
Fire regimes of Northern Rocky Mountain ponderosa pine forests

Ponderosa pine dominates low-elevation forests and savannas from the northern Rocky Mountains to the North Cascades. Douglas-firs and other fir trees are also common among the large, old trees. Historically, ponderosa pine forests were a mosaic of open stands, dense patches of young trees, and areas without any trees at all. Frequent fires maintained ponderosa pines as the biggest, oldest trees, even in places where fir trees would probably take over without fire.

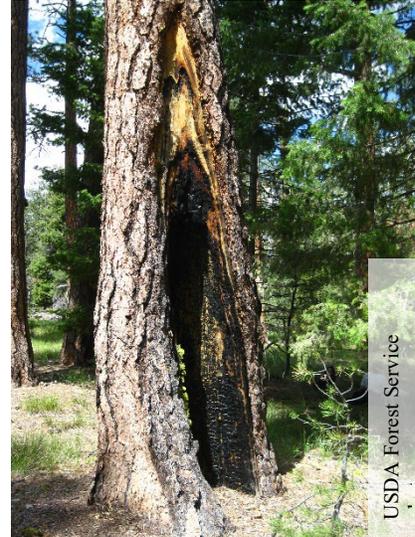
Before the time when fires were kept out of the forests (the early 1930s), there was plenty of litter and undergrowth in ponderosa pine forests, but there were not many young trees or woody fuels. Lightning fires occurred in summer, and American Indians set fires in spring and fall.

Most of the fires were surface fires of low to moderate severity that burned in a patchwork pattern. Stand-replacement fires were infrequent, but they were an important part of the fire regime.

Results from fire history studies show that average fire intervals in ponderosa pine forests of the northern Rocky Mountains ranged from 6 years to 50 years. Most studies report averages of 6 to 15 years. Fires were less frequent but more severe at higher elevations, in moist sites, and on north-facing slopes.

As fires have been kept out of ponderosa pine forests in the northern Rocky Mountains, fuel loads have increased - particularly ladder fuels. Many ponderosa pine forests have a lot of Douglas-firs and other fir species in the understory, and not many ponderosa pines. Many forests are denser than they were in the past. Cheatgrass has invaded some ponderosa pine forests, increasing the fine fuels.

Many ponderosa pine forests of the northern Rocky Mountains have changed over the past century. They now have longer fire intervals, but when fires occur they tend to be more severe and possibly larger than what occurred historically. The size and frequency of severe fires are likely to continue to increase with climate change. Large, severe fires threaten the integrity of ponderosa pine ecosystems.



Adapted from: Fryer, Janet L. 2016. Fire regimes of Northern Rocky Mountain ponderosa pine communities. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Missoula Fire Sciences Laboratory (Producer). Available: https://www.fs.usda.gov/database/feis/fire_regimes/Northern_RM_ponderosa_pine/all.html [2017, April 24].

Fire Regimes in Rocky Mountain Lodgepole Pine/Subalpine Fir Forests

Wildland fires usually occurred at intervals from about 100 years to 300 years in lodgepole pine/subalpine fir forests, although sometimes fires were more frequent. Most fires were either stand-replacing or mixed-severity, but low-severity fires occurred occasionally. Where there are a lot of ladder fuels, fallen logs and branches, and dense tree crowns, these forests are likely to have stand-replacing fires. They can be crown fires or severe surface fires – or a combination of crown and surface fire. In dry locations where fuels are sparse, fires are likely to be a patchwork of mixed severities.



In forests dominated by Rocky Mountain lodgepole pine, the amount of fuel is related to stand age. If a young stand is very dense, with interlocking crowns, sparse lower limbs, and few understory plants, it is unlikely to burn at all unless the wind is very strong; then it may burn in a crown fire. As the forest gets older, the trees may be killed by bark beetles or dwarf mistletoe, and young fir trees may grow in, increasing the ladder fuels. Then the stand becomes likely to burn in either stand-replacing or mixed-severity fire.

Research from two national parks shows how fire regimes in lodgepole pine forests can vary:

- A study in forests containing western larch and Rocky Mountain lodgepole pine in Glacier National Park showed that forests with a dry climate and gentle topography experienced mixed-severity fires about every 25 to 75 years. Forests on wetter, steeper, sites experienced stand-replacing fires at longer average intervals, ranging from 140 to 340 years.
- A study in Yellowstone National Park showed that low-elevation lodgepole pine forests experienced mixed-severity fires about every 25-150 years; higher-elevation forests experienced stand-replacing fires at longer intervals, ranging from 300-400 years.

Because fire intervals are long in most Rocky Mountain lodgepole pine forests, it is hard to say for sure whether fire suppression efforts have changed these forests substantially. Where these forests had some low-severity fires in the past, they now have almost none. Lack of fire may be making forests more uniform and therefore more susceptible to epidemics of bark beetles. In addition, the uniform fuels could mean that future fires will be mostly stand-replacing; there will be little mixed-severity fire.

Adapted from: Anderson, Michelle D. 2003. *Pinus contorta* var. *latifolia*. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Available: <https://www.fs.usda.gov/database/feis/plants/tree/pinconl/all.html> [2017, April 26]. **and**

Arno, Stephen F. 2000. Fire in western forest ecosystems. In: Brown, James K.; Smith, Jane Kapler, eds. *Wildland fire in ecosystems: Effects of fire on flora*. Gen. Tech. Rep. RMRS-GTR-42-vol. 2. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station: 97-120.

Fire Regimes in Whitebark Pine Forests



Whitebark pine fire regimes vary a lot in space and time. The most common kind of fire is of mixed-severity. A history of mixed-severity fire creates a complex pattern of tree survival and mortality on the landscape. Mixed severity fires occurred in the past at 60- to 300-year intervals; sometimes they occurred at intervals longer than 500 years!

Some fires in whitebark pine stands burn in sparse surface fuels and have low severity, killing only the smallest trees and the thinnest-barked overstory trees, such as subalpine fir. Fires are likely to be more severe if they burn in areas with heavy fuel loads or when the weather is especially dry and windy. These conditions help fire spread into the tree crowns and kill large patches of whitebark pines that may be hundreds of years old. Burned openings in whitebark pine stands provide good locations for Clark's nutcrackers to cache the heavy, nutrient-rich seeds of whitebark pine.

Many whitebark pine forests from the northern Rockies to the North Cascades have had occasional large, stand-replacing fires. These fires occurred at intervals of 250 years or even longer. The fires were usually driven by strong winds. They often originated in dense forests at lower elevations. Whitebark pines were often the first trees to become established on these large burns because their seeds were brought in by Clark's nutcrackers. Fir, spruce, and lodgepole pine trees seeded in more gradually from the edges, since they did not get any help from birds!



Because fire intervals are very long in whitebark pine forests, it is hard to say how fire suppression has changed them. In some areas, lack of fire could be leading to loss of whitebark pine and replacement by more shade-tolerant trees, such as spruce and fir. Even if whitebark pine seedlings are resistant to infection from white pine blister rust, they could have trouble getting a start on life if fire has not first cleared the soil and killed the small trees of competing species.

Adapted from: <http://whitebarkfound.org/ecology-management/fire-regimes/>, <http://whitebarkfound.org/ecology-management/threats/> and Larson, Evan R.; Van De Gevel, Saskia L.; Grissino-Mayer, Henri D. 2009. Variability in fire regimes of high-elevation whitebark pine communities, western Montana, USA. *Ecoscience*. 16(3): 282-298.