner, San Joaquin and southern California resource areas, January 1, 1985[1/]

Species	National Forest			Other public			Private			All ownerships		
	Timberland	Woodland	Total	Timberland	Woodland	Total	Timberland	Woodland	Total	Timberland	Woodland	Total
	Million cubic feet											
Oak group:												
Coast live oak	--	12	12	--	14	14	--	8	8	--	34	34
Canyon live oak	28	124	152	11	16	27	70	232	302	109	372	481
Interior live oak	1	37	38	--	8	8	3	152	155	4	197	201
California black oak	287	22	309	16	--	16	172	39	211	475	61	536
Valley oak	1	--	1	--	--	--	5	20	25	6	20	26
Blue oak	--	66	66	--	63	63	--	334	334	--	463	463
Engelmann oak	--	1	1	--	9	9	--	--	--	--	10	10
Total	317	262	579	27	110	137	250	785	1,035	594	1,157	1,751
Nonoak group:												
Pacific madrone	--	--	--	--	--	--	2	--	2	2	--	2
California-laurel	--	--	--	--	--	--	1	--	1	1	--	1
Bigleaf maple	2/	--	2/	--	--	--	--	--	--	2/	--	2/
California buckeye	--	--	--	--	--	--	--	15	15	--	15	15
White alder	3	--	3	3	--	3	15	4	19	21	4	25
Aspen	3	4	7	--	--	--	2	--	2	5	4	9
Walnut	--	--	--	--	--	--	1	--	1	1	--	1
Eucalyptus 3/	--	--	--	--	--	--	--	28	28	--	28	28
Unclassified	5	--	5	--	--	--	--	--	--	5	--	5
Total	11	4	15	3	--	3	21	47	68	35	51	86
All species	328	266	594	30	110	140	271	832	1,103	629	1,208	1,837

-- = none found.

1/ Totals may be off or disagree with other tables because of rounding.

2/ Less than 500,000 cubic feet.

3/ Includes all species of eucalyptus that were found.

Table 20—Volume of hardwood growing stock on unreserved hardwood woodland, by forest type and owner, California, January 1, 1985

Forest type	National Forest	Other public	Private	All owners
		Million cubic feet		
Oak group:				
Coast live oak	53	88	659	800
Canyon live oak	346	11	459	816
Interior live oak	37	37	345	419
California black oak	97	--	93	190
Oregon white oak	22	51	336	409
Valley oak	1/	29	151	180
Blue oak 2/	111	78	803	992
Engelmann oak	1	--	--	1
Total	667	294	2,846	3,807
Nonoak group:				
Aspen	9	--	--	9
Bigleaf maple	1/	--	10	10
California buckeye	--	--	45	45
Pacific madrone	97	86	242	425
Cottonwood	8	--	80	88
California-laurel	--	--	132	132
Eucalyptus 3/	--	--	221	221
Tanoak	51	--	--	51
Total	165	86	730	981
All forest types	832	380	3,576	4,788

-- = none found.

1/ Less than 500,000 cubic feet.

2/ Includes hardwood volume in Digger pine type.

3/ Includes all species of eucalyptus that were found.

Table 21—Volume of hardwood growing stock on unreserved hardwood woodland, by forest type and owner, north coast resource area, California, January 1, 1985

Forest type	National Forest	Other public	Private	All owners
		Million cubic feet		
Oak group:				
Coast live oak	--	--	50	50
Canyon live oak	15	--	100	115
California black oak	7	--	47	54
Oregon white oak	6	51	257	314
Valley oak	--	29	19	48
Blue oak 1/	2/	2/	2/	2/
Total	28	80	473	581
Nonoak group:				
Pacific madrone	8	--	167	175
Tanoak	10	--	--	10
Total	18	--	167	185
All forest types	46	80	640	766

-- = none found.

1/ Includes hardwood volume in Digger pine type.

2/ Less than 500,000 cubic feet.

Table 22—Volume of hardwood growing stock on unreserved hardwood woodland, by forest type and owner, central coast resource area, California, January 1, 1985

Forest type	National Forest	Other public	Private	All owners
		Million cubic feet		
Oak group:				
Coast live oak	41	65	602	708
Canyon live oak	10	--	--	10
Interior live oak	--	--	170	170
Valley oak	--	--	55	55
Blue oak 1/	28	9	132	169
Total	79	74	959	1,112
Nonoak group:				
Pacific madrone	72	86	75	233
California-laurel	--	--	128	128
Eucalyptus 2/	--	--	193	193
Tanoak	25	--	--	25
Total	97	86	396	579
All forest types	176	160	1,355	1,691

-- = none found.

1/ Includes hardwood volume in Digger pine type.

2/ Includes all species of eucalyptus that were found.

Table 23—Volume of hardwood growing stock on unreserved hardwood woodland, by forest type and owner, northern interior resource area, California, January 1, 1985

Forest type	National Forest	Other public	Private	All owners
	Million cubic feet			
Oak group:				
Canyon live oak	146	--	15	161
Interior live oak	1/	--	--	1/
California black oak	24	--	--	24
Oregon white oak	12	--	79	91
Valley oak	1/	--	--	1/
Blue oak 2/	3	1	44	48
Total	185	1	138	324
Nonoak group:				
Aspen	5	--	--	5
Bigleaf maple	1/	--	6	6
Pacific madrone	4	--	--	4
Cottonwood	4	--	--	4
Tanoak	4	--	--	4
Total	17	--	6	23
All forest types	202	1	144	347

-- = none found.

1/ Less than 500,000 cubic feet.

2/ Includes hardwood volume in Digger pine type.

Table 24—Volume of hardwood growing stock on unreserved hardwood woodland, by forest type and owner, Sacramento resource area, California, January 1, 1985

Forest type	National Forest	Other public	Private	All owners
		Million cubic feet		
Oak group:				
Coast live oak	--	--	--	--
Canyon live oak	51	11	97	159
Interior live oak	--	--	50	50
California black oak	44	--	--	44
Oregon white oak	4	--	--	4
Valley oak	--	--	41	41
Blue oak 1/	14	19	328	361
Total	113	30	516	659
Nonoak group:				
Aspen	2/	--	--	2/
Bigleaf maple	--	--	4	4
Pacific madrone	13	--	--	13
Cottonwood	4	--	80	84
California-laurel	--	--	4	4
Tanoak	12	--	--	12
Total	29	--	88	117
All forest types	142	30	604	776

-- = none found.

1/ Includes hardwood volume in Digger pine type.

2/ Less than 500,000 cubic feet.

Table 25—Volume of hardwood growing stock on unreserved hardwood woodland, by forest type and owner, San Joaquin and southern California resource areas, January 1, 1985

Forest type	National Forest	Other public	Private	All owners
		Million cubic feet		
Oak group:				
Coast live oak	12	23	7	42
Canyon live oak	124	--	247	371
Interior live oak	37	37	125	199
California black oak	22	--	46	68
Valley oak	--	--	36	36
Blue oak 1/	66	49	299	414
Engelmann oak	1	--	--	1
Total	261	109	760	1,131
Nonoak group:				
Aspen	4	--	--	4
California buckeye	--	--	45	45
Eucalyptus 2/	--	--	28	28
Tanoak	--	--	--	--
Total	4	--	73	77
All forest types	265	109	833	1,208

-- = none found.

