November 1996

Fire in the Dry Interior Forests of British Columbia

Patrick Daigle
B.C. Ministry of Forests
Research Branch
31 Bastion Square
Victoria, BC V8W 3E7
(250) 387-3542

Introduction

Fire is a natural ecological process, especially in the dry interior forests. However, fire exclusion by human intervention has changed the situation dramatically. A buildup of fuels over the past 60 years places these forests at greater risk of larger and more intense fires.

This research extension note describes forests with frequent stand-maintaining surface fires (Natural Disturbance Type 4 in the Biodiversity Guidebook), explains the ecological role of fire and the consequences of its exclusion, presents options for managing these sites, and highlights a few research initiatives under way in the province.

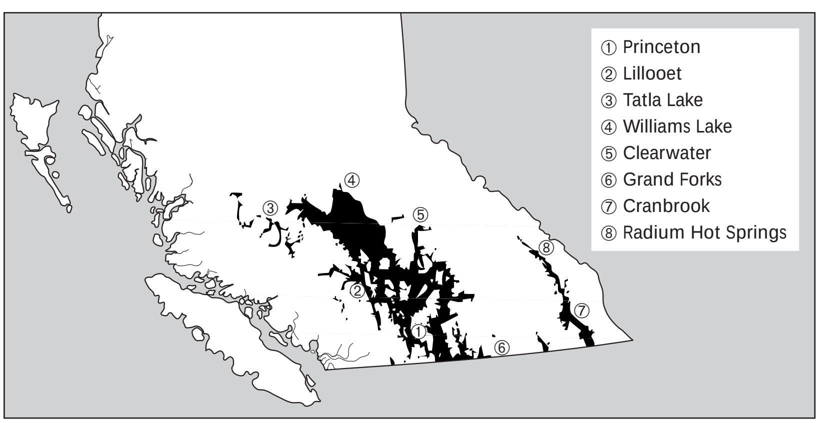

figure 1 *Distribution of dry interior forests (Natural Disturbance Type 4), in B.C.*

Description

Dry interior forests occur at low elevations and are typically restricted to droughty sites. They may also be found on steep south-facing slopes or fire-prone areas. Frequent low-intensity stand-maintaining surface fires characterize dry interior forests. These forests include the Ponderosa Pine (PP) and Interior Douglas-fir (IDF) biogeoclimatic zones, and related late seral and climax grasslands and shrublands such as those found in the Bunchgrass (BG) and dry parts of the Interior Cedar-Hemlock (ICH) biogeoclimatic zones. In British Columbia, these forests stretch to north of Williams Lake, east to Cranbrook, west to Tatla Lake, and south to the Canada-U.S. border. Figure 1 shows the range of these forest types.

Within these forests, plants have been subjected to the long-term influence of fire. Some species, such as ponderosa pine, western larch, ceanothus, saskatoon, and bluebunch wheatgrass, are "fire adapted." That is, over many centuries, they evolved strategies that help them to maintain populations on sites where fires commonly occurred. Other vegetation, such as Douglas-fir, is not as well adapted. Historically, frequent fires tended to reduce the abundance of young Douglas-fir because thin bark and low-hanging branches made these trees vulnerable to fire.

The Historic Role of Fire

Before European settlement, dry low-elevation interior forests and grasslands experienced frequent, low-intensity wildfires or purposeful fires set by aboriginal peoples every 5–20 years. These periodic surface fires consumed fallen needles and branches, killed many smaller trees, and kept live trees, dead standing trees, and ladder fuels, and coarse woody debris relatively light (compared with wetter high-elevation or coastal forests). Fires also rejuvenated many herb and shrub species while selecting against others, thinned the younger stands, and raised the height of the live tree crowns. Due to the discontinuous fuels, crown fires were rare. These surface fires affected both the appearance and ecological role of these lands (Figure 2).

Occasionally, fire would torch the tree crowns, killing large trees and creating small openings in which trees, shrubs, forbs, and grasses could germinate. Of course, fire intensity and frequency were inherently variable, producing a natural mosaic of uneven-aged forests interspersed with grassy and shrubby openings.

Because fire affected stand and landscape composition and structure, it affected the availability of plant and animal habitat as well. Relatively open, patchy, multi-storied stands containing mostly ponderosa pine (though in some cases Douglas-fir and western larch) provided suitable niches for species of:

- birds (such as Sharp-tailed Grouse and Flammulated Owls)
- mammals (such as badger)
- shrubs (such as huckleberry, Rocky Mountain maple, and birchleaf spirea)
- herbs and grasses (such as bluebunch wheatgrass and pinegrass)
- soil organisms (because fire affected soil conditions such as pH and nutrient cycling).

figure 2 *In the dry interior, open forests were relatively common before European settlement.*

Consequences of Fire Exclusion

During this century, fire prevention, urbanization, domestic grazing, forest harvesting, and road networks have changed dry interior forests substantially. Fire suppression activities have increased the average fire interval dramatically. Table 1 shows the first and last known fire dates and average fire frequency at several study sites in dry interior forests. The historical fire frequency varied between 7 and 20 years. In more recent times, most of these sites have not had fires for 30 to nearly 90 years. From an ecological standpoint, the current area burned is too low to maintain fire-dependent ecosystems in an optimum state of health, diversity, and stand structure that is resistant to intense crown fires.

