Restoration Fuels Treatments in Old-Growth

Visiting Research Plots in Western Larch and Ponderosa Pine Forests

NORTHERN ROCKIES FIRE SCIENCE NETWORK

Field Trip Summary 4 | May 2014

Mick Harrington and Steve Arno, retired research foresters with the USFS Rocky Mountain Research Station, took participants of the May 2014 Large Wildland Fires Conference through a 300-year-old stand of ponderosa pine (*Pinus ponderosa*) and western larch (*Larix occidentalis*). While there, they discussed their research, which compared various combinations of thinning and burning a dense Douglas-fir (*Pseudostuga menziesii*) understory to restore old-growth forest structure. Their research included a detailed assessment of fuels and the potential to reduce fire severity. At the study site near the Snow Bowl ski area north of Missoula, Montana, the establishment of most old-growth trees occurred sometime between 1660 and 1700. Historically, these forests experienced frequent surface fires with a mean fire-return interval averaging 27 years (range 15-42 years). Since 1919, however, there have been no fires in this unharvested site.

As a result of successful fire exclusion since the early 1900s, Douglas-fir establishment and growth beneath the old ponderosa pine and western larch overstory has been considerable (Figure 1). High understory tree densities have produced stressful growing conditions, resulting in thin crowns, slow growth, and reduced cone production by old overstory trees. The dense Douglas-fir understory, which has high levels of dwarf mistletoe infection has also increased crown fire potential through the formation of continuous fuels from the forest floor to the canopies of the old overstory trees. To restore the old-growth forests to a stand structure similar to those found historically, researchers used combinations of thinning and burning fuel treatments aimed at reducing the presence of surface and ladder fuels and, ultimately, the risk of crown fires.

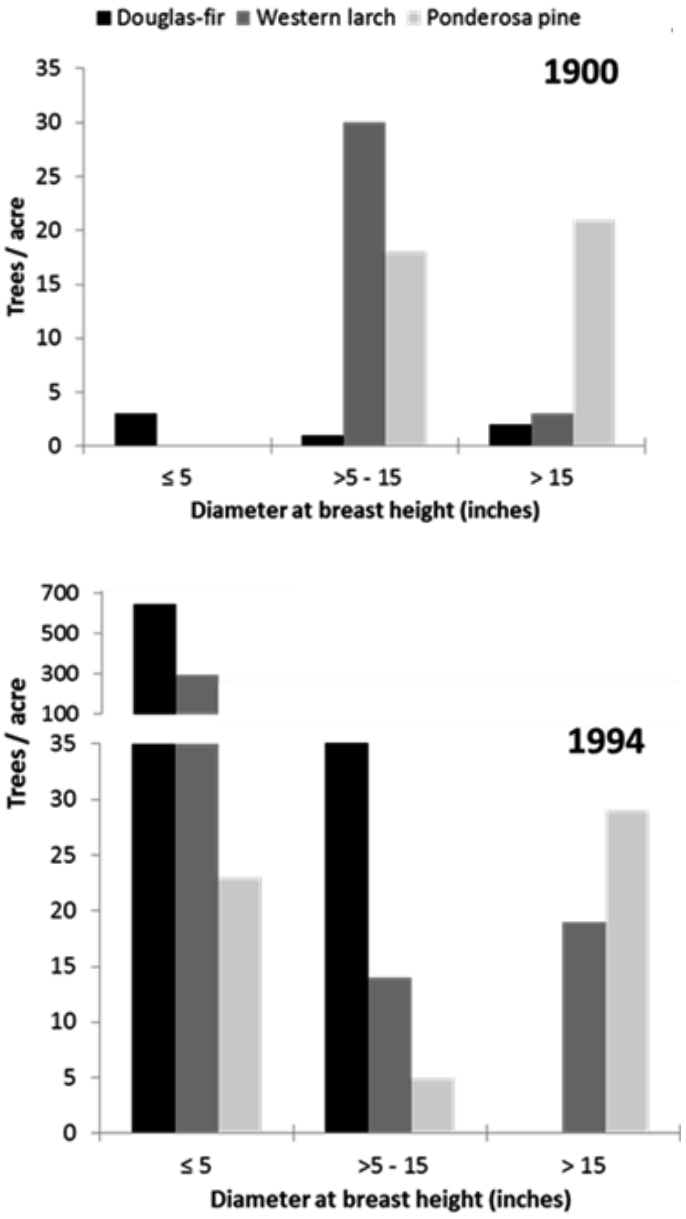

Figure 1. Densities of small trees (≤5-inch DBH) by species in 1900 (top) and 1994 (bottom). Figure modified from Arno et al. 1997.