1/ Includes hardwood volume in Digger pine type.

2/ Includes all species of eucalyptus that were found.

Table 26—Total tree volume, growing-stock volume, and sawtimber volume of hardwoods on unreserved timberland and unreserved woodland outside National Forests, by species, California, January 1, 1985[1/ 2/]

Species	Total tree			Growing stock			Sawtimber		
	Timberland	Woodland	Total	Timberland	Woodland	Total	Timberland	Woodland	Total
	Million cubic feet								
Oak group:									
Coast live oak	203	1,145	1,348	125	702	827	75	313	388
Canyon live oak	886	536	1,422	640	385	1,025	235	134	369
Interior live oak	63	689	752	44	471	515	19	140	159
California black oak	1,762	255	2,017	1,236	180	1,416	524	65	589
Oregon white oak	265	527	792	188	367	555	49	66	115
Valley oak	46	240	286	32	164	196	13	65	78
Blue oak	2	1,504	1,506	1	1,001	1,002	--	312	312
Engelmann oak	--	17	17	--	9	9	--	--	--
Total	3,227	4,913	8,140	2,266	3,279	5,545	915	1,095	2,010
Nonoak group:									
Tanoak	2,691	--	2,691	1,556	--	1,556	913	--	913
Pacific Madrone	1,080	382	1,462	886	304	1,190	464	65	529
California-laurel	379	213	592	272	154	426	130	78	208
Bigleaf maple	142	8	150	103	6	109	40	--	40
California buckeye	2	42	44	1	24	25	--	4	4
Giant chinkapin	34	--	34	25	--	25	14	--	14
Alder 3/	194	5	199	153	4	157	88	--	88
Aspen	5	--	5	4	--	4	3	--	3
Cottonwood 4/	8	24	32	7	20	27	4	19	23
Walnut	1	--	1	1	--	1	--	--	--
Willow	9	7	16	7	6	13	1	3	4
Eucalyptus 5/	6	264	270	6	221	227	5	117	122
Unclassified	2	--	2	1	--	1	--	--	--
Total	4,553	945	5,498	3,022	739	3,761	1,662	286	1,948
All species	7,780	5,858	13,638	5/5,288	4,018	9,306	2,577	1,381	3,958

-- = none found.

1/ Total tree volume includes wood and bark volumes from ground level to the ends of all stems, and branches of all trees 5.0 inches in d.b.h. and larger; includes cull trees and cull sections of trees. Growing-stock volume includes wood volume above a 1-foot stump to a 4-inch-top outside bark, of sound trees 5.0 inches in d.b.h. and larger; excludes cull trees and cull sections of trees. Sawtimber volume includes wood volume in straight sections free of defect that are at least 8 feet long to a 9-inch-top outside bark in trees that are 11.0 inches in d.b.h. and larger.

2/ Totals may be off or disagree with other tables because of rounding.

3/ Includes red alder and white alder.

4/ Includes black cottonwood and Fremont cottonwood.

5/ Includes all species of eucalyptus that were found.

Table 27—Total tree volume, growing-stock volume, and sawtimber volume of hardwoods on unreserved timberland and unreserved woodland outside National Forests, by species, north coast resource area, California, January 1, 1985[1/ 2/]

Species	Total tree			Growing stock			Sawtimber		
	Timberland	Woodland	Total	Timberland	Woodland	Total	Timberland	Woodland	Total
	Million cubic feet								
Oak group:									
Coast live oak	23	150	173	14	86	100	5	18	23
Canyon live oak	308	55	363	224	41	265	95	15	110
Interior live oak	43	29	72	31	18	49	16	--	16
California black oak	383	88	471	271	60	331	132	14	146
Oregon white oak	197	409	606	138	288	426	32	49	81
Valley oak	38	79	117	26	52	78	9	21	30
Blue oak	3/	--	3/	3/	--	3/	--	--	--
Total	992	810	1,802	704	545	1,249	289	117	406
Nonoak group:									
Tanoak	2,289	--	2,289	1,311	--	1,311	758	--	758
Pacific madrone	790	279	1,069	645	223	868	320	36	356
California-laurel	286	18	304	204	12	216	97	--	97
Bigleaf maple	79	--	79	59	--	59	28	--	28
California buckeye	1	--	1	3/	--	3/	--	--	--
Giant chinkapin	23	--	23	11	--	11	11	--	11
Alder 4/	148	--	148	121	--	121	56	--	56
Cottonwood 5/	2	--	2	2	--	2	3/	--	3/
Willow	9	--	9	7	--	7	1	--	1
Eucalyptus 6/	6	--	6	6	--	6	5	--	5
Unclassified	2	--	2	1	--	1	--	--	--
Total	3,635	297	3,932	2,373	235	2,608	1,276	36	1,312
All species	4,627	1,107	5,734	3,077	780	3,857	1,565	153	1,718

-- = none found.

1/ Total tree volume includes wood and bark volumes from ground level to the ends of all stems, and branches of all trees 5.0 inches in d.b.h. and larger; includes cull trees and cull sections of trees. Growing stock volume includes wood volume above a 1-foot stump to a 4-inch top outside bark, of sound trees 5.0 inches in d.b.h. and larger; excludes cull trees and cull sections of trees. Sawtimber volume includes wood volume in straight sections free of defect that are at least 8 feet long to a 9-inch top outside bark in trees that are 11.0 inches in d.b.h. and larger.

2/ Totals may be off or disagree with other tables because of rounding.

3/ Less than 500,000 cubic feet.

4/ Includes red alder and white alder.

5/ Includes black cottonwood and Fremont cottonwood.

6/ Includes all species of eucalyptus that were found.

Table 28—Total tree volume, growing-stock volume, and sawtimber volume of hardwoods on unreserved timberland and unreserved woodland outside National Forests, by species, central coast resource area, California, January 1, 1985[1/ 2/]

Species	Total tree			Growing stock			Sawtimber		
	Timberland	Woodland	Total	Timberland	Woodland	Total	Timberland	Woodland	Total
	Million cubic feet								
Oak group:									
Coast live oak	176	959	1,135	109	594	703	68	287	355
Canyon live oak	40	--	40	30	--	30	15	--	15
Interior live oak	--	284	284	--	206	206	--	106	106
California black oak	8	33	41	6	24	30	3	8	11
Oregon white oak	5	--	5	4	--	4	2	--	2
Valley oak	--	90	90	--	61	61	--	20	20
Blue oak	--	314	314	-	204	204	--	57	57
Total	229	1,680	1,909	149	1,089	1,238	88	478	566
Nonoak group:									
Tanoak	310	--	310	195	--	195	131	--	131
Pacific madrone	170	103	273	143	81	224	90	29	119
California-laurel	78	195	273	57	142	199	31	78	109
California buckeye	--	16	16	--	9	9	--	--	--
Giant chinkapin	2	--	2	2	--	2	--	--	--
Eucalyptus 3/	--	232	232	--	193	193	--	94	94
Total	560	546	1,106	397	425	822	252	201	453
All species	789	2,226	3,015	546	1,514	2,060	340	679	1,019

-- = none found.

