Forest Service

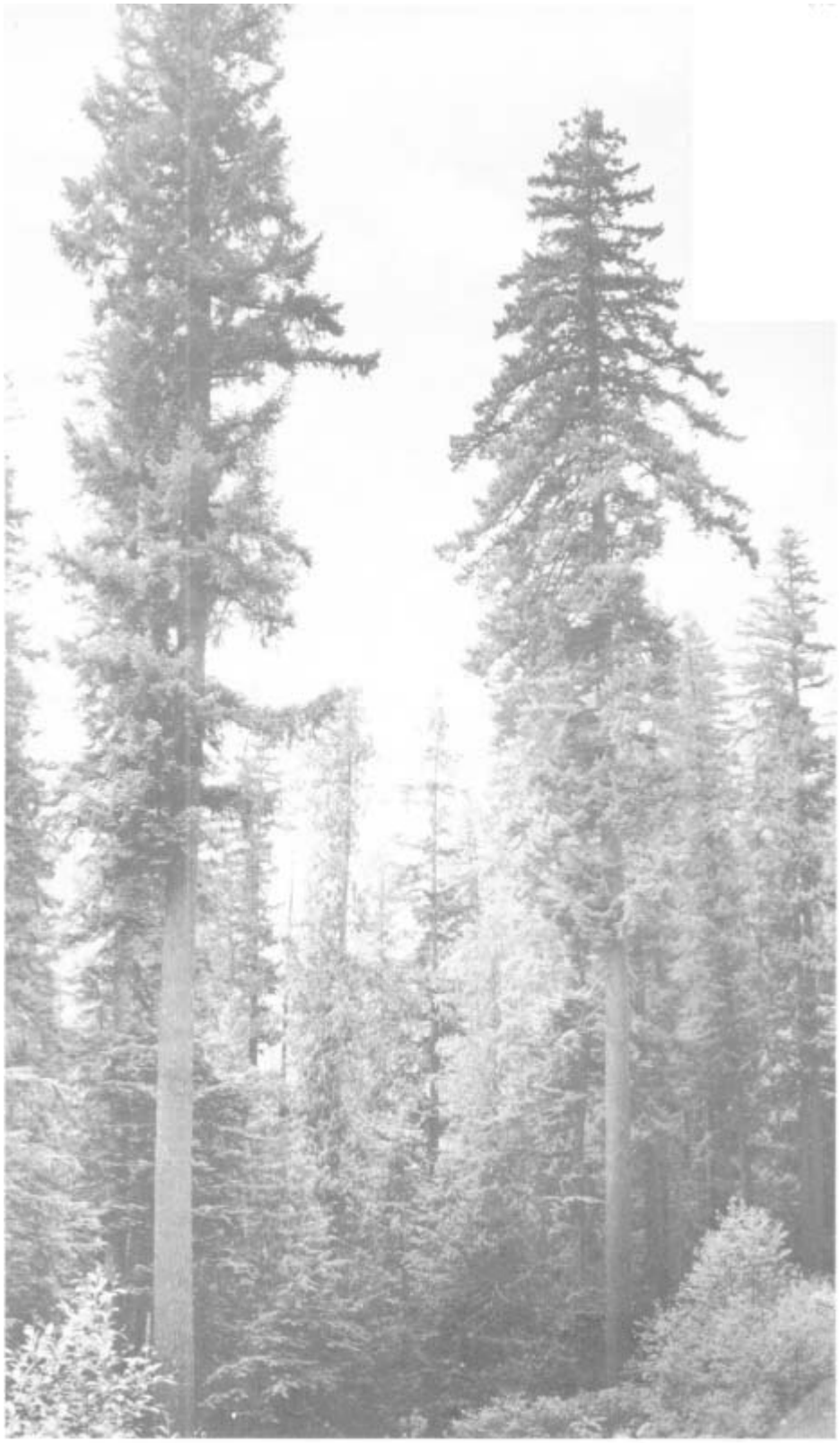
United States Department of Agriculture

FS-235

Douglas-Fir

An American Wood

Douglas-fir is one of the fastest growing conifers in the temperate zone and grows to a magnificent size in older stands. An abundant supply and excellent wood characteristics make it the single most important lumber species in the United States. It is used extensively for dimensional lumber, plywood, and pulp.