Specifically, excluding fire has altered dry interior forests in the following ways:

- increased tree density
- changed species composition—shade-tolerant trees are favoured, and shrub and herb vegetation are less diverse and productive
- increased tree mortality due to higher incidence and/or severity of bark beetles and defoliators
- increased tree mortality due to greater root contact between tree species vulnerable to root rot
- slowed organic matter decomposition and nutrient cycling
- changed forest floor litter from a leaves-herbs-needles mix to a primarily needles-twigs mix
- enhanced likelihood of crown fires due to more continuous fuels and greater canopy closure
- increased fire size and intensity
- produced more homogeneous landscapes and stands
- created less aesthetically pleasing stands
- decreased grasslands due to encroachment of ponderosa pine and Douglas-fir.

Uncovering the Past: FIRE HISTORY

- A *fire regime* is a standard way of describing a fire's characteristics and effects. Fire regimes are commonly described by fire frequency, severity (degree of mortality or effects of the fire), and size (area of burned patches). Fire regimes determine the mix of plants present in particular ecosystems.
- By taking cross-sections from fire-scarred trees and dating the annual growth rings associated with each scar (particularly from trees with multiple scars), we can determine the *fire frequency* (number of fires in a particular area over a certain period of time) and *mean fire interval* (years between first and last fires divided by the number of fire intervals, which is one fewer than the number of fires). It is possible that other fires occurred but did not leave a fire scar.
- The Biodiversity Guidebook recognizes five natural disturbance types. The two principal agents of disturbance in British Columbia are wildfires and windstorms. The guidebook refers to disturbance events as either rare, infrequent, or frequent; and either stand-initiating or stand-maintaining. It uses biogeoclimatic units to further describe the ecosystems that make up the disturbance types. When combined with clear management objectives, a fire regime can be used as a template for future management actions.

table 1 *First and last known fire dates and fire frequency in dry interior forests*

Site (Forest Region)	First Fire	Last Fire	Mean Fire Interval (years)
Riske Creek (Cariboo Region)	1759	1926	9.8
Dewdrop Range (Kamloops Region)	1542	1967	18.4
Battle Bluff (Kamloops Region)	1757	1913	9.2
East Kootenay, location unknown (Nelson Region)	1729	1908	13.7
Canal Flats (Nelson Region)	1628	1937	20.6
Alex Fraser Research Forest (Cariboo Region)	1754	1915	12.3
Koocanusa Lake (Nelson Region)	1813	1940	6.8

What Are Our Options?

Because past fire suppression has provided us with benefits such as maintaining timber values, we will continue to control fires. However, our attempts to exclude fire may need to be tempered to sustain fire-adapted ecosystems.

Forest resource managers have several options and must balance ecological, social, and economic tradeoffs when making choices. Some costs and benefits can be expected within the next decade; others will be apparent over longer time periods.

Option 1. Continue to suppress fires

If fire suppression efforts are maintained, managers can anticipate that the forest will continue to change. Stand structures will be characterized by higher density, by stagnation or relatively slow growth of trees, by tree mortality due to droughty conditions, and by greater accumulations of dead, dry, and ladder fuels. Greater numbers of shade-tolerant climax tree species—such as Douglas-fir, and sometimes grand fir, western redcedar, and western hemlock—will be present. Biodiversity, forage, and habitat for fire-adapted plants and animals dependent on grassland and open forest conditions will be lost. Insect and disease problems, and the risk of more intense and larger crown (rather than surface) fires will also rise. In addition, the risk of losing timber, water quality, recreational opportunities, visual resources, property values, and human lives will increase. Finally, the need to deploy fire suppression resources to protect people and structures in the wildland-urban interface will grow as will fire suppression expenditures.

On the other hand, by continuing to suppress wildfires, managers can derive short-term benefits such as retaining merchantable timber volumes, water quality, recreational opportunities, some types of wildlife habitat, and visual resources, and protecting property values and human lives. Ultimately, as some have said, "it's not *if* these dry forests will burn, it's *when* they will burn" or "it's not fire suppression, it's fire deferral." Historically, these sites have experienced relatively frequent low-intensity surface fires; it is unlikely that wildfires can be suppressed on these sites forever.

Option 2. Use prescribed fire

Two options are available: prescribed fires (applying fire to a specific area under specific conditions) (Figure 3)

or prescribed natural fires (allowing naturally caused fires to burn).
On sites where prescribed fire is successfully implemented, managers may expect decreased risk of high-intensity, stand-replacing, rapidly spreading wildfire. The risk of losing water quality, property values, and human lives may also be lower. In addition, the judicious use of prescribed fire can improve forest health, nutrient cycling, forage for wildlife and livestock, recreation, aesthetics, wildlife habitat, and biodiversity. It may also increase stand resilience to drought and improve the vigour of the vegetation surviving the prescribed burn.

