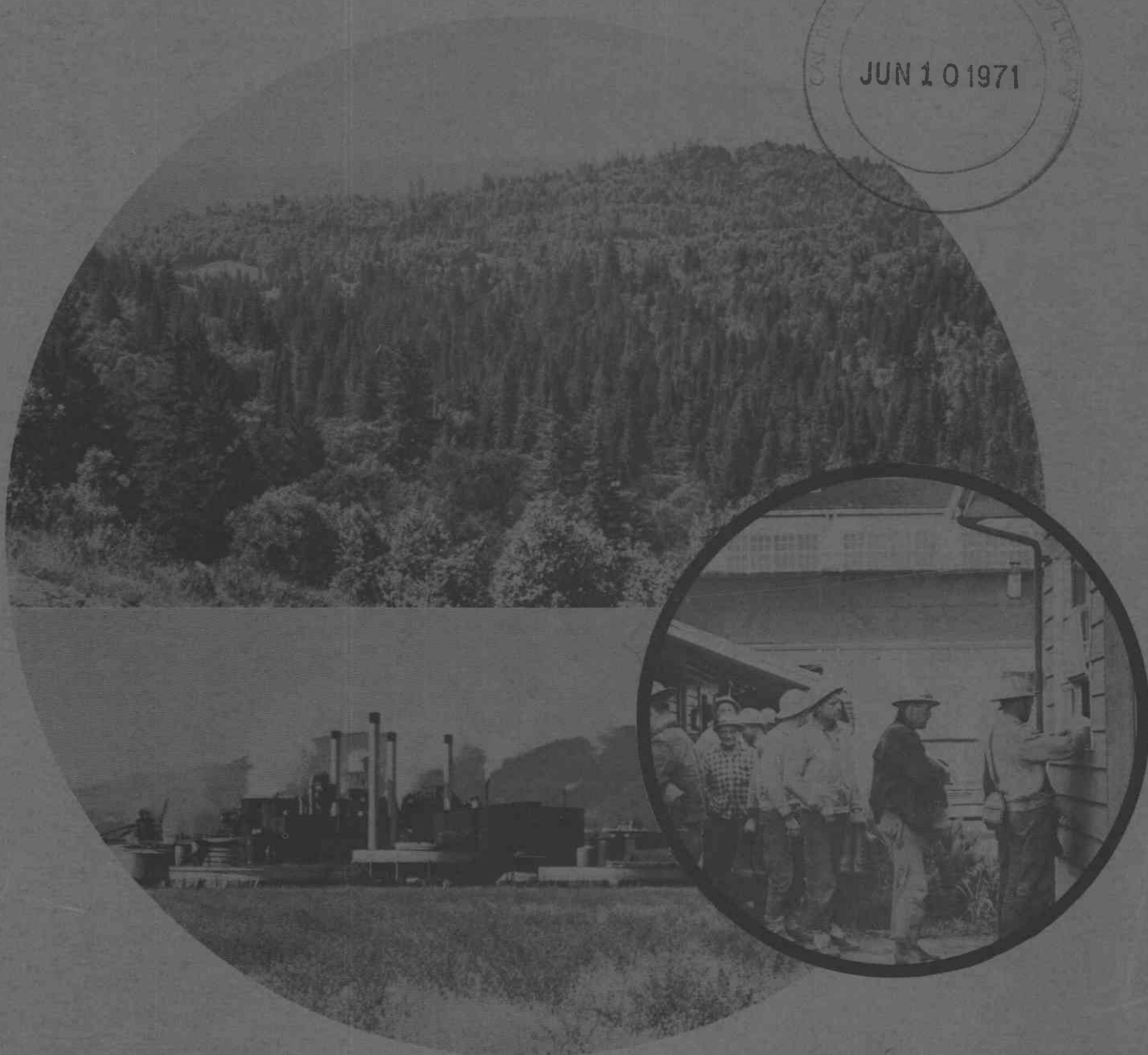


California's Forest Industries -- Prospects for the Future

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Foreword

This report has been prepared in recognition of the need for a current evaluation of the long-term prospects for forest industrial development in California. Emphasis is on the relationship between California's changing timber resources and its forest industrial development and employment.

This report is based upon a recently completed base-line study of the prospects for the timber economy of the California Water Resource Region made by the Pacific Northwest Forest and Range Experiment Station for the California Region of the U. S. Forest Service.¹ The original study was undertaken for the use and consideration of the Economic Subcommittee of the California Region Framework Study Committee. The results of that study will be included in the economics appendix of the California Water Resources Region Comprehensive Framework Study. The report presented here differs from the earlier study primarily because of a redefinition of the study area to exclude Klamath County, Oreg.

¹ Oswald, Daniel D. *Present and prospective development of the timber resources and forest industries in the California Water Resource Region.* (Unpublished Pacific Northwest Forest and Range Exp. Sta. USDA Forest Serv. Admin. Rep.) 1969. 66 pp., illus.

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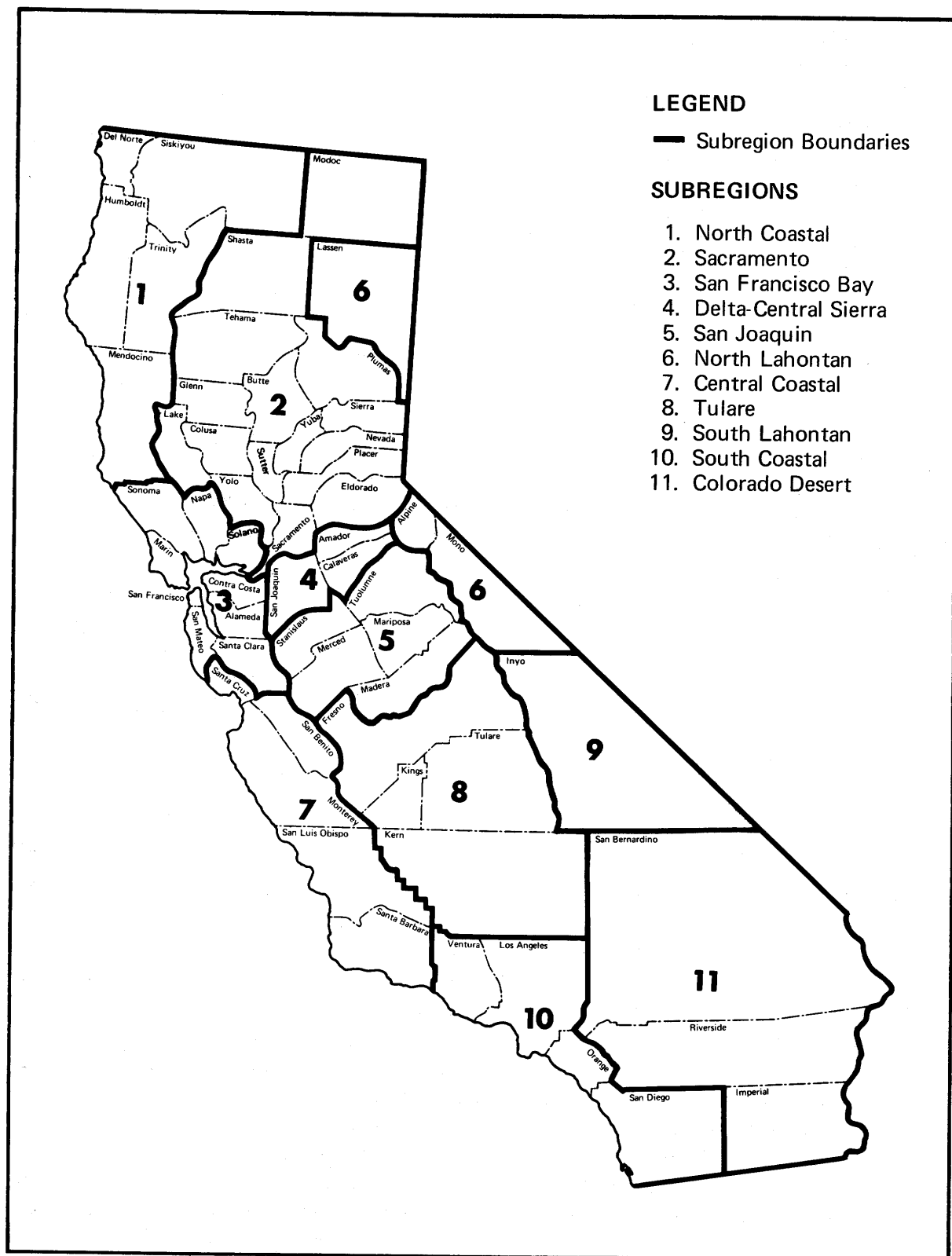


Figure 1. — California economic subregions.

Introduction

California's timberlands and forest products industries have played an important part in the growth of California's economy. Discovery of gold at the site of the first waterpowered sawmill in interior California triggered the gold rush of 1848, an event that led the California Territory into booming growth and statehood. Following that discovery, the lumber industry grew in inland California to meet demand for timbers and lumber in the mines and communities of the Mother Lode in California and the Comstock Lode in Nevada. On the coast, the lumber industry developed in response to needs for lumber in construction of San Francisco, other coastal communities, and the river communities of interior California. Both the coastal and inland areas had vast timber reserves readily available for conversion to lumber.

Historically, many communities in the State located at the sites of the early sawmills. The growth of those communities was determined by the success of the mills and the demand for lumber. Today, the State's economy is a diversified one in which forest products manufacture accounts for less than 5 percent of the value added in manufacture. But the forest products industries are still the major factor in many local and some regional economies within the State. For such areas, demand for forest products, as well as supply of raw material, dictates the health of the economy.

This study was undertaken to determine the probable future economic contribution of the forest resource and forest industries in California. The measure of economic contribution emphasized in the study is employment in the

two major wood-using standard industrial classifications, lumber and wood products, and paper and allied products.

For purposes of analysis, California's 100-million-acre area has been divided into 11 water resource related subregions defined by county boundaries (fig. 1). These subregions are defined by the county boundaries most closely approximating the hydrological units used in planning by the State of California Department of Water Resources (California Department of Water Resources 1967).

The first part of this report contains a brief discussion of man's impact to date on California's forest resource and describes the resource as it exists today. The timber resource information contained in this report is based on an updating of the 1963 California Forest Survey timber inventory, which was reported in USDA Forest Service Resource Bulletin PSW-4 (Oswald and Hornibrook 1966).

The second part of this report is a discussion of recent and current activities in the forest industries. Trends in timber harvest are discussed, and recent development of the several forest industries is traced. This section also includes a geographic profile of the current forest industries and defines their contribution to the economies of the subregions shown in figure 1.

Future timber supplies are discussed in the third section of the report. This section also presents the underlying assumptions concerning local and national demand for wood products, the future availability of land for timber production, intensity of forest management,

and trends in harvest and utilization. Estimates of future growth and inventories are also presented.

Projections of forest industrial development are based on an allocation of the projected timber harvest to the major forest industrial sectors. Projected development in these sectors is expressed in terms of raw material consumption and forest industrial employment. The implications of the prospective forest industrial development and employment are discussed in this and the concluding section of the report.

The base year for the projections developed in this study is 1965. Output years for projected resource supply and related economic activities are 1980, 2000, and 2020. The "plan period" referred to in the study is the 55-year projection period, from base year 1965 to final output year 2020.

Detailed tables of the resource, present and projected production and employment, and forest industry development are presented in Appendix A. Definition of terms used in the text are in Appendix B.

The projections in this report should not be considered as predictions of what will be the situation in the output years. Rather, they represent estimates of levels of activity expected for those years within the framework of the assumptions made. The projections contained herein are base-line projections. As such, they represent expectations for wood supply and related economic activity assuming ongoing trends. If projections are to serve their main function, they will result in plans of action that will alter some of the inputs, invalidate some of the original assumptions, and result in different levels of activity than originally projected.

The forest resource -- its historical use and current status

California's rich forest resource was scarcely affected by man until little over a century ago. The native inhabitants had little impact on the forests of this region. Their consumption of wood was negligible, probably confined to the use of forest litter for fuel. Their major impact — its extent unknown — was in the use of fire to clear forested areas. The establishment of mission settlements, small agricultural communities, and the Spanish land grant ranches that accompanied Spain's claim to the region probably marked the first consumptive use of the forest resource. Limited amounts of wood were used for building, in addition to its use as fuel. However, impacts on the forest resource were minimal and very localized.

Significant exploitation of the forest resource and development of forest industry began with the discovery of gold in California in 1848. Early logging and milling activities were confined to the more easily accessible areas along the coast and areas close to the mining centers in the central Sierra Nevada. The species used in the early days of logging activity were primarily redwood for construction in the cities around San Francisco and pines in the mining regions of California and Nevada.

Following the initial period of mining activity, population increases and resultant growth of coastal and interior cities resulted in more or less continuous growth in harvesting activities through the remainder of the 19th century and the first two decades of this century. The primary end product, lumber, was used in local markets; exports in the late 1800's played only

a small part in the growth of the industry. In the early 1920's, harvesting activities and lumber production experienced sharp increases to new highs, which lasted through 1929.

Following the early depression years during which timber harvest and lumber production dropped to one-third of the 1929 total, the annual harvest and lumber production resumed an upward trend. By 1940, the harvest level had reached the 1929 level. Timber harvest stabilized during the war years. Following the war, harvest levels in California resumed the prewar upward trend, carrying lumber production to all time highs in the mid-1950's and providing the raw material for tremendous growth in an essentially new industry for California, the softwood plywood industry. Timber harvest levels in the 1960's declined moderately from the mid-1950's peak, with accompanying declines in lumber and plywood production. It is estimated that California's forests have yielded over 200 billion board feet of timber products over the last 120 years.

The long history and localized nature of lumbering and timber harvest in California and the changes in species used have resulted in a forest resource of rather complex structure. Large areas of mature, young-growth timber are concentrated in the North Coastal and Central Sierra subregions of the State, primarily on private land. But much of the State is still stocked with old-growth sawtimber stands, mostly on National Forest lands. Large areas of commercial forest land that were formerly stocked with conifers are now poorly stocked or are stocked with hardwoods of little or no

commercial value. This condition occurs primarily on private lands in the North Coastal subregion. Much of the area in this condition has resulted from unsuccessful attempts at conversion to grazing following removal of the original conifer stands. In many areas of the State, selective logging of valuable commercial

species from mixed stands has created multi-story stands and stands with species composition that is different from that of the original stand.

In the wake of the gold rush, the population influx into the State and resultant cultural development had considerable impact on the

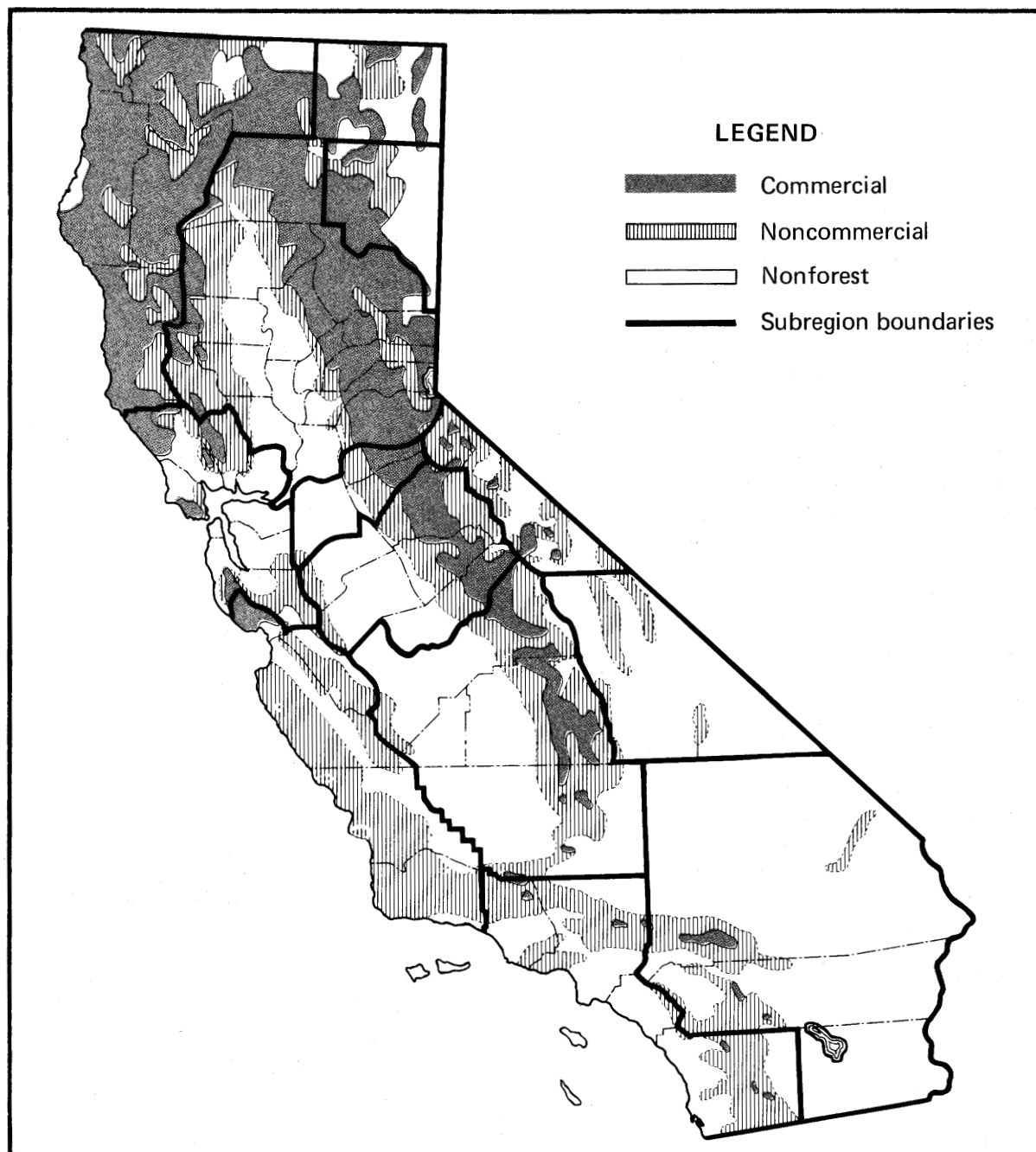


Figure 2. — Forest areas of California.

availability of forest lands for the production of wood products. Historically, the major impact was the conversion of timberlands for farming and grazing, activities that have accompanied the settlement of most regions in the United States. With continued population growth, the needs and demands of a huge population centered in large urban complexes have now reached the most remote areas in the State. These demands — for water, power, roads, and mountain recreation — have all taken timberlands out of timber production. Although the extent of California's original forests is unknown, study of available information regarding the forest resource and its use leads to the conclusion that a very substantial majority of the original forest-land area in California remains forested.