F-437209

Douglas-Flr

(Pseudotsuga menziesii (Mirb.) Franco)

Bernard T. Bormann[1]

Distribution

Douglas-fir is widely scattered throughout western North America from the mountains of Mexico to British Columbia, Canada (fig. 1). Two subspecies have been identified. Coastal Douglas-fir (variety *menziesii*) is found west of the Cascade Range and Sierra Nevada from sea level to 5,000 feet. Rocky Mountain Douglas-fir (variety *glauca* (Biessn.) Franco) is found in the eastern Cascades and Sierra Nevada and throughout the Rocky Mountains at elevations of 1,800 to 8,000 feet in the north and to nearly 11,000 feet in the south.

Both varieties are adapted to an extremely wide variety of soils and climates. In the coastal region, the species is commonly found in pure, even-aged stands thought to have developed following clearcutting or wildfires. Approaching its latitudinal or elevational limits, Douglas-fir is more commonly found growing with other species.

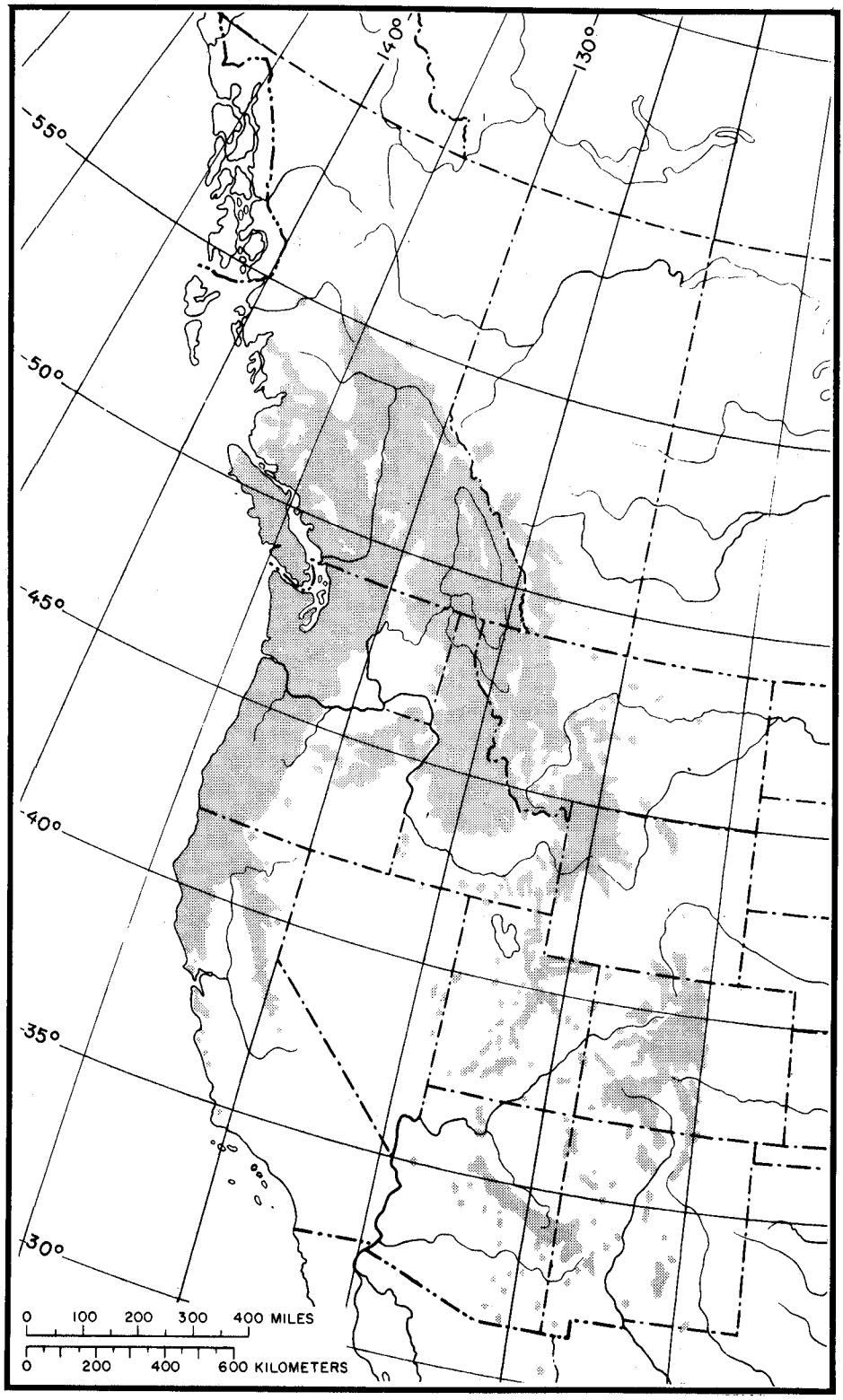


Figure l—Natural range of Douglas-fir. F-532736

[1]Research Plant Physiologist, U.S.Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station, Forestry Sciences Laboratory, Juneau, Alaska.

Description and Growth

Douglas-fir is a coniferous tree that often reaches magnificent size. Heights of 150 to 250 feet and diameters of 3 to 6 feet are common in coastal stands that are 200 to 800 or more years old. The tallest intact standing tree that has been documented was 330 feet tall and grew near Littlerock, Wash. The maximum size of Rocky Mountain Douglas-fir is 150 feet in height and 4 feet in diameter on the best sites.

Douglas-fir is distinguished by a dense, cone-shaped crown, sharp-pointed buds, and three-pronged bracts that protrude between cone scales (fig. 2). The needlelike leaves are dark yellow green in the coastal variety or blue green in the Rocky Mountain variety. They are 3/4 to 1-1/4 inches long, flattened, and flexible. Stems are long, very straight, and cylindrical. The bark on young trees is gray, thin, and smooth. In older trees it becomes brownish red, medium to very thick, and deeply fissured.

Seed production varies from tree to tree and from year to year, large crops occur at intervals of 2 to 11 years. Seeds are dispersed by the wind and germinate readily on most soils, provided there is sufficient moisture. To survive, seedlings must receive light and their roots must reach mineral soil quickly.

