Fires in the High Cascades

New Findings for Managing Whitebark Pine

Michael Murray

Whitebark pine is a keystone species supporting a variety of high-mountain flora and fauna. Each year several million tourists and recreationists experience the beautiful forests while visiting ski areas, rustic lodges, and backcountry trails of western national parks and forests (Murray 2005). These picturesque timberline trees are popular subjects for postcards, artwork, and interpretive signs.

Alarmingly, in some locations, the nonnative blister rust disease and an ongoing mountain pine beetle epidemic have killed entire stands of whitebark pine (Kendall 1998). After nearly a century of fire exclusion in the high elevations of the Cascade Range (extending from southern British Columbia through Washington and Oregon to northern California), the question arises whether whitebark pine is being impacted by lack of fire. Over the past several decades, whitebark pine has become one of the most threatened trees in the Western United States.

Conserving whitebark pine is a high priority for land management agencies. Many States and Provinces are working toward developing tools such as fire, genetics, and silviculture to aid in this conservation effort.

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Whitebark pine is a valuable high mountain resource that fire managers can help protect and prosper. Photo: USDI National Park Service.

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Understanding Fire's Role

Understanding fire regimes and the existing conditions is the first step towards reintroducing fire in the high elevations of the Cascade Range. Research studies have provided a clearer understanding of fire regimes in the Rocky Mountains (Arno and Peterson 1983, Murray and others 1998); however, little research has been performed in the distinctly different Cascade Range.

Cascade Range Study

Our research group began the Cascadian whitebark pine study with these objectives in mind: to gain an understanding of the Cascade Range fire regimes as associated with whitebark pine forests; to describe the historic and existing stand conditions; and to estimate potential ecological effects of fire exclusion policies.

The study area focused on Mount Rainier, North Cascades, Crater Lake National Parks, and adjacent national forests. Sixty plots from 55 distinct sites were inventoried, each site having at least 25 percent or greater canopy coverage of whitebark pine in relation to other tree species.

Field researchers examined the tree rings on partial cross-sections sawn from 57 fire-scared tree boles.

An additional 700 increment cores (pencil-sized samples bored from the tree by using a specialized coring instrument) were examined.

Diverse Fire Regimes

We found fire to be a common, yet a complex element of whitebark pine forests of the Cascades during the past several centuries. The presence of charcoal in 88 percent of the sample illustrates fire's nearly ubiquitous role.

Of 101 fire events detected, we dated 57 percent directly from fire scars, often supported by the surrounding stand age reconstruction. Thirty-seven percent were dated from stand reconstructions with no corresponding data from fire scars. Historical sources and field observations verified the remaining 6 percent of fire events.

Cascadian whitebark pine forests support an impressive range of fire frequency. We detected fire return intervals for every 10-year class up to 160-169 years (fig. 1). Sixty-seven percent of fires occurred at 9- to 90-year intervals. However, an additional 18 percent of plots supported evidence of only a single fire—suggesting longer, even multi-century intervals.

Fires often fail to leave discernible evidence. It is possible that sampling missed some events, thus overestimating fire interval lengths. This potential shortcoming is inherent to fire history research (Agee 1993).

Comparing Fuels and Fire Frequency

The wide range of fire intervals explains the variety of site and fuel conditions encountered. Statistically, we found significantly shorter fire intervals with increasing latitude.

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The northern Cascades tend to support more complete understory vegetation cover, providing more surface fuels. For example, the pinegrass communities of the north averaged more frequent intervals than the dryland sparse grass to the south (Table 1).

Examining the most recent burn at each site, we found that 56 percent were high severity events and 44 percent were low severity. When we went back in time to consider all burns evident at each site (101 total), 54 percent were low severity and 46 percent were high severity.