Forests Occupy 42 Percent of State's Land Area

Today, over 42 million acres of California's 100-million-acre land area are forested. The forested areas extend through the length and width of the State and are generally absent only in the Central Valley and the desert region of southeastern California (fig. 2).

Commercial forest lands² available for the production of timber total over 17 million acres, 17 percent of the State's land area. The commercial forests extend throughout the Coast Ranges from Monterey Bay northward to the Oregon border; they extend across the southern reaches of the Cascade Range in the northern part of the State; and they blanket much of the Sierra Nevada through its entire length. Only scattered patches of commercial forest land occur in the mountains of southern California (fig. 2).

Commercial Forest Area Concentrated in Two Northern Subregions

The North Coastal and Sacramento subregions combined account for 77 percent of the available commercial forest area in California — 7.2 million acres in the North Coastal subregion, and 6.2 million acres in the Sacramento subregion. The remaining 4 million acres are scattered over the other nine subregions (table 1).

²Definitions of terms used in this report are given in Appendix B.

Table 1. — Area of land by subregion and forest-land classes, California, 1965
(In thousand acres)

Subregion	Total land area ¹	Total forest-land area	Forest land		
			Commercial	Unproductive	Productive reserved
All subregions	100,207	42,416	17,345	23,816	1,255
North Coastal	11,255	9,683	7,156	2,122	405
Sacramento	17,383	11,374	6,249	4,975	150
San Francisco Bay	4,450	1,772	418	1,316	38
Delta-Central Sierra	1,939	919	382	536	1
San Joaquin	5,988	2,866	916	1,679	271
North Lahontan	5,311	2,334	1,055	1,250	29
Central Coastal	7,175	3,528	152	3,361	15
Tulare	13,023	4,393	771	3,282	340
South Lahontan	6,462	666	7	659	--
South Coastal	7,006	3,146	103	3,040	3
Colorado Desert	20,215	1,735	136	1,596	3

¹Source: 1964 Census of Agriculture, U. S. Bureau of the Census.

The North Coastal subregion consists of five northwestern California counties. It is a sparsely populated mountainous area that is 86 percent forested — two-thirds, by commercial forests. This subregion contains most of California's redwood and Douglas-fir forests as well as considerable areas of true firs, pine, and mixed stands of conifers. It is the most important wood-producing area in California.

The Sacramento subregion is comprised of 16 northern California counties. Two-thirds of the area is forested, about half of which is occupied by commercial forests located in the mountainous areas to the east, north, and west of the extensive farmlands of the Sacramento Valley. The commercial forests of this subregion consist mainly of pine and mixed stands of pine, Douglas-fir, and true firs. This area is the second most important wood-producing area in the State. It is the center of the California pine industry and of a secondary manufacturing industry based upon the pine resource.

Of the remaining subregions, San Francisco Bay, Delta-Central Sierra, San Joaquin, North

Lahontan, and Tulare have locally important but relatively small commercial forest acreages. Pine and mixed conifer forests prevail in all but the San Francisco Bay subregion, which has redwood and Douglas-fir forests. The stands of commercial species in the Central Coastal, South Lahontan, South Coastal, and Colorado Desert subregions are small and scattered and have little importance for timber production.

Commercial Forest Ownership Almost Evenly Divided Between Public and Private Owners

Public ownership accounts for 9.3 million acres or 53 percent of the State's commercial forest acreage.³ The National Forests, with 8.7 million acres, account for most of the public commercial forest land. Private ownerships account for 8.1 million acres, 47 percent of the total. In the North Coastal subregion, 51 percent of the commercial forest acreage is in private ownerships, and National Forests account

³ The resource inventory data contained in this section are for 1965, the base date for the study.

Table 2. — Area of commercial forest land by subregion and ownership class, California, 1965

(In thousand acres)

Subregion	Total	National Forest	Other public	Private
All subregions	17,345	8,710	543	8,092
North Coastal	7,156	3,186	316	3,654
Sacramento	6,249	3,265	153	2,831
San Francisco Bay	418	---	10	408
Delta-Central Sierra	382	98	22	262
San Joaquin	916	637	7	272
North Lahontan	1,055	612	28	415
Central Coastal	152	15	5	132
Tulare	771	690	1	80
South Lahontan	7	5	---	2
South Coastal	103	84	1	18
Colorado Desert	136	118	---	18

Source: USDA Forest Service.

for 45 percent; other public, the remaining 4 percent. In the Sacramento subregion, National Forests contain 52 percent of the commercial forest area; private ownership, 45 percent; and other public, 3 percent. None of the other subregions display the balanced forest ownership pattern evidenced in these two main timber resource subregions. The San Francisco Bay subregion's commercial forest lands are privately owned, but in the remaining subregions, National Forest ownership dominates. In none of the subregions is the "other public" ownership category of major importance relative to the other ownerships (table 2).

Three-Fourths of Commercial Forest Area Contains Sawtimber Stands — Old Growth Still Prevails

Of 12.8 million acres of sawtimber stands on California's commercial forest area, 8.7 million acres are classed as old growth (Oswald and Hornibrook 1966). Two-thirds of the old-growth acreage is on National Forest lands,

which have a relatively short cutting history. These old-growth stands occur throughout most of the State. Some have been cut on a selective basis that has little changed the age of the stands. Young sawtimber stands are found throughout the State also but are primarily in the redwood type areas of the North Coastal subregion and in pine and mixed conifer forests of the Sacramento and Delta-Central Sierra subregions. Almost two-thirds of the area of young sawtimber stands is in private ownership.

Most of Sawtimber Inventory Is in Two Northern Subregions

Seventy-seven percent of California's sawtimber inventory of 299 billion board feet is concentrated in two subregions; the North Coastal subregion has 132 billion board feet and the Sacramento subregion has 98.5 billion board feet. The San Joaquin, Tulare, and North Lahontan subregions contain 21.3, 19.8, and 11.1 billion board feet, respectively, of the State's sawtimber. The other subregions contain lesser amounts (table 3).

Table 3. — Volume of sawtimber on commercial forest land by subregion and owner group, California, 1965 (International 1/4-inch scale)

(In million board feet)

Subregion	All owners	National Forest	Other public	Private
All subregions	299,064	159,328	7,681	132,055
North Coastal	132,089	54,918	5,487	71,684
Sacramento	98,523	57,689	1,104	39,730
San Francisco Bay	5,565	---	188	5,377
Delta-Central Sierra	6,435	3,097	172	3,166
San Joaquin	21,311	16,139	97	5,075
North Lahontan	11,094	7,749	180	3,165
Central Coastal	1,468	183	15	1,270
Tulare	19,784	17,293	437	2,054
South Lahontan	82	56	---	26
South Coastal	1,517	1,262	1	254
Colorado Desert	1,196	942	---	254

Over Half of Sawtimber Volume Is in Public Ownerships

Fifty-six percent of the State's sawtimber volume is held in public ownerships. National Forests contain 159 billion board feet or 53 percent of the State's total. Of the 132 billion board feet of privately owned timber, about 37 percent is owned by forest industry, and 63 percent is owned by farmers and other miscellaneous private owners.

The percentage of total sawtimber in public ownership varies from subregion to subregion. In the North Coastal subregion, 46 percent of the sawtimber volume is publicly owned, and in the Sacramento subregion, 60 percent. In the

North Lahontan, San Joaquin, and Tulare subregions, publicly owned sawtimber accounts for 71, 76, and 90 percent, respectively (table 3).

Douglas-fir Is Most Abundant Species

No single species accounts for a majority of the sawtimber volume. Douglas-fir is most abundant, accounting for about 30 percent of the total, followed by the true firs with 27 percent, ponderosa pine with 19 percent, and redwood with 9 percent. Hardwoods account for only 2 percent of the State's sawtimber volume.

Recent trends and current activity in the forest products industries

The forest products industries in California — as they exist today — reflect the substantial changes that have occurred since World War II. During the postwar period, the forest products industries developed significant product diversity for the first time by addition of woodpulp, board, and plywood manufacture to the historically dominant lumber industry. Timber harvest and forest products output have been higher in every year of the postwar era than at any previous time.

Log Production

The post-World War II trend in California log production has been shaped to a large degree by the changing availability of Douglas-fir in the North Coastal subregion. The early years of log production were dominated by the pines from the interior mining regions. Between 1880 and 1920, redwood was the leading species harvested. From 1920 until 1950, ponderosa pine again led all other species in amount harvested. At that time, Douglas-fir became the most important timber species, a position it has not relinquished to date.

In 1946, Douglas-fir accounted for only 19 percent of California's log production. Its share of State log production increased to 36 percent in 1952, and 44 percent in 1956. By 1962 the Douglas-fir share had decreased to 38 percent; and in 1968, only 32 percent of California's log production was Douglas-fir.

Before Douglas-fir became a leading species, the Sacramento subregion was the main contributor to the State's log production. In 1946, it accounted for 45 percent of California's 3 bil-

lion-board-foot cut; the North Coastal subregion supplied 28 percent; and the other subregions combined supplied 27 percent. In 1948, the North Coastal subregion surpassed the Sacramento subregion in log production (fig. 3). The emergence of the North Coastal subregion as the predominant log supply region came at a time when production trends in the remainder of the State were stable. By 1955, the peak year for California's log production, the North Coastal subregion accounted for 55 percent of the State's 6 billion-board-foot log production. During the period 1946-55, the North Coastal subregion's log production quadrupled; that of the Sacramento subregion showed an increase of 22 percent; and the other subregions combined had an increase of 29 percent.

Although Douglas-fir in the North Coastal subregion was the main contributor to increased log production in the 10 years after the war, redwood log production also increased in this subregion, reaching new highs annually from 1950 through 1956. Zivnuska et al. (1965) recognized the reason for the tremendous postwar growth in log production in the North Coastal area. In the late 1940's, Douglas-fir forests of California's North Coastal subregion and southwestern Oregon represented the "last frontier" in terms of large tracts of privately owned old-growth timber in the United States. This available supply of raw material, coupled with the demand generated by the postwar housing boom in nearby southern and central California, triggered the rapid expansion of log production and forest pro-

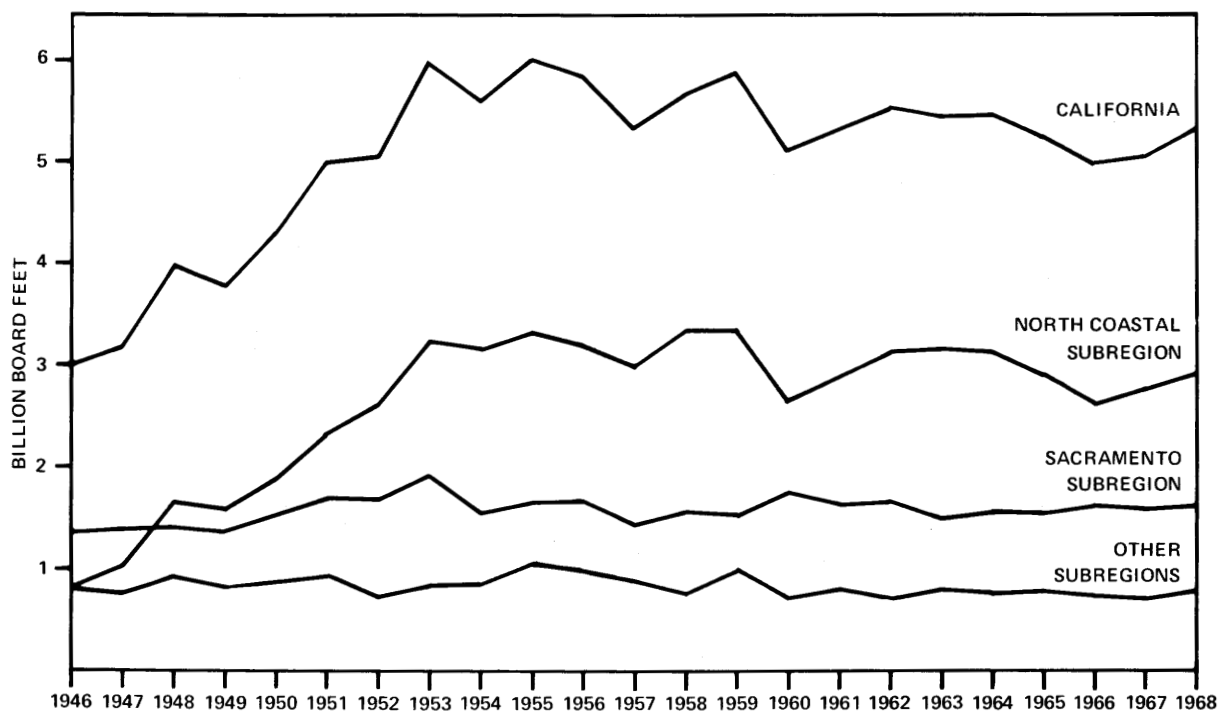


Figure 3. — Log production in California and selected subregions 1946-68. (Source: California Division of Forestry and USDA Forest Service.)

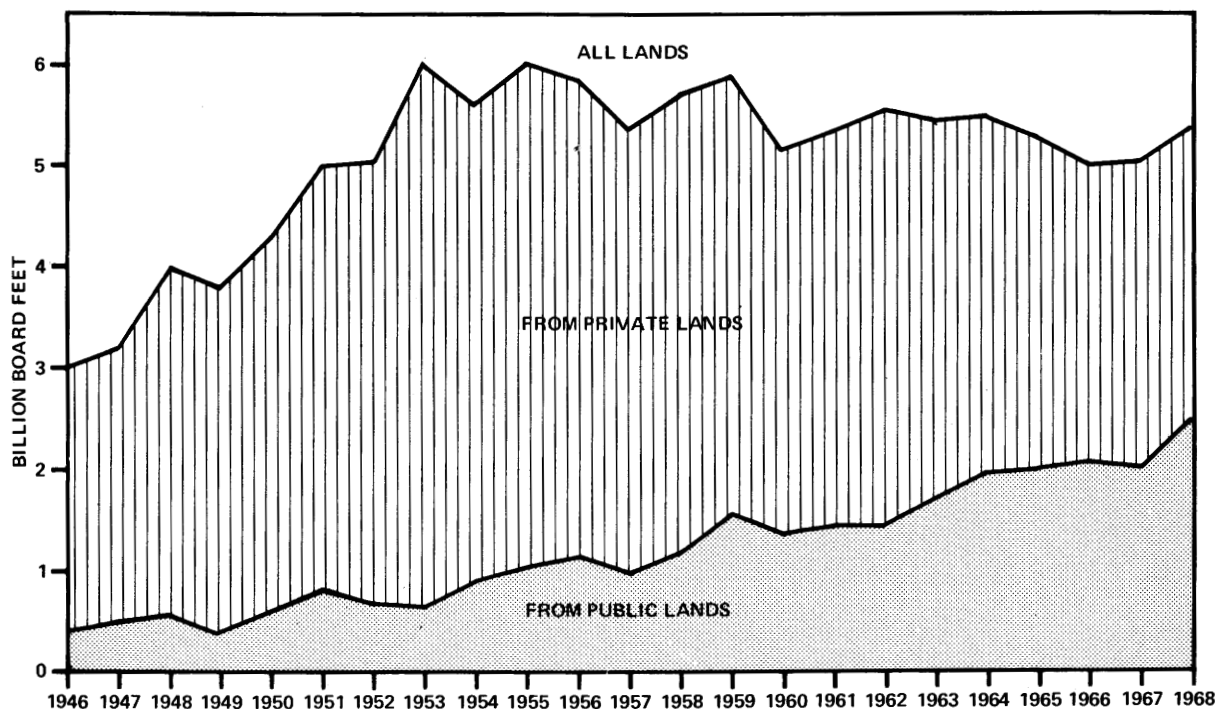


Figure 4. — Log production in California by owner, 1946-68. (Source: California Division of Forestry and USDA Forest Service.)

ducts manufacture in the North Coastal subregion.

Since the mid-1950's, the trend in California log production has been downward. Log production in the base year 1965 and in 1968 was about 5.3 billion board feet, a decrease of 11 percent from the 1955 level. In both 1965 and 1968, the North Coastal subregion accounted for 55 percent of the State's log production, compared with 30 percent for the Sacramento subregion and 15 percent for the other subregions combined.

Log production in the Sacramento subregion has changed little since the mid-1950's. In the North Coastal subregion, log production has fallen 12 percent from the high levels of the mid and late 1950's because of a decrease in the production of Douglas-fir. The privately held old-growth reserves of Douglas-fir, primarily on farmer and miscellaneous private holdings in the North Coastal subregion, have been rapidly depleted.

Log production in the other subregions combined dropped 24 percent from 1955 to 1968 — contributing substantially to the statewide decline in log production that has occurred since the 1950's. Within this group of smaller subregions, only the Tulare and San Joaquin have shown an upward trend in log production in recent years. The Delta-Central Sierra, North Lahontan, and San Francisco Bay subregions experienced 25-, 61-, and 68-percent declines in log production from 1955 through 1968.

The moderate decline in California's log production in recent years tends to mask the decreasing availability of private timber. During the period 1955-68, total log production in the State decreased 11 percent but log production on private lands decreased 43 percent. During the same period, log production from public lands — primarily National Forests — increased 240 percent, making up for most of the decline in private log production (fig. 4).

The recent subregional trends in log production reflect subregional timberland ownership patterns. In the North Coastal and Sacramento subregions, public and private ownerships are in approximate balance, and increases of allowable cuts in publicly held old-growth timber have offset substantially the declines in private timber harvest. Forest-land ownership in the

Delta-Central Sierra and San Francisco Bay subregions is predominantly private; hence, public holdings are not available to offset the log production declines that have come with depletion of privately held old-growth timber. The Tulare and San Joaquin subregions have predominantly public forests. Increased allowable cuts on these lands have more than offset declining private harvests in recent years.

The North Lahontan subregion has experienced declining log production, even though it has more public than private timberland. However, unlike most of the other subregions, this subregion's public forests have experienced an active continuous public sales program dating back to about 1920. Thus, no large reserve of public old-growth timber was available to offset declining private timber harvests in the last 20 years.

