

An aerial photograph of a vast, dense forest of tall, slender redwood trees. The forest is lush green, with sunlight filtering through the canopy, creating a dappled light effect. A dark, winding river or stream flows through the lower portion of the forest, reflecting the surrounding greenery. The overall scene is serene and majestic, showcasing the natural beauty of a redwood forest.

OUR GROWING REDWOODS



Important Dates in Redwood Forest History

- 1769:** California coast redwoods first discovered when Spanish explorers reach Monterey Bay.
- 1794:** Archibald Menzies, English botanist, collects first redwood specimens for botanical study.
- 1833:** Joseph R. Walker exploration party discovers Sierra "bigtrees," shorter but bulkier trees than coast redwoods, in Sierra Nevada Mountains. His journal record passes unnoticed.
- 1834:** John Cooper builds state's first commercial sawmill in Sonoma County.
- 1847:** Stephen Endlicher recognizes coast redwood as entirely new genus, names it Sequoia.
- 1850:** California admitted to the Union, adopts first forest fire laws.
- 1852:** A. T. Dowd discovers Calaveras North Grove while pursuing wounded bear. Discovery brings Sierra bigtrees to attention of the world.
- 1854:** French botanist, Decaisne, recognizes Sierra "redwood" as another species of Sequoia.
- 1864:** President Lincoln approves grant of Mariposa Grove (*Sequoia gigantea*) to State of California. (Tract returned to federal ownership in 1905 for preservation in Yosemite National Park.)
- 1885:** California creates nation's first state board of forestry.
- 1905:** E. T. Allen appointed first state forester of California.
- 1909:** California Forest Protective Association organized by forest industries.
- 1916:** California Redwood Association organized.
- 1918:** Save-the-Redwoods League formed.
- 1921:** Save-the-Redwoods League acquires first groves of what is now the 37,763-acre Humboldt Redwoods State Park.
- 1922:** Redwood lumber industry establishes tree nurseries and begins organized reforestation program.
- 1927:** Legislature creates State Park Commission with Division of Parks (now the Division of Beaches and Parks).
- 1945:** California Forest Practice Act enacted. State Board of Forestry reorganized.
- 1947:** State acquires Jackson State Forest, begins program demonstrating redwood timber management.
- 1950:** Forest industries certify first Redwood Tree Farm in concerted program to encourage growing redwood timber as a continuous crop on privately owned, taxpaying forest land. Redwood Region Conservation Council founded.
- 1964:** World's tallest tree discovered on Redwood Tree Farm lands of Arcata Redwood Co. near Orick, Calif.

Redwood Highlights

California's redwoods are destined to remain a permanent part of the American scene. Always there will be old redwood giants in the government-owned state and national parks. In the privately owned producing forests, new generations of young-growth redwoods are growing rapidly into a magnificent renewable resource for the future.

- There are two "redwood" species, *Sequoia gigantea* or bigtree of the Sierra and *Sequoia sempervirens* or coast redwood, in California. The Giant Sequoia or bigtree, the shorter and bulkier of the two, is virtually all in National Park groves. Coast redwoods, usually slimmer and taller, comprise by far the greater part of California's redwood acreage.
- The total acreage of government-owned coast redwood forest is three times the total area of San Francisco.
- Arranged in a strip, government-owned coast redwood forests would make a solid strip a mile wide stretching more than 355 miles, almost the distance from New York to Pittsburgh or from Los Angeles to Phoenix.
- Approximately 643,000 acres of privately owned forest land in the Redwood Region are enrolled in the forest industry's Tree Farm program, dedicated to growing timber crops on a perpetual basis. Some 92.4 percent of today's young-growth coast redwood volume is on privately owned forest land.
- A redwood forest renews itself naturally. Not only does the tree produce seed prolifically, but the root system of redwood stumps sends up sprouts repeatedly.
- Young redwood is virtually unmatched in its capacity for tremendously fast growth. New young-growth trees often equal the height of thousand-year-old giants in less than a man's lifetime.
- Young-growth redwood in the producing forests today is beginning to hit its best growth strides. Rate of redwood forest growth has increased 56 percent since the government timber inventory of 1952, and the amount of young-growth sawtimber volume has more than doubled since the 1948 inventory.
- Today's supply of standing young-growth redwood timber is expected to double in volume again by the year 2000.
- Projections in a recent study made for the National Park Service indicate that total redwood growth will equal removal by 1975 and that sawtimber growth and removal will reach a balance by 1985.





Ridge after ridge of coast redwood roll into mist-shrouded distance on producing timberlands of Georgia-Pacific Corp. near Eureka, Calif. Aerial view gives perspective of the redwoods not often seen from roads or overlooks.

OUR GROWING REDWOODS

Of all the myriad plants that crowd across Earth's botanical spectrum, perhaps none stir men's emotions so profoundly as do the trees. This is particularly true of the redwoods, whose longevity and spectacular dimensions set them apart as forest monarchs. The life span of a redwood tree is of such extent that it inevitably becomes a patriarch among the other kinds of trees with which it dwells.

The redwood forest is a climax forest; that is, it is the final stage in a succession of natural plant communities to inhabit the land. It varies considerably from one area to another throughout its range. The finest stands, those occasional groves of pure redwood which have excited the world's admiration, are found on the deep, moist soil of river benches and lower slopes. Visitors to redwood parks and groves see the finest specimens of the trees, but a large part of the total

redwood acreage would draw no special comment except for an occasional large tree. Contrary to general belief, not all redwoods are large and old. The larger trees attract attention, but the trees of a redwood forest normally consist of all ages and sizes and are a mixture of redwoods with other species of trees.

All Americans have a stake in seeing that California's unique redwood forests are used without impairment and that enough old giants are preserved so that future generations of Americans also may stand in awe under the silent shadows of the unique groves that have been saved for this purpose. This redwood reference booklet presents an objective examination of the amount of old-growth redwood forest being set aside for posterity, of the management of the producing forests of the Redwood Region and of the outlook for the redwood forests.

Not One Species, But Two

It is believed that redwoods have been growing in California for 40 million years, or even longer. They once flourished in other parts of the world during the mild, humid climate of the Miocene epoch before successive ice masses pushed southward across the continents. Geologists have discovered fossil remains of redwoods in various sections of the United States, Greenland, Siberia, western Europe and Asia. *Taxodiaceae*, the redwood family of trees, today comprises 10 genera and 16 species. These include the *Taxodium* (baldcypress) of the southeastern United States and Mexico; a deciduous relative, *Metasequoia*, growing in central China; Japan's *Cryptomeria*, Tasmania's *Athrotaxis* and several other trees of eastern and southern Asia.