This species is especially well adapted to silvicultural systems that involve complete removal of overstory trees on all but the harshest sites. Large clearcuts usually require planting of nursery-grown seedlings to insure full stocking. Where there is a large amount of logging residue, some site preparation is necessary to establish a suitable planting site.

Juvenile growth of Douglas-fir is less rapid than that of some native hardwoods and shrub species, especially on the better sites. Consequently, mechanical or chemical removal of competing species is often necessary to establish pure stands. Tree growth in pure stands 20 to 80 years old is extremely rapid, outproducing most other species in North America. The profitability of dense stands is often improved by precommercial and commercial thinning. In unmanaged stands on the best sites, yields of 20,000 cubic feet (130,000 board feet, Scribner rule) per acre can be achieved in 110 years, but on average sites, even old-growth stands rarely contain more than 17,000 cubic feet (100,000 board feet, Scribner rule) per acre.

Figure 2- Douglas-fir leaves and cones. **F-308969**

Although Douglas-fir is considered generally free of pests compared to most other species, many agents can cause damage to seeds, seedlings, and mature trees. Several parasitic fungi, such as the laminated root rot *(Phellinus weirii)* and the shoestring root rot *(Armillariella mellea),* can cause extensive damage to trees of all ages. Red ring rot *(Fomes pini)* is an important heartrot. Dwarf mistletoe *(Arceuthobium douglasii),* a parasitic plant, causes stem malformation. Many insects devour Douglas-fir seeds while they are still in the cone. The cone moth *(Barbara colfaxiana)* is a serious pest of the Rocky Mountain variety, and the cone gall midges *(Contarinia oregonensis* and *C. washingtonensis)* are pests of Pacific coast trees. Large stands of Rocky Mountain Douglas-fir can be defoliated by the Douglas-fir tussock moth *(Orgyia pseudotsugata)* and the spruce budworm *(Choristoneura occidentalis).* Browsing and clipping by hares, mountain beaver, deer, and elk can damage and kill large numbers of seedlings and saplings. Bears have been known to strip bark of larger trees. Strong winds, especially after heavy rains, blow down trees, and ice and snow storms can result in broken tops. Crown fires destroy trees of all ages. The thick bark on older trees makes them resistant to ground fires.