However, using prescribed fire carries risks: it may damage overstory trees and create points for disease entry, burn beyond its boundaries, and decrease air quality. Using prescribed fire also requires detailed planning, and extensive communication with communities to describe the purpose of and need for the burns.

Option 3. Use mechanical treatments: thinning and/or pruning

To reduce fuels, stands may be thinned from below (favouring fire-adapted tree species such as ponderosa pine and western larch) and produce logs or chips. Pruning the lower portion of tree crowns reduces the quantity of ladder fuels and lessens the probability of crown fires.

On sites where fuels are successfully reduced by mechanical means, managers can anticipate that advantages and disadvantages will be similar to those listed under Option 2. Thinnings may also earn revenues that offset or exceed the cost of treatment. However, some plants and animals that depend on fire to cycle soil nutrients, raise soil pH, or germinate seeds may not benefit from mechanical fuel reduction alone.

Option 4. Use a combination of treatments (Figure 4)

To determine suitable treatment combinations and set priorities, managers can stratify the dry low-elevation forests by variables such as aspect, fuel load, management objectives, insect and disease problems, and smoke sensitivity. For example, sites with low merchantable volumes might be suitable for a prescribed burn; continued fire suppression might be advised on sites with high property values. Where safety and private property are most at risk, creating fuel breaks might be suitable. And, if a fire or insect epidemic has already occurred, a salvage harvest might be required.

figure 3 *Using prescribed fire.*

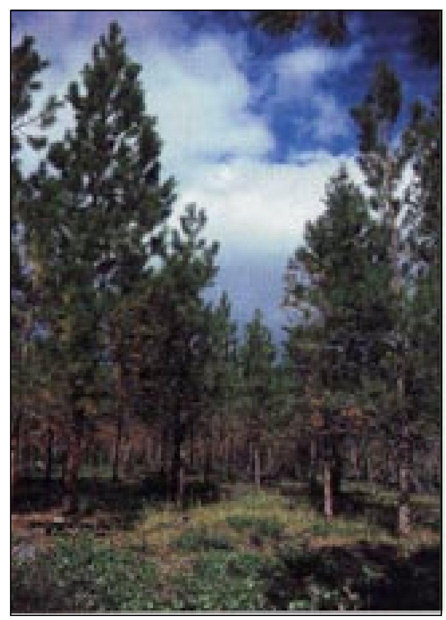

figure 4 *A thinned, pruned and under-burned stand.*

Addressing Fire Issues: Current Initiatives

Research results provide the opportunity to translate our understanding of fire regimes, history, and effects into timely applications at the stand and landscape levels. Several research projects across the province are investigating the role of fire in the dry low-elevation forests:

- Ecosystem Maintaining Burning Evaluation and Research (EMBER) is a joint provincial–federal project begun in 1992. Its goal is to assist in developing an integrated prescribed fire program for dry interior forests of the Nelson Forest Region.
- Researchers at the Pacific Forestry Centre (Canadian Forest Service) have developed and are testing SCORCH, a model for use with prescribed fires. The model assists managers in predicting the effects of particular burning conditions on stand structure and composition.
- Steve Taylor (Canadian Forest Service) is examining fire history and stand structure on the Okanagan Mountain fire. Entomologist Lorraine Maclauchlan (BCFS, Kamloops Forest Region) is investigating the forest health implications on this site.
- In the Stein Valley, Ken Lertzman and several of his graduate students from Simon Fraser University are determining the disturbance histories and successional dynamics of individual stands. They are then applying this information to examine how the frequency of disturbances varies across the landscape.

figure 5 *Sampling to determine fire frequency.*

Acknowledgements

Thanks to Rosalind Penty who edited (and wrote portions of) this extension note, John Parminter who provided photographs and project guidance, and several people who provided technical review. Doug Patterson provided an earlier draft of the note. FRDA II provided funds to produce this extension note.

Further Reading

British Columbia Ministry of Forests. Prescribed fire for responsible forest and range management. Regional and district offices or Protection Branch, Victoria, B.C. (pamphlet)

Brown, J. 1995. Fire regimes and their relevance to ecosystem management. *In* Managing forests to meet peoples' needs. Proc. 1994 Society of American Foresters/Canadian Institute of Forestry Conference. SAF, Bethesda, Md. pp. 171–178.

Parminter, J. [1996] Natural disturbance ecology. *In* Ecological principles of forest management. J. Voller and S. Harrison (editors). B.C. Min. For., Res. Br., Victoria, B.C. In prep. (chapter)

Starr, L. (editor). 1994. Fire ecology and management. Natural Resource News Special Edition. Blue Mtns. Nat. Res. Inst., La Grande, Oreg. (newsletter)

Walstad, J., S. Radesovich, and D. Sandberg. 1990. Natural and prescribed fire in Pacific Northwest forests. Oreg. State Univ. Press, Corvallis, Oreg. (textbook)