The earliest known discovery of California redwoods by white men occurred in 1769 when the Gaspar de Portolá expedition of Spanish explorers reached Monterey Bay and recorded finding the countryside "well forested with very high trees of a red color." They named them "Palo Colorado" (red tree). In 1847 an Austrian botanist, Stephen Endlicher, recognized the tree as being a new genus. Endlicher was also a linguist who had studied the remarkable Cherokee alphabet devised by an American Indian, Sequoyah (1770-1843). Determined to honor the unusual red man, he named the new genus "Sequoia." California's redwoods now grow in plantations elsewhere in the world, helping to perpetuate the species.

Sequoia gigantea

There are actually two species of "redwood" in California. One is the Giant Sequoia, *Sequoia gigantea*, commonly called the bigtree. It is found in National Park groves and isolated areas on the western slopes of the Sierra Nevada at altitudes from 3,000 to 8,900 feet. It generally grows in association with sugar pine, ponderosa pine, white fir, incense cedar and California black oak. It is never found in pure stands of any size, and its total area (about 35,000 acres) always has been small. However, some of California's best known tree giants—such as the world's largest tree, the General Sherman—are Giant Sequoias.



Sequoia gigantea
Big Tree
Sierra Redwood

Almost all of these—98.6 percent—are now preserved in more than 70 federal or state groves along the species' narrow 260-mile range from Placer County southward to southern Tulare County, so that virtually none are being cut today. They are noted for their great bulk. The General Grant Tree, for example, contains enough wood to build 50 six-room frame houses. Still larger is the General Sherman Tree which is 101 feet around at its base and weighs an estimated 6,000 tons. Its largest branch, a hundred feet from the ground, is seven feet in diameter.

Although the bristlecone pine, which grows within 100 miles of the Giant Sequoias, claims the world's record for longevity (4,600 years), *Sequoia gigantea* may live more than 3,000 years. Much of its survival ability is due to the extraordinary qualities of its cinnamon-red bark—sometimes measuring as much as two feet in thickness and highly flavored with tannin—which makes the tree practically invulnerable to insects. Spongy and fibrous, the bark is nearly as fireproof as asbestos. One bigtree struck by lightning during a July thunderstorm some years ago smoldered quietly without dying until a snowstorm put out the fire in October. The root system of a single tree may spread in a great flat mat up to four acres in size. The tree's heartwood is a brilliant rose purple. John Muir was among those who wrote letters with a pen dipped in "its rosy purple drops of sap."

Sequoia sempervirens

By far the most abundant species of redwood is *Sequoia sempervirens*, better known as the California redwood or coast redwood. This has been the source of commercial redwood lumber since the days of Russian colonization in 1809. Coast redwood grows extensively over an area of 1.69 million acres stretching along the northern California coast from southern Monterey County north for over 500 miles to a point just over the Oregon border. The region is a broken strip of irregular width, rarely reaching more than 30 miles inland from the ocean-fed fog belts of the coast. The forests within it are not all redwood, for intermixed with the coast redwoods are Douglas fir, hemlock, spruce, lowland white fir and other forest trees. Coast redwoods tend to be younger and smaller in diameter



Sequoia sempervirens
California Redwood
Coast Redwood



Superlative old redwoods are reserved for public enjoyment on Georgia-Pacific Corp. Tree Farm near Fortuna. This grove illustrates the "climax forest" in which redwood has eliminated all other species of trees. Many redwood companies are holding similar properties for recreational use.

than the Giant Sequoia of the Sierra, but are usually taller.

Redwood is best known for its Paul Bunyan proportions; in height the coast redwood is among the world's tallest trees. It is common to find trees 200 feet tall. On river benches, where soil is moist and deep, trees 300 feet tall are not uncommon. The height, however, is not a factor of age. Coast redwood on the best sites can attain 200 feet in less than a century.

The world's tallest redwood tree is a newly discovered champion on Tree Farm lands of Arcata Redwood Co., about 10 miles east of the Pacific Ocean near Orick, in Humboldt County. Though its age is estimated at between 400 and 800 years, its 367.8-foot height easily tops that of the former champion, the 356.5-foot Rockefeller Tree located in Humboldt Redwoods State Park 58 miles to the south. Growing with the new king and discovered at the same time by a National Geographic Society team are the world's second-, third-, and sixth-tallest redwood trees. The company has named a distinguished panel of people from government, industry and the public to advise on protection of the famous trees.

The tallest trees are not necessarily those with maximum diameter, however. The much-visited Founders Tree near Dyerville, for example, stands 352.6 feet tall but is only 12 feet in diameter, whereas elsewhere a 20-foot-diameter tree is only 308 feet tall. Nor is there any relationship between age and diameter. Various trees that measure 12 feet in diameter have been found

to range in age from under 500 years to as much as 2,200 years.

It is the coast redwood which makes up the great bulk of the redwood resource and is the only redwood managed for use in the producing-forest area.

GOVERNMENT PARKS AND FORESTS

An objective view of the great extent to which the most spectacular of the redwoods already have been acquired by government for perpetual preservation provides assurance that always there will be redwood forests and groves for man's enjoyment.

As of July, 1964, there were 107,458 acres of coast-redwood parks and groves in 28 state parks and one national monument dedicated to perpetual preservation. Federal, state and local government agencies own an additional 136,000 acres of coast redwood forest land, including 3,000 acres of government-owned redwood forest land in southern Oregon. About 37.5 percent of the existing volume of California's old-growth coast redwoods is situated within these government holdings.

Government-owned coast redwood parks and forest add up to an area 12 percent greater than the five boroughs of Greater New York City. Stretched out in a solid belt, all of the coast-redwood forest land in government ownership would form a mile-wide strip over 355 miles long, almost the distance from New York

Recuperative power of a redwood forest is illustrated in these photos, taken 50 years apart, at Scotia Inn, Scotia, Calif. In 1910 view at left, hillside had been clear-cut and burned to convert it into pasture. Yet, despite heavy grazing by sheep, a dense young redwood forest again dominated the site by 1960.



City to Pittsburgh or from Los Angeles to Phoenix, Ariz. (Table 4) At the present time, much of this acreage is undeveloped and inaccessible to visitors by road or trail.

The number of old-growth trees in the redwood state parks is estimated at about 1,500,000. Not all redwood park acreage consists of old-growth trees, but because precise measurement of park timber volume has been neither necessary nor required, only knowledgeable estimates have been made. One estimate by independent consulting foresters (1964) puts the amount of old-growth timber at 5.6 billion board feet on 59,000 acres.

Much credit for the extensive area of coast redwood park land belongs to the Save-the-Redwoods League. This group came into being in 1918 after the original highway through some of the best of the redwood belt was first proposed in 1910. The League's purpose was to raise funds to acquire and preserve in their natural condition all of the groves through which the highway would pass. The League does the groundwork in purchasing properties, then turns them over to the State. About 80,000 acres have been obtained for preservation in this way.

California Redwood Association member companies and other redwood lumber companies with forest holdings have cooperated in the League's program, some through outright land gifts. The industry has continued to withhold from harvest the timber on additional tracts of superlative scenic value in anticipation that funds can be raised to acquire them for park use.

