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WESTERN HEMLOCK

Tsuga heterophylla, Pine family—Pinaceae

Western hemlock's distinctive appearance is a product of its short, delicate needles; abundant little cones; drooping branch tips; and the bent-over leader at the treetop. This tree is smaller, slower-growing, and often shorter-lived than its majestic associates, including Sitka spruce near the coast, Douglas-fir west of the Cascades, western redcedar along northwestern rivers and streams, and western white pine in northern Idaho. However, a closer look at the mature forest reveals that young hemlocks far outnumber regeneration of the other species. When the lofty spruce, coastal Douglas-fir, redcedar, or white pine lose vigor and die, a dense stand of smaller hemlocks will replace them. Root competition from hemlocks may even hasten the demise of their larger associates.

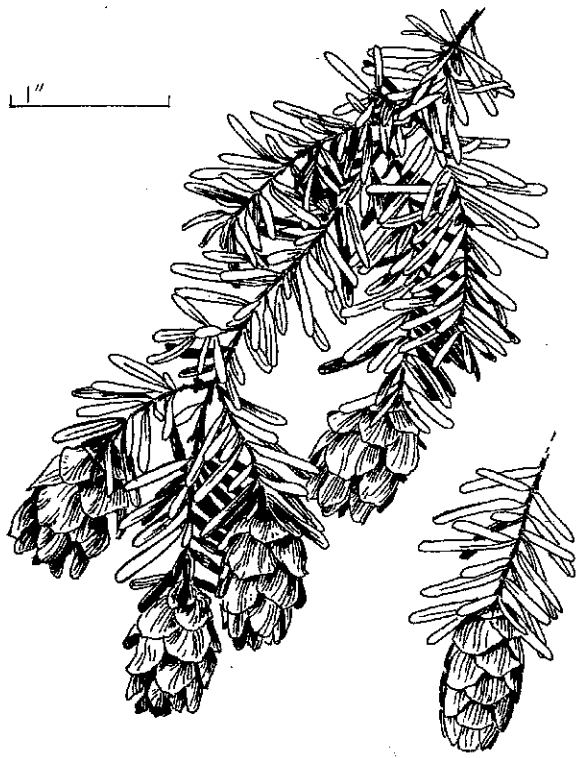
Where It Grows

Western hemlock is one of several trees whose main distribution follows the North Pacific coast, west of the Cascades and the British Columbia Coast Range. It extends from the redwood forest in northernmost California to south-central Alaska's Kenai Peninsula. From northwestern Oregon to the Alaska Panhandle, western hemlock will, barring disturbance, eventually dominate all but the driest forest habitats. It is abundant in western Washington from sea level to elevations of at least 3500 feet (1070 m) and is designated as Washington's State Tree.

Like numerous other coastal Northwest species, western hemlock also inhabits the wettest area of inland mountains—the region historically dominated by western white pine. Here—in southeastern British Columbia, northeastern Washington, northern Idaho, and northwestern Montana—western hemlock occupies moist habitats, especially north-facing slopes, up to about 5000 feet (1500 m). The valleys it occupies generally receive at least 32 inches (800 mm) of precipitation in the average year. Still, western hemlock is less prevalent across this inland area than it is west of the Cascades due to many intervening dry valleys and to more frequent fires, which favor its competitors.

Appearance

The small needles and cones and drooping branch tips and leader give young western hemlocks a graceful appearance. As the trees grow, they develop a long, thick canopy that casts a dense shadow. Despite western hemlock's modest size by Northwest standards, it is thought to be the largest of the ten or so hemlock species



western hemlock

found in the northern hemisphere. At middle elevations in the coastal mountains, very old hemlocks sometimes attain diameters of 6 to 8 feet (1.8 to 2.4 m) and heights of 200 feet (60 m) or more (Van Pelt 2001). In inland areas on sites with minimal moisture stress, old hemlocks can reach a diameter of 4 feet (1.2 m).