1/ Total tree volume includes wood and bark volumes from ground level to the ends of all stems, and branches of all trees 5.0 inches in d.b.h. and larger; includes cull trees and cull sections of trees. Growing-stock volume includes wood volume above a 1-foot stump to a 4-inch-top outside bark, of sound trees 5.0 inches in d.b.h. and larger; excludes cull trees and cull sections of trees. Sawtimber volume includes wood volume in straight sections free of defect that are at least 8 feet long to a 9-inch-top outside bark in trees that are 11.0 inches in d.b.h. and larger.

2/ Totals may be off or disagree with other tables because of rounding.

3/ Includes all species of eucalyptus that were found.

Table 29—Total tree volume, growing-stock volume, and sawtimber volume of hardwoods on unreserved timberland and unreserved woodland outside National Forests, by species, northern interior resource area, California, January 1, 1985[1/ 2/]

Species	Total tree			Growing stock			Sawtimber		
	Timberland	Woodland	Total	Timberland	Woodland	Total	Timberland	Woodland	Total
	Million cubic feet								
Oak group:									
Canyon live oak	245	9	254	172	6	178	50	3	53
Interior live oak	--	10	10	--	6	6	--	1	1
California black oak	516	32	548	361	22	383	139	4	143
Oregon white oak	63	104	167	46	68	114	15	13	28
Valley oak	2	--	2	1	--	1	1	--	1
Blue oak	--	57	57	--	37	37	--	11	11
Total	826	212	1,038	580	139	719	205	32	237
Nonoak group:									
Tanoak	29	--	29	16	--	16	10	--	10
Pacific madrone	59	--	59	48	--	48	24	--	24
California-laurel	4	--	4	3	--	3	2	--	2
Bigleaf maple	36	8	44	25	6	31	4	--	4
California buckeye	1	--	1	1	--	1	--	--	--
Giant chinkapin	9	--	9	6	--	6	3	--	3
White alder	9	--	9	7	--	7	5	--	5
Total	147	8	155	106	6	112	48	--	48
All species	973	220	1,193	686	145	831	253	32	285

-- = none found.

1/ Total tree volume includes wood and bark volumes from ground level to the ends of all stems, and branches of all trees 5.0 inches in d.b.h. and larger; includes cull trees and cull sections of trees. Growing-stock volume includes wood volume above a 1-foot stump to a 4-inch-top outside bark, of sound trees 5.0 inches in d.b.h. and larger; excludes cull trees and cull sections of trees. Sawtimber volume includes wood volume in straight sections free of defect that are at least 8 feet long to a 9-inch-top outside bark in trees that are 11.0 inches in d.b.h. and larger.

2/ Totals may be off or disagree with other tables because of rounding.

Table 30—Total tree volume, growing-stock volume, and sawtimber volume of hardwoods on unreserved timberland and unreserved woodland outside National Forests, by species, Sacramento resource area, California, January 1, 1985[1/ 2/]

Species	Total tree			Growing stock			Sawtimber		
	Timberland	Woodland	Total	Timberland	Woodland	Total	Timberland	Woodland	Total
	Million cubic feet								
Oak group:									
Coast live oak	4	--	4	2	--	2	2	--	2
Canyon live oak	183	131	314	133	90	223	45	25	70
Interior live oak	15	121	136	10	81	91	2	15	17
California black oak	583	49	632	410	35	445	162	16	178
Oregon white oak	--	14	14	--	11	11	--	4	4
Valley oak	--	41	41	--	31	31	--	15	15
Blue oak	2	556	558	1	363	364	--	101	101
Total	787	912	1,699	556	611	1,167	211	176	387
Nonoak group:									
Tanoak	63	--	63	34	--	34	14	--	14
Pacific madrone	58	--	58	48	--	48	29	--	29
California-laurel	9	--	9	7	--	7	--	--	--
Bigleaf maple	27	--	27	19	--	19	8	--	8
White alder	17	--	17	13	--	13	12	--	12
Aspen	2	--	2	2	--	2	1	--	1
Cottonwood 3/	6	24	30	5	20	25	4	19	23
Willow	--	7	7	--	6	6	--	3	3
Total	182	31	213	128	26	154	68	22	90
All species	969	943	1,912	684	637	1,321	279	198	477

-- = none found.

1/ Total tree volume includes wood and bark volumes from ground level to the ends of all stems, and branches of all trees 5.0 inches in d.b.h. and larger; includes cull trees and cull sections of trees. Growing-stock volume includes wood volume above a 1-foot stump to a 4-inch-top outside bark, of sound trees 5.0 inches in d.b.h. and larger; excludes cull trees and cull sections of trees. Sawtimber volume includes wood volume in straight sections free of defect that are at least 8 feet long to a 9-inch-top outside bark in trees that are 11.0 inches in d.b.h. and larger.

2/ Totals may be off or disagree with other tables because of rounding.

3/ Includes black cottonwood and Fremont cottonwood.

Table 31—Total tree volume, growing-stock volume, and sawtimber volume of hardwoods on unreserved timberland and unreserved woodland outside National Forests, by species, San Joaquin and southern California resource areas, January 1, 1985[1/ 2/]

Species	Total tree			Growing stock			Sawtimber		
	Timberland	Woodland	Total	Timberland	Woodland	Total	Timberland	Woodland	Total
	Million cubic feet								
Oak group:									
Coast live oak	--	36	36	--	22	22	--	8	8
Canyon live oak	110	341	451	81	248	329	30	91	121
Interior live oak	5	245	250	3	160	163	1	18	19
California black oak	272	53	325	188	39	227	88	23	111
Valley oak	6	30	36	5	20	25	3	9	12
Blue oak	--	577	577	--	397	397	--	143	143
Engelmann oak	--	17	17	--	9	9	--	--	--
Total	393	1,299	1,692	277	895	1,172	122	292	414
Nonoak group:									
Pacific madrone	3	--	3	2	--	2	1	--	1
California-laurel	2	--	2	1	--	1	--	--	--
California buckeye	--	26	25	--	15	15	--	4	4
White alder	20	5	25	18	4	22	15	--	15
Aspen	3	--	3	2	--	2	2	--	2
Walnut	1	--	1	1	--	1	--	--	--
Eucalyptus 3/	--	32	32	--	28	28	--	23	23
Total	29	63	92	24	47	71	18	27	45
All species	422	1,362	1,784	301	942	1,243	140	319	459

-- = none found.

1/ Total tree volume includes wood and bark volumes from ground level to the ends of all stems, and branches of all trees 5.0 inches in d.b.h. and larger; includes cull trees and cull sections of trees. Growing-stock volume includes wood volume above a 1-foot stump to a 4-inch-top outside bark, of sound trees 5.0 inches in d.b.h. and larger; excludes cull trees and cull sections of trees. Sawtimber volume includes wood volume in straight sections free of defect that are at least 8 feet long to a 9-inch-top outside bark in trees that are 11.0 inches in d.b.h. and larger.