The redwood parks and forests form an important part of California's vast system of public park, wilderness and other recreational lands, the largest in the nation. More than 40 percent of the entire land area of the state is in government-owned holdings open to recreational use.

THE PRODUCING FORESTS

Equally important as the great acreage of redwood groves set aside in parks for public enjoyment is another category of redwood timberland—the producing or commercial forest—being utilized to serve man's product needs. Wherever people may live and whatever they may do, they are inescapably dependent upon the resources of the land. California's material wealth is derived in large measure from the soil, and here in the Redwood Region is found some of the greatest timber-growing land in the world. It is the basis of an important part of the state's economy. How this land is managed is of vital importance to every Californian and to every citizen of the United States.

There are 1,586,000 acres* of producing coast-red-

* (By Forest Service definition, which classifies redwood type as "forests in which 20 percent or more of the stand is redwood." The California classification of redwood type, that "in which redwood comprises 20 percent or more of the commercial conifer cover," puts the total coast redwood acreage at 1,918,000 acres. However, even though acreage differs according to each definition, the timber volumes obtained are the same.



Stages in redwood growth are shown on Simpson Timber Co. Tree Farm near Arcata, Calif. Top: Stumps are hidden by redwood sprouts and other growth 10 years after logging. Bottom: Young-growth redwoods and their conifer associates have taken over other slopes 20 years after logging.





Two methods of redwood renewal are stump sprouting (left) and casting of seed from parent trees (seedlings circled in photo at right). Familiar "fairy ring" of new trees has grown from root system around old stump on Tree Farm lands of Union Lumber Co. near Fort Bragg, Calif. Root sprouting gives redwood forests great reproduction power. Forester (right) measures height of seedlings in freshly exposed mineral soil on Miller Redwood Co. timberlands near Crescent City, Calif. Few take root in thick mat of litter which covers forest floor of old-growth forests.

wood forest in the Redwood Region (plus another 10,000 acres in Oregon), most of it privately owned. The privately owned producing area contains 62.5 percent of the volume of all old-growth coast redwoods, according to a 1964 study by Frank & Dean Solinsky, Inc., San Francisco consulting foresters. The study indicated that, counting young growth as well, these private producing forests contain over 75 percent of all coast redwood timber volume, nearly 26 billion board feet of the total 34 billion board feet (Scribner Log Rule).

The producing forests, which supplied timbers to the first Spanish missionaries to reach California, played an important role in the winning of the West. A wide range of products has continued to flow to the nation from these forests over the last century.

Redwood Growth

Coast redwood is one of the fastest growing trees in the world. It is common for a vigorous young tree to increase its diameter at a rate of an inch or more a year.

Many stands of redwood at 80 years of age contain 75,000 board feet of timber per acre—an impressive volume when compared with the average of 95,000 board feet per acre found in static old-growth stands. On the better redwood sites, more than 150,000 board feet per acre has been measured in 80-year-old stands of young growth.

Loggers of the past century worked through the forest so slowly that cut-over lands were reseeded readily from adjoining trees. This resulted in natural stands now up to 100 years old. Emanuel Fritz, professor emeritus of forestry at the University of California and one of the foremost authorities on the redwoods, has termed these stands "probably the densest and most heavily producing young forests in the world."

The capacity of young redwood trees for fast growth has been measured in a test plot on timberlands of the Georgia-Pacific Corporation near Eureka. The plot, a stand of 46-year-old redwood containing 95,200 board feet per acre, was thinned by removing 25 percent of the volume of trees. In the next five years the remaining trees spurted in growth, adding back 60 percent of the volume which had been removed. It is estimated that at the end of an additional five-year period, the stand volume will be greater than the original volume before thinning. The stand is now growing at a rate of 2,800 board feet per acre per year. The growth rate increased 21 percent per year due to the thinning.

Growth rate mounts rapidly in redwood trees for the first 60 years, then begins to level off. In one exceptional test plot studied by Professor Fritz, young-growth trees added an average of 5,000 board feet an acre per year for a decade.

Accelerated growth is beginning to take place throughout the producing forests of the region as static

old-growth redwoods slowly give way to younger managed stands. Preliminary figures from the latest government inventory of the nation's forest resource indicate that the rate of redwood timber growth has increased 56 percent over the growth rate measured in 1952.

It is significant that 92.4 percent of today's total young-growth redwood volume is on privately owned forest land. Here are tomorrow's forest giants, the promise of redwood timber crops for the future.

A significant research program to produce a strain of super-redwood from cuttings of the newly discovered world's tallest trees has been initiated by Arcata Redwood Co. Cuttings from Arcata's record-holding trees are being grown at three forestry research stations in California and by the industry's forest nursery in Washington.

Another study, this one on the effects of fertilizing redwood trees, has been conducted for six years on lands of Simpson Timber Co. near Eureka. A University of California farm adviser believes, on the basis of these studies, that the minimum 60-year period required to grow a marketable redwood tree could be shortened by 20 years.

Chief forester of Union Lumber Co. discusses redwood tree farming with high school forestry students at annual Redwood Region Junior Logging Conference. There are 645,017 acres of timberland enrolled in the Redwood Region Tree Farm program to grow repeated crops of trees.



FOREST INDUSTRY TREE FARM PROGRAM

Of long-range importance in the producing redwood forest area is the forest-industry Tree Farm program, in which most of the large industrial timberlands and many of the smaller private holdings are enrolled. These lands are pledged to management for perpetual forest growth; that is, for the growth and regrowth of successive crops of trees under forestry practices. The Tree Farm program is intended to make certain that there always will be redwood forests producing wood for man's use.

In October, 1964, there were 123 Redwood Tree Farms comprising 645,017 acres of timberland enrolled in the Tree Farm program. A tree farmer is a private timberland owner who is protecting his timber from fire, insects and disease and is managing it for growth of repeated timber crops. There is no tax advantage; certified tree farmers pay local, state and federal taxes in common with all other property owners.

The Redwood Region Tree Farm program is sponsored by the California Redwood Association, 617 Montgomery St., San Francisco 94111. To obtain certification and the right to display the Redwood Region Tree Farm sign, a timberland owner must first submit his land to inspection by an association forester who checks the standard of forestry practices.

More and more, the job of the redwood tree farmer is becoming the task of managing young-growth forests. The increasing importance of young-growth management is seen in the rapidity by which this younger-aged timber is increasing in volume. The U. S. Forest Service found stands of young redwood sawtimber* in 1948 to contain 6.4 billion board feet. Today, young-growth coast redwood sawtimber has expanded in volume to more than 14 billion board feet. Part of this increase is due to the great amount of young-growth timber now hitting its best strides in growth, and part of it is due to development of better techniques of measurement.

The principal means available to the redwood tree farmer for stimulating growth and obtaining maximum wood production from his forest land are planned harvests of mature trees and protection of the forest from fire and animal damage.

Harvesting

All timber harvesting on private lands in California must meet requirements of the State Forest Practice Act, which sets standards of reforestation, fire protection, erosion control and other measures to promote maximum sustained-yield productivity of the forest.