The Lumber Industry

The lumber industry has historically been the major component of the forest industries in California. Only since World War II has there been significant development of other primary wood using industries. In 1965, the State's lumber industry produced 5 billion board feet of lumber, 14 percent of the national total. Virtually all of the lumber produced was softwoods — 17 percent of the Nation's softwood production for that year. California's lumber industry has utilized over 85 percent of the annual roundwood harvest in recent years.

The postwar period has been the most active period in California lumber industry history. Lumber production, which had reached new highs of about 2.3 billion board feet during the war years, increased to almost 4 billion board feet in 1948. The industry's growth during this period occurred in both of the State's lumbering regions.⁴

⁴The California redwood lumber region has been defined by the Bureau of the Census to consist of the following counties: Del Norte, Humboldt, Mendocino, Sonoma, Marin, San Francisco, Contra Costa, Alameda, San Mateo, Santa Clara, Santa Cruz, and Monterey. The region approximates this study's North Coastal, San Francisco Bay, and Central Coastal subregions combined. The pine lumber region embraces the remainder of the State, and approximates the remainder of this study's subregions. Lumber industry trends in each of the two lumber regions adequately reflect trends that have occurred in the grouped subregions.

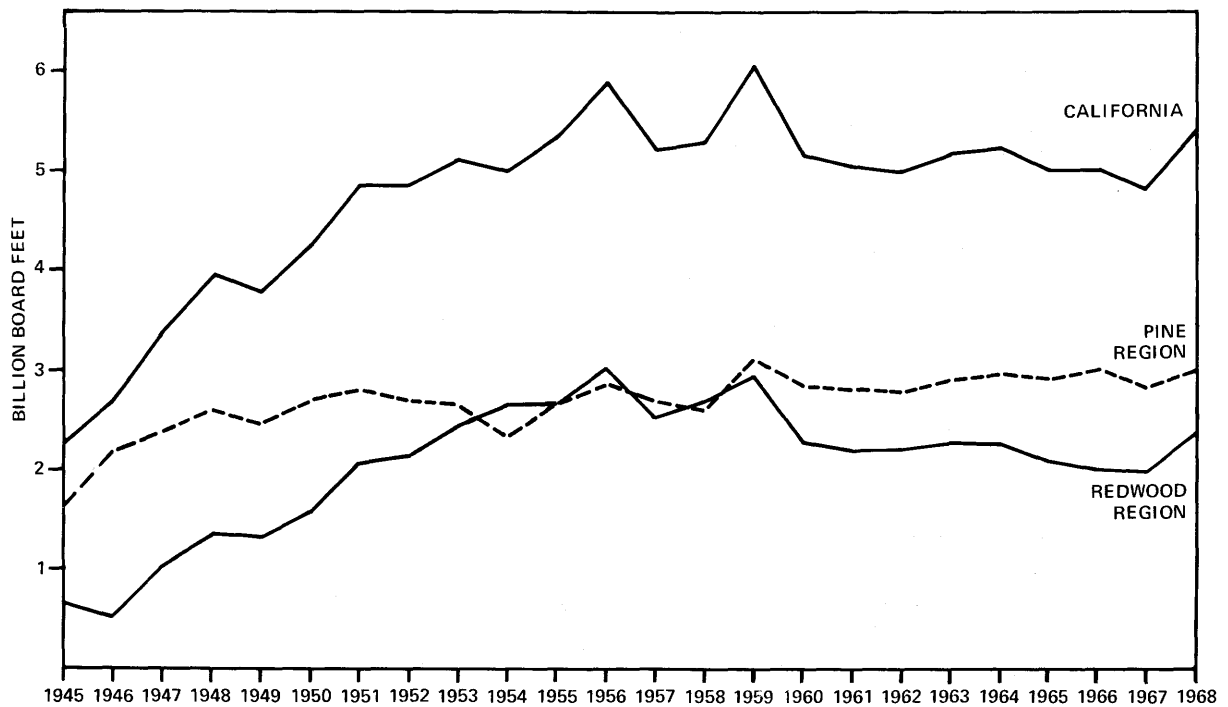


Figure 5. — Lumber production in California by lumber region, 1945-68. (Source: U. S. Bureau of the Census.)

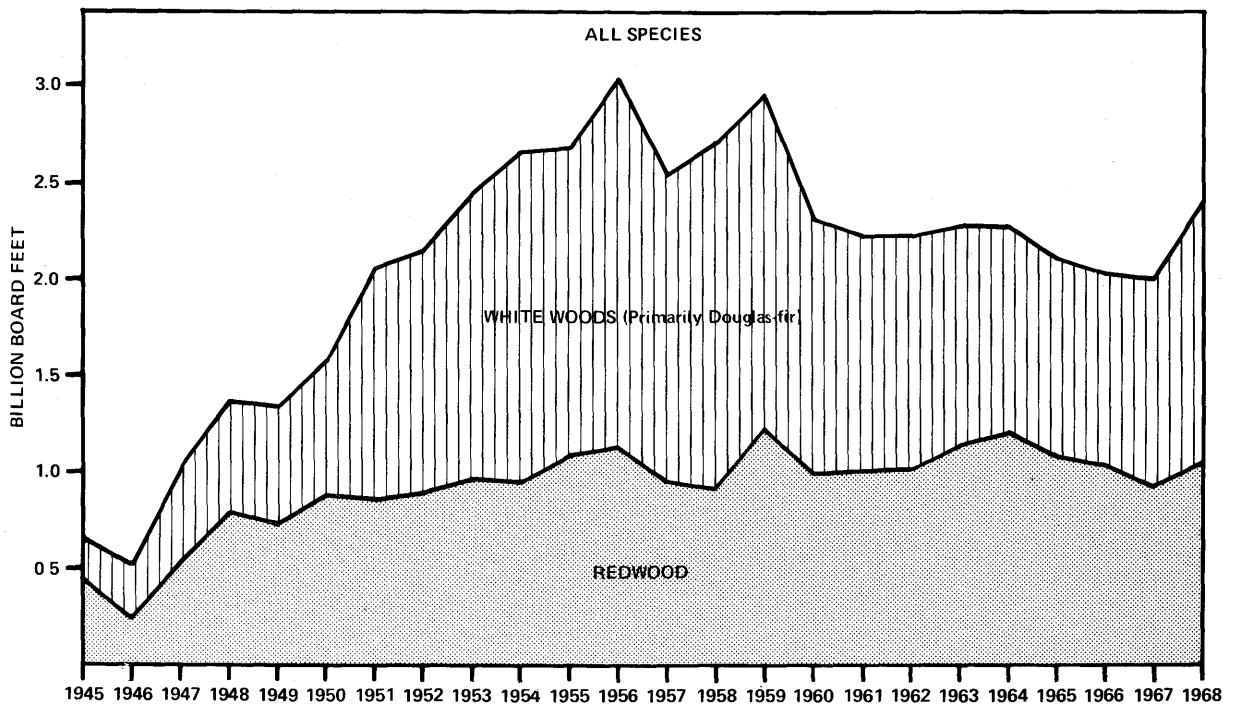


Figure 6. — Lumber production in the California redwood lumber region by species groups, 1945-68. (Source: U. S. Bureau of the Census.)

Lumber production continued to climb in the early 1950's and in 1956 peaked at 5.9 billion board feet. The increase in lumber production during this period was concentrated in the redwood lumber region and was primarily due to the growth of the Douglas-fir lumber industry (figs. 5 and 6).

After a decline in 1957-58 caused by a general economic slowdown, California lumber production reached an all-time high of 6 billion board feet in 1959. From 1953 through 1959, the two lumber regions were equal contributors to the State's total production. In 1960, statewide production fell sharply to 5.2 billion board feet, and three-fourths of the production decline was concentrated in the redwood lumber region. Since 1960, statewide lumber production has fluctuated little. During this period, a downtrend in the redwood lumber region has been countered by an upward trend in the pine lumber region (fig. 5).

In the redwood lumber region, redwood lumber production trended upward from 1945 to the mid-1960's. But Douglas-fir production peaked in 1956 and has trended downward since then. In 1964, redwood lumber production exceeded that of Douglas-fir in the redwood lumber region for the first time since 1950 (fig. 6). The decline in Douglas-fir lumber production in this region since 1956 — after its meteoric rise during the first half of that decade — probably resulted from two factors.

The plywood industry is centered in the redwood lumber region and competes directly with the lumber industry for raw material, namely Douglas-fir roundwood. From 1947 through 1964, the plywood industry yearly increased its share of the Douglas-fir harvest. By the early 1960's, plywood plants in the redwood lumber region were receiving one-third of a diminishing harvest of Douglas-fir roundwood (Muerle and Hornibrook 1965). But the major factor underlying the declining lumber production is the decreasing availability of Douglas-fir timber.

In the late 1940's and early 1950's, there was a seemingly endless supply of Douglas-fir stumpage in northwestern California. It was the most abundant species in the area and had been generally neglected by the resident redwood industry. Most of the Douglas-fir harvested in the 10 years following World War II came from the

many small ownerships in the farmer and miscellaneous private category that held much of the Douglas-fir resource. Hundreds of sawmills — mostly small in size — entered the industry to process the Douglas-fir. The expansion peaked in the mid-1950's, and by the end of the decade, the available supply of raw material had tightened as Douglas-fir on small private ownerships was cut out.

In the pine lumber region of California, pine lumber production peaked in 1948 and has declined gradually since that time. However, increased production of white fir and Douglas-fir lumber in this region has more than offset the decline in pine production. The result has been an almost continuous uptrend in total lumber production since World War II (fig. 5).

The makeup of the sawmilling industry changed rapidly after World War II. From the 1850's through the 1930's, the mill count fluctuated between 150 and 320 mills, with a trend toward fewer and larger installations. The number increased substantially in the early 1940's and by 1945 stood at about 450. By the following year, there were over 900 sawmills, as hundreds of small mills went into operation after the end of the War. The mill count rose to almost 1,000 by 1948, the high point for number of mills in the State and also for number of small mills (fig. 7).

The small mills were important during a period when sharp increases in demand for lumber called for rapid expansion of productive capacity. By the end of the 1940's, capacity added in medium and large size mills had started to replace the smaller inefficient operations, and the trend toward larger mills was resumed. The number of medium to large mills peaked with lumber production in 1956, but the total mill count dropped below 700. By 1962, there were less than 300 mills in California. Medium to large mills, which accounted for 62 percent of the production in 1948, produced 90 percent of the State's 1962 production. By 1968 the mill count had dropped to 216 sawmills. These mills produced about the same amount of lumber as did 800 mills in 1951, indicating the strong trend toward larger mills in recent years. More detailed information on numbers of sawmills is presented in table 6 of Appendix A.

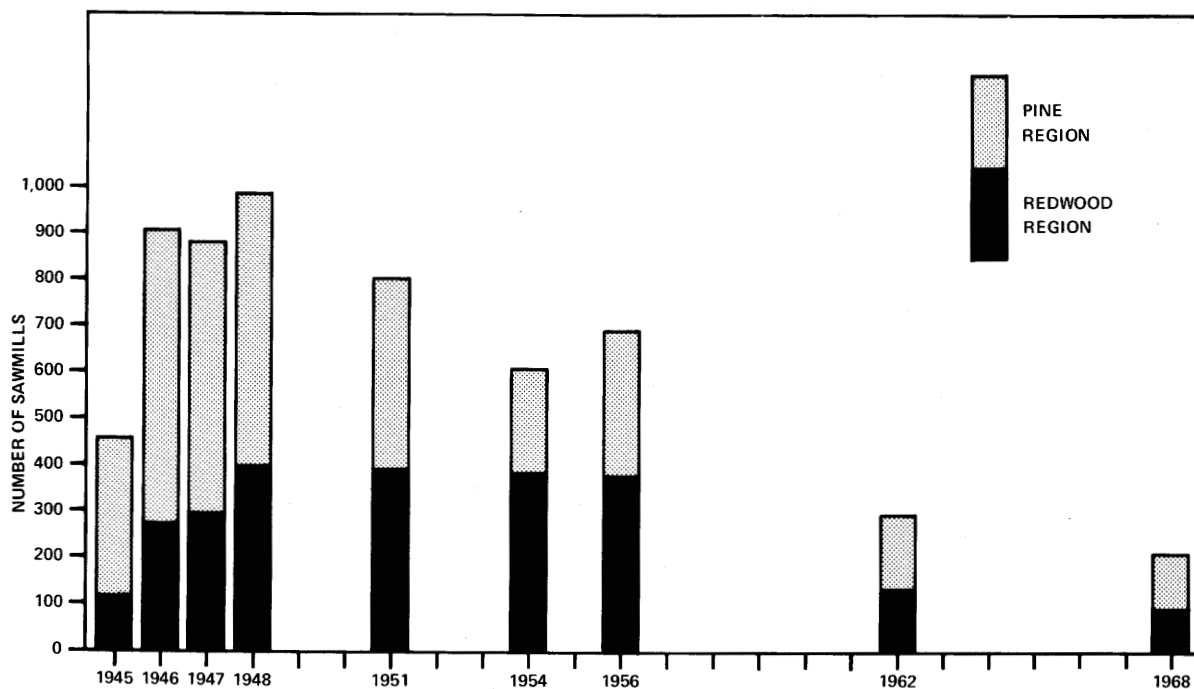


Figure 7. — Number of active sawmills in California by lumber region, 1945-68. (Source: USDA Forest Service.)

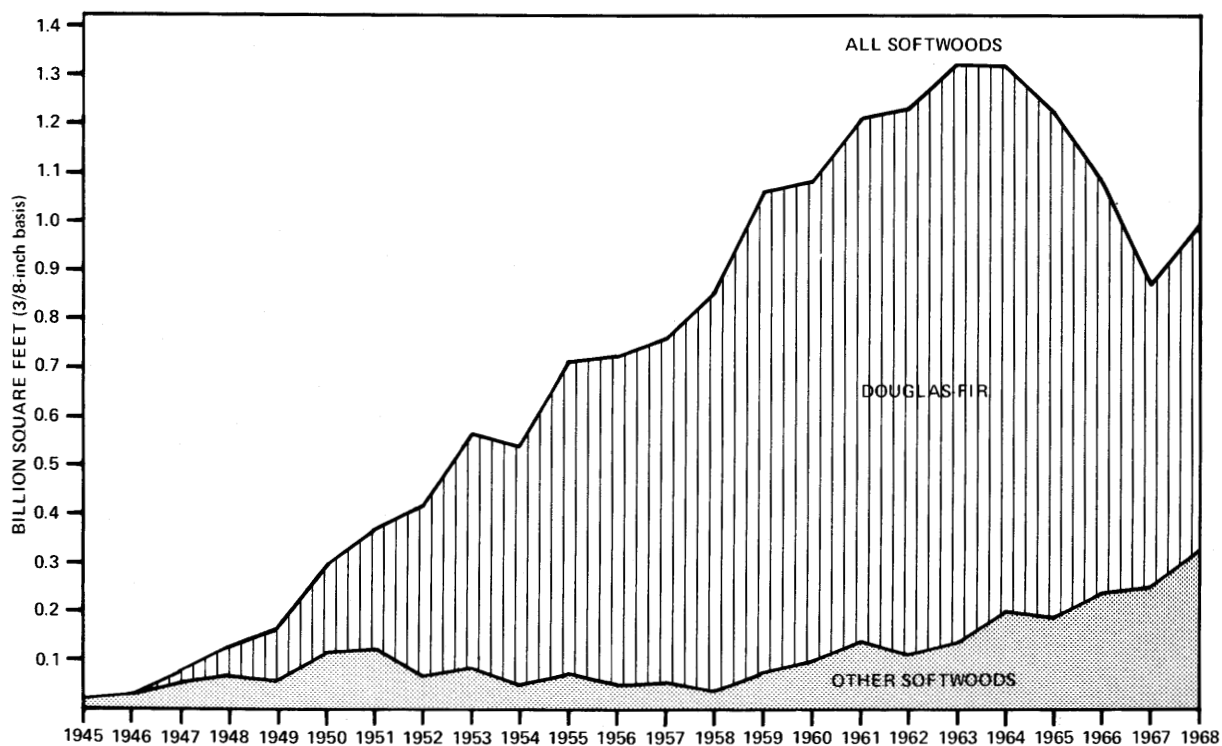


Figure 8. — Softwood plywood production in California by species, 1945-68. (Source: U. S. Bureau of the Census and USDA Forest Service.)

The Plywood Industry

Although the origin of California's plywood industry dates back to the 19th century, the industry was of little importance until Douglas-fir plywood production commenced in the coastal area of northern California in 1947. From that time, plywood production increased yearly with the addition of new plant capacity and peaked in 1963-64. In 1965, softwood plywood production in California totaled 1,222 million square feet (3/8-inch basis), 10 percent of the Nation's softwood plywood production. California had accounted for over 14 percent of the national totals in 1961 and 1962. The magnitude of the contribution of Douglas-fir to growth in the plywood industry is illustrated in figure 8.

Since 1964, plywood production in California has dropped off sharply, even though national production of softwood plywood has continued to climb. From 1964 to 1968, production fell 25 percent, led by a 40-percent decrease in Douglas-fir plywood production. During that same period, although production of white fir, pine, and redwood plywood combined increased 60 percent, the volume increase was not nearly enough to offset the losses in Douglas-fir production. The magnitude of the impact of dwindling supply of raw material on the Douglas-fir production decline is not yet known. During the same period, there was a downturn in residential construction in California — the major market for California-produced Douglas-fir plywood. However, increases in production of other softwood plywoods in California and continued growth in Douglas-fir plywood production in the Northwest during this period strengthens the assumption that supply of raw material is a major factor in the decline of Douglas-fir and total softwood plywood production in California.

The softwood plywood industry is concentrated near the Douglas-fir resource in the North Coastal subregion. This subregion has also been the location of green veneer plants which peel logs and sell the veneer to layup plants. Such operations, numerous during the expansion period, have diminished considerably in recent years. Pine and white fir plywood production is concentrated in the inland subregions, and hardwood plywood production is

located near markets in the South Coastal subregion.

The Board Industries

The development of the board industries in California, which began in 1950-51, has been based on the use of wood residues from the lumber and plywood industries. Initial development consisted of one hardboard plant in the North Coastal subregion and a particleboard plant in the Sacramento subregion. Although no additional hardboard plants have been built in California, hardboard production has increased through expansion of capacity in the existing plant. Hardboard production in 1965 was 310 million square feet (1/8-inch basis), 10 percent of the total national production (Anonymous 1966).