Other Names

The variety of names, both scientific and common, applied to the Douglas-fir tree, reflects the confusion that has historically surrounded its botanical

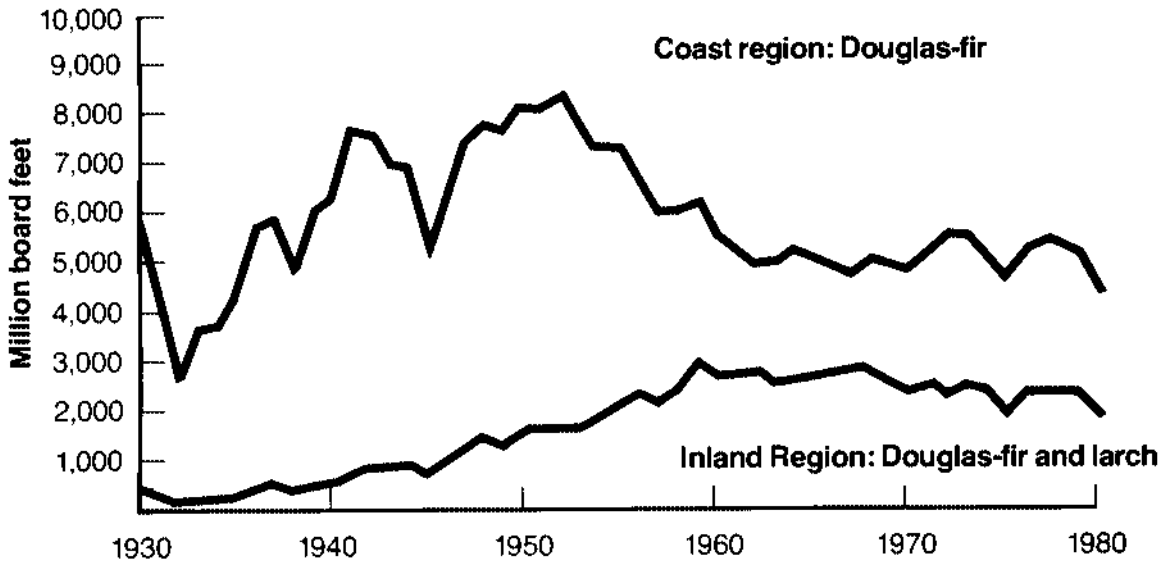


Figure 3–Production of Douglas-fir from 1930 to 1980.

relationship. The tree was first described in 1803 by a British botanist from a specimen collected by Archibald Menzies while on an expedition to the west coast of North America. It was alternately considered to be a kind of pine *(Pinus),* a true fir *(Abies),* a spruce *(Picea),* and a hemlock *(Tsuga).* Finally, in 1825, Scottish botanist David Douglas was sent to America by the British Royal Horticultural Society to study this species.

In 1867, based on specimens collected by Douglas, the tree was recognized as a separate genus among conifers and given the new name *Pseudotsuga.* This was a rather unfortunate choice, since it literally means "false hemlock," a genus to which it is only remotely related. Even after the new genus was established for it, confusion continued about the correct combination for the botanical name. *Pseudotsuga douglasii* and *Pseudotsuga mucronata* can be found in the literature, but it was the combination *Pseudotsuga taxifolia* that became most widely accepted and was in use for over half a century. This combination, however, overlooked an earlier published name for the tree, and in 1950, in accordance with international rules governing botanical nomenclature, the name was changed to its present form, *Pseudotsuga menziesii.*

Common names applied to this tree also reflect the past confusion regarding its botanical affiliation. The name Douglas-fir commemorates the Scottish botanist and is the name by which this tree is most frequently known today worldwide. Many other common names have been used, some of the more widely known being Douglas-spruce, Douglas-yew, and Oregon-pine.

Douglas-fir lumber has been marketed under the names yellow-fir and red-fir, depending on color variations of the wood, which are supposedly associated with property differences. In foreign markets, the wood of Douglas-fir is still sometimes marketed as Oregon-pine or merely as Oregon.