Restoration / Fuel Treatments

The following treatments were compared for effects on tree vitality and fire potential -

- Cut Douglas-fir understory (cut trees were left on site in all treatments); pile and burn slash,
- Cut Douglas-fir understory; conduct prescribed understory burn,
- Cut Douglas-fir understory, thin western larch and ponderosa pine overstory; pile and burn slash,
- Cut Douglas-fir understory; thin overstory western larch and ponderosa pine; conduct prescribed understory burn, and
- Control, no treatment

Treatment Effects and Findings

On-site fuels data with fire behavior models showed that crown fire potential decreased significantly with treatments. Additionally, the growth and vigor of overstory ponderosa pine and western larch trees increased on all treated sites. Treatments resulted in elevated crown base heights and increased predicted torching indices, which imply the potential for crown fire initiation was dramatically reduced for treated stands. Predicted crown fire spread was also considerably reduced with the treatments.

Figure 2. Rocky Mountain dry mesic montane mixed-conifer forest. Photo courtesy of Montana Natural Heritage Program.

Treated sites were structurally and physiologically different than untreated sites.

- Tree basal area was reduced from 145 to 120 ft^2/acre with understory removal and by half with combined understory removal and overstory thinning.
- Soil moisture was greater in treated than untreated sites. Increased soil moisture on treated sites was detectable for up to 5 years following thinning and burning.
- Sap flow (soil moisture use), foliar nitrogen content, foliage production, and radial growth were higher for overstory trees on treated sites than on untreated sites.
- Basal area growth in treated sites was double that of control sites for old overstory ponderosa pine trees and up to 2.5 times greater for western larch.
- Crown base heights averaged 7 feet in control sites compared to 50 feet in treated sites, thus the predicted torching indices under severe fire weather conditions averaged 20 mph for untreated sites and more than 200 mph for treated sites.

Management Recommendations

With support of the public and other stakeholders, old-growth forest restoration may include careful reintroduction of fire, silvicultural treatments, and re-treatments. Managers might want to consider -

- Reducing mortality risks to old fire-adapted trees by removing ladder fuels, girdling small diameter trees to induce tree mortality without initially increasing fuel loads, and removing duff mounds around large trees to reduce fire-induced cambium injury, especially for trees with fire scars and heart rot.
- Re-treating sites at appropriate intervals.
- Maintaining control sites, even after demonstration projects are completed, to allow for future comparisons and studies.
- Educating and engaging the public and other stakeholders in the value of ecologically-based management to gain support for treatment actions and provide opportunities for learning and adaptive management.

Additional Reading & Information

Arno, S.F., H.Y. Smith, and M.A. Krebs. 1997. Old growth ponderosa pine and western larch stand structures of pre-1900 fires and fire exclusion. Research Paper INT-RP-495. U.S. Department of Agriculture, Forest Service, Intermountain Research Station, Ogden, Utah. 20 p.

Fiedler, C.E. and M.G. Harrington. 2004. Restoring vigor and reducing hazard in an old-growth western larch land (Montana). Ecological Restoration 22(2):133-134.

Sala, A. and R.M. Callaway. 2004. Physiological responses of old-growth ponderosa pine and western larch to restoration cutting and burning treatments. Online [6 October 2014].

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The Northern Rockies Fire Science Network (NRFSN) aims to be a go-to resource for managers and scientists involved in fire and fuels management in the Northern Rockies. The NRFSN facilitates knowledge exchange by bringing people together to strengthen collaborations, synthesize science, and enhance science application around critical management issues.