2/ Totals may be off or disagree with other tables because of rounding.

3/ Includes all species of eucalyptus that were found.

Table 32—Volume of all hardwood trees on unreserved timberland outside National Forests, by species and hardwood form class, California, January 1, 1985[1/]

Species	Hardwood form class						
	1	2	3	4	5	6	Total
	Million cubic feet						
Oak group:							
Coast live oak	1	13	84	27	101	1	227
Canyon live oak	76	196	268	92	73	5	710
Interior live oak	6	10	20	7	3	1	47
California black oak	143	429	482	148	91	33	1,326
Oregon white oak	19	65	72	31	35	2	224
Valley oak	1	14	11	5	5	--	36
Blue oak	--	--	--	1	2	--	3
Total	246	727	937	311	310	42	2,573
Nonoak group:							
Tanoak	846	470	150	59	20	30	1,575
Pacific madrone	111	255	360	150	41	5	922
California-laurel	38	108	79	36	17	11	289
Bigleaf maple	15	29	35	21	13	3	116
California buckeye	--	2/	--	1	2	1	4
Giant chinkapin	24	--	--	--	--	1	25
Alder 3/	108	34	8	7	2	2	161
Aspen	3	1	1	--	2/	--	5
Cottonwood 4/	1	4	2	--	--	--	7
Walnut	1	--	--	--	--	--	1
Willow	--	2	2	1	3	1	9
Eucalyptus 5/	3	2	--	--	--	--	5
Total	1,151	905	637	275	98	54	3,120
All species	1,397	1,632	1,574	586	408	96	5,693

-- = none found.

1/ Includes wood volume from a 1-foot stump to a minimum 4-inch-top outside bark in trees 5.0 inches in d.b.h. and larger; includes cull trees.

2/ Less than 500,000 feet.

3/ Includes red alder and white alder.

4/ Includes black cottonwood and Fremont cottonwood.

5/ Includes all species of eucalyptus that were found.

Table 33—Volume of all hardwood trees on unreserved timberland outside National Forests, by species and hardwood form class, north coast resource area, California, January 1, 1985[1/]

Species	Hardwood form class						
	1	2	3	4	5	6	Total
	Million cubic feet						
Oak group:							
Coast live oak	1	2	2/	9	41	1	54
Canyon live oak	35	74	88	26	20	1	244
Interior live oak	5	6	13	5	1	1	31
California black oak	27	84	108	48	14	3	284
Oregon white oak	17	45	55	20	32	1	170
Valley oak	1	12	10	3	5	--	31
Blue oak	--	--	--	2/	--	--	2/
Total	86	223	274	111	113	7	814
Nonoak group:							
Tanoak	720	382	129	53	18	26	1,328
Pacific madrone	98	163	258	118	18	4	659
California-laurel	34	62	67	32	14	9	218
Bigleaf maple	10	18	18	12	2	1	61
California buckeye	--	2/	--	--	2	--	2
Giant chinkapin	17	--	--	--	--	--	17
Alder 3/	98	16	1	5	--	1	121
Cottonwood 4/	1	1	--	--	--	--	2
Willow	--	2	2	1	2	1	8
Eucalyptus 5/	3	2	--	--	--	--	5
Unclassified	1	--	--	--	--	--	1
Total	982	646	475	221	56	42	2,422
All species	1,068	869	749	332	169	49	3,236

-- = none found.

1/ Includes wood volume from a 1-foot stump to a minimum 4-inch-top outside bark in trees 5.0 inches in d.b.h. and larger; includes cull trees.

2/ Less than 500,000 feet.

3/ Includes red alder and white alder.

4/ Includes black cottonwood and Fremont cottonwood.

5/ Includes all species of eucalyptus that were found.

Table 34—Volume of all hardwood trees on unreserved timberland outside National Forests, by species and hardwood form class, central coast resource area, California, January 1, 1985[1/]

Species	Hardwood form class						
	1	2	3	4	5	6	Total
	Million cubic feet						
Oak group:							
Coast live oak	--	11	82	17	60	--	170
Canyon live oak	--	5	20	5	3	--	33
California black oak	1	1	3	1	--	--	6
Oregon white oak	--	1	2	1	--	--	4
Total	1	18	107	24	63	--	213
Nonoak group:							
Tanoak	110	68	11	6	--	--	195
Pacific madrone	6	52	61	23	11	--	153
California-laurel	3	42	10	1	--	1	57
Giant chinkapin	2	--	--	--	--	--	2
Total	121	162	82	30	11	1	407
All species	122	180	189	54	74	1	620

-- = none found.

1/ Includes wood volume from a 1-foot stump to a minimum 4-inch-top outside bark in trees 5.0 inches in d.b.h. and larger; includes cull trees.

Table 35-Volume of all hardwood trees on unreserved timberland outside National Forests, by species and hardwood form class, northern interior resource area, California, January 1, 1985 1/

Species	Hardwood form class						
	1	2	3	4	5	6	Total
	Million cubic feet						
Oak group:							
Canyon live oak	19	55	62	33	25	3	197
California black oak	57	148	103	43	25	11	387
Oregon white oak	2	19	15	10	3	1	50
Valley oak	--	--	--	1	--	--	1
Total	78	222	180	87	53	15	635
Nonoak group:							
Tanoak	5	5	2	--	--	4	16
Pacific madrone	6	13	23	4	3	1	50
California-laurel	--	2	--	1	2	1	6
Bigleaf maple	5	9	5	6	5	--	30
California buckeye	--	--	--	1	--	1	2
Giant chinkapin	5	--	--	--	--	1	6
White alder	4	--	3	--	--	--	7
Total	25	29	33	12	10	8	117
All species	103	251	213	99	63	23	752

-- = none found.

1/ Includes wood volume from a 1-foot stump to a minimum 4-inch-top outside bark in trees 5.0 inches in d.b.h. and larger; includes cull trees.

Table 36-Volume of all hardwood trees on unreserved timberland outside National Forests, by species and hardwood form class, Sacramento resource area, California, January 1, 1985 [1/]

Species	Hardwood form class						
	1	2	3	4	5	6	Total
	Million cubic feet						
Oak group:							
Coast live oak	--	--	2	1	--	--	3
Canyon live oak	18	45	56	12	11	--	142
Interior live oak	1	4	5	--	1	--	11
California black oak	49	148	178	27	44	7	453
Blue oak	--	--	--	1	2	--	3
Total	68	197	241	41	58	7	612
Nonoak group:							
Tanoak	11	15	8	2/	2	--	36
Pacific madrone	1	27	17	4	9	--	58
California-laurel	--	2	2	2	1	--	7
Bigleaf maple	--	2	12	3	6	2	25
White alder	--	13	1	--	1	--	15
Aspen	2	--	--	--	--	--	2
Cottonwood 3/	--	3	2	--	--	--	5
Willow	--	--	--	--	1	--	1
Total	14	62	42	9	20	2	149
All species	82	259	283	50	78	9	761

-- = none found.