Evidence demonstrates repeated fires within many stands alternated between lethal stand-replacing events and relatively low severity

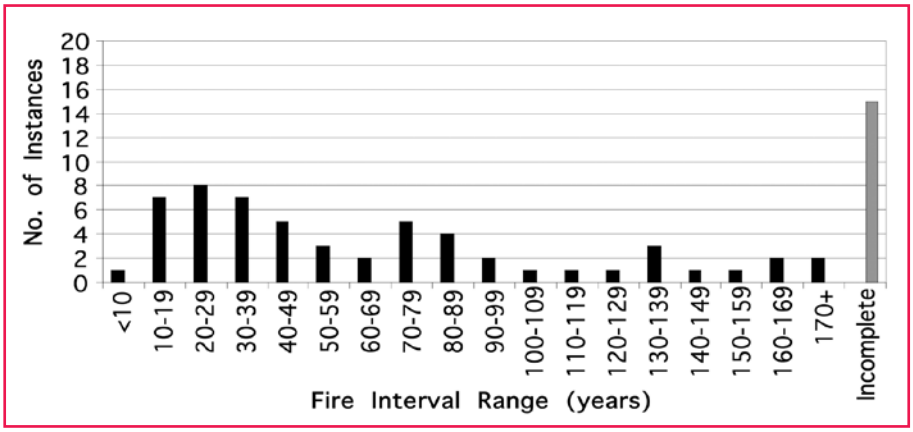


Figure 1—*Distributional frequency of fire intervals from plots. Last bar denotes instances where only a single fire was detected (incomplete interval).*

Table 1—*Comparison of fire intervals for each forest community based on dominant understory.*

Dominant Understory Vegetation	No. of Sites	No. of Intervals	Standard Deviation (of the Intervals)	Average Interval (Years)*
Pinegrass	3	9	39	44
Dwarf Huckleberry	20	25	48	55
Mountain Juniper	3	5	44	64
Green Fescue	5	9	57	84
Dryland Grass	12	10	86	93
Pinemat Manzanita	4	1	-	130
Extremely Sparse	8	0	-	>250 years

*Multiple-site average fire intervals (Barrett and Arno 1988)

burns, which left most trees alive. The casual observer will often notice these stands are composed of multiple-age classes. Thus, Cascadian whitebark pine forests provide excellent examples of mixed severity regimes.

The impressive breadth of severity and frequency mirrors the character of whitebark pine forests. The complex biophysical nature of the subalpine zone is undoubtedly the driver behind this. Local weather, aspect, slope, fuel patchiness, and stand structure interact forming a diverse milieu over short distances. As such, fire regimes are as site-specific as they are species-specific.

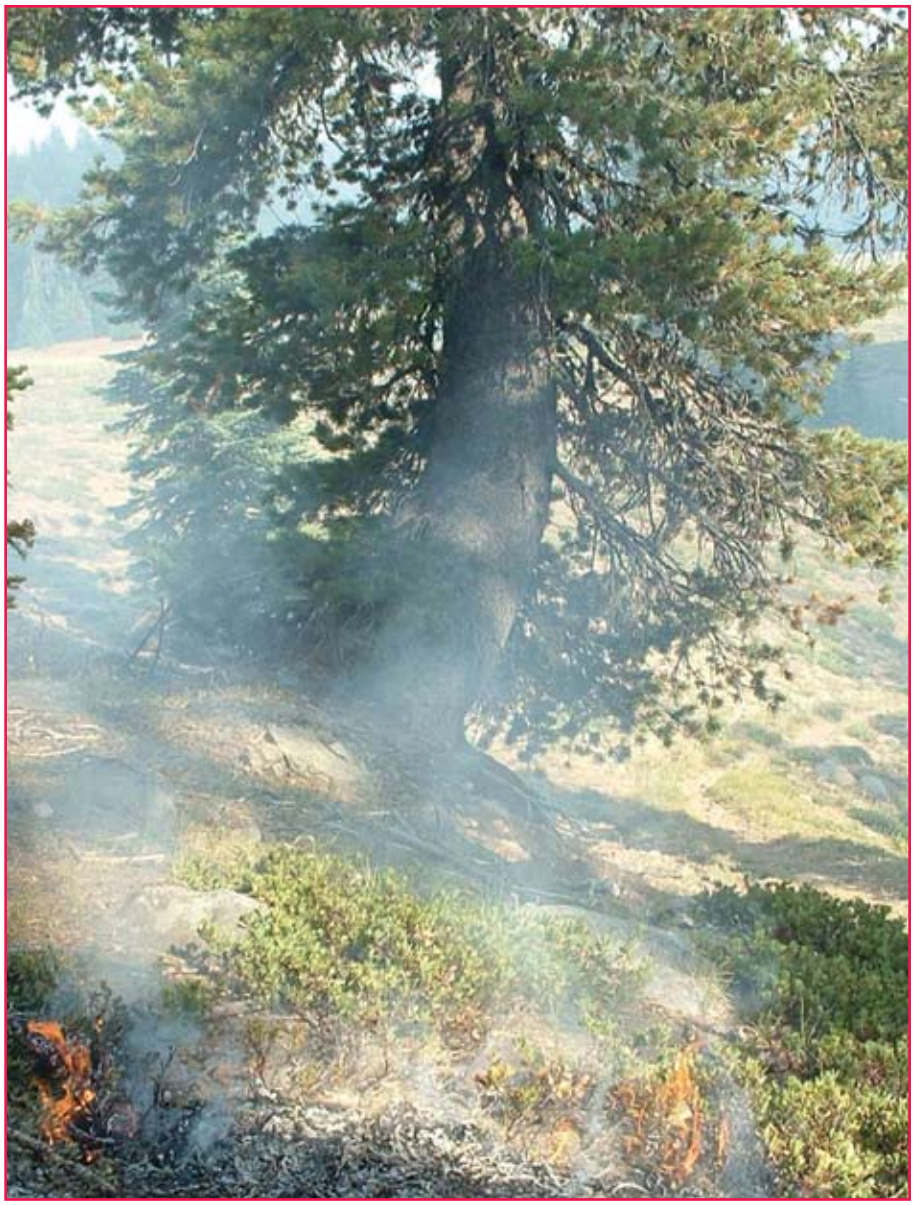
Is Fire Exclusion Affecting Whitebark Pine?