Particleboard production has climbed rapidly since the mid-1950's, owing to expansion of existing facilities and construction of new plants. In 1965, particleboard production was 146 million square feet (3/4-inch basis), about 18 percent of the Nation's production for that year (Anonymous 1966).

The Pulp Industry

Although the pulp and paper industry has a long history in California, successful large scale woodpulp operations have their origins in the post-World War II period. Like the board industries, the woodpulp plants have developed and expanded through the use of wood residues from the lumber and plywood industries. California's first major pulpmill was built in the San Francisco Bay subregion in 1948. Production of woodpulp increased gradually during the 1950's because of expansion of the existing facility and addition of a pulpmill in the Sacramento subregion. Three large pulpmills were added in the 1960's, two in the North Coastal subregion, and one in the Sacramento subregion. Statistics for California's woodpulp production are not available. However, based upon installed capacity in operation, woodpulp production is estimated at about 315,000 tons in 1965. Based upon increases in installed capacity since 1965, 1968 production is estimated at about 700,000 tons, less than 2 percent of the Nation's total.

Exports

The foreign log and pulpwood market was of little importance in California until recently. Log exports amounted to only 15 million board feet in 1965, and there were no chip exports at that time. But since then, exports of both commodities have grown rapidly, following the lead of the Pacific Northwest. Almost all of the exported wood — in both forms — goes to Japan. The amount of logs and chips shipped to Japan and other destinations in 1968 was significant — 212 million board feet of logs and 192,000 tons of chips. Most of the exported logs originated in the North Coastal subregion and were shipped from Eureka, a North Coastal port. The exported chips originated primarily in the inland subregions and were exported from Sacramento, an inland port which also handles export logs.

Subregional Distribution of Industries, 1965

For many years, the level of forest industrial development and its geographical distribution within California have reflected both resource availability and the presence and growth of major market areas. Harvest of raw material and the initial steps of manufacturing that involve large weight loss are necessarily resource oriented. Industries engaged in secondary manufacture of forest products, including finishing and fabrication processes, are generally located in major market areas. These industries are often completely independent of the State's forest resources.

The characteristic resource and market orientations of the different manufacturing processes of forest industries are quite evident in their subregional distribution. In 1965, the North Coastal subregion contained 53 percent of the 700 logging establishments in the State, 41 percent of the sawmills and planing mills, and 46 percent of the veneer and plywood plants. However, only 2 percent of the millwork and miscellaneous plants — and no paper and allied products establishments⁵ — were located there (table 8). This subregion contained

55 percent of the State's installed sawmill capacity as well as 68 percent of the softwood plywood capacity, 35 percent of the particleboard capacity, and the only hardboard plant in the State (table 9). With the recent completion of two pulpmills, the North Coastal subregion now has 50 percent of the State's installed woodpulp capacity, enhancing its position as California's center of primary forest products manufacture and doubling the State's pulping capacity.

The Sacramento subregion also contains a major concentration of primary forest products manufacturing facilities. In 1965, this subregion had 29 percent of the State's logging establishments and 24 percent of the sawmills and planing mills, but only 10 percent of the millwork plants and less than 2 percent of the paper and allied products establishments. The subregion accounted for 30 percent of the State's sawmill capacity in addition to 16 percent of the softwood plywood capacity, half of the particleboard capacity, and 18 percent of the woodpulp capacity.

Each of the other resource-oriented subregions in California commands smaller concentration of forest industries because of relatively small size. The San Francisco Bay subregion has elements of resource-oriented primary manufacturing but, in addition, is a major market and a center of secondary manufacturing of forest products. In 1965, the subregion contained 14 percent of the State's sawmills and planing mills, 20 percent of the millwork plants, and 28 percent of the paper and allied products establishments. This subregion accounted for only 2 percent of the State's sawmill capacity and 7 percent of its softwood plywood capacity in 1965. However, 53 percent of California's woodpulp capacity was located in the subregion.

The South Coastal subregion contains California's largest market and manufacturing complex and, in addition, is far removed from the important forest resource concentrations in the State. In 1965, this subregion had only 7 percent of the State's sawmills and planing mills, mostly the latter. Although 34 percent of California's plywood plants were located in this subregion, all were manufacturers of hardwood plywood using substantial amounts of material originating outside California. However, the

⁵ This category includes pulpmills. The North Coastal subregion had two pulpmills under construction in 1965, but neither operated for a substantial portion of that year.

South Coastal subregion accounted for 49 percent of the millwork and miscellaneous wood products plants and 65 percent of the paper and allied products establishments, essentially all concerned with secondary stages of manufacture. Detailed data on the distribution of the forest products industries are in tables 8 and 9 of Appendix A.

Value Added, 1963

In 1963, the value added by manufacture of forest products in the lumber and wood products (SIC⁶ 24) and paper and allied products (SIC 26) industries in California totaled \$867 million (1963 dollars), 5 percent of the State's total value added (table 10). Thirty-three percent of the value added by the manufacture of forest products was in the South Coastal subregion. The North Coastal (23 percent), San Francisco Bay (19 percent), and Sacramento (13 percent) subregions accounted for most of the remainder of value added in these two sectors for the State.

Almost 90 percent of the value added in the paper and allied products industry was concentrated in the major population and market centers in the South Coastal and San Francisco Bay subregions, where fabrication of paper and board products is centered. Unlike paper and allied products, value added in lumber and wood products is concentrated in the primary wood processing centers in the North Coastal and Sacramento subregions. These two subregions account for 61 percent of California's value added in lumber and wood products. Value added attributable to secondary manufacturing of lumber and wood products is concentrated in the South Coastal and San Francisco Bay subregions.

In 1963, there were five subregions in which the combined forest products industries — SIC 24 and SIC 26 — contributed 10 percent or more to the total value added in manufacturing. The subregions most dependent on the forest products industries were the North Coastal, which derived 92 percent of all value added from forest products, and the North Lahontan, which derived 73 percent. The Sac-

ramento, Delta-Central Sierra, and San Joaquin subregions derived 17, 13, and 10 percent, respectively, from forest products (table 10).

Preliminary data from the 1967 "Census of Manufactures" (U. S. Bureau of the Census 1970) indicate that value added in SIC 24 increased only 5 percent from 1963 to 1967, compared with an increase of 36 percent in value added for all manufactures in California. The subregions that rely substantially on this industrial sector for their economic activity have undoubtedly lagged behind the State in economic growth during the 1963-67 period. Value added in SIC 26 increased 34.5 percent during the same period, reflecting a continuing orientation to markets and their growth.

Employment in the Forest Industries

California's forest industrial employment experienced its most explosive growth period in the 10 years after World War II. During that period, forest industrial employment doubled, culminating at 84,000. Since the mid-1950's, employment in the forest industries (SIC 24 and 26) has remained stable (fig. 9). This stable condition is the product of many offsetting trends among the factors that influence and determine employment. Major among these factors are changes in industrial mix within the forest industrial complex, increase in labor productivity, the constraining effects of resource availability, and market growth.

Generally speaking, forest industrial employment in the resource areas of California has decreased since the mid-1950's, owing to increases in productivity and decreasing availability of raw material. Because of the magnitude of the employment decline in sawmills and planing mills, this downward trend has been only slightly moderated by changes in industrial mix through growth of the plywood, board, and pulp industries. Forest industrial employment in population and market centers has displayed continuous growth in recent years, showing the positive response of secondary manufacturing activities to market growth. These different regional trends have offset each other, resulting in stable employment in the forest industries for the State as a whole.

Employment in lumber and wood products climbed rapidly in the postwar period and

⁶Standard Industrial Classification — see Definition of Terms in Appendix B.

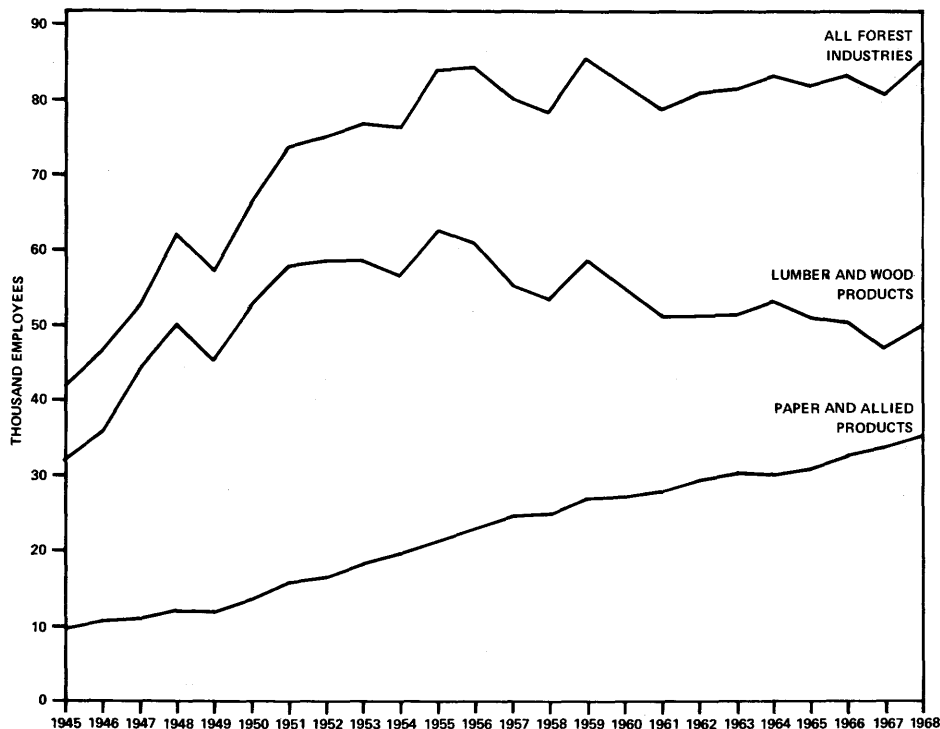


Figure 9. — Average annual employment in California's forest industries, 1945-68. (Source: State of California, Department of Employment; U. S. Department of Labor, Bureau of Labor Statistics.)

peaked in 1955 at slightly over 62,000 — almost twice the 1945 level. By 1968, lumber and wood products employment had dropped 20 percent from the 1955 level (fig. 9). Employment in paper and allied products has climbed continuously since the mid-1940's and by 1968 was 3.5 times the 1945 level of 10,000 (fig. 9). The rapid and continuous employment growth in paper and allied products is closely tied to California's postwar population growth.

Employment in California's lumber and wood products industries totaled 51,000 in base year 1965. Of this total, over 19,000 or 38 percent were employed in the North Coastal subregion, followed by 22 percent in the Sacramento subregion, 17 percent in the South Coastal subregion, and 10 percent in the San Francisco Bay subregion. The remaining 13 percent was distributed among six of the other seven subregions (table 7).

Employment in paper and allied products totaled 30,800 in 1965. Of the total, over 17,000 or 56 percent were located in the South Coastal subregion and 10,000 or 33 percent were in the San Francisco Bay subregion (table 7). The resource subregions had little employ-

ment in this sector. The addition of pulping capacity in the North Coastal subregion after 1965 had very little effect on the percentage distribution of paper and allied product employment by subregion.

Nine percent of the lumber and wood products employment in the State was in logging, 46 percent in sawmills and planing mills, 18 percent in millwork plants, 10 percent in plywood and veneer plants, 6 percent in container manufacturing plants, and 11 percent in miscellaneous wood products establishments. In aggregate, 65 percent of the employment was in resource-oriented primary manufacture — logging, sawmilling, and production of softwood plywood and veneer. The remainder was in secondary manufacturing activities that are generally market oriented — millworking, and production of wooden containers and miscellaneous wood products.

Only 25 percent of the employment in paper and allied products was in primary manufacture; 75 percent of the employment was in market-oriented establishments that manufacture converted paper products from purchased or transferred paper stock.

Projected timber supply

The future supply of raw material from California's forests will be determined by the interactions of many factors that will reflect the demands of the State's and Nation's populace. The demand for wood and paper products has traditionally been the most apparent factor, given resource availability. But it is becoming increasingly apparent that there are other demands — often more important than the production of timber products — that must be fulfilled by our timberlands. The State's growing population must be supplied with water and power in increasing amounts, and these commodities have their origins in the State's timbered regions. In addition, demand is increasing for unmarred landscapes and recreational opportunities in the mountain areas. Demand for improved transportation networks is also increasing, and many of these enter and cross the State's timberlands. Many of these demands will involve tradeoffs with timber production on the State's timberlands.

The first part of this section deals with the assumptions underlying the projections of future wood supply from California's timberlands — national and State demand for timber products; population impact on timberland availability; and trends in forest management and wood utilization. The latter part of the section presents projections of future wood production, timber inventories, and growth. Timber inventory and growth were projected for each subregion by use of the stand table projection method, taking into consideration the existing timber resource, related growth rates, trend and plan levels of timber removal by har-

vesting, anticipated management impacts, and projected inventory loss through reclassification of commercial forest land.

National Demand for Timber Products To Rise

The national demand for timber products was projected to the year 2000 in the report "Timber Trends in the United States" (USDA Forest Service 1965a). A number of factors of economic growth were considered in developing demand projections for roundwood. They included population, household formation, gross national product (GNP), disposable personal income, and construction activity. The Timber Trends study projected an increase in consumption of domestically produced roundwood — from 10.3 billion cubic feet in 1962 to 18.7 billion cubic feet in 2000.

Recent Forest Service projections of national demand for timber products have taken into consideration different assumptions about growth in population, household formations, GNP, dwelling unit construction, and nonresidential construction. For these recent demand projections, population is projected to increase to 308 million by 2000. GNP is projected to rise 4.3 percent annually — to \$2,700 billion (1958 dollars) by 2000. Both disposable personal income and expenditures for nonresidential construction are projected to nearly quadruple from 1968 to 2000. And residential construction, which accounts for much of the timber products consumed, is projected to rise from 1.8 million dwelling units in 1968 to 3.5 million units by the year 2000.

With the exception of population (which is lower), the projected levels of these factors are substantially higher than those used in the Timber Trends study. Given the price assumption used in the Timber Trends study — stable prices for primary wood products relative to prices of all commodities — the lower population projection combined with higher projected levels for other economic indicators results in a demand for domestically produced roundwood of 28.2 billion cubic feet by 2000.

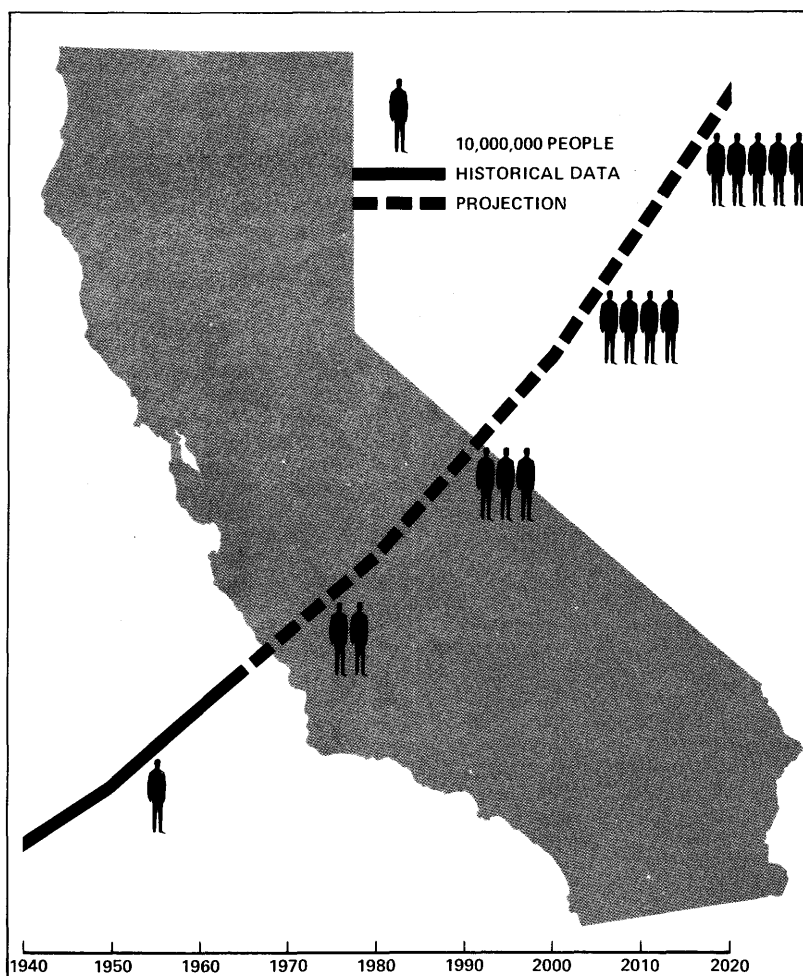
A higher wood products price structure, relative to the prices of substitutes, would encourage substitution and lower the quantity of wood products demanded. For the recent Forest Service projections, change in the price assumption to reflect late 1968 prices plus a 1-percent annual increase results in a projected demand for domestic roundwood of 21 billion cubic feet in the year 2000.

California's Share of National Demand To Increase

California differs from the other major timber producers among the Western States in the markets for its forest products. The other Western States have primarily national markets for their forest products. California is the major market for its own forest products. The California markets consume about 60 percent of the State's lumber production (Western Wood Products Association 1969) and a substantial proportion of the softwood plywood production (Zivnuska et al. 1965). The State is also a major importer of lumber, plywood, and wood-pulp.

California's population is projected to increase to 38 million by 2000, and to 55 million in 2020, more than tripling the 1965 level of 18 million (fig. 10, table 16). The State's share of

Figure 10. — California population estimates, 1940-2020. (Source: historical data, U. S. Bureau of the Census; projections, Water Resources Council.)



the Nation's population will increase from 9 percent in 1965 to 12 percent in 2000 — and 14 percent by 2020. This projected increase will mean that an increasingly larger share of the Nation's population — and implicitly, a larger share of the other economic factors and national forest-products demand — will be located in California. On the basis of current and projected population distribution and the projected national demand for timber,⁷ California's demand for domestic timber should rise from a current level of about 1 billion cubic feet to 3.4 billion cubic feet in 2000. This is a conservative appraisal of the State's share of national demand for forest products, since California has historically accounted for a larger share of the other economic determinants of timber product demand than population would indicate. Given the projected growth in demand for timber products in California and nationwide, the supply limitations imposed by a diminishing resource — which have already had some effect on production levels of wood products — will operate, in the long run, as the major constraints on production levels of forest products derived from California's timberlands.