Western hemlock's fine foliage and branching arrangement give the boughs a delicate spraylike appearance unlike other needle-leaved conifers. The flat, blunt needles range from about ¼ to ¾ inch (0.5 to 2 cm) long on any given branch. The species name *heterophylla* means "variable leaves." Needles have white bands (of microscopic pores) on the underside and grow in a somewhat two-ranked pattern, from opposite sides of the twigs. Western hemlock cones, also small and delicate, are borne in large quantities on the branches throughout most of the canopy. They are tan and papery and less than 1 inch (2.5 cm) long when mature. They are borne in such plenty that they often cover the forest floor.

Near its upper elevational limits on mountain slopes, western hemlock commonly mingles with its high-elevation relative, mountain hemlock (see the next chapter). Occasionally trees have foliage or cones that appear intermediate between the two species—for example, denser leaf arrangement on twigs and larger cones than normal for western hemlock. However, little evidence of actual hybridization between these species has been confirmed, and it seems that trees that appear intermediate are probably western hemlocks that acquired some characteristics similar to mountain hemlock's.

The bark on large western hemlocks is dark brown and heavily furrowed, superficially resembling Douglas-fir. This can be confusing in the dim light of an old hemlock forest, which may contain relict Douglas-firs. However, these species are easily distinguished by examining the bark. Douglas-fir bark is several inches thick and when sliced reveals bands of light tan and dark brown, whereas hemlock bark is only about 1 inch (2.5 cm) thick, and the inner layers are dark red to purple.

Ecological Role

While faster-growing and larger associates depend on fire, blowdown, or other disturbances to perpetuate themselves, western hemlock employs a different strategy. It is amazingly well adapted to achieving dominance over all other species in the dense forest when there is no major disturbance for a long period of time. For one thing, hemlock yields seed in abundance. Eight million seeds averaging roughly 260,000 per pound (570,000 per kg) were produced per acre (20 million per ha) in an Oregon forest one year. The seeds can germinate and grow on a variety of seedbeds, beneath shrubs or other trees. This tree begins to yield cones at age twenty-five or thirty and then outproduces all its associates. The seeds have a membranous wing, allowing them to travel 0.5 mile (1 km) from the parent tree in just a light wind. Small wonder that western hemlock saplings are commonly found growing in places far from any seed-bearing hemlocks.

Because of intense competition from established vegetation under a forest canopy, conifer seedlings are often most successful getting established on a rotten log. One of these logs in the coastal rain forest may support hundreds of western hemlock seedlings accompanied by only a few of the less shade-tolerant Sitka spruce and rarely a Douglas-fir seedling, despite the presence of spruce and Douglas-fir in the overstory.

Hemlock seedlings can survive at a very slow rate of growth for many decades, until a favorable event such as toppling of a large tree gives a few of them the opportunity to grow more rapidly and perhaps even reach into the forest canopy. Many seedlings on rotten logs succeed in extending roots down into underlying mineral soil, and as the log disintegrates, the developing trees display a stilted root system. A

small western hemlock tree is sometimes seen perched atop a broken-off rotting snag more than 15 feet (4.5 m) above the ground; inspection will reveal that one or more roots extend down the stump into the damp soil.

Although individual hemlocks grow more slowly than do their shade-intolerant competitors, they can accumulate more biomass or wood volume per acre than coastal Douglas-fir, Sitka spruce, or other species do, because they are able to sustain good growth at higher densities (U.S. Forest Service 1990). However, dense old hemlock forests are prone to heavy damage by fungi that cause root or stem rot, defoliating insects such as hemlock looper and black-headed budworm, and the parasitic plant dwarf mistletoe. At lower elevations, western hemlock seldom attain 300 years of age before they succumb to