Most timber harvesting in the redwoods is carried on by selective cutting. Under this system, the larger mature trees in a stand are marked for cutting at one time, leaving smaller trees more room to put on added

* Sawtimber includes all trees 11 inches or more in diameter at breast height.



Selectively logged forest is shown on Simpson Timber Co. Tree Farm near Arcata, Calif. Mature Douglas firs have been harvested, leaving redwoods more room to put on growth. Opening up the forest to sunlight also promotes growth of browse plants on the forest floor, improving wildlife habitat. Forest-development roads give access for fire protection, forest management and recreational use.

growth. Controlled harvests such as this thin out the trees. Each tree in a dense stand competes with others around it for available food, moisture and sunlight; growth of the stand may come to a virtual standstill when competition becomes too keen. However, redwood "leave trees" are noted for their ability to increase growth rapidly after such a harvest. The remaining trees also provide seed for reforesting the land with new redwoods.

In some areas with rough terrain, soil problems or other obstacles, selective harvesting is not practicable.

In such cases, the clearcut method is used. All trees are removed and the area is planted with seedlings or aerially reseeded immediately to restock the forest. This follow-up is assured, because it is a requirement of the State Forest Practice Act. The ability of a redwood forest to rebound after logging may be seen today in many dense sawtimber-size stands that have come back on areas clearcut in the late 1800s. Some of these stands came back in spite of repeated burning by settlers who were trying to convert old clearcut areas to pastureland.

Reforestation

The scientific name of the coast redwood, *Sequoia sempervirens*, is well chosen. It is truly "the always green Sequoia." A redwood forest renews itself in two ways.

The first method of redwood renewal is stump sprouting, which begins after a tree is harvested. Within a few years the well-known "fairy ring" pattern of new trees surrounds the old stump. From one to several hundred sprouts may start around a parent stump, but competition rapidly reduces their number. In the 25th year, there may be a maximum of only 10 or 15 trees remaining in the ring, most of which can survive for more than 50 years before continued competition further reduces their number. Tree farmers have learned that it does not pay to thin these sprouts too early, because a reduction too soon to five or six trees well spaced around the stump will only encourage the growth of still more sprouts.

Stump sprouts may average two to three feet of height growth annually, but are capable of growing to a height of eight or ten feet in their first full year following sprouting. Sprouting is even more vigorous among young-growth trees than it is among mature giants. When sprouts are cut off, others reappear promptly.

The second method of redwood renewal is reseedling. A coast redwood tree generally begins to produce fair crops of good seed cones around its 20th year. A big specimen may produce over a million seeds a year, seeds so tiny that 100,000 of them weigh only a pound. They rain down upon the ground in a redwood forest by the billions, drifting on the wind for hundreds of feet from their source. However, they require a seedbed of freshly exposed earth in order to become established. For this reason seeds germinate in harvest areas, but seldom take root in untouched old-growth forests where the forest floor is covered with a thick mat of humus and litter.

Redwood rarely grows in pure stands except in old groves which have eliminated all other competing species of trees. Young redwood seedlings most commonly grow in association with other kinds of trees. Seedlings which germinate from seed may gradually catch up with sprouts after a slower start.

Hand planting of redwood seedlings was undertaken in a comprehensive industry program as early as 1923. Years of experience in this forward-looking effort eventually proved that nature does a better job of re-establishing redwood forest cover under normal conditions. However, industry foresters today still plant redwood seedlings in some problem areas where there is no natural regeneration.

In 1960, one redwood company in the northern section of the Redwood Region cleanlogged an area of predominantly old-growth redwood after a severe wind-storm had caused widespread timber blowdown in the locality. Under a State-approved plan, the company

immediately reseeded by helicopter with two of the redwood's companion species of trees to provide an associated crop to grow up with the young redwood anticipated from resprouting redwood stumps and natural seedfall. In the third growing season which followed, a count showed excellent restocking averaging 1,460 young trees to the acre (there are between 20 and 40 trees to the acre in an old-growth redwood stand).

Studies of the succession of plant communities on newly harvested redwood forest land illustrate the steps nature goes through to re-establish a redwood forest. Where slash and logging debris have been burned, fireweed—the darling of the honeybee—moves in promptly and may make a solid field temporarily. On the river flats willow, alder, laurel and an occasional maple appear, accompanied by various shrubs and weeds. On slopes the succession is somewhat different. Hardwoods such as tanoak, madrone and black oak, together with brush species, may dominate during the early years after cutting. These intruders grow rapidly and are soon conspicuous.

Redwood sprouts quickly appear from stump roots on the site in the first year after harvest. Other conifer seedlings, such as Douglas fir and spruce, make their appearance more slowly, suppressed by the partial shade of the brush and hardwoods ahead of them. The shade-enduring conifers (evergreens with needle-like foliage) struggle along for several decades until their tenacity brings them well up into the crowns of the hardwoods, where they then shoulder the leafy trees aside and take over the site as associates of the redwoods. Alders may persist among the redwoods and other conifers for up to 75 years, and laurel even longer.

In less than 50 years, however, the new stand of timber may be 90 to 100 percent conifer, with redwood predominating. Redwoods of seedling origin and Douglas firs may eventually catch up to the sprout-origin redwoods, since rapid initial height growth of the redwood sprouts tapers off after the first few years.

The final stage of plant succession will be reached when the redwoods crowd out all other species of trees and completely dominate the site. This, then, would be the final "climax forest."

Protection

The vitality of the redwood and its resistance to enemies set the species apart from other trees. Redwoods simply have no tree-killing insect enemies or diseases. Several kinds of insect pests find redwood a congenial host in which to live, but none alone can kill it. There are also several kinds of fungi which attack the tree's heartwood, particularly in old trees. They may cause the center of a tree to rot out to within eight or ten inches of the bark. But though finally only a small percentage of the outside wood may be unaffected, the tree remains not only alive but healthy.



Explosive growth possible for a coast redwood tree when harvest of surrounding trees releases it from competition for moisture and sunlight is illustrated in this cross section of a redwood log on display at Georgia-Pacific Corp. Big Lagoon operations in California. Counting a year's growth for each ring above, it took the tree 85 years to reach a diameter of 12 inches. Left behind by early day loggers, the tree burst into growth at 55 times its earlier rate and reached a 4½-foot diameter in the next 30 years.

Old-growth redwood forests show many scars from fires, as many as three or more big ones in a century. Fires have been known to burn inside hollow trees with the intensity of a furnace, yet the extremely high moisture content of redwood and the absence of gums and resins create such resistance to heat that the outside of the tree remains cool to the touch.