Population Pressures Will Reduce Forest-Land Base

Population growth in California will result in the conversion of timberlands to other uses. Historically, land clearing for farming, grazing, reservoirs, homesites, and highway and power transmission line rights-of-way have reduced the forested area in the State. Such conversions are expected to continue in the future, resulting in loss of forest acreage, timber inventory, and timber growth.

Local and national demand will result in removal of timberlands, through reclassification, to park and wilderness status, municipal watersheds, recreational subdivisions, and similar single uses. Both public and private lands will be affected. Although physical removal of the timber is not involved in this type of reclassification, the volume and growth, as well as the area, are lost to timber production.

Relative impacts of the various alternative

uses of timberlands have changed over time and will continue to do so. Conversions to farm and grazing lands, which have accounted for much of the alternative use to date, will probably diminish. However, reclassification for various types of recreational use seems likely — in keeping with population growth, increases in leisure time and disposable income, and an increased environmental awareness on the part of the public.

Recent Trends in Forest Management and Utilization To Continue

The level of cut to be realized from California's timberlands in the decades to come will be determined by the response of the timberland owners to forest products demand, as reflected in their management and harvesting activities. The supply of raw material available for harvest for most of the plan period — certainly through the end of this century — will come from trees and stands already established. Harvest of private timber will continue to be responsive to demand. On industrial holdings, this response will be tempered by concern for future raw material requirements. Public lands are not as far along in the conversion of old-growth timber as are private lands, and harvesting activities directed at creating regulated forests and protecting multiple use values will continue throughout the plan period.

In projecting California's future timber harvest level, recent trends in forest management and timber utilization are assumed to continue. Fire control and prevention programs should keep acreage burned at current levels, despite the increased hazards associated with heavier recreational use of the State's forests. Progress in salvage of merchantable mortality will continue because of improved accessibility to mortality through extension of the forest road networks. Artificial regeneration after harvest cutting will insure rapid and adequate restocking on public and industrial private ownerships, but little progress is projected for farm and miscellaneous private ownerships.

Increased demand for forest recreation has led public land managers to modify timber harvesting activities in some areas in order to maintain recreational and scenic values throughout

⁷ "Stable price" assumption.

the growth and harvest cycle. Modified management is also practiced where watershed considerations are of primary importance. Such modified management, which decreases usable growth and yield, will be extended to an increasing acreage of commercial forests in public ownership and will also have some impact on private lands in the future.

In recent years, industry has extended the supply of wood raw material by using more of what has been called cull material, as well as pieces previously left in the woods as logging debris. In addition, more of the previously unused species are gaining acceptability. Industry is expected to continue to make progress in improved utilization of available raw material.

Commercial Forest Area To Decline 5 Percent

California's commercial forest area is projected to decline by 879,000 acres or 5 percent during the period 1965-2020. Over 42 percent of this commercial forest-land loss is projected to occur by 1980, with average annual losses of 25,000 acres. Average annual losses of 9,000 acres and 16,000 acres, respectively, are projected for the periods 1980-2000 and 2000-20 (table 19).

Loss of productive timberland from the unreserved commercial forest base has been assumed to average 16,000 acres annually over the projection period, a continuation of recent trends. In projecting area loss, however, impacts have been varied over time and among the subregions. The allocation of land loss has been varied to reflect anticipated intense pressures for wild-land recreational opportunities and second-home development in the 1970's, and the impact of a population in excess of 40 million people after the year 2000.

Impact of Acreage Loss To Fall on Least Important Resource Subregions

Most of the commercial forest-land losses are expected to occur in the subregions containing, or adjacent to, areas of population concentration. San Francisco Bay, Central Coastal, South Coastal, and Colorado Desert subregions combined have projected losses totaling 534,000 acres by the year 2020 — 61 percent

of the loss projected for the State. In 1965, these subregions accounted for less than 5 percent of the State's commercial forest area, saw-timber inventory, and net growth.

The major timber resource subregions of the State will also lose some land to timber production. Water impoundments and road construction will continue in these subregions. These subregions also contain the areas most likely to be reclassified as wilderness. However, their remoteness from the population centers should result in smaller land loss than is anticipated in the timbered areas adjoining population centers.

Private Timber Harvest Decline To Continue

The downward trend in California's timber harvest — which started in the mid-1950's — is projected to continue through the year 2000. Underlying this trend is the decreasing availability of timber from the private sector. California's annual harvest and the harvest from the private sector peaked at the same time; both have since declined. The trend and its projection reflect the decreasing availability of privately held old-growth timber, which until very recently was the mainstay of California's forest industries.

Timber cut on private lands was projected from current levels to future levels with consideration for the availability of mature timber, changing rates of growth, and projected levels of allowable cut on public lands. These projections represent a modification of recent trends in timber harvest on private lands.

Harvesting activities on private land in some areas of the State are shifting into young-growth stands of timber. The impact of decreasing cut of old growth on private lands is anticipated to be moderated by rising harvest levels in young-growth timber. The conversion of privately held old growth will be completed by 2000, and there will be a growth-cut balance on private timberlands, with prospects for small increases in cut over the remainder of the plan period.

Public Timber Harvest Increase To Continue

The timber harvest on public land — which in recent years has risen rapidly, moderating

the effect of the private timber harvest decline — is projected to increase about 15 percent from current levels by 1980. The public timber harvest is then projected to remain at 1980 levels for the remainder of the plan period. This projection does not take into consideration the impacts that could be expected from fertilization, genetic improvement, and other forms of intensified management that might become realities on California's timberlands in the future.

The projected level of cut on public lands — National Forests, State forest, public domain, and Indian trust lands — is based upon each agency's planned allowable cut. The allowable cut is determined by each agency charged with management of public timberlands and is a schedule of annual harvest levels for some specified planning period. For this study, current harvest levels were increased moderately in the early part of the plan period to account for the

expected contribution of intermediate cuttings to allowable cut on public lands. Throughout the plan period, most of the harvest from public lands will continue to come from old-growth forests.

Total Timber Harvest Projected To Decline 20 Percent

California's timber harvest, which in 1965 totaled almost 5.3 billion board feet, is projected to decline to 4.4 billion board feet in 1980 and will continue to decline to 4.2 billion board feet by the end of this century. It is anticipated that cutting in the private sector will then be concentrated in young forests and will be based upon growth. Growth is projected to increase on private lands during the period 2000-20, accounting for a projected moderate increase in the harvest in the last period of the projection. The State's harvest is projected to be 4.4 billion board feet in 2020 (fig. 11).

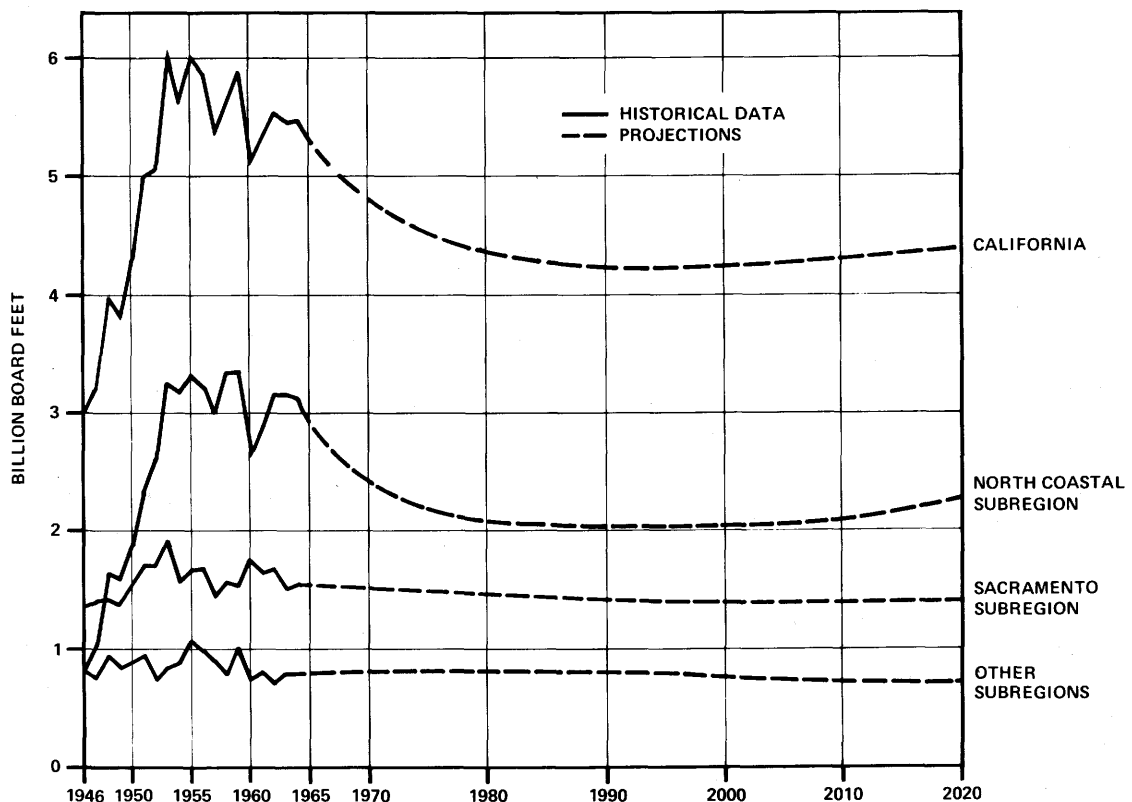


Figure 11. — Recent and projected timber harvest in California and selected subregions, 1946-2020. (Source: historical data, California Division of Forestry; projections, USDA Forest Service (see also table 12).)

Timber Harvest Decline Will Be Concentrated in North Coastal Subregion

In the North Coastal subregion, the timber harvest is projected to decline 29 percent, from 2.9 billion board feet in 1965 to less than 2.1 billion board feet by 2000. This projected decline represents 82 percent of the projected statewide decline in timber harvest, an indication of the concentration of the current private harvest in this subregion. The moderate increase in projected statewide timber harvest in the last 20 years of the period is also concentrated in the North Coastal subregion (fig. 11).

Timber harvest in the Sacramento subregion is projected to decrease from less than 1.6 billion board feet in 1965 to 1.4 billion board feet in 2020, a 10-percent decline. Only the San Joaquin and Tulare subregions have projected increases in timber harvest over current levels. The San Francisco Bay subregion, which in 1965 had a harvest of 148 million board feet, has a projected 85-percent decrease in harvest over the projection period because of anticipated withdrawal of forest lands from timber production.

Sawtimber Inventory To Decrease by 28 Percent

Continued cut in excess of growth and withdrawal of lands from timber production will reduce the State's current 299 billion-board-foot inventory by 28 percent to 214 billion board feet by 2020. Between 1965 and 1980, the average annual inventory decrease will be 2.36 billion board feet; between 1980 and 2020, it will be 1.27 billion board feet. The growing-stock inventory will decline by 8 percent during the 55-year period. The inventory decline is not evenly distributed among the subregions. The North Coastal subregion is projected to experience a 13-percent decline in sawtimber inventory in the next 55 years; the Sacramento subregion, 45 percent. The magnitude of the projected inventory decline in this subregion is due to the current large concentration of old-growth timber, much of which will be removed during the plan period. Inventory decline in other subregions will vary from 12 percent in the North Lahontan to 95 percent in the three southern subregions. The inventory decline projected for the southern subregions is

due to anticipated land loss through reclassification (table 20).

Sawtimber Growth To Increase 40 Percent

Net annual growth of sawtimber is projected to increase from current levels of 2.5 billion board feet per year to 3.5 billion board feet annually by 2020, an increase of 36 percent (table 21). When growth is expressed as a percentage of sawtimber inventory, the current growth rate is 0.9 percent; by 2020 it will reach 1.6 percent. The projected increase in the growth rate — and in total growth — is due to the conversion of slow-growing old-growth forests into young, rapidly growing forests.

Growth Increase Concentrated in North Coastal Subregion

In the North Coastal subregion, sawtimber growth will increase from 1,511 million to 2,205 million board feet during the 55-year period, an increase of 46 percent. By 2020, this subregion will account for two-thirds of California's total sawtimber growth. Sawtimber growth will increase 33 percent in the Sacramento subregion and 56 percent in the North Lahontan subregion; only minor changes in growth will occur in the other subregions.

The variation of projected growth responses among the subregions is due to several factors. In the North Coastal subregion, the abundance of second-growth timber on highly productive land will be responsible for the growth increases. The Sacramento subregion and the other subregions in the Sierra Nevada are characterized by relatively large portions of old-growth timber, compared with the North Coastal subregion. And the average productivity of the forest land in these subregions is lower than that of the North Coastal subregion. The large projected increase in sawtimber growth in the North Lahontan subregion is due to the impact of young-growth stocking.

California Will Approach Sawtimber Cut-Growth Balance

In 1965, sawtimber harvest was double the sawtimber growth in California. This reflects

the continued harvesting activities in old-growth sawtimber that still remain in the State, contributing little net growth but supporting large harvests. By 1980, decreasing cut and increasing net growth will result in a cut 46 percent greater than net annual growth. By 2000, the cut will exceed growth by only 25 percent, a relationship that will extend to the end of the plan period. Sawtimber growth and harvest are

expected to be in balance on private lands by year 2000. But cutting of old-growth on public lands is assumed to continue through the plan period, accounting for the excess of cut over-growth. The cubic-foot harvest, which exceeded the cubic-foot growth by 37 percent in 1965, will be in balance with growth by 1980 and will remain so for the remainder of the plan period.

The outlook for future forest industrial development

In recent times, California's primary forest products industries have experienced their most active period of growth and diversification. Since the war, both the lumber and plywood industries have experienced rapid growth followed by significant decline. The board industry has grown steadily since the war. And the pulp industry, after a slow start in the 1950's, experienced its most rapid growth in the 1960's. The exporters of logs and chips were significant contenders for raw material in the late 1960's.

The changes in industrial mix and industrial consumption patterns in recent years, as well as those that will occur in the future, are the result of many factors. The nature of the raw material determines the range of product possibilities, and over time, technology tends to extend the range of those product possibilities. Competition in the market between regional suppliers of like products affects industrial development in each region. Competitive substitution of one wood product for another, or between wood and nonwood products, also helps to shape forest products industrial development.

Not to be overlooked is the availability of raw material. If there is an abundance of raw material, the other factors mentioned determine the industrial mix as well as the scale of industrial development; but if raw material is in short supply, the supply helps to determine the scale of industrial development. Industries that maximize utilization of raw material and value added per unit of input have a competitive ad-

vantage over other industries in the raw material market. All of these factors have been and will continue to be operative in determining the industrial consumption pattern in California's forest industries. To the extent possible, all have been considered in projecting the industrial consumption of wood raw material from California's timberlands.

For the purposes of this study, wood exporters and out-of-State shippers (to domestic industry) have been considered consumers of industrial raw material. Although they don't process the raw material locally, the exporters and shippers are a factor in shaping the development of the resident industries. Exports and out-of-State shipments will be discussed under the log consumption and pulpwood consumption headings of this section.

Roundwood Consumption To Decline

Consumption of California-produced roundwood is projected to decline from 883 million cubic feet in 1965 to a low point of 764 million cubic feet in 1980 — a decline of 13 percent (fig. 12). From the 1980 level, it is projected to increase to 829 million cubic feet in 2020. The saw log-veneer log component of roundwood consumption is expected to drop considerably during the projection period. But this drop is offset substantially by projected increases in consumption of roundwood pulpwood, which totaled only 5 million cubic feet in 1965. After little change in 1980, roundwood pulpwood consumption is projected to increase to 84 million cubic feet by 2000 and

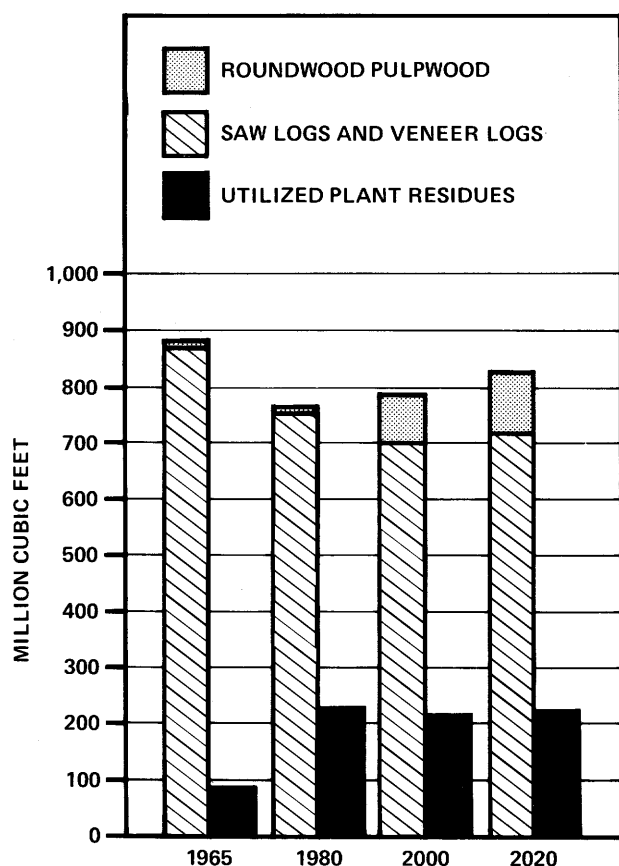


Figure 12. — Estimated wood consumption in California, by type of raw material, 1965-2020.

106 million cubic feet in 2020. By 2020, pulpwood consumption is expected to account for 13 percent of total roundwood consumption.

Much of the roundwood that will be used for pulping is expected to consist of material now considered logging waste and the yields of cultural practices such as thinning. Currently, much of the sound wood that is cut in logging operations is left in the woods. This material will be used for wood and paper products when it becomes economical to do so. As raw material supply continues to diminish, the forest industries are expected to utilize more completely the tree as it is found in the woods. Harvest methods and practices in the recent past have left almost 20 percent of the cubic volume of cut growing stock in the woods.

Residue Consumption To Increase

Consumption of plant residues,⁸ excluding use for fuel, is projected to increase from 86 million cubic feet in 1965 to 229 million cubic feet in 1980 — an increase of 166 percent. From 1980 through 2020, residue consumption is expected to remain almost constant, varying between 229 and 219 million cubic feet (table 11). Rapid growth in residue consumption through 1980 is expected as a result of eventual complete utilization of chippable residues and substantial progress in the use of sawdust and shavings. Essentially all chippable residue now used as fuel is expected to be redirected eventually for use by pulp and board industries.