1/ Includes wood volume from a 1-foot stump to a minimum 4-inch-top outside bark in trees 5.0 inches in d.b.h. and larger; includes cull trees.

2/ Less than 500,000 cubic feet.

3/ Includes black cottonwood and Fremont cottonwood.

Table 37-Volume of all hardwood trees on unreserved timberland outside National Forests, by species and hardwood form class, San Joaquin and southern California resource areas, January 1, 1985 [1/]

Species	Hardwood form class						
	1	2	3	4	5	6	Total
	Million cubic feet						
Oak group:							
Canyon live oak	4	17	42	16	14	1	94
Interior live oak	--	--	2	2	1	--	5
California black oak	9	48	90	29	8	12	196
Valley oak	--	2	1	1	--	--	4
Total	13	67	135	48	23	13	299
Nonoak group:							
Pacific madrone	--	--	1	1	--	--	2
California-laurel	1	--	--	--	--	--	1
White alder	6	5	3	2	1	1	18
Aspen	1	1	1	--	2/	--	3
Walnut	1	--	--	--	--	--	1
Total	9	6	5	3	1	1	25
All species	22	73	140	51	24	14	324

-- = none found.

1/ Includes wood volume from a 1-foot stump to a minimum 4-inch-top outside bark in trees 5.0 inches in d.b.h. and larger; includes cull trees.

2/ Less than 500,000 cubic feet.

Table 38-Volume of all hardwood trees on unreserved woodland outside National Forests, by species and hardwood form class, California, January 1, 1985 [1/]

Species	Hardwood form class						
	1	2	3	4	5	6	Total
	Million cubic feet						
Oak group:							
Coast live oak	--	69	314	309	71	10	773
Canyon live oak	1	107	154	121	86	1	470
Interior live oak	--	57	237	177	89	1	561
California black oak	3	66	70	41	13	--	193
Oregon white oak	23	94	199	50	54	--	420
Valley oak	13	8	104	39	52	--	216
Blue oak	87	237	399	262	256	14	1,255
Engelmann oak	--	--	9	--	--	--	9
Total	127	638	1,486	999	621	26	3,897
Nonoak group:							
Pacific madrone	16	150	100	38	--	--	304
California-laurel	11	69	55	19	--	--	154
Bigleaf maple	--	--	--	6	12	--	18
California buckeye	--	--	8	17	14	--	39
Alder 2/	4	--	--	--	--	--	4
Cottonwood 3/	--	--	10	10	--	--	20
Willow	--	1	4	--	5	--	10
Eucalyptus 4/	203	15	3	--	--	--	221
Total	234	235	180	90	31	--	770
All species	361	873	1,666	1,089	652	26	4,667

-- = none found.

1/ Includes wood volume from a 1-foot stump to a minimum 4-inch-top outside bark in trees 5 inches in d.b.h. and larger.

2/ Includes red alder and white alder.

3/ Includes black cottonwood and Fremont cottonwood.

4/ Includes all species of eucalyptus that were found.

Table 39-Volume of all hardwood trees on unreserved woodland outside National Forests, by species and hardwood form class, north coast resource area, California, January 1, 1985 [1/]

Species	Hardwood form class						
	1	2	3	4	5	6	Total
	Million cubic feet						
Oak group:							
Coast live oak	--	--	54	32	3	--	89
Canyon live oak	--	--	28	13	--	--	41
Interior live oak	--	10	4	4	--	--	18
California black oak	--	12	21	27	--	--	60
Oregon white oak	23	74	168	23	20	--	308
Valley oak	13	--	35	4	10	--	62
Total	36	96	310	103	33	--	578
Nonoak group:							
Pacific madrone	--	138	72	13	--	--	223
California-laurel	--	12	--	--	--	--	12
Total	--	150	72	13	--	--	235
All species	36	246	382	116	33	--	813

-- = none found.

1/ Includes wood volume from a 1-foot stump to a minimum 4-inch-top outside bark in trees 5 inches in d.b.h. and larger.

Table 40-Volume of all hardwood trees on unreserved woodland outside National Forests by species and hardwood form class, central coast resource area, California, January 1, 1985 1/

Species	Hardwood form class						
	1	2	3	4	5	6	Total
	Million cubic feet						
Oak group:							
Coast live oak	--	69	251	264	68	10	662
Interior live oak	--	32	111	63	29	--	235
California black oak	--	15	9	--	--	--	24
Valley oak	--	--	61	--	42	--	103
Blue oak	2	30	96	76	60	--	264
Total	2	146	528	403	199	10	1,288
Nonoak group:							
Pacific madrone	16	12	28	25	--	--	81
California-laurel	11	57	55	19	--	--	142
California buckeye	--	--	--	9	3	--	12
Eucalyptus 2/	185	9	--	--	--	--	194
Total	212	78	83	53	3	--	429
All species	214	224	611	456	202	10	1,717

-- = none found.

1/ Includes wood volume from a 1-foot stump to a minimum 4-inch-top outside bark in trees 5 inches in d.b.h. and larger.

2/ Includes all species of eucalyptus that were found.

Table 41-Volume of all hardwood trees on unreserved woodland outside National Forests, by, species and hardwood form class, northern interior resource area, California, January 1, 1985 [1/]

Species	Hardwood form class						
	1	2	3	4	5	6	Total
	Million cubic feet						
Oak group:							
Canyon live oak	--	4	2	--	5	--	11
Interior live oak	--	--	--	6	2	--	8
California black oak	--	2	13	7	--	--	22
Oregon white oak	--	20	27	20	13	--	80
Blue oak	--	10	21	6	19	--	56
Total	--	36	63	39	39	--	177
Nonoak group:							
Bigleaf maple	--	--	--	6	4	--	10
Total	--	--	--	6	4	--	10
All species	--	36	63	45	43	--	187

-- = none found.

1/ Includes wood volume from a 1-foot stump to a minimum 4-inch-top outside bark in trees 5 inches in d.b.h. and larger.

Table 42-Volume of all hardwood trees on unreserved woodland outside National Forests, by species and hardwood form class, Sacramento resource area, California, January 1, 1985 [1/]

Species	Hardwood form class						
	1	2	3	4	5	6	Total
	Million cubic feet						
Oak group:							
Canyon live oak	1	39	21	29	62	--	152
Interior live oak	--	2	39	40	23	--	104
California black oak	--	14	16	5	10	--	45
Oregon white oak	--	--	4	7	21	--	32
Valley oak	--	8	--	23	--	--	31
Blue oak	40	90	150	76	80	7	443
Total	41	153	230	180	196	7	807
Nonoak group:							
Bigleaf maple	--	--	--	--	8	--	8
California buckeye	--	--	--	--	2	--	2
Cottonwood 2/	--	--	10	10	--	--	20
Willow	--	1	4	--	4	--	9
Total	--	1	14	10	14	--	39
All species	41	154	244	190	210	7	846

-- = none found.