Protection from fire is nevertheless important in redwood forests. Industrial redwood tree farmers spread a network of radio and telephone communications over their lands. They build and maintain thousands of miles of access roads. They fell dead snags that would blaze into punky torches showering sparks into the wind if hit by lightning. They train and equip firefighting crews, carry on fire-detection patrol work and maintain weather-observation stations during fire season. They close down logging operations when fire danger is high. When fire strikes on a company's lands, or those of its neighbors, the companies quickly muster loggers and sawmill workers, bulldozers, trucks and pickups into a mobile army of firefighters.

The California Division of Forestry is responsible for directing firefighting on state and private wildlands. All such forest lands in the state have been under organized protection since 1924. Fire prevention and suppression on federal land are the responsibility of the U. S. Forest Service, other federal agencies and contracting organizations.

MULTIPLE USE OF THE REDWOODS

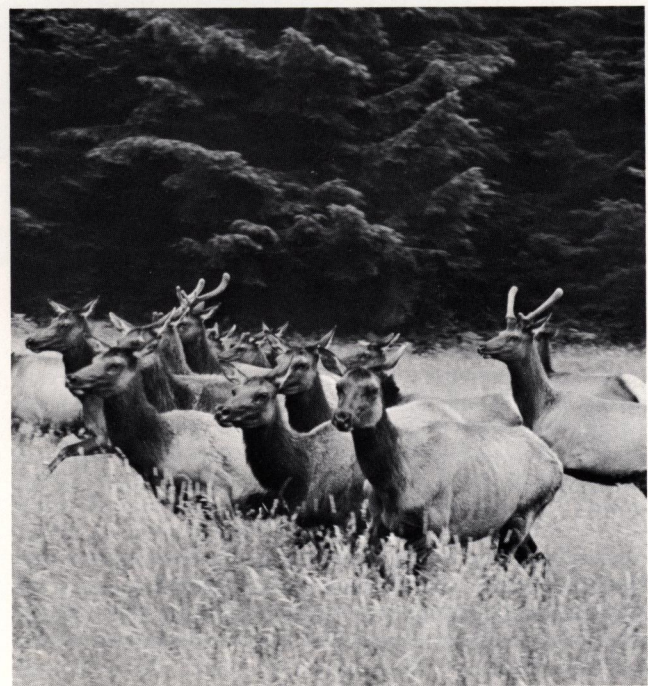
Tree farming to grow and harvest repeated wood crops in the redwoods is compatible with other uses of these forests for recreation, wildlife and water. The redwood tree farmer's forest management program can enhance these other values by maintaining youth, health and vigor in the forest.

Wildlife is scarce in dense stands of old-growth redwood. When trees shade out browse plants on the forest floor, food sources for deer, elk and other animals are eliminated. Tree Farm harvesting operations, which open up overcrowded stands and permit sunlight to reach the ground, create excellent conditions for wildlife. Roosevelt elk, for example, have proliferated in timber-harvest areas of redwood Tree Farm lands.

Recreation visits to the extensive areas of producing redwood forests off main highways become practical only when forest-development roads have been pushed into the timber for loggers. The roads which bring products from the forest may also serve to bring visitors to the forest.

Although grazing is compatible with tree farming in some types of forests, this is not true of the redwoods. Damage to young tree growth by grazing is so severe that all types of livestock on redwood forest land must be controlled closely.

An upsurge of wildlife follows tree farming in the redwoods as old-growth forests are opened to sunlight. Roosevelt elk shown here have multiplied on young-growth timberlands in the northern section of the redwood belt. Pioneers of the 1840's feared traveling in dense redwoods because they found no game for food.



IMPACT ON LOCAL COMMUNITIES

Timber harvesting has been the mainstay of the Redwood Region's economy for more than a century. It continues to be the dominant factor today in the economic life of the Northern California coast.

A survey of forest industries in six Redwood Region counties* by the North Coast Timber Association showed that they give full-time employment to 20,500 people with an estimated annual gross payroll of \$123,000,000. The wood-products industry in these counties purchases local services and supplies valued at \$30,000,000 annually and pays property taxes of \$8,000,000 a year. It has a total investment in plant, equipment and timber of over \$400,000,000. The industry's annual sales of forest products total \$320,000,000. In Humboldt County alone forest products account for 70 percent of the area's basic economy.

PRODUCT USES

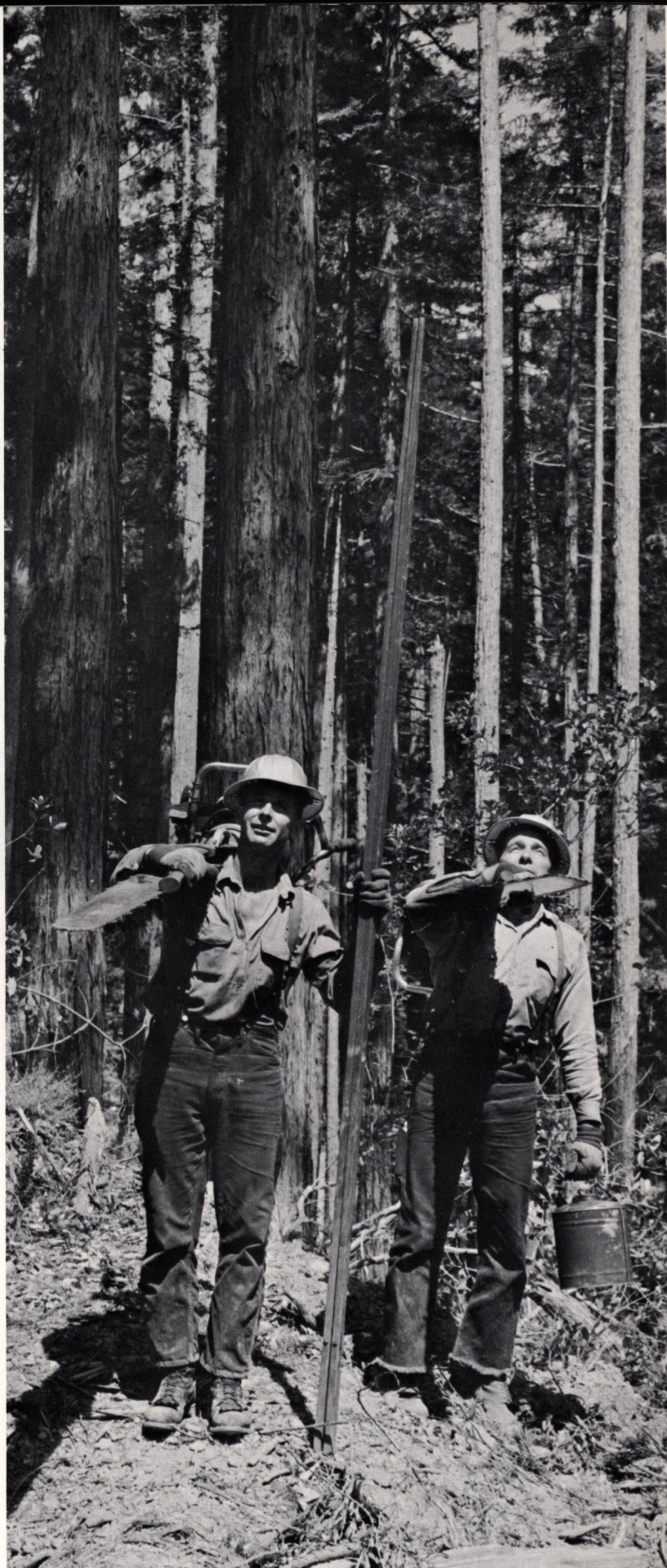
The unusual beauty, color and durability of coast redwood make it one of the prized species of wood for man's use. Its color ranges from light pink to mahogany. The sapwood is a pale yellow. It keeps its shape well, holds paint tenaciously and is highly resistant to attack by termites and decay-producing fungi. It long has been a popular wood for siding and interior paneling, particularly in modern houses, and its well-known resistance to decay makes it valuable for specialty uses such as tanks and pipes, sills, greenhouses, frames and doors.

