REDWOOD

. . . *an American wood*

Redwood is a coniferous tree outstanding for its large size, sprouting capacity, and the physical characteristics of its wood. The heartwood has a range of reddish hues, is straight-grained, and has a high degree of resistance to decay. Redwood is used chiefly in high-quality materials for building construction. Low shrinkage, resistance to decay, and lack of odor and taste make the heartwood useful in products for storing liquid and solid food. The northern California coast is the natural range of the coastal redwood tree.

FS–262
September 1974
U.S. Department of Agriculture Forest Service

COVER: F-506455

The main in lower left conrner indicates the great size of teh redwoods.

For sale by the Superintendent of Documents, U.S. Government Printing Office
Washington, D.C. 20402 - Price 25 cents
Stock Number 0101-00878

REDWOOD

. . . an American wood

James L. Lindquist[1]

DISTRIBUTION

The northern California coast, a region of moderate to heavy winter rain and frequent fog, is the natural range of the coastal redwood tree *(Sequoia sempervirens* [D. Don] Endl.). This area–often referred to as "the Redwood Region" in informational brochures –is a narrow belt about 450 miles long and seldom more than 25 miles wide, along the Pacific Coast from southwestern Oregon to southern Monterey County in central California (fig. 1). The northern portion is characterized by relatively continuous stands; south of San Francisco, redwood more commonly grows in small, isolated, locally suitable sites along streams and alluvial flats.

Rainfall averages between 40 to 50 inches over most of the range. Temperatures normally range from 50° to 60° F.; extremes seldom exceed 100° F. or fall below 30° F. During most of the summer, fog covers a large portion of the region. Presence of heavy rain, summer fog, and a cool moderate temperature produces a humid environment of low evaporation.

Soils of the region are podsolic, reddish-brown clay to sandy loams, generally moderate to deep on slopes, and have high moisture retention characteristics. Redwood grows from sea level to 2,500 feet elevation. The range of redwood is limited by several factors, including lack of fog, unfavorable temperatures, lack of moisture, and absence of root hairs.

Redwood grows in association with other conifers and broad-leaved trees; the most important associate is Douglas-fir *(Pseudotsuga menziesii* [Mirb.] Franco). Redwood also mixes with grand fir *(Abies grandis* [Dougl.] Lindl), western hemlock *(Tsuga heterophylla* [Raf.] Sarg.), Sitka spruce (Picea sitchensis [Bong.] Carr.) and tanoak *(Lithocarpus densiflorus* [Hook. & Arn.] Rehd.).

[1] Research forester, Pacific Southwest Forest and Range Experiment Station, Berkeley, California; stationed at Arcata, Calif.

NOTE: This publication supersedes unnumbered Redwood, issued 1959.

DESCRIPTION AND GROWTH

Redwood is one of three native North American trees of the Taxodiaceae, a formerly abundant family of trees that covered most of the northern hemisphere in the geologic past. Close relatives are the giant sequoia *(Segaoiudendron giganteum [Lindh.]* Buchh.) of California and the bald-cypress *(Taxodium distichum* [L.] Rich.) of the southeastern states.

Most mature redwood are between 200 and 300 feet tall, and range from 6 to 12 feet in diameter. The crown in the old-growth trees (more than 100 years old) is often short and ragged. Often trees have dead tops. The bole has a dark reddish-brown thick fibrous bark.

Needles are of two kinds; those on vigorous terminal shoots are small and scalelike; those on other branches are dark shiny green, solitary, spirally arranged, and about one-half to 1 inch long. The twisting of the needles results in flat branchlets (fig. 2).

Cones are three-fourths to 1 inch in length, are ovate, dark brown, and have 20 to 30 flattened and wrinkled scales. Redwood is a heavy seeder, producing large seed crops nearly every year after about 15 years of age. Viability of the seed is low, about 10 to 20 percent. Seedlings generally require an open, disturbed, mineral seedbed for establishment. Seldom are seedlings found in undisturbed stands.

Perhaps the most prominent among the characteristics of redwood that have contributed to its economic and historic importance are size and age. Maximum recorded values are: 367 feet tall, 20 feet in diameter, and about 2,200 years old. Redwood has a pattern of growing in dense groves, often containing many extremely large trees. Elsewhere, isolated individuals may be found.