1/ Includes wood volume from a 1-foot stump to a minimum 4-inch-top outside bark in trees 5 inches in d.b.h. and larger.

2/ Includes black cottonwood and Fremont cottonwood.

Table 43-Volume of all hardwood trees on unreserved woodland outside National Forests, by species and hardwood form class, San Joaquin and southern California resource areas, January 1, 1985 [1/]

Species	Hardwood form class						
	1	2	3	4	5	6	Total
	Million cubic feet						
Oak group:							
Coast live oak	--	--	9	13	--	--	22
Canyon live oak	--	64	103	79	19	1	266
Interior live oak	--	13	83	64	35	1	196
California black oak	3	23	11	2	3	--	42
Valley oak	--	--	8	12	--	--	20
Blue oak	45	107	132	104	97	7	492
Engelmann oak	--	--	9	--	--	--	9
Total	48	207	355	274	154	9	1,047
Nonoak group:							
California buckeye	--	--	8	8	9	--	25
White alder	4	--	--	--	--	--	4
Willow	--	--	--	--	1	--	1
Eucalyptus 2/	18	6	3	--	--	--	27
Total	22	6	11	8	10	--	57
All species	70	213	366	282	164	9	1,104

-- = none found.

1/ Includes wood volume from a 1-foot stump to a minimum 4-inch-top outside bark in trees 5 inches in d.b.h. and larger.

2/ Includes all species of eucalyptus that were found.

Table 44-Volume of hardwood growing stock on timberland outside wilderness and other reserved areas in National Forests by species and diameter class, California, January 1, 1985 [1/]

Species	Diameter class (inches)										
	5.0-6.9	7.0-8.9	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9	29.0 and larger	All classes
	Million cubic feet										
Oak group:											
Canyon live oak	75	113	111	54	56	58	52	21	82	40	662
Interior live oak	2/	2/	1	--	--	--	--	--	--	--	1
California black oak	71	86	102	87	87	80	80	71	240	114	1,018
Oregon white oak	6	3	3	3	4	4	2	2/	2/	1	26
California white oak	2/	2/	1	--	--	--	--	2/	2/	1	2
Total	152	202	218	144	147	142	134	92	323	155	1,709
Nonoak group:											
Tanoak	13	29	41	44	38	46	31	12	61	17	332
Pacific madrone	17	31	34	26	23	26	23	16	32	4	232
Bigleaf maple	6	10	12	3	3	4	3	2	5	--	48
Golden chinkapin	1	2	2	3	3	3	2	2	6	1	25
Alder	2/	1	2/	1	1	1	1	1	4	--	10
Aspen	1	2	3	1	1	1	1	1	4	1	16
Cottonwood	2/	--	--	--	--	--	1	1	1	--	3
Eucalyptus	1	1	2	--	--	--	--	--	--	--	4
Other hardwoods	2	3	3	1	2	1	1	1	4	1	19
Total	41	79	97	79	71	82	63	36	117	24	689
All species	193	281	315	223	218	224	197	128	440	179	2,398

-- = none found.

1/ Totals may be off or disagree with other tables because of rounding.

2/ Less than 500,000 cubic feet.

Table 45-Volume of hardwood growing stock on unreserved timberland outside National Forests, by species and diameter class, California, January 1, 1985 [1/]

Species	Diameter class (inches)										
	5.0-6.9	7.0-8.9	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9	29.0 and larger	All classes
	Million cubic feet										
Oak group:											
Coast live oak	3	2	7	16	13	21	14	13	28	9	126
Canyon live oak	50	62	82	78	75	50	44	31	107	61	640
Interior live oak	5	3	4	4	7	4	3	3	6	5	44
California black oak	76	121	111	110	115	112	107	90	246	148	1,236
Oregon white oak	26	37	28	24	19	10	15	5	18	3	185
Valley oak	2	2	4	2	1	2	1	2	7	9	32
Blue oak	--	--	--	1	--	--	--	--	--	--	1
Total	162	227	236	235	230	199	184	144	412	235	2,264
Nonoak group:											
Tanoak	115	153	158	170	149	145	139	112	271	143	1,555
Pacific madrone	53	74	64	112	83	92	63	56	177	110	884
California-laurel	27	35	29	35	37	33	23	12	30	12	273
Bigleaf maple	10	12	14	6	15	5	8	8	16	8	102
Giant chinkapin	1	2	5	5	3	1	1	4	2	1	25
Alder	10	25	24	14	14	20	10	9	21	5	152
Aspen	--	--	--	--	--	--	1	--	3	--	4
Cottonwood	--	--	--	2	--	--	--	--	--	5	7
Eucalyptus	--	--	--	--	--	--	2	--	--	4	6
Other hardwoods	2	6	1	--	1	--	1	--	--	--	11
Total	218	307	295	344	302	296	248	201	520	288	3,019
All species	380	534	531	579	532	495	432	345	932	523	5,283

-- = none found.

1/ Totals may be off or disagree with other tables because of rounding.

Table 4C-Volume of hardwood growing stock on unreserved woodland outside National Forests, by species and diameter class, California, January 1, 1985 [1/]

Species	Diameter class (inches)										
	5.0-6.9	7.0-8.9	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9	29.0 and larger	All classes
	Million cubic feet										
Oak group:											
Coast live oak	3.1	32.1	74.7	102.5	115.1	75.0	48.2	59.3	103.1	89.0	702.2
Canyon live oak	38.8	28.3	21.4	24.3	56.3	52.5	68.4	7.3	70.0	17.5	384.9
Interior live oak	71.9	61.9	38.2	39.7	59.7	42.0	54.1	55.0	39.2	9.7	471.5
California black oak	11.1	16.0	23.1	40.2	25.7	24.5	10.2	10.7	19.7	--	181.2
Oregon white oak	30.9	106.4	110.0	64.4	12.3	12.8	11.0	8.5	31.7	--	388.0
Valley oak	1.5	3.1	16.0	3.8	12.9	15.0	--	--	30.3	60.9	143.5
Blue oak	66.2	98.2	181.2	123.6	98.9	64.3	61.6	107.0	165.3	33.9	1,000.2
Engelmann oak	--	4.5	--	--	--	--	--	--	4.5	--	9.1
Total	223.5	350.5	464.6	398.5	380.9	286.1	253.5	247.8	463.8	211.0	3,280.6
Nonoak group:											
Pacific madrone	32.1	72.7	93.8	61.1	10.7	15.7	5.2	--	12.7	--	304.1
California-laurel	11.6	27.2	5.3	20.5	31.0	23.5	9.7	9.2	16.0	--	154.1
Bigleaf maple	--	--	--	5.7	--	--	--	--	--	--	5.7
California buckeye	--	13.8	2.2	2.6	--	5.8	--	--	--	--	24.4
White alder	--	--	4.0	--	--	--	--	--	--	--	4.0
Cottonwood	--	--	--	--	--	--	--	--	5.1	14.5	19.6
Willow	1.4	--	--	4.1	--	--	--	--	--	--	5.5
Eucalyptus	3.8	54.0	29.1	43.2	17.0	25.6	7.6	23.6	8.3	8.6	220.8
Total	48.9	167.7	134.4	137.2	58.7	70.6	22.5	32.8	42.1	23.1	738.2
All species	272.4	518.2	599.0	535.7	439.6	356.7	276.0	280.6	505.9	234.1	4,018.8

-- = none found.