Related Commercial Species

Coastal Douglas-fir is marketed by itself. Rocky Mountain Douglas-fir is usually marketed with western larch *(Larix occidentalis).*

supply

The estimated volume of Douglas-fir sawtimber (trees greater than 9 inches in diameter at breast height) in the United States in 1977 was 514 billion board feet (International 1/4-inch rule) (USDA FS 1982). Most of this volume was in Oregon and Washington (46 and 23 percent, respectively). California had 14 percent and the Rocky Mountain region 17 percent.

Production

Douglas-fir is the most important species for lumber production in the United States. Over the past decade, it has accounted for 64 percent of all lumber produced in the Pacific coast region. Peak production was achieved in 1952. Since then utilization of other species has increased while Douglas-fir production has declined in the region (fig. 3). Recession in 1980 cut production to about half the 1952 figure and resulted in the lowest production since

the 1930's. For the inland region, where Douglas-fir is marketed with larch, combined production of these species rose steadily after 1930, peaking from 1959 to 1967.

Characteristics and Properties

The sapwood of Douglas-fir is whitish or pale yellow; it is narrow in slow-growing trees and up to 3 inches thick in rapidly growing trees. Heartwood is yellow or pale red in Rocky Mountain trees and slow-growing coastal trees, and orange to red in fast-growing coastal trees. Although wood quality of both varieties is extremely variable, average material is rated as strong, moderately hard, and very stiff. Wood specific gravity ranges from 0.43 to 0.46, based on green volume and ovendry weight. The wood density ranges from 32 to 35 pounds per cubic foot at 12 percent moisture content.

Coastal trees are stronger and denser than Rocky Mountain trees. Boards cut from old-growth trees of both varieties are generally stronger and denser than boards cut from second-growth trees. The wood is rather difficult to work with handtools, splits easily, but has good machining properties. It can be readily kiln-dried using normal procedures.

High density Douglas-fir wood is of intermediate durability, ranking with dense southern pine in decay resistance but is less durable than the cedars, bald cypress, and redwood. The wood is difficult to impregnate with preservatives and must often be incised to allow penetration. Douglas-fir ranks low in paint-holding ability, especially on exterior surfaces, but has good staining properties.

Douglas-fir fibers are relatively long, large in diameter and have thick cell walls. Paper products made from them have high tearing strength, but their tensile strength is lower than that of paper products made from fibers of western hemlock *(Tsuga heterophylla).*

Principal Uses

Douglas-fir predominates in structural wood markets primarily because of its strength and availability in large sizes. It also leads in use for construction-grade plywood and high-grade veneer. Principal uses are in construction and for poles, pilings, and railroad ties. It is also used extensively in paper products and various types of millwork, flooring, pallets, boxes, crates, ladders, and furniture. In the Western States, firewood, hog fuel, and Christmas trees are important uses. It is widely used as an ornamental tree and is planted throughout the world.

References

Fowells, H. A., comp. Silvics of forest trees of the United States. Agric. Handb. 271. Washington DC: U.S. Department of Agriculture; 1965. 762 p.

Harlow, W. M.; Harrar, E. S.; White, F. M. Textbook of dendrology. 6th ed. New York: McGraw-Hill; 1979. 510 p.

Hepting, G. H. Diseases of forest and shade trees of the United States. Agric. Handb. 386. Washington, DC: U.S. Department of Agriculture; 1971. 658 p.

McArdle, Richard E.; Meyer, W. H.; Bruce, D. The yield of Douglas-fir in the Pacific Northwest. Tech. Bull. 201. Washington, DC: U.S. Department of Agriculture; 1961. 74 p.

Owston, P. W.; Stein, W. I. *Pseudotsuga*. In: Seeds of woody plants in the United States. Agric. Handb. 450. Washington, DC: U.S. Department of Agriculture; 1974. 450 p.

Panshin, A. J.; de Zeeuw, C. Textbook of wood technology. 3d. ed. New York: McGraw-Hill; 1970. 705 p.

U.S. Department of Agriculture, Forest Service. An analysis of the timber situation in the United States 1952–2030. For. Resour. Rep. 23 Washington, DC: U.S. Department of Agriculture; 1982. 528 p.

October 1984
Supersedes unnumbered American Woods leaflet Douglas-fir, 1960.