This species is the only commercial conifer that reproduces by sprouts, After logging, sprouts develop vigorously and quickly, and a new crop of trees is started. Sprouting seems to be related to both size and age of the tree; the larger and older the tree, the lower

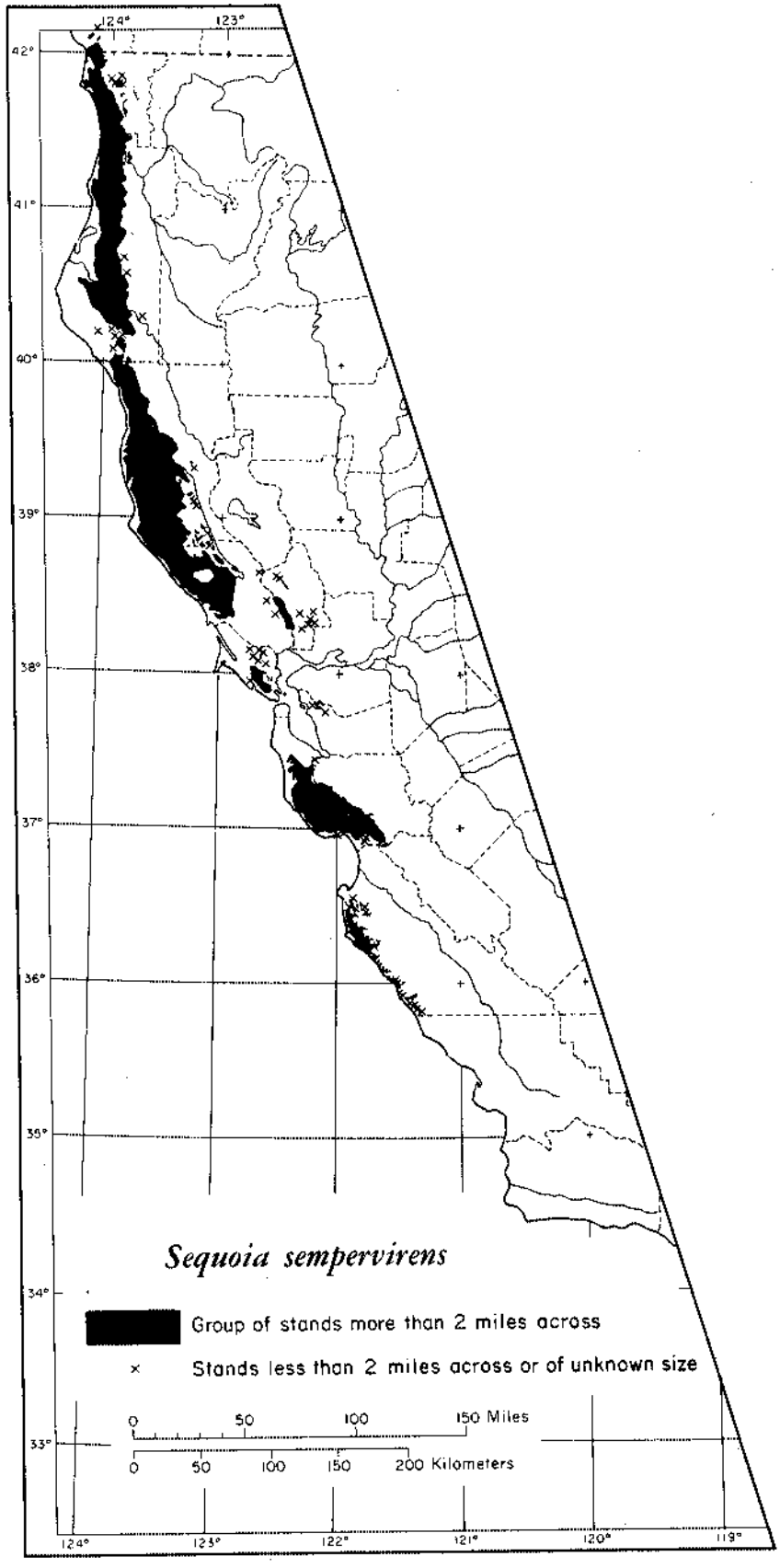

Figure 1–Natural range of redwood *(Sequoia sempervirens* [D. Don] Endl.).

F-84621

Figure 2–Foliage and cones of redwood.

the chance of sprouting. Redwood seedlings generally remain small (less than 1 foot) until 5 to 6 years old, when they have a burst of rapid height growth.

The history of harvesting redwood has largely been that of changes in equipment for handling large logs. The changes from ox skidding, stream drives, cable skidding, railroads, tractors, and trucks to move the logs have resulted in basic patterns in harvesting. Differing harvesting practices have created environmental conditions under which the new stands have regenerated. Introduction of trucks and tractors permitted a form of selective harvest which was designed to prolong the cutting of the old-growth stands. Before then, little effort was made to insure a continuing supply of trees. The movement to selective cutting marked the realization that time was running out on prime old. growth stands.