western hemlock seedling on a western redcedar stump

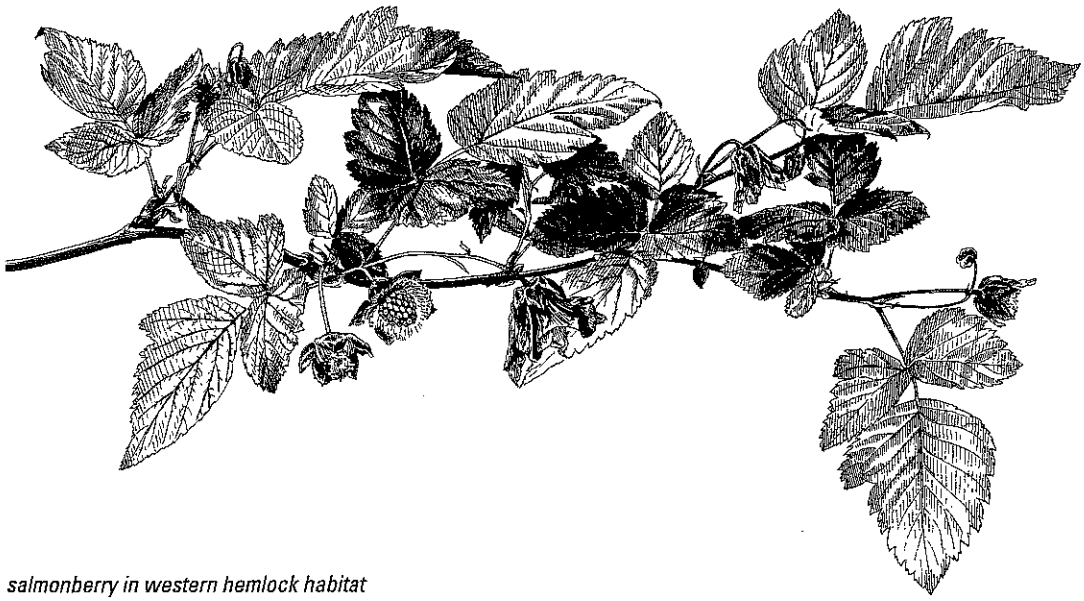
disease or weather damage such as breaking off or uprooting in high winds. (Trees at higher elevations may live longer.) Their shallow roots and thin bark also make them highly vulnerable to fire.

Partially because of the dense shade and root competition, old hemlock forests support only sparse undergrowth. In contrast, young forests that arise after fire, windthrow, or some forms of logging have a profusion of herbaceous plants and shrubs that provide forage and fruits favored by wildlife. Similarly, a variety of tree species commonly gets established in a burned hemlock forest. On burned or heavily logged sites, western hemlock seedlings do not compete in initial height growth with red alder, coastal Douglas-fir, western white pine, western larch, or other shade-intolerant tree species, and they may be damaged by excessive exposure to the drying sun. But after other species become well established, the shade they cast is favorable for western hemlock, which then increases in the understory.

In recent years, ecologists have discovered that concepts of disturbance and succession in western hemlock forests are actually more complex than previously thought. Studies reveal that much of today's western hemlock forest was historically subject to mixed-severity fires that killed most hemlocks and other fire-susceptible trees but allowed many shade-intolerant trees to survive or to regenerate in abundance (Arno 2000). Principal beneficiaries of fire were Douglas-fir in coastal forests and western larch, white pine, and lodgepole pine in inland forests. Fire-resistant survivors became important old-growth features in the ecosystem—for instance, as habitat for cavity-nesting birds and mammals. With the general success of fire suppression in old forests, especially west of the Cascades, there is no mechanism for perpetuating historic conditions, including large, fire-resistant trees.

Human History

Native peoples had many uses for western hemlock (Moerman 1998). Several tribes cooked bark to make extracts for treating tuberculosis, rheumatic fever, or hemorrhage. The inner bark served as a survival food in winter. Boiled bark made reddish brown or darker dyes for fish nets and lines that rendered them invisible to fish. Some coastal tribes submerged hemlock trees and anchored them underwater to collect



salmonberry in western hemlock habitat

herring eggs that would stick on the foliage and could then be gathered for food.

Until about 1920, lumber mills regarded western hemlock as a weed tree, apparently because they assumed that the wood had poor qualities similar to eastern hemlock (*Tsuga canadensis*). Later, they learned that western hemlock wood is superior to its eastern kin from almost all standpoints. Today's forest industry makes extensive use of western hemlock wood. It absorbs preservative treatments well and is used for pilings, poles, and railroad ties. It is suitable in strength and nailing characteristics for construction lumber and is made into flooring for gymnasiums. It provides excellent wood pulp for various types of paper and serves as a source of cellulose fiber used in the manufacture of rayon and many plastics. The bark is rich in tannin and has a long history of use in tanning leather.

Thus, just as western hemlock's biological importance in Northwest forests is well established, it has proven to be a Cinderella tree from the commercial viewpoint.