Forest industries have recently made rapid progress in utilization of plant residues. As recently as 1962, only half of the available plant residues from sawmills and plywood plants were used; three-fourths of the residue use was for fuel in generation of power. In 1968, two-thirds of the plant residues were used, and only one-third of the used residues were for fuel.

Even greater use of these residues for raw material is expected to result from increased value of wood for pulp as demand increases for chips for domestic pulping and for export. Adding impetus to increased utilization of residues are impending air pollution controls that will make current burning practices unacceptable as a means of waste disposal. Additional residues should become available for pulping as alternative economical power sources replace wood-fired boilers at some mills.

Log Consumption To Decline 20 Percent

The volume of logs consumed for lumber, plywood, and miscellaneous products is projected to decline from 878 million cubic feet in 1965 to 705 million cubic feet in 2000. A small increase from that level is expected in the last period of the projection.

Consumption by resident industries is expected to drop from 853 million cubic feet in

⁸ Wood residues, excluding bark.

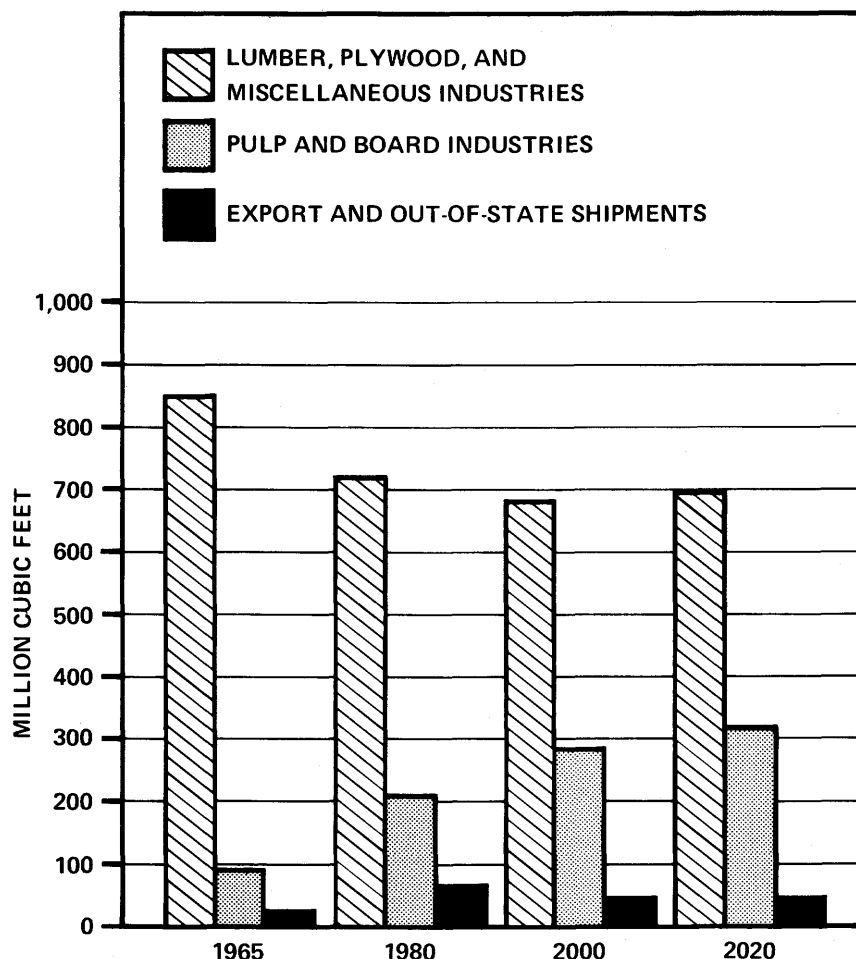


Figure 13. — Estimated wood consumption in California by industry group, 1965-2020.

1965 to 678 million cubic feet by 2000 (fig. 13). The changes in consumption by subregion are expected to be quite variable. For the projection period, the North Coastal subregion has a projected 25-percent decrease in log consumption, but in the Sacramento subregion, the expected decrease is only 11 percent. The Central Coastal and San Francisco Bay subregions have a projected 84-percent decrease in log consumption. Only the Tulare and San Joaquin subregions have projected log consumption increases for the projection period (table 22).

Out-of-State shipment of logs started in the last century. In modern times, such shipments have been a continuous activity, because of the proximity of some California timberlands to wood processing centers in

other States. Most of the log shipments originate in the North Coastal subregion and, to a lesser extent, the Sacramento and North Lahontan subregions. Their destination is mainly Oregon, although some are shipped to Nevada. In recent years, these shipments have averaged about 2.5 percent of California's timber harvest, and they are expected to continue at that proportion, declining from 22 million cubic feet in 1965 to 18 million cubic feet in 2020 (table 22).

Offshore export of California logs has recently become an activity of significant magnitude. Only 3 million cubic feet of logs were exported in 1965. However, by 1968, exports had increased to over 42 million cubic feet, about 5 percent of the State's log production for that year. Most of the export logs go to

Japan. The Japanese entry into the wood raw material markets in the State initially took underutilized raw material, primarily young-growth redwood and white woods that had limited local markets because of the availability of old-growth timber. But Japan's basic need for wood raw material is resulting in increased competition with local industry in the log market.

The logs for export have originated primarily on private lands. Recent limitations on export of Federal timber indicate a continuation of that log origin pattern. As timber harvest on private land declines and as local industry progresses further in the transition to a young-growth timber economy, exporters are expected to face stiffer competition in log markets and to look elsewhere for raw material.

Offshore exports of California logs are expected to peak in the early 1970's and, by 1980, are projected to decline to 20 million cubic feet, less than half the 1968 level. Further decline to 10 million cubic feet is projected for the year 2000 and beyond (table 22).

Logs for plywood production have not been separated from those for lumber in this study. The kind of logs used by these two forest products industries is essentially the same. Rapid growth of the plywood industry on the basis of availability of Douglas-fir in the North Coastal subregion has halted. The Douglas-fir segment of the plywood industry will likely decline as supply limitations put pressure on manufacturers who do not own timber resources. A probable combination of pressures in the product markets and short supply of suitable raw material has already served to precipitate some of these operators from the active producer ranks. As a result, veneer consumption is no longer increasing its share of total log consumption. A generally stable relationship between use of logs for plywood and lumber is assumed for the projection period, with veneer logs accounting for about 10 percent of the annual domestic log consumption.

Miscellaneous wood products, including poles, piling, fenceposts, shakes and shingles, box wood, etc., have accounted for a minor and diminishing part of the log harvest in re-

cent times — about 1 percent. Since this trend is expected to continue, consumption for these products has been treated as part of saw-log and veneer log consumption.

Pulpwood Consumption To Increase Sharply

In marked contrast to decline in consumption of logs for lumber and veneer, use of wood for pulping and board production will increase throughout the projection period. The 1965 consumption of wood by pulp and board producers has been estimated at 91 million cubic feet. By 1968, with the addition of two pulpmills and with chip exporting activities, consumption of pulpwood increased to an estimated 155 million cubic feet. The projected pulpwood consumption levels are 236 million cubic feet in 1980, 303 million cubic feet in 2000, and 333 million cubic feet in 2020 (table 23).

By 1967, the Japanese started to import wood chips from California. In 1968, the first full year of export activity, an estimated 14 million cubic feet of chips were exported — 9 percent of the pulpwood produced in California for that year. California's growing wood-pulp and board industries are not yet utilizing all of the economically available chippable residues. Export of chips is expected to peak before 1980 and then to decrease as increased capacity in pulpmills and board plants demands most of the chippable residues from wood products manufacturing industries. The Japanese are now importing from California material that was previously burned as unwanted waste. When local demand exceeds the potential supply of unexported chips and when domestic consumers are forced to use roundwood, rising domestic price structures are expected to reduce the amounts of wood chips available for export.

Pulpwood exports — in chip form — are projected at almost 27 million cubic feet in 1980, 11 percent of the projected California pulpwood consumption. By 2000, pulpwood exports are expected to drop to less than 19 million cubic feet, 6 percent of the State's consumption. Exports are expected to stay at that level through the last 20 years of the projection period (table 23).

Pulpwood consumption by resident industries is expected to remain concentrated in the subregions that currently account for most of the consumption. Future location of pulpmills is assumed to depend upon essentially the same criteria that have resulted in the current distribution of the industry. Major among these are adequate wood, water, and transportation.⁹

The North Coastal subregion is projected to increase consumption from 25 million cubic feet in 1965 to 102 million cubic feet in 1980, 123 million cubic feet in 2000, and 150 million cubic feet in 2020 (table 23). This subregion had only one hardboard and two particleboard plants in 1965; it has since added two pulpmills, and a new particleboard plant is under construction. Projected developments include a pulpmill on the coast of Mendocino County by 1980 and a pulpmill in the coastal area of Humboldt-Del Norte Counties between 1980 and 2000. Additional capacity is expected through expansion of existing pulpmills and board plants. Expansion of pulping capacity in the North Coastal subregion is expected to be accompanied by addition of papermaking facilities.

Pulpwood consumption in the Sacramento subregion is projected to increase from 21 million cubic feet in 1965 to 63 million cubic

feet in 1980, 81 million cubic feet in 2000, and 84 million cubic feet in 2020. This subregion had two particleboard plants and two pulpmills in 1965. Projected developments include expansion of existing pulping facilities in the northern Sacramento Valley and addition of a large pulp and paper complex in the southern part of the subregion by 1980. An additional pulping facility is projected for this subregion between 1980 and 2000; expansion of particleboard capacity is expected toward the end of the projection period.

The San Francisco subregion, which in 1965 consumed 41 million cubic feet of pulpwood, is expected to experience an increase in consumption to 71 million cubic feet by the year 2000 with the addition of a large pulp and paper facility. There is no projected change for the South Coastal-Colorado Desert subregions, which consume about 4 million cubic feet of raw material annually for pulping and board. Particleboard plants are projected for the San Joaquin and Tulare subregions by 2000.

In summary for the entire State, pulpwood consumption for resident pulpmills is projected to increase from 66 million cubic feet in 1965 to 276 million cubic feet in 2020. Consumption for board plants — both particleboard and hardboard — is projected to increase from 25 million cubic feet to 39 million cubic feet over the projection period. Exports are expected to rise through 1980 and then to decline. Projected pulpmill capacities by subregion are given in table 15 of Appendix A.

⁹The problem of effluent disposal was not considered as limiting for this study. In absence of technological solutions to air and water pollution problems, the projected pulpmill developments might not be realized.

Employment trends in the forest products industries

Employment in the forest products industries is a function of levels of production and worker productivity. Technology has resulted in well-established trends of increasing worker productivity at all stages of manufacture in the forest products industries. These trends are expected to continue.

In the long run, levels of production in the resource-oriented areas are tied to the availability of raw material, given market demand for the products. In these areas, the forest products industries are mainly involved in the conversion of raw material into primary products. Logging, lumber and plywood production, and pulp and board production are the manufacturing activities usually located in resource areas. Future trends in forest industrial employment in California's resource-oriented subregions will depend primarily on the timber resource — the raw material supply for the industries.

Levels of production in market areas depend on market demand, which is related to population growth and concentration. California has several population and market centers which have significant concentrations of industries involved in secondary manufacturing of wood and paper products. Future employment trends in the forest products industries in these areas will be dependent upon population growth and related demand. Primary forest products required by the market-oriented sec-

ondary manufacturing industries will probably be utilized to the extent that they are available from sources within California. However, lack of locally available raw material will have little impact on the existence and development of secondary forest products manufacture in the population and market centers of the State.

Separate projections of employment in lumber and wood products and paper and allied products were made for each subregion. In the resource subregions whose population projections do not indicate development of major population concentrations, projections of employment are based upon projected availability of raw material and continuation of recent trends in physical productivity. In the market-oriented subregions, employment is projected, based on a continuation of recent regional trends in sector employment-population growth relationships. For subregions that have large population centers or are projected to have large population centers as well as timber resources, employment projections have been made by combining projected resource derived employment with employment projected on the basis of population growth.

Forest Industrial Employment To Increase

California's forest industrial employment, which in 1965 was 82,000, is projected to climb to about 132,000 in 2020, a 61-percent

increase (fig. 14). The gains in employment are expected to be concentrated in the current population centers as well as those projected to develop. The San Francisco Bay, South Coastal, Colorado Desert, and Central Coastal subregions combined have a projected 140-percent increase in forest industrial employment, from 44,000 in 1965 to 105,000 in 2020. All of the increase will be in secondary manufacturing processes, 9,000 in lumber and wood products, and 52,000 in paper and allied products. These four subregions, which in 1965 accounted for 53 percent of California's forest industrial employment, will have 89 percent of such employment in 2020.

Forest Industrial Employment Decline Will Continue in Resource-Oriented Subregions

The North Coastal, Sacramento, Delta-Central Sierra, San Joaquin, North Lahontan, and Tulare subregions will continue to have a substantial part of their forest industrial activity in primary manufacturing processes. In

these subregions, forest industrial employment will decline 29 percent between 1965 and 2020 because of substantial declines in employment in lumber and wood products. Of the resource subregions, only the Tulare subregion is projected to have increased employment owing to the anticipated increase in secondary manufacture related to the growth of the Fresno metropolitan area. In the other resource subregions, projected employment declines will range from 7 percent in the San Joaquin to 49 percent in the North Coastal, and 58 percent in the North Lahontan.

Employment in Lumber and Wood Products Industries To Drop 15 Percent by Year 2020

Average annual employment in the lumber and wood products industries was 51,000 in 1965. Projected employment in this sector is 46,800 in 1980, 44,300 in 2000, and 43,400 in 2020—a 15-percent drop over the 55-year plan period (table 17).

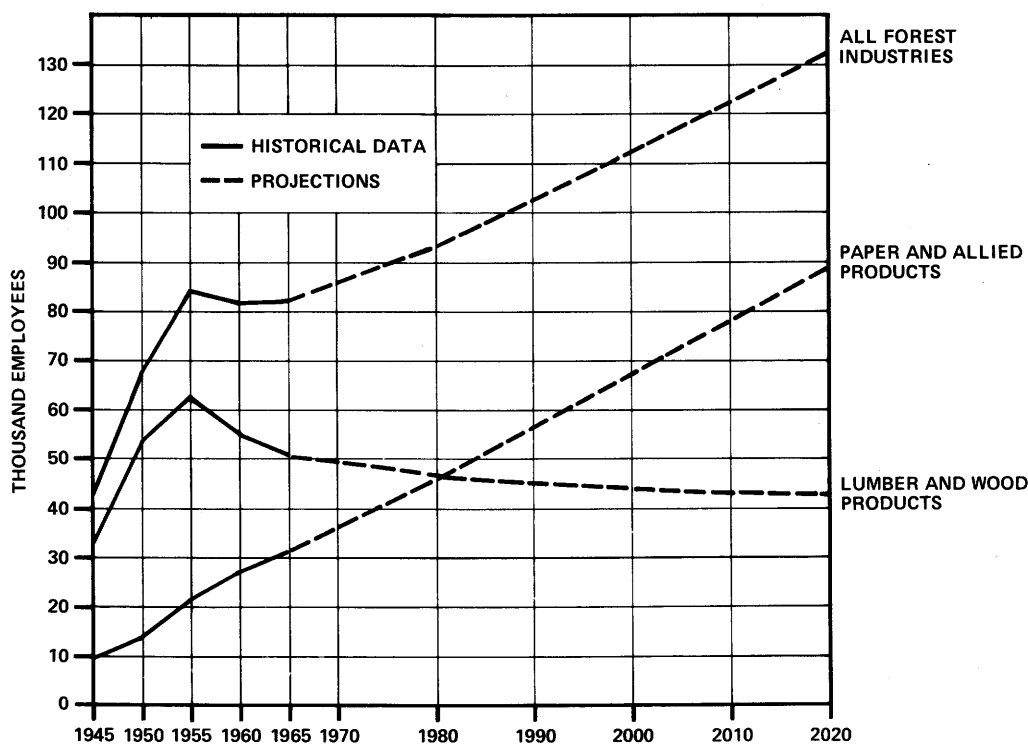


Figure 14. — Recent and projected employment in the forest industries of California, 1945-2020. (Source: historical data, State of California, Department of Employment; U. S. Department of Labor Statistics. Projections by USDA Forest Service.)

Lumber and wood products employment in the North Coastal subregion was 19,400 in 1965, 38 percent of the State's employment in that sector. By 2020, the employment is projected at 7,400, a 62-percent decline. This projected decline is due to a combination of increasing physical productivity and decreased availability of raw material, and it underlines the current and anticipated orientation of the industry in the subregion to primary manufacturing. Lack of major metropolitan market centers, now and prospectively, will forestall the development of substantial secondary manufacturing activities in this subregion.

Employment in the lumber and wood products industries in the Sacramento subregion is projected to drop from 11,300 in 1965 to 7,700 by 2020. This subregion currently has a well-established millworking industry based upon remanufacture of pine lumber for external markets. In addition, the Sacramento County area is a population center on the verge of becoming a major metropolitan area. Thus, the millworking industries that are now manufacturing specialty pine products for national markets will be bolstered by other secondary manufactures for a growing local market. However, increased employment in secondary manufacturing plants is expected to offset only a small portion of the decline in employment in primary wood products manufacture that will occur because of increased productivity and lower production levels.

In the San Joaquin subregion, a projected increase in secondary manufacturing employment does not offset projected decreases in employment in primary wood products manufacturing; a net decrease of 38 percent in lumber and wood products employment from 1965 to 2020 is expected. The Delta-Central Sierra and North Lahontan subregions, without any offsetting increases in secondary manufacturing, have projected decreases in lumber and wood products employment of 55 and 58 percent, respectively, from 1965 to 2020.

The Tulare subregion will experience an increase in primary manufacturing of lumber and wood products in addition to growth in secondary wood products manufacturing associated with the growing Fresno metropolitan area. The result will be an increase in lumber and wood products employment from 1,400 to

2,400 from 1965 to 2020 — an increase of 70 percent. The San Francisco Bay subregion will experience an accelerated decline in employment in the primary phases of lumber and wood products manufacture. But that decline is expected to be more than offset by increases in employment in secondary phases of manufacture. Lumber and wood products employment is projected to rise from 4,900 to 7,500, an increase of 51 percent.