COMMON NAMES

Only two other common names are now used for this species: coast redwood and California redwood. This species should not be confused with giant sequoia of the southern Sierra Nevada of California.

RELATED COMMERCIAL SPECIES

Redwood is a distinctive product on the market; the volume of production refers only to this species.

SUPPLY

The supply of redwood should be considered at two levels; available old growth redwood timber and available young-growth timber. This distinction is helpful because of basic differences in value, harvesting methods, and market acceptance of redwood products.

The redwood forest type according to the Forest Service's Forest Survey definition consists of stands with a plurality of stems in redwoods. In previous inventories, an area was classified as redwood type if it had 20 percent of its timber value in redwood. Under that classification, acreage of redwood type totaled 1.6 million acres of commercial redwood. Under the present definition, redwood acreage is 915,000 acres. Of the 915,000 acres, 803,000 acres are available for commercial timber production, with volume estimated at 23.6 billion board feet. The remaining commercial acres are reserved from timber production in national, state, and county parks. Most of the 803,000 acres of commercial redwood forest is privately owned.

Young-growth stands–trees less than 100 years old –are found on about 580,000 acres of the commercial redwood forest. Some young-growth stands have large volumes, and are starting to be cut for lumber and logs for export. Partial cuttings have been made on some of the 240,000 acres of old-growth stands that comprise the rest of the commercial redwood lands.

Cutting rates have far exceeded the growth rates of redwood. Therefore, the total volume of the species has steadily declined. But the growth rates have increased because old stands, which show little net growth, have been harvested. Old-growth stands are being replaced by young stands that grow much faster. Most of the available old stands will probably be cut by the end of the 1900's. Long-range forecasts suggest that sawtimber growth and harvest will be in balance in the late 1900's. In 1968, net growth was an estimated 568 million board feet, and log harvest that year was 1 billion feet.[2] Growth and harvest volumes will continue to come closer together as the supply of old stands dwindle, annual harvest decreases, and sawtimber growth increases.

PRODUCTION

Harvesting redwood for commercial purposes began in the mid-1800's. Production ranged from 100 to 200 million board feet per year until the end of the century (fig. 3). Except for the depression years of the 1930's, production remained relatively uniform at about 500 million board feet a year. The building programs in the mid-1940's started a rapid rise in volume harvested. Harvest has averaged about 1 billion board feet since the early 1950's. Most of the commercial harvesting of the redwood is in three northern counties in California: Del Norte, Humboldt, and Mendocino. Increased harvest has been coupled with an increas-

[2] Unpublished data on file, Pacific Northweat Forest and Range Experiment Station, Portland, Oreg.

