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Dendrochronological Investigations of the Fire History in the Sinclair Restoration Area, Kootenay National Park, British Columbia

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Background

Fires were once common natural disturbances in the Rocky Mountain forests of western Canada[1,2]. Historic fire suppression has, however, resulted in forest stands that are now densely stocked and prone to high severity lethal crown fires[3]. Site specific reference conditions, based on historic fire regime information, create effective management directives to return forests to their natural range of variability and reduce the risk of wildfires[4,5]. For this study, an integrative approach was used to identify the processes that previously operated to maintain pre-historical stand structures in Kootenay National Park. Two hypotheses were proposed: either the stand was maintained by indigenous burning; or, the stand was maintained by lightning ignited fires.

Methods: Fire Scars and Fire History

When low severity surface fires pass through an area, heat from the fire can be concentrated on one face of the tree, resulting in focused cambial death and the creation of a fire scar[6]. Scars are prone to further damage during subsequent fire events, allowing a tree to record multiple events. Fire scars retrieved from the Sinclair Restoration Area were pattern matched using annual growth rings of trees to identify individual fire years and the seasons when they occurred.

Image courtesy of Kiera Smith

Results: Indigenous Burning or Lightning Ignited Fires?

It is difficult to determine whether the pre-historical stand structure of the Sinclair Restoration Area was maintained by repetitive indigenous burning, or was a result of lighting. Below findings are bolded, whereas those that could not be tested due to the variability of results are in italics.

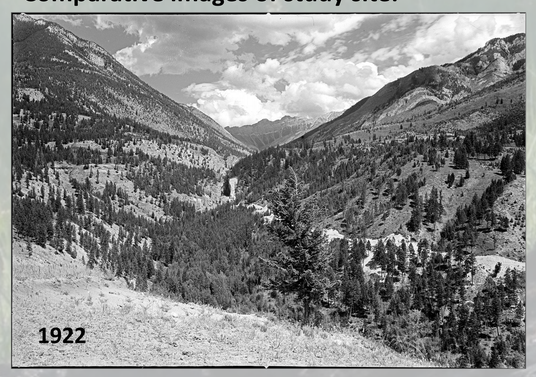
Hypothesis	Fire Return Interval	Record of Indigenous Use		Seasonality	Climate	Modern stand encroachment
		Ethnographic	Archaeologic			
A) stand maintained by indigenous burning	Shorter than other interior Douglas-fir stands	**Use of fire**	**Use of area**	**Fires occur during traditional burning seasons**	*Fire events are correlated to climate*	**Cessation with colonization**
B) Stand maintained by lightning fires	**Comparable to other interior Douglas-fir stands**	None	No use of area	**Fires occur during lightning season**	*Fire events are correlated to climate*	**Cessation with fire suppression**
Sources of Data	Regional fire scar records[3]	Indigenous[11]	Parks Canada archaeologic survey	Tree rings; fire scar seasonality[1]	Climate analysis [7,8,9]	Tree rings; archival records[12]

Table modified from Lepofsky et al. (2003)[10]

Study Site

The study site is located in the Sinclair Restoration Area in Kootenay National Park, near the town of Radium Hot Springs, British Columbia.

Comparative images of study site:

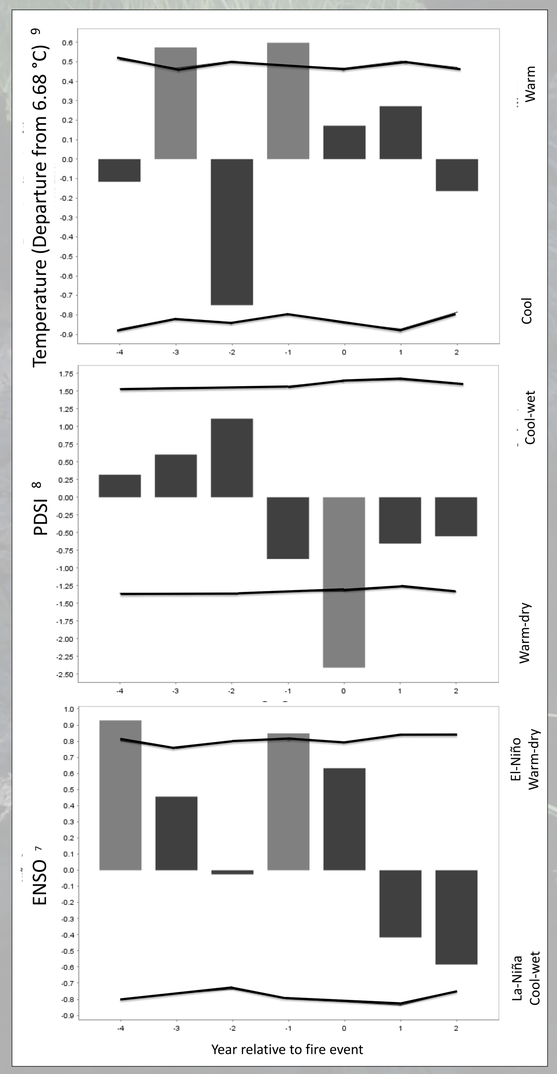


Historical: The study site in 1922, 33 years after the last fire event. The area was characterized by an open canopy of mature Douglas-fir trees and a grass dominated understory. (Image courtesy of Library and Archives Canada/[Morrison Parsons Bridgland]/BRI19222-B22-177)

Present Day: The study site in 2009, 120 years after the last fire event. Ongoing fire suppression has resulted in a dense understory of small Douglas-fir trees. (Image courtesy of Mountain Legacy Project)

Results: Fire Events and Climate

Light grey bars are used to indicate years in which the climate was significantly correlated to fires in the Sinclair Restoration Area. The findings show that fires generally occurred in hot, dry summers, most likely after the ground fuels had dried.



Results: Fire Events

Eleven trees with 27 fire scars were collected in the Sinclair Restoration Area. Five common fire events (>2 trees recording the same fire) in the fall of 1795, 1808, 1840, 1869, and 1889 were recorded. The fires occurred approximately every 24 years, and are characterized as high frequency, low severity, events that enabled large trees to survive the fires. The lack of evidence for fires prior to 1795 is likely a result of limited sample depth due to: the death and decay of older samples; the oldest trees were not sampled; and, the limited size of the study area.

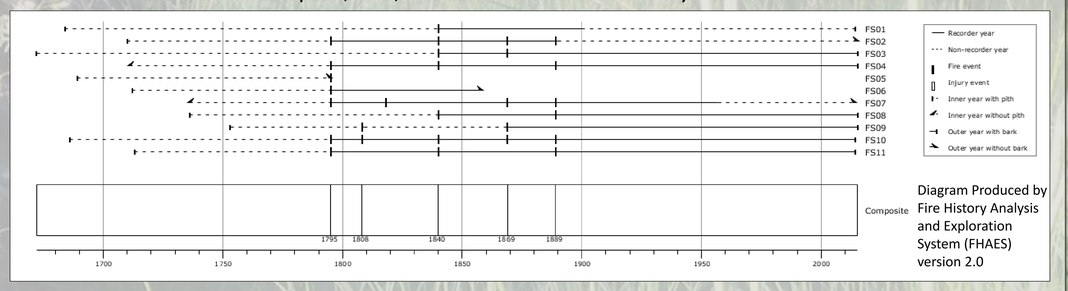


Diagram Produced by Fire History Analysis and Exploration System (FHAES) version 2.0

Conclusions and Management Suggestions

- Although the mechanisms of ignition cannot be discerned, fire was once a common disturbance in the Sinclair Restoration Area with a return interval of approximately 24 years. These high frequency, low severity, fires helped to maintain open grasslands with mature Douglas-fir trees.
- The area has not experienced a fire in 120 years and is outside the natural range of variability. The forest is densely stocked with trees and has a thick duff layer capable of sustaining a high severity fire, a significant hazard to the town of Radium Hot Springs
- To reduce this hazard and restore the forest to its natural range of variability, thinning of the forest is required in conjunction with low severity prescribed burns.

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