



HIGHLY VARIABLE HISTORICAL FIRE IN THE WESTERN OREGON CASCADES

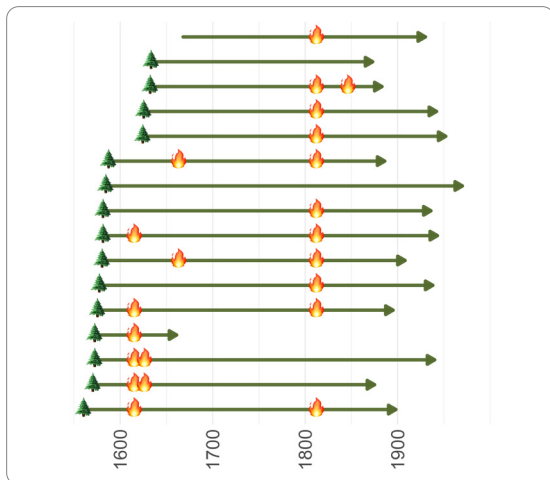
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Understanding the historical range of variability in wildfire helps managers understand the degree to which different forest types are departed from historical conditions and potentially less resilient to future climate and disturbance. Information about historical fire disturbance also helps prioritize and plan forest restoration treatments. Researchers have created extensive tree-ring based fire histories throughout seasonally dry forests of the western United States. But until recently, no comparable fire histories exist for the most productive Douglas-fir dominated forests in the western Oregon Cascades.

In this study, researchers used tree-ring evidence to reconstruct historical fire occurrence and tree establishment at 36 randomly located sites throughout the Willamette and Mt. Hood National Forests in northwestern Oregon. At each ~5-acre site, researchers removed cross sections from 15-20 stumps and cross-dated both fire scars embedded in tree rings and the pith of the tree that indicates the year of tree establishment. These records provide important new information about the nature of wildfire in highly productive, Douglas-fir dominated forests that are a critical part of the economic and cultural life of the region.



Cross-dated fire scar in a partial cross section from an old-growth Douglas-fir stump Photo: James D. Johnston.



Graphic showing fire history of a typical site. The trees represent tree establishment and the fires represent cross-dated fire scars.

KEY FINDINGS

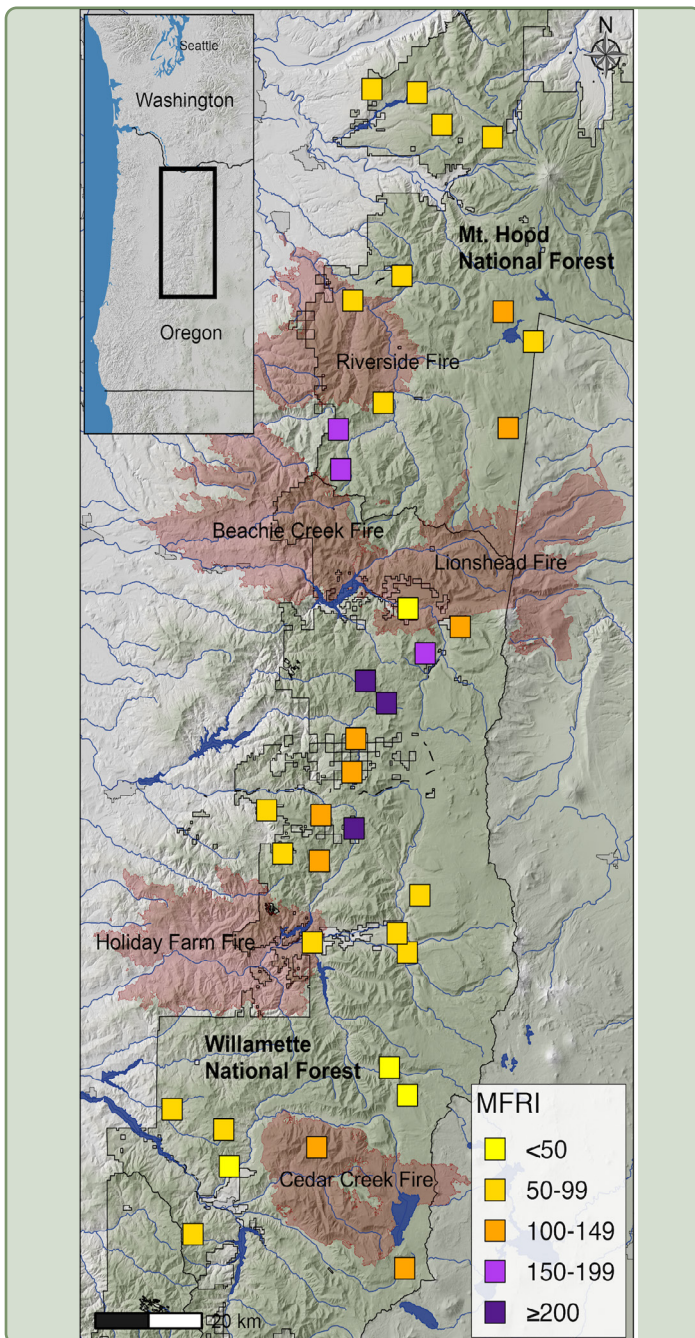
- There was extraordinary diversity in fire frequency across sites. Some sites burned as often as every 26 years, while other sites went hundreds of years without fire.
- Many forest stands established following stand-replacing fire, but succession in other stands was driven primarily by moderate severity fire.
- Tree establishment after stand-replacing fire lasted as long as 100 years with succession to closed canopy conditions often interrupted by multiple reburns.
- Fire and tree establishment records indicate several large fires that burned hundreds of years ago that were at least as large as the 2020 Labor Day fires.

