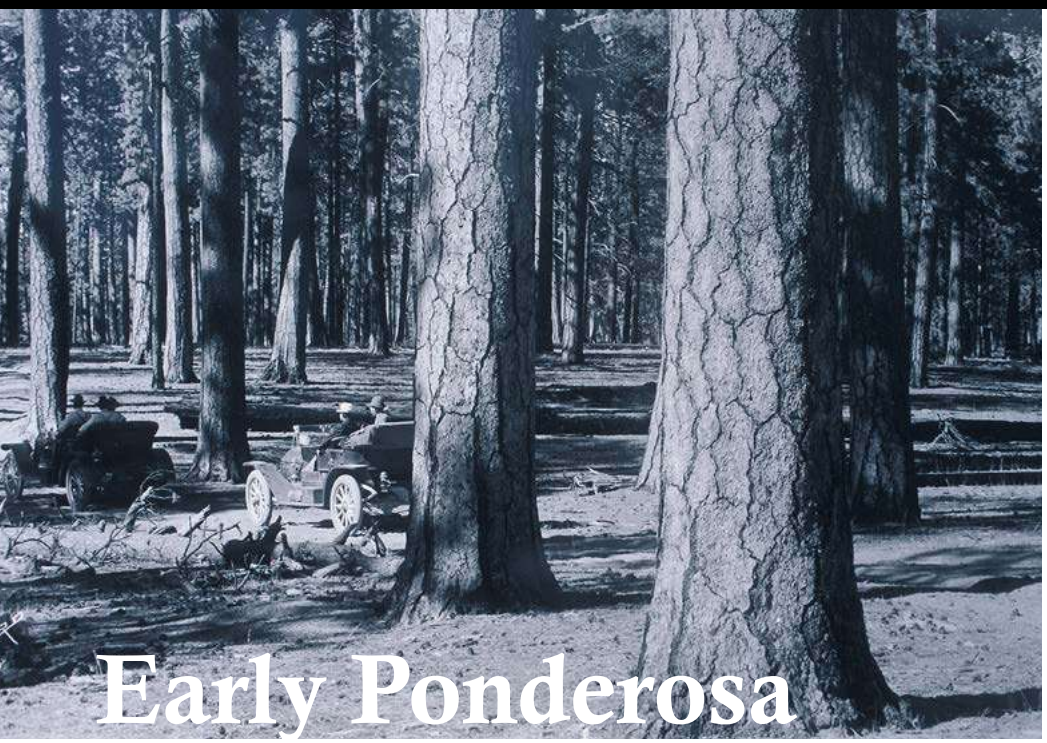

*An open stand of old-growth ponderosa pine in Oregon at the turn of the 20th century (on the Deschutes National Forest today). Photo: USDA Forest Service.*

# Early Ponderosa Pine Forests: Notes on Fire Ecology*

**Stephen F. Arno**

**Exhausted immigrants soon entered a realm of giant pines, grassy glades, and clear-flowing streams.**

Wildland fire shaped the historical ponderosa pine and mixed-conifer forest landscapes throughout the West. Fire was also a controlling force in most of the drier vegetation types, ranging from shortgrass prairie to chaparral, scrub oak, and pinyon–juniper woodlands. It is therefore no surprise that wildland fire suppression in all of these landscapes has had profound effects.

## OPEN-GROWN CONDITIONS

Ponderosa pine ranges from Mexico to Canada, covering about 40 million acres (16 million ha) across parts of most Western States. Historical photos and accounts of southwestern ponderosa pine forests document their open-grown conditions, with an undergrowth of luxuriant grass. In a 1960 monograph about changes in southwestern pine forests since white settlement, Charles Cooper cited a number of locations and sources (Cooper 1960).

In 1857 and again the following winter, Lieutenant Edward Beale led a famous corps of camels that was expected to revolutionize transportation across the Southwest. In what is now northern Arizona (on the Coconino National Forest), Beale described "a glorious forest of lofty pines, through which we have travelled ten miles [16 km]" (Lesley 1929). He recorded seeing "beautiful, broad grassy vales extending in every direction. The forest was perfectly open and unencumbered with brush wood."