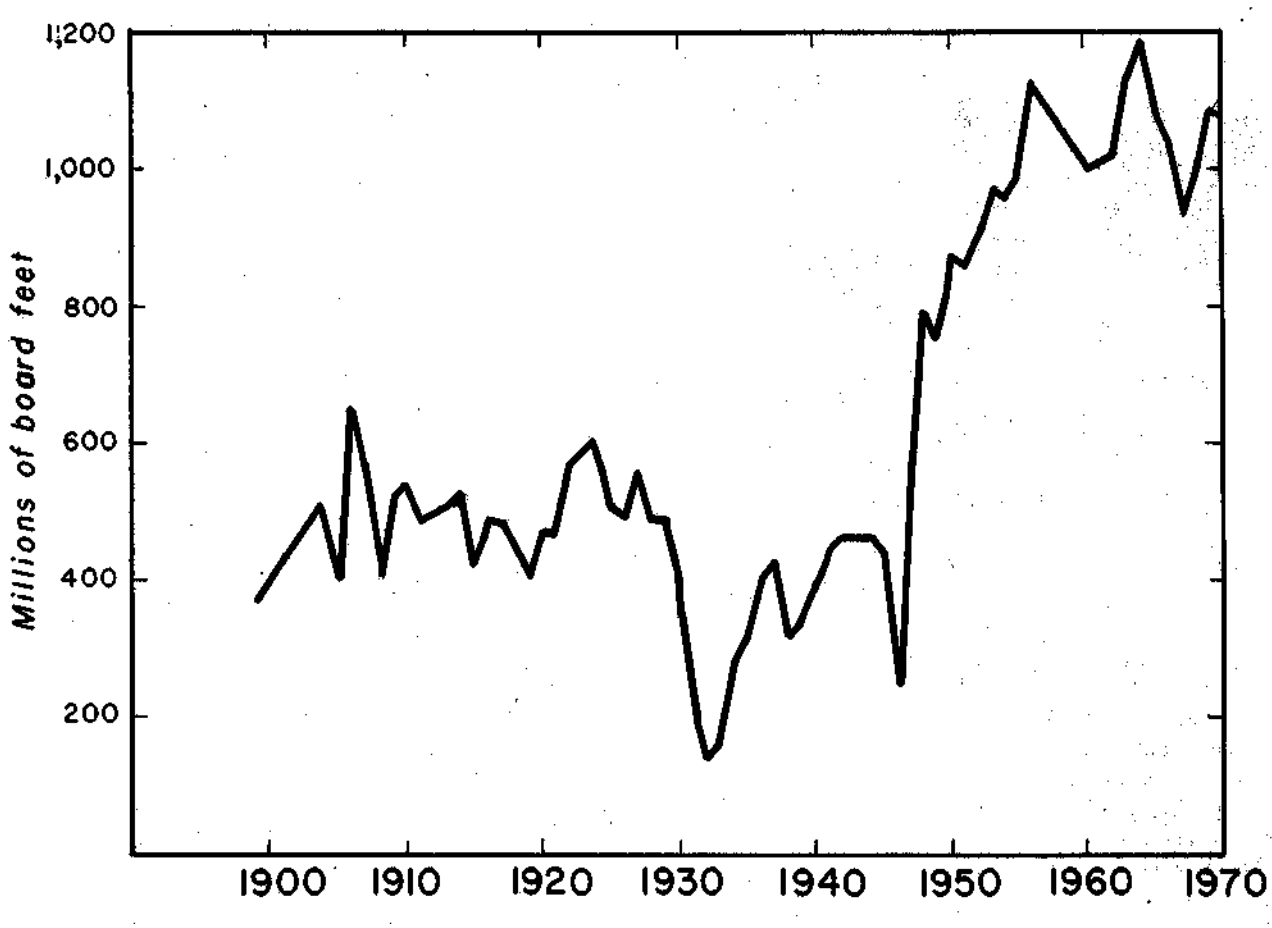

Figure 3–Redwood lumber production 1900–1970.

ing trend toward more complete utilization of the trees cut. Increasing value of the old-growth trees has resulted in use of smaller diameter logs and logs formerly discarded because of poor quality. Volume of logs used in manufacture of lumber during 1968 was about 900 million of a total harvest of 1 billion board feet. Wood chips from residues of sawmills and poor quality logs are used in pulp and particle board plants. Pulp industry and overseas exports of small logs and chips expanded strongly in the late 1960's. These markets took 76 million board feet of redwood in 1968. Exports show promise of providing a future market for the increased volume of small logs that will result from intensification of young-growth management. The portion of the total volume that is derived from old-growth is estimated at about 66 percent.

Fire is the major enemy of this species–especially the young trees. There is evidence that repeated fires have extensively damaged trees. Old-growth trees have a strong ability to continue to survive after extensive damage by fire or mechanical injury. Frequently old trees have dead top, but the tree is far from dead. Fire scars permit the entry of some diseases; these generally cause a reduction in both quality and quantity of the wood, but rarely does disease kill a tree. Two species of heart rot are often found in the lower logs of old-growth trees.

Insect and animal damage is minimal. Only a few insects cause minor losses of timber. Rarely do insect populations reach epidemic levels that cause devastation in other species. Rodent damage to seeds and seedlings may locally become severe. Losses in growth as the result of bark stripping by squirrels and black bear have also been reported.

CHARACTERISTICS AND PROPERTIES

The wood of redwood is exceptionally staight-grained, has high dimensional stability, and is tesistant to warping. The wood is moderately strong in bending, strong in endwise compression, stiff, and moderately low in resistance to shock. The heartwood is relatively free from taste and odor, making the wood useful for food packaging. The wood is relatively free from volatile oils and resins, making it somewhat fire resistant. When dried, the wood is relatively lightweight (28 lb. per cubic foot at 12 percent moisture), and is regarded as moderately strong. Paint adheres

well to the surface. The natural tones of the wood are retained by use of clear finishes. Because redwood resists decay, it can do without a protective coating if necessary; it weathers to warm silvery-gray. The natural color of the fresh and weathered wood is pleasing. And the combination of rich colors, narrow grain, and massive size of knot-free boards imparts a sense of strength and richness that many find attractive.

The heartwood and sapwood in this species differ markedly. The outer 2 to 3 inches of all trees–the living sapwood–is white. As this tissue dies and becomes heartwood it turns to tones ranging from light pink to dark reddish-brown. Parallel to the color change is a change in the wood durability–sapwood is not as decay-resistant as heartwood.