Completely finished and sealed redwood siding has appeared on the market, and more redwood plywood is becoming available. Bark products and chemicals made from bark are finding increasing use. Larger volumes of redwood are being used in forest-industry glue-up departments which turn out graceful timber trusses for churches and other special structures.

Young-growth redwood is finding its way into more and more products; some mills in the region are operating entirely on young-growth timber. Hardboard has become an important use. Two pulp mills being built in the region will use redwood chips made from leftover sawmill residues. Hardboard and pulp mills assure a high degree of utilization of each tree harvested. Late in 1964 new wood processing plant construction estimated at \$100 million was in progress in Mendocino, Humboldt and Del Norte counties.

* Humboldt, Mendocino, Del Norte, Sonoma, Santa Cruz and part of Siskiyou.

"Choppers" move into a producing redwood forest to harvest mature trees marked by company forester. Timber production has been economic mainstay of California's North Coast counties for more than a century.





World's oldest young-growth redwoods have reached diameter of over six feet at 150 years of age on privately owned timberland in California's Sonoma County. This redwood sprouted from root system of parent stump (visible behind industry forester) after Russian colonists logged the area to build Fort Ross in 1812-15.

FUTURE OF THE REDWOODS

An examination of what is happening in California's redwood forests offers tangible clues to the outlook. A recently completed study authorized by the National Park Service shows that growth is rapidly catching up with removal in the redwoods and that growth and removal of sawtimber-sized trees may be expected to be in balance by 1985. In volume of wood grown, including trees not yet of sawtimber size, growth and drain may be in balance by 1975, according to the report's projections of supply and demand. Already an estimated 20 percent of the annual harvest occurs in large young-growth stands—trees regrown since logging years ago.

Changing patterns of land ownership in the northern part of the Redwood Region suggest that tree farming will become increasingly widespread there. The study made for the National Park Service discloses a continuing flow of land from small, loosely-held holdings to larger, permanent industrial ownerships committed to long-range forestry programs. In a study of land ownership in Mendocino County, both the number and the acreage of ownerships 700 acres in size or larger increased over the 10-year period studied. During that period, holdings of timber producers increased from 30 to 38.7 percent of total land area while those of ranchers and farmers declined from 54.4 to 49.6 percent.

However, this trend toward larger, more stable ownerships in the northern part of the redwood belt is offset to some extent by an increase of non-forestry uses in the southern part of the region close to urban population centers.

Present volume of redwood young-growth timber today is more than twice the volume reported by the Forest Service in 1948. Projections in the Park Service study indicate that it may have doubled again by the year 2000.

The redwood situation may be summarized in this way: Large areas of today's outstanding old trees already have been preserved for future generations in government parks and groves. More are being added. In the producing forests, sawtimber growth is accelerating and may be expected to balance removal in the next 20 years. Much of the producing redwood forest land is already enrolled in the forest industry's Tree Farm program to grow timber as a renewable crop, and holdings of these permanent industrial ownerships seem destined to increase.

Always we shall have superlative stands of redwoods in the parks. We also have, and shall continue to have in the future, thrifty stands of young-growth redwoods in the producing forests. These timberlands have a beauty and power of their own to capture the imagination. They are a tribute to man's ability to use and to renew a magnificent natural resource.

STATISTICAL TABLES

TABLE 1

AVERAGE TREE DIAMETER (INCHES) IN A YOUNG-GROWTH REDWOOD FOREST

(All species over 10.5 inches*)

Age (Years)	Average Site (160)**	Good Site (200)**	Best Site (240)**
20	14.4	15.4	16.1
30	16.8	18.1	19.4
40	18.4	20.4	21.9
50	20.0	22.1	23.8
60	21.3	23.6	25.4
70	22.4	24.8	27.0
80	23.5	26.0	28.5
90	24.5	27.3	29.8
100	25.3	28.4	31.0

Source: "Empirical Yield Tables for Young-Growth Redwood," Bulletin 796, California Agricultural Experiment Station, August, 1963.

*All tree diameters given in this booklet are measured at breast height.

**Numbers listed are the site indexes which are a measure of the quality of the growing area. The site index refers to the average total heights of dominant redwood trees in a stand at the age of 100 years. Heights are given in feet.

TABLE 2

ANNUAL ADDITION OF WOOD PER ACRE IN A YOUNG-GROWTH REDWOOD FOREST

(Periodic annual increment of board feet to trees of all species over 10.5 inches diameter)

Age (Years)	Average Site (160)*	Good Site (200)*	Best Site (240)*
20-30	1,260	2,840	4,670
30-40	1,730	2,980	4,430
40-50	1,840	3,060	4,380
50-60	1,920	2,940	4,060
60-70	2,000	2,880	3,760
70-80	1,980	2,730	3,400
80-90	1,950	2,590	3,220
90-100	1,850	2,440	3,190

Source: "Empirical Yield Tables for Young-Growth Redwood," Bulletin 796, California Agricultural Experiment Station, August, 1963.

*Numbers listed are the site indexes which are a measure of the quality of the growing area. The site index refers to the average total heights of dominant redwood trees in a stand at the age of 100 years. Heights are given in feet.

TABLE 3

YOUNG-GROWTH REDWOOD TIMBER YIELDS

(Board-foot volumes per acre, trees of all species over 10.5 inches diameter breast high—International 1/4-Inch Log Rule)

Age (Years)	Average Site (160)*	Good Site (200)*	Best Site (240)*
20	7,000	23,900	46,500
30	19,600	52,300	93,200
40	36,900	82,100	137,500
50	55,300	112,700	181,300
60	74,500	142,100	221,900
70	94,500	170,900	259,500
80	114,300	198,200	293,500
90	133,800	224,100	325,700
100	152,300	248,500	357,600

Source: "Empirical Yield Tables for Young-Growth Redwood," Bulletin 796, California Agricultural Experiment Station, August, 1963.

*Numbers listed are the site indexes which are a measure of the quality of the growing area. The site index refers to the average total heights of dominant redwood trees in a stand at the age of 100 years. Heights are given in feet.