Joseph Rothrock, a botanist with the Wheeler Survey of 1875, described the region just south of Gallup, NM (Cooper 1960):

> *Gaining the summit, a thousand feet [300 m] above Fort Wingate, we were at an altitude of about 8,000 feet [2,400 m] above the sea, a fine, open, park-like region with a large growth of yellow pine [ponderosa and fir] covering the hillsides. A diversified herbaceous vegetation was out in the most brilliant colors, beautifying alike the woods and open grounds. … Good forage was abundant.*

Cooper (1960) described the same area as "almost bare of herbaceous ground cover, and dense thickets of pine saplings predominate."

Clarence Dutton's 1887 U.S. Geological Survey report on the Grand Canyon Region said of the Kaibab Plateau (Biswell 1972):

> *The trees [ponderosa] are large and noble in aspect and stand widely apart, except part of the plateau where spruces [likely Douglas-fir] predominate. Instead of dense thickets where we are shut in by impenetrable foliage, we can look far beyond and see the tree trunks vanishing away like an infinite colonnade. … There is a constant succession of parks and glades—dreamy avenues of grass and flowers …. From June until September there is a display of wild flowers which is quite beyond description.*

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** The article is adapted from Fiedler and Arno (2015).*

**Ponderosa pine's decline is due to the effects of fire exclusion through wildland fire suppression and prevention.**

Hundreds of miles farther north, pioneers on the Oregon and California trails rejoiced when, after months of struggling to cross scorching plains and deserts, they sighted the ponderosa pine forest. Exhausted immigrants soon entered a realm of giant pines, grassy glades, and clear-flowing streams. Rebecca Ketcham's 1853 account of reaching eastern Oregon's Blue Mountains conveyed the pioneer sentiment (Evans 1991): "Our road has been nearly the whole day through the woods, that is, if beautiful groves of [ponderosa] pine trees can be called woods. … The country all over is burnt over so often there is not the least underbrush, but the grass grows thick and beautiful."

Although the early descriptions all focused on an open forest of large ponderosa pines, several accounts described patches of young pines as well (Cooper 1960). One account is from John Hanson Beadle in 1873, based on his 5 years of exploring "the undeveloped West" (Beadle 1873). Beadle traversed the 75-mile-long (121-km-long) Defiance Plateau extending from northern Arizona into New Mexico. He found that "tall sugar pines [ponderosa] from 3 inches to 2 feet [8 cm to 0.6 m] in diameter, mingled with a few dwarfish oaks, were scattered in regular proportion" (Beadle 1873). This aligns with findings in California by Harold Weaver that ponderosa pine can regenerate successfully in open stands of large trees, despite frequent wildland fires (Weaver 1943). It also debunks assertions by the early Forest Service that "light burning" would eliminate pine reproduction (Greeley 1920).

An extensive review of historical conditions also confirms Weaver's finding that trees in forests dominated by ponderosa pine throughout most of the West were irregularly spaced (Hood and Miller 2007). Patches of pines of different ages were generally open growing, with grassy meadows in the openings. Although some patches were fairly dense, the forest generally had 40 to 60 trees of all sizes per acre. Low- to moderate-intensity surface fires predominated in ponderosa pine woodlands throughout the West.

## PONDEROSA PINE DEGRADATION

Today, many of these open woodlands have become dense forests averaging hundreds of trees per acre, including thickets that erupt into a crown fire when lightning or people ignite them under dry conditions. A huge part of the wildland–urban interface is in ponderosa pine-dominated forests bordering public lands. No wonder there is an ever-increasing problem with controlling wildfires. Weaver (1943) and Cooper (1960) already noted that fire exclusion in ponderosa pine was resulting in dense thickets of young trees. Today, the thickets are even more widespread,

*Ponderosa pine with regeneration on the Lincoln National Forest in New Mexico in 1922 (part of the Capitan Wilderness today). Photo: S. Strickland, USDA Forest Service.*

## Living Artifacts: "Indian Trees"

Indian Trees are officially recognized as living artifacts because of distinctive scars in the bark made by American Indians as long ago as the 17th century. Indian women, with help from children, peeled away the inner bark on one side of the tree each spring, when the bark was saturated with sugar and nutrient-rich sap. The women used a long wooden chisel called a spud.