1/ Totals may be off or disagree with other tables because of rounding.

Table 47-Gross annual growth of hardwood growing stock on unreserved timberland by species and owner, California, 1984 [1/]

Species	National Forest	Other public	All private	All owners
		Thousand cubic feet		
Oak group:				
Coast live oak	--	46	2,765	2,811
Canyon live oak	19,800	1,820	13,393	35,013
Interior live oak	--	--	1,526	1,526
California black oak	29,700	2,667	28,491	60,858
Oregon white oak	900	426	4,772	6,098
Valley oak	--	11	833	844
Blue oak	--	--	57	57
Total oak group	50,400	4,970	51,837	107,207
Nonoak group:				
Tanoak	11,000	6,737	58,559	76,294
Pacific madrone	7,100	4,021	26,810	37,931
California-laurel	--	1,128	8,963	10,089
Bigleaf maple	1,600	230	3,139	4,967
California buckeye	--	--	52	52
Giant chinkapin	500	42	651	1,193
Alder 2/	400	286	6,217	6,904
Aspen	400	--	92	492
Cottonwood 3/	--	--	176	176
Walnut	--	--	41	41
Willow	--	--	259	259
Eucalyptus	--	--	92	92
Unclassified	400	--	38	438
Total nonoak group	21,400	12,444	105,089	138,933
All species	71,800	17,414	156,926	246,140

-- = none found.

1/ Totals may be off because of rounding.

2/ Includes red alder and white alder.

3/ Includes black cottonwood and Fremont cottonwood.

Table 48-Average annual mortality of growing stock on unreserved timberland by species and owner, ail California resource areas, 1984 [1/]

Species	National Forest	Other public	All private	All owners
		Thousand cubic feet		
Oak group:				
Coast live oak	--	4	283	287
Canyon live oak	900	176	1,348	2,424
Interior live oak	--	--	95	95
California black oak	2,800	298	2,920	6,018
Oregon white oak	--	19	367	385
Valley oak	--	--	70	70
Blue oak	--	--	2	2
Total oak group	3,700	497	5,085	9,281
Nonoak group:				
Tanoak	700	978	8,470	10,149
Pacific madrone	1,000	329	1,555	2,884
California-laurel	--	46	464	510
Bigleaf maple	--	18	205	223
California buckeye	--	--	1	1
Giant chinkapin	--	6	43	49
Alder 2/	--	12	317	329
Aspen	--	--	14	14
Cottonwood 3/	--	--	12	12
Walnut	--	--	1	1
Willow	--	--	5	5
Eucalyptus 4/	--	--	14	14
Unclassified hardwoods	400	--	--	400
Total nonoak group	2,100	1,389	11,101	14,591
All species	5,800	1,886	16,186	23,872

-- = none found.

1/ Totals may be off because of rounding.

2/ Includes red alder and white alder.

3/ Includes black cottonwood and Fremont cottonwood.

4/ Includes all species of eucalyptus found.

Table 49-Area of unreserved coast live oak type outside National Forests by hardwood and conifer basal area classes, California, January 1, 1985 [1/]

Hardwood basal area per acre	Conifer basal area per acre (square feet)					
	0-24	25-49	50-74	75-100	100+	Total
Square feet	- - - - - - - - - - Thousand acres - - - - - - - - - -					
0-24	142	--	--	--	--	142
25-49	189	--	--	--	--	189
50-74	48	10	--	--	--	58
75-99	95	10	--	--	--	105
100-124	48	--	--	--	--	48
125-149	152	--	--	--	--	152
150+	48	10	--	--	--	58
Total	722	30	--	--	--	752

-- = none found.

1/ Includes 39,000 acres classified as timberland and 713,000 acres classified as woodland.

Table 51-Area of unreserved canyon live oak type outside National Forests by hardwood and conifer basal area classes, California, January 1, 1985 [1/]

Hardwood basal area per acre	Conifer basal area per acre (square feet)					
	0-24	25-49	50-74	75-100	100+	Total
Square feet	- - - - - - - - - - Thousand acres - - - - - - - - - -					
0-24	79	--	--	--	--	79
25-49	71	8	--	--	--	79
50-74	135	24	8	--	--	167
75-99	118	8	8	--	--	134
100-124	41	8	8	8	--	65
125+	134	16	8	8	8	174
Total	578	64	32	16	8	698

-- = none found.

1/ Includes 290,000 acres classified as timberland and 408,000 acres classified as woodland.

Table 51-Area of unreserved interior live oak type outside National Forests by hardwood and conifer basal area classes, California, January 1, 1985 [1/]

Hardwood basal area per acre	Conifer basal area per acre (square feet)					
	0-24	25-49	50-74	75-100	100+	Total
Square feet	- - - - - - - - - - Thousand acres - - - - - - - - - -					
0-24	317	--	37	--	--	354
25-49	272	--	--	--	--	272
50-74	37	--	--	--	--	37
75-100	80	8	--	--	--	88
100-124	--	--	--	--	--	--
125+	45	--	--	--	--	45
Total	751	8	37	--	--	796

-- = none found.

1/ Includes 62,000 acres classified as timberland and 734,000 acres classified as woodland.

Table 52-Area of unreserved California black oak type outside National Forests by hardwood and conifer basal area classes, California, January 1, 1985 [1/]

Hardwood basal area per acre	Conifer basal area per acre (square feet)					
	0-24	25-49	50-74	75-100	100+	Total
Square feet	- - - - - - - - - - Thousand acres - - - - - - - - - -					
0-24	114	8	--	--	--	122
25-49	81	8	15	--	--	104
50-74	80	38	15	--	--	133
75-99	58	23	8	--	--	89
100-124	30	38	--	8	--	76
125+	66	8	8	8	--	90
Total	429	123	46	16	--	614

-- = none found.

1/ Includes 475,000 acres classified as timberland and 139,000 acres classified as woodland.

Table 53-Area of unreserved Oregon white oak type outside National Forests by hardwood and conifer basal area classes, California, January 1, 1985 [1/]

Hardwood basal area per acre	Conifer basal area per acre (square feet)					
	0-24	25-49	50-74	75-100	100+	Total
Square feet	- - - - - - - - - - Thousand acres - - - - - - - - - -					
0-24	64	--	--	--	--	64
25-49	83	--	--	--	--	83
50-74	160	8	--	--	--	168
75-99	8	--	--	--	--	8
100-124	40	8	--	--	--	48
125+	40	--	--	--	--	40
Total	395	16	--	--	--	411

-- = none found.

1/ Includes 92,000 acres classified as timberland and 319,000 acres classified as woodland.