TABLE 4
ACREAGE AND VOLUMES OF REDWOOD TIMBER IN PUBLIC AND PRIVATE OWNERSHIP
IN CALIFORNIA (AND OREGON*) 1964

(Volumes in millions of board feet, 12 inches diameter breast high and larger, Scribner Log Rule. Acres in thousands.)

COAST REDWOOD	STATE PARKS	OTHER PUBLIC	TOTAL PUBLIC	PRIVATE	TOTAL
Old Growth:					
Acres	59	59	118	247	365
Volume	5,611	1,541	7,152	11,940	19,092
Percent by volume	29.4	8.1	37.5	62.5	100
Young Growth:					
Acres	32	77	109	1,213	1,322
Volume	588	540	1,128	13,767	14,895
Percent by volume	4	3.6	7.6	92.4	100
Total Coast Redwood:					
Acres	91**	136	227	1,460	1,687
Volume	6,199	2,081	8,280	25,707	33,987
Percent by volume	18.2	6.1	24.3	75.7	100
GIANT SEQUOIA	PUBLIC RESERVE	PRIVATE	TOTAL		
Old Growth:					
Acres	24	—	24		
Volume	1,475	1	1,476		
Percent by volume	99.9	0.1	100		
Young Growth:					
Acres	11	1	12		
Volume	250	24	274		
Percent by volume	91.2	8.8	100		
Total Giant Sequoia:					
Acres	35	1	36		
Volume	1,725	25	1,750		
Percent by volume	98.6	1.4	100		

*Of the total coast redwood, less than one percent is located in Oregon.

**Timber cover only. Lakes, streams, meadows, roads, etc., excluded.

Note: Public ownership includes State Parks, U.S. National Forests, National Parks, Bureau of Land Management, Bureau of Indian

Affairs, counties and municipalities, the State Division of Forestry and other State lands—some held for State Park exchange purposes.

Source: Frank and Dean Solinsky, Inc., consulting foresters, San Francisco.

TABLE 5
PROJECTED COAST REDWOOD VOLUMES AND REDWOOD PRODUCING FOREST ACREAGES*

Years 1953 - 2023

(Thousands of acres)

(Millions of board feet - International 1/4-Inch Log Rule)

Year	Old Growth		20-60 Yrs.		0-20 Yrs.		Total	
	Acres	Volume	Acres	Volume	Acres	Volume	Acres	Volume
1953	1,100	24,785	443	10,562	375	480	1,918	35,827
1963	784	16,844	485	14,137	685	—	1,918	30,981
1973	449	10,117	636	18,485	833	—	1,918	28,602
1983	201	4,531	943	23,240	709	—	1,853	27,771
1993	1	31	1,165	27,915	622	—	1,788	27,946
2003			1,128	29,175	596	—	1,724	29,175
2013			1,107	30,241	552	—	1,659	30,241
2023			1,074	31,137	520	—	1,594	31,137

*Source: "The Effect of Commercial Operations on the Future of the Coast Redwood Forest," John G. Miles, consulting forester. A study prepared for the National Park Service, 1963. Figures are net volumes after projected allowance for harvest and other removals by natural cause.

TABLE 6

SAWTIMBER VOLUME BY TYPE ON PRODUCING
(COMMERCIAL) REDWOOD REGION FOREST LANDS

(All species of trees)

(Millions of board feet - International 1/4-inch Log Rule)

	1963
SOFTWOODS:	
Douglas Fir	63,729
Redwood	30,981
Pine	6,103
True Fir	5,821
Other	1,537
Total Softwoods*	108,171
HARDWOODS:	
Tanoak	1,574
Madrone	682
Other	578
Total Hardwoods	2,834
TOTAL ALL SPECIES	111,005
Total Public Ownership**	42,000
Total Private Ownership	69,005
TOTAL	111,005

*Softwood: Statistics of Forest Survey Release #19 (Jan. 1953) Projected to 1963 in Miles Report for U.S. Park Service (Does not include timber reserved from commercial use)

**Does not include Areas Reserved from Commercial Timber Use
Source: North Coast Timber Association

TABLE 7

FOREST INDUSTRY ACTIVITY IN PRINCIPAL
REDWOOD REGION COUNTIES - 1962

(Covers production from all timber species, including redwood)

COUNTY	NUMBER OF TIMBER OPERATORS	OUTPUT OF ALL FOREST PRODUCTS (millions of board feet)	PERCENT OF STATE OUTPUT
Del Norte	78	194.1	3.5
Humboldt	350	1,457.5	26.2
Marin (and Napa)	9	1.6	—*
Mendocino	218	730.4	13.1
Monterey (and San Luis Obispo)	14	7.3	0.1
San Mateo	9	21.1	0.4
Santa Cruz	31	27.5	0.5
**Siskiyou	81	410.9	7.4
Sonoma	75	158.1	2.8
TOTALS	865	3,008.5	54.0

Source: California State Division of Forestry, State Forest Notes No. 19—January, 1964.

*Less than one tenth of one percent

**Only a small portion of county in Redwood Region

TABLE 8

1963 ESTIMATED OWNERSHIP OF SAWTIMBER ON PRODUC-
ING (COMMERCIAL) REDWOOD REGION FOREST LAND

(All species of trees)

(Millions of board feet - International 1/4-Inch Log Rule)

National Forest	32,375
Indian Service	3,500
Bureau Land Management	4,000
Other Federal	25
State of California	2,000
Counties and Municipalities	100
TOTAL PUBLIC	42,000
Private Ownership	69,005
GRAND TOTAL	111,005

Source: North Coast Timber Association

TABLE 9

PRODUCING (COMMERCIAL) FOREST LAND OF PRINCIPAL
REDWOOD REGION COUNTIES

(All forest land; includes redwood)

(Thousands of acres)

COUNTY	PUBLIC	PRIVATE	TOTAL
Del Norte	299	152	451
Humboldt	446	1,294	1,740
Marin	—	31	31
Mendocino	249	1,056	1,305
Monterey	5	11	16
San Mateo	5	54	59
Santa Cruz	—	125	125
Siskiyou (Portion)	428	20	448
Sonoma	4	292	296
TOTAL	1,436	3,035	4,471

Source: "Forest Statistics for California,"
Forest Survey Release No. 25, Table 12 (1953)

TABLE 10

TALLEST COAST REDWOODS

NAME and LOCATION	HEIGHT IN FEET
Howard A. Libbey Tree	367.8
ARCO Grove of the Giants Humboldt County, Calif.	
Harry W. Cole Tree	367.4
ARCO Grove of the Giants	
National Geographic Society Tree	364.3
ARCO Grove of the Giants	
Rockefeller Tree	356.5
Humboldt Redwoods State Park, Calif.	
Founders Tree, Humboldt Redwoods State Park	352.6
Hill-Davis Tree	352.3
ARCO Grove of the Giants	

Source: National Geographic Magazine, July, 1964.