Many Tribes used the inner bark, which was like a thick layer of saturated felt, as a food sweetener and as an additive to preserve the mixture of dried meat, tallow, nuts, and berries called pemmican. They also used the saturated inner bark to preserve the heavy cord or thin rope they made from sinew.

Many Indian Trees have multiple scars from different years. However, the bark peelers were careful not to cut away the inner bark and cambium completely around the tree, thus killing it by girdling it. Indian Trees grow in nearly all Western States, including Colorado, Utah, Arizona, and New Mexico.

**Thickening of the forest canopy has serious implications for western watersheds and stream-flows.**

making it nearly impossible to protect old orange-bark ponderosa pines from severe wildfires.

One tragic result is that "Indian Trees"—living artifacts and a classic part of our national heritage in the West (see the sidebar on the previous page)—can no longer be protected from wildfires. In western Montana alone, hundreds of Indian Trees are documented and designated as historic objects that must be preserved, and at least two areas have interpretive displays (Arno and others 2008; Josefsson and others 2012). During the Lewis and Clark Expedition (1803–06), Captain Meriwether Lewis recorded Indian Trees on his journey up Lolo Creek and over the Bitterroot Mountains (DeVoto 1997).

The upper Bitterroot River drainages have the highest known concentration of Indian Trees. Professor Lars Östlund and his students from Umeå University in Sweden documented 274 Indian Trees in the two areas they studied alone. One forest road branching off from U.S. Highway 93 at the southern end of the Bitterroot Valley leads to Indian Trees Campground, which contains multiple Indian Trees. A display at the entrance shows how Indian women peeled the sap-rich inner bark of these pines in spring. However, the open-grown ponderosa pines are being invaded and crowded out by young Douglas-firs due to the elimination of wildland fire. Even before you get to the campground, you see some of the big, ancient, bark-peeled ponderosa pines and the young invading Douglas-firs.

*Virgin ponderosa pine stand on the Lincoln National Forest in New Mexico in 1928. Heavy grazing by goats has eliminated pine reproduction and most herbaceous ground cover. Photo: E.S. Shipp, USDA Forest Service.*

On moist sites in mixed-conifer forests—which historically didn't burn as often—fuels accumulated and thickets of Douglas-fir and white fir let wildland fires torch through patches of forest. The burns sometimes became wind-driven crown fires, which were limited in size by a landscape mosaic that included open forest, aspen groves, and grassy meadows. Native insects and diseases weakened and killed ponderosa pines in the original forests, but frequent wildland fires tended to limit their impact. Today, various species of bark beetles, rust and root-rot fungi, dwarf mistletoe, and needle-cast disease take a heavy toll.

On south- or west-facing slopes, relict old-growth ponderosa pine stands can still be found at surprisingly high elevations—6,000 feet (1,800 m) in the Northwest and 8,500 feet (2,600 m) in the Southwest. However, such sites have now been mostly taken over by firs. In the Northern Rockies, the original area of forest dominated by ponderosa pine, which included trees 500 to 800 years old, is thought to have decreased by about 40 percent. The decline is due to the effects of fire exclusion through wildland fire suppression and prevention. On southern Utah's Fishlake National Forest, ponderosa pine once covered about 135,000 acres (55,000 ha); but by 1998, it occupied only about 41,000 acres (17,000 ha), mostly due to encroachment by firs (Hood and Miller 2007).

## ADVERSE IMPACTS

Thickening of the forest canopy has serious implications for western watersheds and streamflows. The dense cover of trees intercepts a large percentage of the rain and snow, allowing most of it to evaporate or sublimate directly back into the dry atmosphere, thereby preventing replenishment of groundwater. Then, when a conflagration engulfs the forest, accelerated erosion can wreak havoc in the form of downstream flooding, washing out roads and filling streambeds and reservoirs with silt and debris.

In many parts of the Interior West and Rocky Mountains, unregulated livestock grazing to supply mining boomtowns began in the 1860s; although Federal agencies enacted grazing restrictions in the 1920s, effective enforcement was difficult to achieve until late in the 20th century. Abusive grazing trampled and removed native grasses and forbs as well as flowering herbaceous plants, leaving bare ground that was colonized by unpalatable shrubs and a variety of noxious weeds that now plague meadows and forests. Countless millions of dollars have been spent applying a variety of herbicides to control weeds on forest land, mostly with limited success.

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