A tree inventory of living and dead individuals with increment core sampling enabled us to track and analyze historical changes in growth and abundance of all species. Since the earliest year of our analysis, it appears that tree volume has increased markedly.

Overall, late-seral species (fir and mountain hemlock) have taken over 12.5 percent of stands. Therefore, although fire exclusion has not led to the reduction of whitebark pine, it is allowing competing species to dominate where whitebark pine once presided. The same trend is true in the Rocky Mountains where subalpine fir is actually reducing whitebark pine through competition (Keane and Arno 1993).

Reintroducing Fire

Since fire has clearly been an important historic component in these forests, this study provides the guidance to reintroduce this missing element.



Reintroducing lightning-ignited fire to whitebark pine ecosystems may maintain this important timberline tree. The Bybee Complex Fire of 2006 (pictured) was a successful application of lightning-fire at Crater Lake National Park's whitebark pine zone. Photo: Courtesy of the USDI National Park Service.

Regime characteristics (frequency and severity) revealed by this study provide guidance for managers to match site-specific regimes for reasonable prescription. However, given the inherent high variability, local resource specialists and ecologists should be used to fine tune prescriptions.

Evaluating fire history and fuel conditions of individual stands prior to any management-ignited burning is critical for these sensitive forests. Specialists should assess stands for visual clues indicating frequent fire including extensive grass or shrub cover and fire scars. Pure whitebark pine forests with sparse living and dead fuels should receive lower priority for prescribed fire.

Recommendations for Managing Cascadian Whitebark Pine with Fire

- **Promote fire as a natural element of whitebark pine forests.** Knowing that nearly all Cascadian whitebark forests have burned in the past calls for the reintroduction of fire to support ecological integrity, including fuel maintenance.
- **Plan management burns based on site-specific regime.** Not all whitebark pine forests burned the same. Site visits and analysis by fire ecologists will provide interpretation of historic regimes to guide management prescriptions.
- **Prioritize stands with historically frequent nonstand replacing fires.** These stands are most impacted by the modern exclusion of fire. Extensive understory vegetation and fire scars are good indicators.
- **Work with pathologists to protect disease-resistant trees.** Retaining naturally resistant trees provides a lifelink to the pine's future. Trained forest technicians can identify such candidate trees prior to burning operations or during lightning-fires (safety permitting). Managers can provide protection from flames by mitigating ladder and surface fuels in the immediate vicinity of selected trees.
- **Support lightning-ignited fires.** Because whitebark pine tends to be in remote wildernesses and parks, and often in areas of discontinuous fuels, immediate threats to human developments are rare. Lightning-ignited fires are beneficial from a cost savings (dollar per area) perspective while providing multiple ecological benefits. When carefully managed, these fires are preferred over prescribed burns, which tend to be more impacting through associated manipulative actions (e.g. control lines, tree felling, etc.).

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