The Northwest Fire Science Consortium is a regional fire science delivery system for disseminating knowledge and tools, and a venue for increasing researcher understanding of the needs of practitioners.

RESULTS

Diverse origins of stands. Douglas-fir dominated forests of the western Oregon Cascades have very diverse origins and stand histories. Many of the stands studied had an overstory of even-aged Douglas-fir that established following stand-replacing fire that occurred anywhere from 700 to 200 years ago. But other stands developed multiple cohorts of Douglas-fir following moderate severity fire.

Highly variable fire frequency. Most stands that experienced a large stand-replacing fire that reset succession also experienced multiple non-stand-replacing fires following



Mean Fire Return Interval (years) of Western Cascade Forests.

stand initiation. Mean fire return intervals, or the average length of time between fires, was shorter than predicted by standard fire ecology theory in western Oregon Douglas-fir forests. More than 80% of sites had mean fire return intervals (MFRI) of less than 150 years. More than half of sites had MFRI of less than 100 years, and 11% of sites had MFRI of less than 50 years.

The importance of reburns. Today, Douglas-fir in the Oregon Cascades re-establishes quickly on sites following stand-replacing fire. But historically, stand re-initiation following stand-replacing fire often lasted for 50-100 years or longer. These long periods of stand initiation were relatively short pulses of tree establishment interrupted by multiple reburns.

Large fires. Coherent age structure across nearby sites provide evidence of very large fires that occurred hundreds of years ago in several areas, including the Bull Run watershed and the upper Clackamas River. But the frequency of fire and diversity of age structure across the landscape suggest that small patches of high severity and moderate severity fire were historically the most important drivers of succession across much of the western Oregon Cascades.

MANAGEMENT IMPLICATIONS

New fire histories show that many western Oregon Cascades forest stands are significantly departed from historical fire disturbance regimes. The longest fire free interval for more than half of the sites examined was the interval between the last fire that burned in the 19th century and the present day.

Between a quarter and a third of federally managed forests in western Oregon are young stands (generally <80 years old) that were replanted at very high densities following clearcutting between 1950 and 1990. Historically, young stands often experienced multiple reburns, and this research questions the potential for today's tree plantations to develop into structurally complex forests in the absence of disturbance.

Conventional wisdom suggests that the phenomenal structural complexity and biomass accumulation in old-growth Douglas-fir forests is the result of long fire-free intervals following stand-replacing fire. This research suggests that non-stand-replacing fire is an important contributor to the unique attributes of old-growth Douglas-fir forests.

MORE INFORMATION

This brief is based on the following article:

Johnston, J. D., Merschel, A. G., Schmidt, M. R., & Reilly, M. J. (2026). Diverse historical fire disturbance and successional dynamics in Douglas-fir forests of the western Oregon Cascades, USA. *Ecosphere*, 17(1), e70474.

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