Table 54-Area of unreserved valley oak type outside National Forests by hardwood and conifer basal area classes, California, January 1, 1985 [1/]

Hardwood basal area per acre	Conifer basal area per acre (square feet)					
	0-24	25-49	50-74	75-100	100+	Total
Square feet	- - - - - - - - - - Thousand acres - - - - - - - - - -					
0-24	--	--	--	--	--	--
25-49	222	--	--	--	--	222
50-74	8	--	--	--	--	8
75-100	44	--	--	--	--	44
Total	274	--	--	--	--	274

-- = none found.

1/ Includes 8,000 acres classified as timberland and 266,000 acres classified as woodland.

Table 55-Area of unreserved blue oak type outside National Forests by hardwood and conifer basal area classes, California, January 1, 1985 [1/]

Hardwood basal area per acre	Conifer basal area per acre (square feet)					
	0-24	25-49	50-74	75-100	100+	Total
Square feet	- - - - - - - - - - Thousand acres - - - - - - - - - -					
0-24	1,034	135	--	--	--	1,169
25-49	666	34	--	--	--	700
50-74	471	9	--	--	--	480
75-100	--	--	--	--	--	--
100+	93	--	--	--	--	93
Total	2,264	178	--	--	--	2,442

-- = none found.

1/ Includes 457,000 acres of Digger pine stands in which blue oak is present.

Table 56-Area of unreserved tanoak type outside National Forests by hardwood and conifer basal area classes, California, January 1, 1985

Hardwood basal area per acre	Conifer basal area per acre (square feet)							
	0-24	25-49	50-74	75-99	100-124	125-149	150-199	All classes
Square feet	- - - - - - - - - - - - - - Thousand acres - - - - - - - - - - - - - -							
0-24	39	--	8	--	8	--	--	55
25-49	63	16	--	--	--	--	--	79
50-74	46	8	16	--	--	--	--	70
75-99	63	24	62	8	--	--	--	157
100-124	93	24	--	16	8	--	--	141
125-149	46	24	16	8	8	--	--	102
150-199	78	24	8	8	8	8	--	134
200+	16	24	--	--	--	--	8	48
Total	444	144	110	40	32	8	8	786

-- = none found.

Table 57-Area of unreserved Pacific madrone type outside National Forests by hardwood and conifer basal area classes, California, January 1, 1985 [1/]

Hardwood basal area per acre	Conifer basal area per acre (square feet)					
	0-24	25-49	50-74	75-100	100+	Total
Square feet	- - - - - - - - - - Thousand acres - - - - - - - - - -					
0-24	8	--	--	--	--	8
25-49	15	8	--	--	--	23
50-74	8	15	--	--	--	23
75-99	49	--	8	--	--	57
100-124	49	--	15	--	--	64
125-149	115	--	8	--	15	138
150-199	8	--	7	--	8	23
200+	8	--	--	--	--	8
Total	260	23	38	--	23	344

-- = none found.

1/ Includes 146,000 acres classified as timberland and 198,000 acres classified as woodland.

Table 58-Area of unreserved California-laurel type outside National Forests by hardwood and conifer basal area classes, California, January 1, 1985 [1/]

Hardwood basal area per acre	Conifer basal area per acre (square feet)					
	0-24	25-49	50-74	75-100	100+	Total
Square feet	- - - - - - - - - - Thousand acres - - - - - - - - - -					
0-24	--	--	--	--	--	--
25-49	47	--	--	--	--	47
50-74	28	--	--	--	--	28
75-99	15	--	--	--	--	15
100-124	14	--	--	--	--	14
125-149	--	--	--	--	--	--
150-200	53	--	7	--	--	60
Total	157	--	7	--	--	164

-- = none found.

1/ Includes 71,000 acres classified as timberland and 93,000 acres classified as woodland.

Table 59-Number of volume plots, maximum and mean hardwood stand volume, and standard error of the mean for 13 hardwood forest types outside National Forests, California, 1985 [1/]

Forest type	Volume plots	Stand volume of hardwood growing stock		Standard error of the mean 2/
		Maximum	Mean	
	Number	- - - - - Cubic feet per acre - - - -		
Coast live oak	19	4,038	1,300	±276
Canyon live oak	49	4,128	1,503	±157
Interior live oak	27	3,779	612	±162
California black oak	66	4,000	1,213	±111
Oregon white oak	20	4,498	1,099	±250
Valley oak	7	2,180	994	±256
Blue oak	72	1,767	381	±42
Tanoak	101	6,900	1,679	±134
Pacific madrone	20	4,519	1,705	±1,140
California-laurel	12	3,125	1,677	±273
Alder	5	2,165	1,269	±422
Bigleaf maple	4	1,070	529	±223
California buckeye	6	481	222	±100

1/ Volume for a plot is the per-acre volume in all hardwood species averaged over all subplots (most plots had 5 subplots; some had 3).

2/ 68-percent probability level.

Table 60-Estimated areas of hardwood types outside National Forests and their confidence intervals, by resource area and land class, California, January 1, 1985

Resource area and land class	Total area in hardwood types	Confidence interval (68-percent probability)	Percent
	- - - - - Thousand acres - - - -		
North coast:			
Timberland	1,290	±79	6.1
Woodland	505	±45	8.9
Central coast:			
Timberland	94	±25	26.6
Woodland	1,391	±54	3.9
Northern interior:			
Timberland	322	±49	15.2
Woodland	461	±40	8.7
Sacramento:			
Timberland	257	±42	16.3
Woodland	1,434	±52	3.6
San Joaquin and southern California:			
Timberland	77	±22	28.6
Woodland	1,984	±65	3.3
All resource areas:			
Timberland	2,040	±109	5.3
Woodland	5,775	±116	2.0

Table 61-Estimated volumes of hardwood growing stock in hardwood types outside National Forests and their confidence intervals, by resource area and land class, California, January 1, 1985

Resource area and land class	Total volume in hardwood types	Confidence interval (68-percent probability)	Percent
	- - - - Million cubic feet - - -		
North coast:			
Timberland	3,074	171	5.6
Woodland	720	±178	24.7
Central coast:			
Timberland	546	±84	15.4
Woodland	1,514	±327	21.6
Northern interior:			
Timberland	686	±75	10.9
Woodland	145	±11	7.6
Sacramento:			
Timberland	684	±80	11.7
Woodland	637	±119	18.7
San Joaquin and southern California:			
Timberland	301	±55	18.2
Woodland	942	±139	14.8
All resource areas			
Timberland	5,291	±227	4.3
Woodland	4,018	±419	10.4

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The results of a statewide inventory of California's hardwood resources are presented. This is the first comprehensive inventory with tree and stand measurements ever conducted in the extensive oak woodlands. In timberland areas where hardwoods had been previously inventoried, improved procedures and volume equations developed specifically for the major California hardwood species were used in the new inventory. Included are details on area and volume of hardwoods by ownership; growth and mortality of hardwoods on timberland; hardwood tree cutting on timberland and woodland; the extent of types and species occurrence; stand characteristics; regeneration; extent of grazing in woodland areas; and changes in hardwood area from 1945 to 1985.

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