Wood qualities of the old-growth redwood that make the species so valuable are also found in the young trees. In smaller trees, the percent of sapwood and coarse-grained rapid-grown wood exceeds that found in old-growth trees. Some evidence suggests that second-growth is somewhat reduced in strength, machinability, and specific gravity. But the volume of large knot-free boards in the young trees is much less than in the older trees. Perhaps one result from the shift to young-growth will be the loss of high-quality clear lumber.

PRINCIPAL USES

Bulk of the old-growth redwood volume cut goes directly into high value building construction material. Much of the dimension stock, such as heavy beams, bridge timbers, and planks, goes from the sawmill without further remanufacture. In 1960, about 167 million board feet were used in manufactured products. Three major categories of use were: (1) manufactured building products, such as siding, sash, doors, and veneer for plywood and box products; (2) wooden furniture and fixtures; and (3) refrigeration and cooling equipment. Redwood plywood, used both indoor and outdoor, is a relatively new, rapidly expanding product; from 1960 to 1968 the volume of this product rose from 15 to 23.6 million board feet.

Use of mill and woods residue for pulping and particle board is a relatively new area of utilization, and one that will undoubtedly prove to be a major use of redwood fiber.

Speciality products, including such handsplit items as shakes, shingles, grape stakes, and posts, still are in demand. Other products, such as decorative wood products from the redwood burl, are popular and support a small local industry.

REFERENCES

Adams, K.
1967. The redwoods. New York: Popular Library, 176 p., illus.

Barrette, B. R., D. R. Gedney, and D. D. Oswald
1970. California timber industries—1968. Calif. Dep. of Conserv., 117 p.

Bendsten, B. A.
1966. Strength and related properties of randomly selected sample of second-growth redwood. USDA, Forest Serv. Res. Pap. FPL–53, 16 p.

Brown, H. P., and A. J. Panshin
1940. Commercial timbers of the United States. 1st Ed., McGraw-Hill Book Co., New York, 554 p., illus.

Fritz, E.
1959. Characteristics, utilization, and management of second-growth redwood. Found. for Amer. Res. Mgmt., 29 p.
1960. The life and habits of redwood the extraordinary. Calif. Redwood Assoc., 4 p., illus.

Gill, Thomas G.
1965. Wood used in manufacturing industries. U.S. Dep. Agric. Statist. Bull. 343, 121 p., illus.

Harlow, W. M., and E. S. Harrar
1958. Textbook of dendrology. 4th Ed. McGraw-Hill Book Co., New York, 561 p., illus.

Lindquist, J. L., and M. N. Palley
1963. Empirical yield tables for young-growth redwood. Calif. Agric. Exp. Sta. Bull. 796, 47 p., illus.

Little, Elbert L., Jr.
1953. Check list of native and naturalized trees of the United States (including Alaska). U.S. Dep. Agric. Handbk. 41, 472 p.

Luxford, R. F., and L. J. Markwardt
1932. The strength and related properties of redwood. U.S. Dep. Agric. Tech. Bull. 305, 48 p., illus.

Oswald, Daniel D.
1968. The timber resources of Humboldt County, California. USDA Forest Serv. Res. Bull. PNW–26, Pacific Northwest Forest and Range Exp. Sta., Portland, Ore. 42 p., illus.
1972. Timber resources of Mendocino and Sonoma Counties, California. USDA Forest Serv. Res. Bull. PNW–40, Pacific Northwest Forest and Range Exp. Sta., Portland, Ore. 76 p., illus.

Oswald, Daniel D., and Gerard S. Walton
1966. Forest statistics for Del Norte County, California, 1965. U.S. Forest Serv. Res. Bull. PSW–5, 12 p.

Roy, D. F.
1966. Silvical characteristics of redwood. U.S. Forest Serv. Res. Pap. PSW–28, Pacific Southwest

Forest and Range Exp. Sta., Berkeley, Calif. 20 p., illus.
Schniewind, A. P.
1963. Comparison of young-growth and old-growth redwood machinability, fastening strength, and shrinkage. Univ. Calif. Forest Prod. Lab. Calif. Forest and Forest Prod. No. 33, 8 p.
USDA Forest Products Laboratory
1955. Wood handbook. U.S. Dep. Agric. Handb. 72, 528 p., illus.
USDA Forest Service
1965. Timber trends in the United States. U.S. Dep. Agric. For. Res. Rep. 17, 235 p., illus.
1972. Forest statistics for the United States, by state and region, 1970. U.S. Dep. Agric. Forest Serv., 96 p., illus.

☆ U.S. GOVERNMENT PRINTING OFFICE: 1974 0–547-974