The South Coastal subregion has few plants engaged in primary manufacture of lumber and wood products, but it has a very large secondary manufacturing sector. This subregion has a projected 25-percent increase in lumber and wood products employment — from 8,600 in 1965 to 10,800 in 2020. In the Central Coastal and Colorado Desert subregions, three-fold increases in lumber and wood products employment are expected, based upon anticipated population growth in major metropolitan areas.

Employment in Paper and Allied Products Industries To Triple

Employment in paper and allied products in 1965 was 30,800. Employment in this sector is projected to increase to 46,000 in 1980 and 68,000 by the end of the century. The employment projected for the end of the projection period is over 88,000 — an increase of 187 percent over the 1965 level.

Employment in this sector is much more highly aggregated in secondary manufacturing activities and in population centers than is employment in lumber and wood products. Currently, the primary stages of pulp and paper manufacture account for only a very small part of the total SIC 26 employment. Although the capacity of pulp plants is projected to increase severalfold with attendant increases in employment in primary processes, projected increases in secondary manufacture of paper products indicate that paper and allied products employment will continue to be concentrated in highly populated areas. The South Coastal and San Francisco Bay subregions, which now have 88 percent of the SIC 26 employment, will account for the same percentage of the total paper and allied products employment in 2020 (table 18).

Paper and allied products employment in the North Coastal subregion is projected to increase from none in 1965 to 2,500 by 2020. Almost all of the increase is anticipated between 1965 and 1980 and will be in primary pulp and paper manufacturing. The two North Coastal pulpmills, installed since 1965 and now operating, are expected to become integrated pulp and paper manufacturers by 1980. Employment in this sector in the Sacramento subregion is projected to increase from 700 in 1965 to 2,700 in the year 2020 because of increased activity in both primary and secondary stages of manufacture.

In the San Francisco Bay subregion, employment in the paper and allied products industries is projected to increase from 10,000 in 1965 to 35,700 in the year 2020. In the South Coastal subregion, employment in this sector is expected to increase from a 1965 level of 17,000 to 42,000 in 2020. Essentially all of the projected increases in these two subregions will occur in secondary stages of manufacture.

Of the other seven subregions, the five that now have employment in paper and allied products have projected employment increases in that sector. There is no projected entry into primary manufacture of pulp and paper in these subregions because of water or resource limitations. The North Lahontan and South La-

hontan subregions, which in 1965 had no employment in paper and allied products, have no projected employment in that sector.

For the State as a whole, employment in paper and allied products — which accounted for 38 percent of forest industrial employment in 1965 — is projected to account for two-thirds of such employment by 2020. Trends in employment in this sector are expected to be the major factor in shifting the concentration of California's forest industrial employment from the resource areas to the population concentration areas.

The recent trends in forest industrial employment, and their projections, indicate that California will experience employment growth in this generalized sector of the economy. But to a major degree that growth will not be dependent on the State's own timber resources. Rather, the increased employment will occur in the secondary, market-oriented stages of manufacture and will be located predominantly in the large population centers. Forest industrial employment in the timber resource areas will decline because of decreasing availability of raw material and increasing physical productivity. The North Coastal and North Lahontan subregions will be hardest hit by the projected declines in employment.

Conclusion

In the early days of statehood, California's economic growth was based in large part upon the development of forest products industries, both as a source of building materials and as a major basic industry. As the State's economy grew and diversified, the forest products industries — which also experienced growth and diversification — became a proportionately smaller contributor to the State's economy. But in some local and regional economies within California, forest products industries still dominate.

California's economy will continue to grow. Population is projected to triple in the next 55 years. Attendant with this growth will be increasing demand for wood products in California as well as nationwide. But self-sufficiency in regional timber resources — which was both possible and necessary in the early development of the State — is no longer possible or necessary. The large areas of old-growth timber on private lands — which have been the mainstay of the forest products industries for over 100 years — have diminished to the point where production of wood products has fallen in face of rising demand. A further decline in log production — to 80 percent of current levels — is anticipated by 2000. Wood products originating out of State, which currently account for a substantial part of the wood products consumed in California, will become increasingly important in meeting the anticipated growth in demand.

Factors other than the availability of old-growth timber will also have an impact on the amount of consumable wood available from California forest lands in the future. Commercial forest-land loss to nontimber uses has helped to shape the current resource. Continued loss of commercial forest land, through conversion or dedication to nontimber uses, will further decrease the commercial forest-land base. Most of the loss will occur in the resource subregions that are adjacent to the centers of population growth.

Better use of timber in both the harvesting and manufacturing processes will make possible a moderate increase in consumption by California's forest products industries in the future. This increase will occur despite a decrease in roundwood harvest from the State's forests. The additional raw material obtained by better utilization will be used primarily by the pulp and board industries because of the nature of the material. Consequently, consumption by these industries will increase, but consumption for lumber and plywood will decrease with the projected decrease in log harvest.

For California, the important aspect of the projected decline in log harvest and changes in the forest industrial consumption patterns is the impact of these factors on some of the regional and local economies within the State. In general, the secondary stages of wood and paper manufacture are concentrated in the

population centers, close to consumer or end-use markets and labor markets. In these areas, employment in wood and paper product manufacturing is tied to population growth and is, to a major degree, independent of the availability of raw material from the State's timber resources. These areas will experience growth in employment in the manufacture of wood and paper products. Although this growth in the secondary stages of wood and paper products manufacture and employment will be substantial, it will continue to make only a small contribution to the overall economic growth of the population centers of California.

The major resource subregions within California are relatively remote from the urban industrial complexes. Their economies depend substantially on the forest industries. Within these subregions are communities whose existence depends upon resident forest industries. The wood-using industries located in these subregions are for the most part concerned with the primary stages of manufacture and are directly dependent on the local timber resource.

Technological development results in a diminishing labor requirement to accomplish each of the steps needed to convert standing trees to finished products. Thus, in absence of an increase in the degree of manufacture of the product or in the amount of raw material processed, employment will decrease over time with constant levels of raw material input. In most of the resource-oriented subregions, projected declines in available raw material will add to the employment decline attributable to increasing productivity.

For those subregions whose major basic industry is dependent upon the forest resource, the implications are clear. The days of economic growth — or stability — through increase or maintenance of timber harvest levels are past. Vertical integration — further manufacture of the basic product — has been proposed as a means for increasing employment

within resource regions. It does not seem to be a plausible solution. For much of the product of lumber and plywood plants, no manufacture beyond the primary stage is required before consumption. This is true of most wood used in construction, which in 1962 accounted for over 70 percent of the Nation's lumber and plywood consumption (USDA Forest Service 1965a). Although prefabrication might remove some of the construction process from the building site in the future, the relatively high cost of shipping preassembled components often dictates that prefabrication take place close to the construction site, which means near the market.

The outlook for secondary manufacture of wood and paper consumer products in the resource areas is not favorable. The trend in locational development of secondary manufacturing of wood and paper products — as exhibited in the location of millwork and paper fabricating plants in the market areas — is a manifestation of the economic benefits favoring such location. Finished product manufacture at the market minimizes transportation costs and takes advantage of existing skilled labor markets.

Some gains in employment will accrue in the resource subregions from the increased utilization of residues. Because of the nature of the raw material, these gains will be in the board and pulp and paper industries. But they will offset only slightly the projected employment declines in other sectors of the forest products industries. In summary, future economic growth or maintenance of economic stability in the timber resource subregions of California will be based to a progressively lesser degree upon their timber resources. For those subregions, the trend in timber-based employment is downward. Those subregions must look to diversification to a broader based economy if they are to participate in the future growth and prosperity of California.

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Appendix A

Table 4. — Volume of growing stock on commercial forest land by subregion and owner group, California, 1965

(In million cubic feet)

Subregion	National Forest	Other public	Private	All owners
North Coastal	10,385	1,186	13,468	25,039
Sacramento	10,559	226	6,740	17,525
San Francisco Bay	---	42	986	1,028
Delta-Central Sierra	562	35	537	1,134
San Joaquin	2,930	20	856	3,806
North Lahontan	1,562	41	602	2,205
Central Coastal	34	3	232	269
Tulare	3,140	89	346	3,575
South Lahontan	10	---	5	15
South Coastal	216	(¹)	45	261
Colorado Desert	161	---	45	206
All subregions	29,559	1,642	23,862	55,063

Source: USDA Forest Service.

¹ Less than 500,000 cubic feet.

Table 5. — Annual log production by subregion, California, 1953-68

(In million board feet¹)

Subregion	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968
North Coastal	3,240	3,175	3,309	3,210	2,996	3,338	3,349	2,650	2,892	3,146	3,164	3,141	2,916	2,633	2,756	2,927
Sacramento	1,914	1,564	1,660	1,667	1,455	1,563	1,539	1,751	1,650	1,674	1,510	1,558	1,560	1,624	1,600	1,625
San Francisco Bay	106	155	249	240	230	218	309	238	166	181	201	155	148	106	75	99
Delta-Central Sierra	166	152	147	161	142	138	129	90	166	117	119	91	116	62	96	111
San Joaquin	222	158	220	219	208	182	225	157	197	93	183	193	207	273	256	251
North Lahontan	221	264	264	192	194	82	173	115	134	138	104	142	134	115	77	104
Central Coastal	5	8	21	21	19	36	26	27	28	33	19	24	24	25	29	24
Tulare	109	100	122	135	87	107	112	92	84	139	134	162	146	159	167	202
South Lahontan	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
South Coastal and Colorado Desert	7	24	23	17	16	12	24	16	24	17	27	10	20	11	6	1
All subregions	5,990	5,600	6,015	5,862	5,347	5,676	5,886	5,136	5,341	5,538	5,461	5,476	5,271	5,008	5,062	5,344

Source: California Division of Forestry.

¹Scale unspecified.

Table 6. — Number of sawmills and percent of production by mill size class, California, 1945-68¹

Capacity ² and number of mills	1945	1946	1947	1948	1951	1954	1956	1962	1968
Over 25 million board feet:									
Number	21	24	32	40	42	46	61	59	(³)
Percent of production	48	38	43	43	39	40	43	59	(³)
10-25 million board feet:									
Number	37	43	52	55	97	114	130	90	(³)
Percent of production	26	24	23	19	30	34	34	31	(³)
1-10 million board feet:									
Number	154	278	279	351	380	257	304	92	(³)
Percent of production	23	33	29	33	29	22	21	10	(³)
Less than 1 million board feet:									
Number	245	562	521	538	282	187	180	34	(³)
Percent of production	3	5	5	5	2	4	2	--	(³)
All mills:									
Number	457	907	884	984	801	604	675 ⁴	275 ⁵	216
Percent of production	100	100	100	100	100	100	100	100	100

Source: USDA Forest Service.

¹Data for 1945 through 1951 include Nevada mills, whose contribution is not significant.

²Based upon rated annual capacity in board feet.

³Not available.

⁴Excludes 20 mills that were not classified as to size.

⁵Excludes 22 mills that were not classified as to size.

Table 7. — Number of forest industry establishments and employees by major industry and subregion, California, 1965

Subregion	Lumber and wood products, SIC 24		Paper and allied products, SIC 26	
	Establishments	Employees	Establishments	Employees
North Coastal	568	19,374	---	---
Sacramento	409	11,328	8	701
San Francisco Bay	313	4,947	135	10,043
Delta-Central Sierra	54	2,095	5	1,095
San Joaquin	53	1,144	5	477
North Lahontan	18	326	---	---
Central Coastal	63	684	5	161
Tulare	86	1,399	4	120
South Lahontan	---	---	---	---
South Coastal	571	8,633	311	17,211
Colorado Desert	57	1,085	7	1,000
All subregions	2,192	51,015	480	30,808

Source: U. S. Bureau of the Census and California Department of Employment.

Table 8. — Number of forest industry establishments by industry group and subregion, California, 1965

Subregion	Logging, SIC 2411	Sawmills and planing mills, SIC 2421	Veneer and plywood plants, SIC 2432	Miscellaneous lumber and wood products, SIC 24 except 2411, 2421, 2432	Paper and allied products, SIC 26
North Coastal	370	153	23	22	(¹)
Sacramento	207	88	3	111	8
San Francisco Bay	44	52	4	213	135
Delta-Central Sierra	14	8	1	31	5
San Joaquin	19	14	1	19	5
North Lahontan	9	5	---	4	---
Central Coastal	17	7	---	39	5
Tulare	17	15	---	54	4
South Lahontan	---	---	---	---	---
South Coastal	1	26	17	527	311
Colorado Desert	5	4	1	47	7
All subregions	703	372	50	1,067	480

Source: U. S. Bureau of the Census.

¹Two pulpmills were under construction in 1965.

Table 9. — Capacities of primary wood products processing plants by subregion, California, 1965

Subregion	Sawmills, annual capacity	Softwood plywood plants, annual capacity	Woodpulp mills	Particleboard plants, annual capacity
	Thousand bd. ft.	Million sq. ft., 3/8-inch basis	Tons per 24 hours	Million sq. ft., 3/4-inch basis
North Coastal	3,169,440	979	350 ¹	68
Sacramento	1,701,160	230	225	99
San Francisco Bay	131,900	96	675	---
Delta-Central Sierra	106,000	65	---	---
San Joaquin	297,100	60	---	---
North Lahontan	77,800	---	---	---
Central Coastal	44,480	---	---	---
Tulare	193,980	---	---	---
South Lahontan	---	---	---	---
South Coastal	---	---	35	---
Colorado Desert	17,360	---	---	26
All subregions	5,739,220	1,430	1,285	193

Source: USDA Forest Service and various trade journals.

¹Hardboard plant.

Table 10. — Value added by manufacture by selected major industries and by subregion, California, 1963¹

(In thousand dollars)

Subregion	All manufacturing	Lumber and wood products, SIC 24	Paper and allied products, SIC 26	Total, SIC 24 and 26
North Coastal	220,124	202,958	---	202,958
Sacramento	669,935	102,986	9,192	112,178
San Francisco Bay	3,855,831	41,702	119,973	161,675
Delta-Central Sierra	242,545	18,124	14,077	32,201
San Joaquin	178,902	11,572	6,132	17,704
North Lahontan	6,195	4,496	---	4,496
Central Coastal	210,111	6,882	1,877	8,759
Tulare	327,859	12,452	1,543	13,995
South Lahontan	2,662	---	---	---
South Coastal	10,917,798	90,407	198,769	289,176
Colorado Desert	519,515	11,045	12,342	23,387
All subregions	17,151,477	502,624	363,905	866,529

¹These figures are based upon 1963 Census of Manufactures. Lack of census data for some counties necessitated estimates by the author.

Table 11. — Estimated consumption of roundwood and wood residues by source and use, California, 1965-2020

(In million cubic feet)

Year	Roundwood			Plant residues for pulping and board
	Pulpwood	Saw logs, veneer logs, and miscellaneous	Total	
1965	5	878	883	86
1980	7	757	764	229
2000	84	705	789	219
2020	106	723	829	227

Table 12. — Current and projected log production by subregion, California, 1965-2020 (International 1/4-inch scale)

(In million board feet)				
Subregion	1965 ¹	1980	2000	2020
North Coastal	2,916	2,094	2,058	2,256
Sacramento	1,560	1,475	1,408	1,400
San Francisco Bay	148	98	46	23
Delta-Central Sierra	116	109	102	95
San Joaquin	207	207	225	230
North Lahontan	134	134	122	120
Central Coastal	24	14	5	5
Tulare	146	237	247	245
South Lahontan	---	---	---	---
South Coastal	7	5	3	1
Colorado Desert	12	10	7	4
All subregions	5,270	4,383	4,223	4,379

¹Source: California Division of Forestry.

Table 13. — Current and projected production of saw logs, veneer logs, and miscellaneous industrial timber products by subregion, California, 1965-2020

(In million cubic feet)				
Subregion	1965	1980	2000	2020
North Coastal	472	363	335	360
Sacramento	261	254	236	235
San Francisco Bay	26	18	9	4
Delta-Central Sierra	19	19	19	18
San Joaquin	31	35	39	40
North Lahontan	25	23	21	22
Central Coastal	4	2	1	1
Tulare	37	40	43	42
South Lahontan	--	--	--	--
South Coastal	1	1	1	--
Colorado Desert	2	2	1	1
All subregions	878	757	705	723

Table 14. — Current and projected pulpwood¹ production by subregion, California, 1965-2020
(In million cubic feet)

Subregion	1965	1980	2000	2020
North Coastal	46.7	110.0	143.5	163.7
Sacramento	33.0	81.8	111.9	122.3
San Francisco Bay	4.1	7.3	4.9	3.8
Delta-Central Sierra	1.7	5.2	5.6	5.6
San Joaquin	1.7	10.8	14.3	14.3
North Lahontan	--	5.9	4.7	5.9
Central Coastal	1.0	.9	.9	.9
Tulare	.9	11.6	15.0	15.0
South Lahontan	--	--	--	--
South Coastal and Colorado Desert	2.1	2.1	2.1	2.1
All subregions	91.2	235.6	302.9	333.6

Source: USDA Forest Service.

¹ Includes wood raw material used in the manufacture of hardboard and particleboard, as well as that used in the manufacture of pulp and paper — domestically and otherwise.

Table 15. — Current and projected capacity of woodpulp mills by subregion, California, 1965-2020

(In tons per 24 hours)				
Subregion	1965	1980	2000	2020
North Coastal	350 ¹	1,750	2,100	2,500
Sacramento	225	925	1,225	1,225
San Francisco Bay	675	675	1,175	1,175
Delta-Central Sierra	---	---	---	---
San Joaquin	---	---	---	---
North Lahontan	---	---	---	---
Central Coastal	---	---	---	---
Tulare	---	---	---	---
South Lahontan	---	---	---	---
South Coastal	35	35	35	35
Colorado Desert	---	---	---	---
All subregions	1,285	3,385	4,535	4,935

¹ This capacity is in a hardboard plant. Although hardboard plants are now classified as SIC 24 industries for purposes of reporting employment and value added in manufacture, the capacity is reported here because the raw material requirements and manufacturing processes are similar to those of the woodpulp industry.