TABLE 11
REDWOOD STATE PARKS AND RESERVES (JULY, 1964)

PARK AND LOCATION BY COUNTY	ACRES	CAMPSITES	PICNIC
Admiral Standley, Mendocino	45.2	0	2
Armstrong Redwoods, Sonoma	440.0	21	104
(addition in July, 1964)	3,931.0	0	0
Benbow Lake, Humboldt	222.9	0	45
Big Basin, Santa Cruz	11,521.4	260	90
*Butano, San Mateo	2,176.8	0	0
*Del Norte Coast, Del Norte	5,932.0	0	0
*Forest of Nisene Marks, Santa Cruz	7,278.7	0	0
Fort Ross State Historic, Sonoma	356.0	0	15
Grizzly Creek, Humboldt	149.5	29	33
Hendy Woods, Mendocino	604.7	96	25
Henry Cowell, Santa Cruz	1,736.8	0	220
Humboldt Redwoods, Humboldt	37,762.8	205	80
Indian Creek, Mendocino	15.1	0	10
Jedediah Smith, Del Norte	9,539.5	104	40
*Julia Pfeiffer Burns	1,700.0	0	0
*Maillard Redwoods, Mendocino	242.0	0	0
*Montgomery Woods, Mendocino	647.1	0	0
Mt. Tamalpais, Marin	2,404.3	25	61
Paul Dimmick, Mendocino	11.8	28	12
Pfeiffer Big Sur, Monterey	820.5	218	92
Portola, San Mateo	1,740.3	60	106
Prairie Creek, Humboldt-Del Norte	10,286.1	100	25
Richardson Grove, Humboldt	790.5	184	18
Russian Gulch, Mendocino	1,122.3	35	23
Samuel P. Taylor, Marin	2,576.3	55	128
*Smithe Redwoods, Mendocino	459.1	0	0
Standish Hickey, Mendocino	635.2	154	8
Van Damme, Mendocino	1,826.5	82	5
TOTAL FOR STATE PARKS & RESERVES	106,974.4	1,656	1,142
NATIONAL PARK SERVICE			
Muir Woods National Monument, Marin	484.0	0	10
TOTAL FOR STATE PARKS & RESERVES AND NATIONAL PARK SERVICE	107,458.4	1,656	1,152

*Undeveloped.

Sources: Annual Report, Division of Beaches and Parks, Fiscal Year 1962-63. Summary of Redwood State Parks and Reserves, January 1, 1964, Planning and Control Section, Division of Beaches and Parks. John Mahoney, Regional Forester, U.S. National Park Service.

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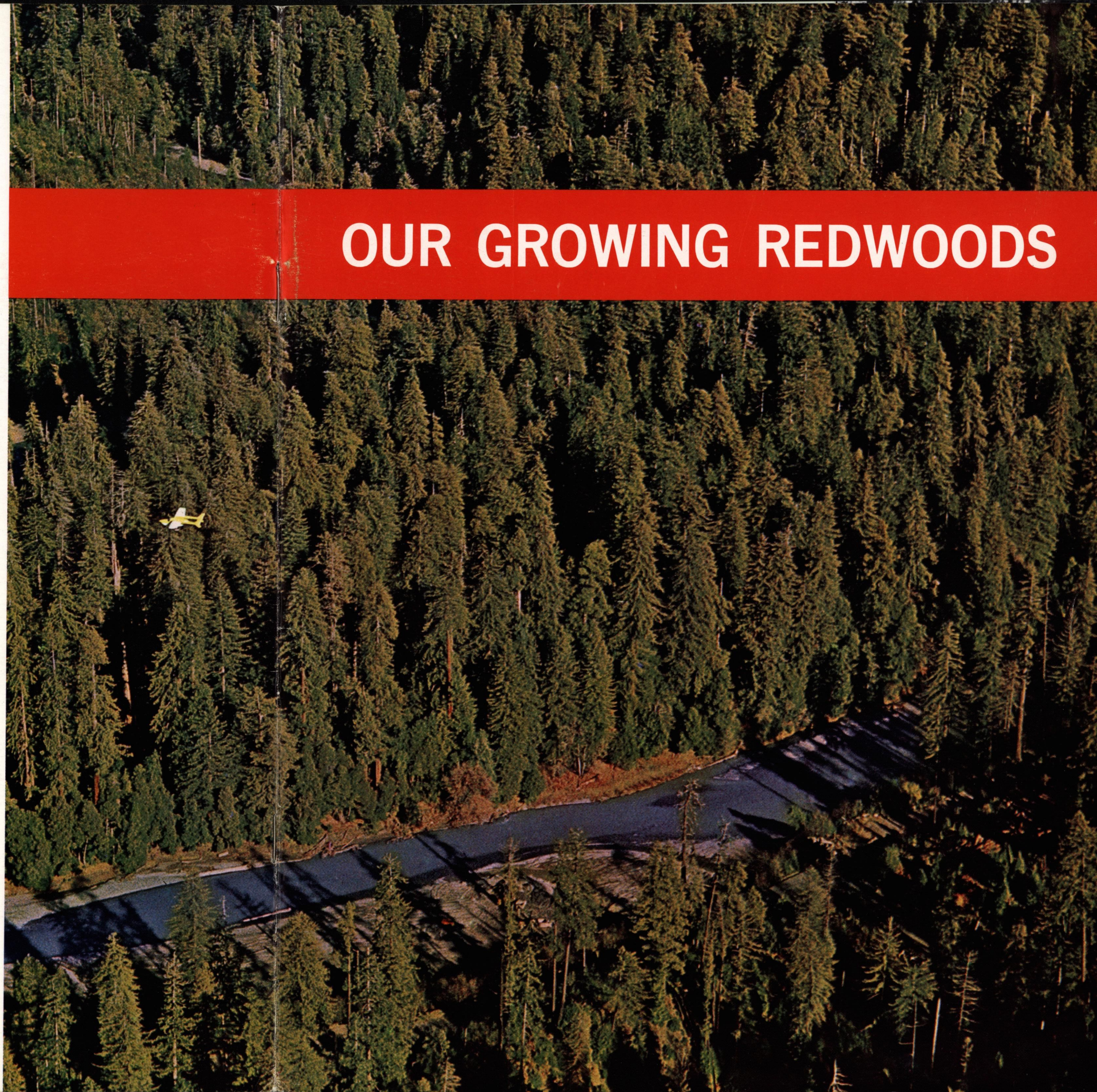
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OUR GROWING REDWOODS



Tallest living things on earth grow in this grove of giants (right) on Tree Farm lands of Arcata Redwood Co. near Orick, Calif. World's tallest tree lifts its spire 367.8 feet above Redwood Creek from a clump just left of the airplane. Second, third and sixth-tallest trees are nearby. Major part of the redwood belt is shown in map above, but Redwood Region and redwood parks extend farther south to Monterey County. Red inset on coast at Orick marks industry Tree Farm with glen of giants holding world's tallest trees (cover).