Table 16. — Current and projected population estimates by subregion, California, 1965-2020¹

(In thousands)

Subregion	1965	1980	2000	2020
North Coastal	208	228	423	879
Sacramento	1,144	1,606	2,855	5,151
San Francisco Bay	4,156	5,926	8,906	12,065
Delta-Central Sierra	286	350	660	1,439
San Joaquin	339	444	783	1,454
North Lahontan	21	27	41	76
Central Coastal	663	976	1,866	3,738
Tulare	958	1,235	2,020	3,697
South Lahontan	14	20	31	41
South Coastal	9,182	12,769	16,957	19,959
Colorado Desert	1,087	1,830	3,577	6,372
All subregions	18,058	25,411	38,119	54,871

¹ Region totals as provided by Water Resources Council, March 1968. Subregional allocations by the State of California Department of Water Resources.

Table 17. — Current and projected employment in the lumber and wood products industries by subregion, California, 1965-2020¹

Subregion	1965	1980	2000	2020
North Coastal	19,374	12,998	9,123	7,408
Sacramento	11,328	10,728	8,636	7,706
San Francisco Bay	4,947	5,478	6,683	7,482
Delta-Central Sierra	2,095	1,753	1,328	953
San Joaquin	1,144	1,081	912	708
North Lahontan	326	251	173	138
Central Coastal	684	1,091	1,628	2,318
Tulare	1,399	1,783	2,033	2,382
South Lahontan	---	---	---	---
South Coastal	8,633	9,905	10,864	10,806
Colorado Desert	1,085	1,692	2,870	3,450
All subregions	51,015	46,760	44,250	43,351

¹ All employment in SIC code 24, as defined by the U. S. Bureau of the Census.

Table 18. — Current and projected employment in paper and allied products industries by subregion, California, 1965-2020¹

Subregion	1965	1980	2000	2020
North Coastal	0	2,450	2,500	2,525
Sacramento	701	2,110	2,755	2,725
San Francisco Bay	10,043	12,455	23,530	35,715
Delta-Central Sierra	1,095	1,085	1,145	1,245
San Joaquin	477	500	750	800
North Lahontan	---	---	---	---
Central Coastal	161	200	250	400
Tulare	120	220	320	520
South Lahontan	---	---	---	---
South Coastal	17,211	25,420	34,780	42,060
Colorado Desert	1,000	1,480	2,020	2,440
All subregions	30,808	45,920	68,050	88,430

¹ All employment in SIC code 26, as defined by the U. S. Bureau of the Census.

Table 19. — Estimated area of commercial forest land by subregion, California, 1965-2020

(In thousand acres)

Subregion	1965	1980	2000	2020
North Coastal	7,156	7,121	7,091	7,061
Sacramento	6,249	6,200	6,150	6,100
San Francisco Bay	418	370	300	200
Delta-Central Sierra	382	370	350	320
San Joaquin	916	915	910	900
North Lahontan	1,055	1,050	1,050	1,050
Central Coastal	152	80	80	50
Tulare	771	765	765	760
South Lahontan	7	---	---	---
South Coastal	103	50	50	---
Colorado Desert	136	50	50	25
All subregions	17,345	16,971	16,796	16,466

Source: USDA Forest Service.

Table 20. — Projected inventory of growing stock and sawtimber on commercial forest land by subregion, California, 1965-2020

Subregion	Growing stock				Sawtimber (International 1/4-inch scale)			
	1965	1980	2000	2020	1965	1980	2000	2020
	----- Million cubic feet -----				----- Million board feet -----			
North Coastal	25,039	25,569	26,489	27,659	132,089	119,623	115,590	114,289
Sacramento	17,525	15,854	14,168	12,622	98,523	84,266	68,787	54,146
San Francisco Bay and Central Coastal	1,297	1,167	1,298	1,240	7,033	5,486	6,208	5,997
Delta-Central Sierra and San Joaquin	4,940	4,829	4,290	4,009	27,746	25,265	21,890	18,311
North Lahontan	2,205	2,146	2,290	2,633	11,094	10,225	9,758	9,772
Tulare	3,575	3,280	2,941	2,633	19,784	17,687	14,900	11,823
South Lahontan, South Coastal, and Colorado Desert	482	200	198	31	2,795	1,140	1,082	152
All subregions	55,063	53,045	51,674	50,827	299,064	263,692	238,215	214,490

Source: USDA Forest Service.

Table 21. — Trend of net annual growth of growing stock and sawtimber on commercial forest land by subregion, California, 1965-2020

Subregion	Growing Stock				Sawtimber (International 1/4-inch scale)			
	1965	1980	2000	2020	1965	1980	2000	2020
	--- Million cubic feet ---				--- Million board feet ---			
North Coastal	405	460	448	461	1,511	1,805	2,015	2,205
Sacramento	137	160	188	171	586	713	824	780
San Francisco Bay and Central Coastal	30	31	33	25	114	130	155	118
Delta-Central Sierra and San Joaquin	31	34	35	29	150	162	166	144
North Lahontan	19	24	33	35	81	93	112	126
Tulare	19	21	21	19	96	101	101	88
South Lahontan, South Coastal, and Colorado Desert	1	---	---	---	7	3	3	---
All subregions	642	730	758	740	2,545	3,007	3,376	3,461

Source: USDA Forest Service.

Table 22. — Estimated consumption of saw logs, veneer logs, and miscellaneous industrial timber products produced in California by subregion, 1965-2020

(In million cubic feet)				
Subregions	1965	1980	2000	2020
North Coastal	464	344	325	350
Sacramento	246	237	220	218
San Francisco Bay	26	18	9	4
Delta-Central Sierra	18	17	17	16
San Joaquin	40	43	49	49
North Lahontan	11	10	9	10
Central Coastal	6	3	1	1
Tulare	40	44	47	46
South Lahontan	---	---	---	---
South Coastal and Colorado Desert	2	2	1	1
All subregions	853	718	678	695
Foreign export	3	20	10	10
Out-of-State shipments	22	19	17	18
Total consumption	878	757	705	723

Source: USDA Forest Service.

Table 23. — Estimated pulpwood consumption by subregion, California, 1965-2020¹

(In million cubic feet)

Subregion	1965	1980	2000	2020
North Coastal	25.1	101.5	122.6	149.7
Sacramento	20.7	62.9	80.9	83.9
San Francisco Bay	40.6	40.6	70.7	70.7
Delta-Central Sierra	---	---	---	---
San Joaquin	---	---	3.0	3.0
North Lahontan	---	---	---	---
Central Coastal	---	---	---	---
Tulare	---	---	3.0	3.0
South Lahontan	---	---	---	---
South Coastal and Colorado Desert	4.2	4.2	4.2	4.2
All subregions	90.6	209.2	284.4	314.5
Foreign export	---	26.8	18.6	18.5
Total consumption ²	90.6	236.0	303.0	333.0

Source: USDA Forest Service.

¹Includes wood raw material used in the manufacture of hardboard and particleboard, as well as that used in the manufacture of pulp and paper — domestically and otherwise.

²Totals do not agree with those in table 14 because of rounding errors.

Appendix B

Definition of terms

Allowable cut. — The volume of timber that may be cut during a given period under specified management plans for sustained production, such as those in effect on National Forests.

Commerical forest land. — Forest land that is capable of producing crops of industrial wood and is not withdrawn from timber use by statute or administrative regulation; includes areas suitable for management to grow crops of industrial wood and generally capable of producing in excess of 20 cubic feet per acre of annual growth; includes both accessible and prospectively accessible areas and both operable and prospectively operable areas.

Commercial species. — Tree species now or prospectively suitable for industrial wood products; excludes so-called weed species.

Cull trees. — Live trees that do not contain at least one merchantable saw log, now or prospectively, because of roughness, rot, or species.

Diameter classes. — A classification of trees based on diameter of the tree outside bark, measured at breast height (4½ feet above the ground). D.b.h. is the common abbreviation for "diameter at breast height."

Employment. — The estimated number of all production and nonproduction workers in

the appropriate SIC code or specially defined occupational category.

Farmer-owned lands. — Lands owned by operators of farms.

Forest industry lands. — Lands owned by companies or individuals operating wood-using plants.

Forest land. — Land at least 10 percent stocked by forest trees of any size, or formerly having had such tree cover and not now developed for nonforest use; includes chaparral areas in the West and afforested areas. The minimum area for classification of forest land is 1 acre. Roadside, streamside, and shelterbelt strips of timber must have a crown width at least 120 feet wide to qualify as forest land. Unimproved roads and trails, streams, and clearings in forest areas are classed as forest if less than 120 feet in width. (See also commerical, noncommercial, productive-reserved, and unproductive forest lands.)

Forest management. — The protection and management of forest lands for the production of timber and related products.

Forest products industries. — See timber products industries.

Forest types. — A classification of forest land based upon the tree species now forming most of stocking. Where no species com-

prises a majority of a stand, types are based on plurality of stocking.

Growing-stock trees. — Live sawtimber trees, poletimber trees, saplings, and seedlings of commercial species meeting specified standards of quality or vigor that are now or may be expected to become suitable for use as industrial wood; excludes cull trees.

Growing-stock volume. — Net volume in cubic feet of growing-stock trees 5.0-inch d.b.h. and over from a 1-foot stump to a minimum 4.0-inch top diameter outside bark at the central stem or to a point where the central stem breaks into limbs.

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

Industrial wood. — All commercial roundwood products, such as saw logs and pulpwood but excluding fuelwood and posts.

Land area. — (a) Census definition — the area of dry land and land temporarily or partially covered by water, such as marshes, swamps, and river flood plains (omitting tidal flats below mean high tide); streams, sloughs, estuaries, and canals less than one-eighth of a statute mile in width; and lakes, reservoirs, and ponds less than 40 acres in area. (b) Forest Survey definition — same as above except maximum width of streams, etc., is 120 feet, and maximum size of lakes, etc., is 1 acre.

Logging residues. — The unused portions of poletimber and sawtimber trees cut or killed by harvesting timber, land clearing, or cultural operations.

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

Mortality. — The volume of sound wood in live sawtimber and poletimber trees (growing-stock trees) dying from natural causes during a specified period.

National Forest land. — Federal lands that have been designated by Executive Order or statute as National Forests or purchase units, and other lands under the administration of

the Forest Service, including experimental areas and Bankhead-Jones Title III lands.

Net annual growth. — The average annual change in volume of sound wood in live sawtimber and poletimber trees resulting from natural causes, i.e., increase in volume in absence of mortality and cutting, minus mortality, plus growth on mortality and growth on one-half the cut during a specified period.

Net volume. — Gross volume less deductions for rot, sweep, or other defects affecting use for timber products.

Noncommercial forest land. — Unproductive forest land incapable of yielding crops of industrial wood because of adverse site conditions, and productive forest land withdrawn from commercial timber use through statute or administrative regulation.

Nonforest land. — Land that has never supported forests and lands formerly forested but now developed for such nonforest uses as crops, improved pasture, residential areas, and city parks, improved roads, and adjoining rights-of-way, powerline clearings, and certain areas of water classified by the Bureau of the Census as land (see definition of land area). In forest areas, unimproved roads, streams, canals, and nonforest strips must be more than 120 feet wide; and clearings in forest areas must be more than 1 acre in size, to qualify as nonforest land.

Nonstocked areas. — Commercial forest land less than 10 percent stocked with growing-stock trees.

Old-growth sawtimber stands. — Sawtimber stands in which 50 percent or more of the net board-foot volume is in old-growth sawtimber trees.

Old-growth sawtimber trees. — Trees that have reached or passed the age of physiological maturity.

Other public lands. — Federal lands other than National Forests, such as lands administered by the Bureau of Land Management, and Indian lands; State, county, and municipal lands.

Ownership. — The property owned by one owner, including all such parcels of land in the United States.

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

Poletimber stands. — Stands at least 10 percent stocked with growing-stock trees, and with poletimber trees making up a plurality of this stocking.

Poletimber trees. — Live trees of commercial species 5.0 to 10.9 inches in diameter at breast height, and of good form and vigor.

Productive-reserved forest land. — Productive public forest land withdrawn from timber use through statute or administrative regulation.

Projected demand. — The estimated quantity of a roundwood product, or products, that would be demanded at specified times in the future under explicit assumptions as to (1) the growth of population and gross national product (GNP), (2) trends in the use of materials, and (3) trends in the prices of timber products relative to substitute materials.

Projected employment. — The estimated employment that would be associated with meeting projected demands for a timber product or products at specified times in the future under explicit assumptions or as to (1) changes in productivity; i.e., output per employee, (2) changes in level of production, and (3) changes in structure of the industry.

Raw material. — In the forest products industries, the wood fiber material used as the basic input in primary manufacturing processes. Includes roundwood, and byproducts such as residues used for fuel or pulping.

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

Saw-log. — A log meeting minimum approved log-grade specifications; or, for species for which approved log grades are lacking, a log

at least 10 feet long, with a minimum d.i.b. of 10 inches, and with a net scale of at least 30 board feet.

Saw-log portion. — That part of the bole of sawtimber trees between the stump and the saw-log top.

Sawtimber stands. — Stands at least 10 percent stocked with growing-stock trees, and with sawtimber trees making up a plurality of this stocking.

Sawtimber trees. — Live trees, 11.0 inches or larger in diameter at breast height, containing at least one minimum saw-log.

Sawtimber volume. — Net volume of the saw-log portion of live sawtimber in board feet, International 1/4-inch scale.

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

Standard Industrial Classification (SIC). — A classification of establishments by type of activity in which engaged. An "establishment" is an economic unit which produces goods or services.

Stocking. — A measure of the degree to which area is occupied or used by trees of specified classes, including (a) all live trees, (b) growing-stock trees, and (c) desirable trees. Classification of forest land and forest types is based on stocking of all live trees. Stocking of growing-stock trees is used to determine stand-size and age class.

Stocking standards. — The minimum number of well-spaced trees required to use fully the area by specified forest types and sites.

Timber cut from growing stock. — The volume of sound wood in live sawtimber and poletimber trees cut for forest products during a specified period, including both roundwood products and logging residues.

Timber cut from sawtimber. — The net board-foot volume of live sawtimber trees cut for forest products during a specified period, including both roundwood products and logging residues.

Timber products. — Roundwood products and

byproducts of primary wood manufacturing plants; includes saw logs, veneer logs and bolts, cooperage logs and bolts, pulpwood, fuelwood, piling, poles, posts, hewn ties, mine timbers, and other round, split, or hewn products.

Timber products industries. — Industries included in Major Group 24, Lumber and Wood Products, Except Furniture; and Major Group 26, Paper and Allied Products, described in the "Standard Industrial Classification Manual" (Bureau of the Budget 1967). The major industries are:

Logging. — (SIC 2411) Logging camps and logging contractors primarily engaged in cutting timber and in producing rough, round primary forest or wood raw materials.

Sawmills and planing mills. — (SIC 2421) Establishments primarily engaged in sawing rough lumber and timber from logs and bolts, or resawing cants and flitches into lumber, including box lumber, and softwood cut stock; planing mills combined with sawmills; and separately operated planing mills which are engaged primarily in producing surfaced lumber and standard workings or patterns lumber.

Veneer and plywood plants. — (SIC 2432) Establishments primarily engaged in producing commercial veneer, either face or technical, and those primarily engaged in manufacturing commercial plywood, including nonwood backed or faced veneer and nonwood faced plywood, from veneer produced in the same establishment or from purchased veneer.

Paper and allied products. — (SIC 26) Establishments primarily engaged in the manufacturing of pulps from wood and other cellulose fibers and rags; the manufacture of paper and paperboard; and the manufacture of paper and paperboard into converted products such as paper coated off

the paper machine, paper bags, paper boxes, and envelopes.

Miscellaneous wood manufacturing. — (All SIC 24 categories except 2411, 2421, 2432) Employment reported for several other SIC divisions within Major Group 24 were combined as miscellaneous wood manufacturing. The group includes hardwood dimension mills, shingle mills, millwork plants, prefabricated structures, wooden containers, and wood preserving. Industries in this group are either secondary manufacturers or they process a small amount of the total log harvest.

Unproductive forest land. — Forest land incapable of yielding crops of industrial wood because of adverse site conditions; includes sterile or poorly drained forest land, subalpine forests, and steep, rocky areas where topographic conditions are likely to prevent management for timber production.

Value added by manufacture. — Adjusted value added is obtained by subtracting cost of materials, supplies and containers, fuel, purchased electric energy, and contract work from value of shipments for products manufactured, plus receipts for services rendered and other receipts such as the sale of scrap. It also includes (1) value added by merchandising operations (i.e., the difference between the sale value and cost of merchandise sold without further manufacture, processing, or assembly), plus (2) the net change in finished goods and work-in-process inventories between the beginning and end of the year (U. S. Bureau of the Census 1966b).

Young-growth sawtimber stands. — Sawtimber stands in which 50 percent or more of the net board-foot volume is in young-growth sawtimber trees.

Young-growth sawtimber trees. — Trees that have not passed the age of physiological maturity.

Oswald, Daniel D.

1970. California's forest industries — prospects for the future. USDA Forest Serv. Resour. Bull. PNW-35, 55 p., illus. Pacific Northwest Forest and Range Experiment Station, Portland, Oregon.

Summarizes recent trends in California's forest based industries and projects the availability of timber and forest industrial development and employment to the year 2020. The projections assume continuation of ongoing trends in forest management and utilization practices. Timber harvest is projected to decline 20 percent by the end of this century. Forest industry employment in harvesting and primary processing of timber will decline but gains in employment are expected in secondary manufacture of wood and paper products in the major population centers.

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The mission of the PACIFIC NORTHWEST FOREST AND RANGE EXPERIMENT STATION is to provide the knowledge, technology, and alternatives for present and future protection, management, and use of forest, range, and related environments.

Within this overall mission, the Station conducts and stimulates research to facilitate and to accelerate progress toward the following goals:

1. Providing safe and efficient technology for inventory, protection, and use of resources.
2. Development and evaluation of alternative methods and levels of resource management.
3. Achievement of optimum sustained resource productivity consistent with maintaining a high quality forest environment.

The area of research encompasses Oregon, Washington, Alaska, and, in some cases, California, Hawaii, the Western States, and the Nation. Results of the research will be made available promptly. Project headquarters are at:

College, Alaska	Portland, Oregon
Juneau, Alaska	Roseburg, Oregon
Bend, Oregon	Olympia, Washington
Corvallis, Oregon	Seattle, Washington
La Grande, Oregon	Wenatchee, Washington



The FOREST SERVICE of the U. S. Department of Agriculture is dedicated to the principle of multiple use management of the Nation's forest resources for sustained yields of wood, water, forage, wildlife, and recreation. Through forestry research, cooperation with the States and private forest owners, and management of the National Forests and National Grasslands, it strives — as directed by Congress — to provide increasingly greater service to a growing Nation.

