

Burning Alternatives Panel:
A Review of Fire Ecology, Fire History and
Prescribed Burning in Southern British Columbia

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Natural fire

Forest fires have been part of the British Columbia environment for thousands of years. Evidence of historic forest fires exists as fossil charcoal, charcoal in aquatic sediments, charcoal layers in soil horizons, burned snags and stumps, fire scarred trees, distinct forest stand structure, historical records and photographs.

Historical fire frequencies can be determined by analysing lake and bog sediments, historical records, determining the age structure of fire origin forests and by ageing fire scars on trees and snags. From such work we know that fire has influenced most forest and rangeland ecosystems in the province.

Fire effects

Wright and Heinselman (1973), summarised the basic roles of fire as follows:

- fire releases mineral elements from living and dead organic substances, with some elements being volatilised,
- fire reduces plant cover shading and therefore increases the input of solar insolation which affects soil temperature and the local microclimate,
- fire regulates the accumulation of above ground dry biomass and can be a major determinant of nutrient cycling and energy flow,
- fire may stimulate the sprouting, flowering and fruiting of shrubs and herbs and can trigger the release of seeds of serotinous tree species,
- fire alters the seedbed and may create large areas of thin ash, humus or bare soil,
- fire may selectively eliminate part of a plant community and eliminate, or temporarily reduce, competition for moisture, nutrients, heat and light,
- post-fire levels of forage and browse plants may be higher than pre-fire levels and represent an important food source for certain wildlife species but forage in old growth forests, such as tree and ground lichens, will be reduced,
- fire is an important regulator of insect populations and can terminate large outbreaks through the destruction of the host trees,

- fire temporarily eliminates some plant parasites and may prevent the germination of some fungi, - fire can control the location of forest/non-forest ecotones, as well as the local occurrence of plants,
- fire, or the lack of it, regulates the total vegetation mosaic through fire size, intensity and frequency; determining the relative abundance of plant communities and successional stages, and
- fire prevents a system-wide succession to climax forest stands by maintaining a mix of successional stages. This mix, coupled with fire's influence on setting or maintaining ecotone boundaries and controlling the local occurrence of plants, influences the diversity of the entire ecosystem.

Given the long fire history of British Columbia, it follows that fire has been a major ecological influence, involving the aforementioned factors, as well as others.

Aboriginal burning

The natives used fire for a variety of purposes, such as light, heat and cooking, to hunt and drive game, to improve the quantity and quality of forage and browse, as well as food and medicinal plants, for clearing trails and areas around camps, for communication and in ceremonies and warfare (Gruell 1985, Steele et al. 1986). Analysis of the fire scar record for dry forest types in western Montana suggests that aboriginal burning has been a factor on the landscape since the 1500's (Arno 1985).

Native burning in the southern interior was likely most frequent in the grasslands and open ponderosa pine forests (Gruell 1985). The combination of natural fires and aboriginal burning shortened the average intervals between fires. Frequent light fires helped grasslands to maintain dominance and expand, while less frequent burning allowed fire tolerant resprouting shrubs and trees, such as serviceberry and trembling aspen, to establish. Longer intervals between fires favour non-sprouting shrubs, such as big sagebrush as well as conifers (Arno 1985).

Frequent fires served to keep the ponderosa pine and interior Douglas-fir forests open and park-like. After the late 1800's, fires became less frequent in these forests in western North America: the natives were moved to reservations, resource management agencies began controlling wildfires, settlers instituted local fire control measures and grazing by domestic stock removed grassland fuels which formerly supported surface fires (Steele et al. 1986). During this century, many stands have filled in with more shade tolerant conifers, resulting in fuel accumulations, increased fire hazard, as well as insect and disease damage (Arno 1985).

European Exploration and Settlement

The arrival and dispersal of growing numbers of European, as well as other explorers and immigrants, resulted in more forest fires. While the natives had been the cause of a certain number of fires, both prescribed and wild, some observers squarely blamed the more recent arrivals:

"It is often stated that the Indians are responsible for this (forest) destruction, and it is doubtless true that since they find the whole region in process of being ravaged by fires which they can not prevent, they have become more careless than before. They would not, however, willingly destroy their own hunting grounds, and the best evidence of their care is found in the fact that, while along the North Kootanie Pass (which so far has been scarcely used, except by the Indians,) the woods are generally unburnt, those in the vicinity of the parallel Crow Nest Pass (sic), which has now been for a few years a route used by whites, are entirely destroyed and represented only by bleaching or blackened trunks." (Dawson 1886).

This observation, however, does not allow for the fact that the Crow's Nest Pass fire could have been a natural lighting caused event. Sometimes perceptions are affected by personal bias. Nevertheless, fires caused by the white man resulted from escaped smudges, campfires and signal fires. Prescribed burning, of a sort, was carried out to kill timber and create a fuelwood supply, clear the land, improve domestic forage and drive game.

Historical Fires

A number of large and damaging conflagrations swept North America in the 1800's, giving rise to an anti-fire sentiment. A few of the more prominent fires are described, as follows:

- 1825 Miramichi, New Brunswick
Man-caused due to land clearing and slash burning, burned over 1 214 000 ha in uncut forest and spruce budworm-killed stands,
- 1848 Nestucca, Oregon
Burned over 121 000 ha
- 1849 Siletz, Oregon
Burned over 324 000 ha
- 1865 Silverton, Oregon
Burned over 400 600 ha

- 1871 Peshtigo, Wisconsin and Michigan
Man caused due to land clearing and slash burning, burned in forest and extensive slash. Over 1,500 people died.
- 1881 Michigan, in eastern Michigan
Caused by land clearing, slash burning and lightning. Burned over 400 000 ha in forest and slash, killing 169 people.
- 1886 Vancouver, British Columbia
A land clearing fire spread through slash and destroyed the city, killing more than a dozen people.
- 1902 Yacolt, Washington and Oregon
Caused by land clearing and slash burning. Burned more than 400 000 ha in slash and forest, killing 38 people.
- 1908 Fernie, British Columbia
A forest fire engulfed the town and destroyed it in less than two hours. Three thousand people were left homeless.
- 1910 Idaho, Idaho and Montana
A complex of fires caused by lightning, slash burning, land clearing and railroads. Burned over 1 214 000 ha, mostly in forest. At least 85 people were killed.

It was estimated that by 1917 the timber on 26 000 000 hectares - or two-thirds of the once-forested land - had been totally destroyed by fire and that half of the remaining timber had been seriously damaged (Whitford and Craig 1918). This amounted to 3.1 billion cubic metres. Whether or not these statistics were accurate, the prevailing attitude was described:

"The popular belief that the supply of timber was inexhaustible was expressed in the cheapness of stumpage. Unless his equipment was destroyed, the lumberman considered the damage occasioned by forest fire as negligible." (Whitford and Craig 1918).

Fire Prevention Legislation

In the midst of these fire outbreaks, the first fire prevention legislation was passed in British Columbia. The Bush Fire Act of 1874 provided for fines or imprisonment if an unattended fire escaped and resulted in damage to private or Crown land, during the period from June to September (SBC 1874, 37 Vict., No. 22).

Oddly enough, this act was not enforced unless at least two-thirds of the settlers in a district petitioned the Lieutenant-Governor in Council to request it. In 1887 the law was changed and given province wide application (SBC 1887, 50 Vict., Ch. 3.). The Bush Fire Act may have been of little benefit, since there was no organisation to enforce it. However, fire prevention sentiment was growing and the use of controlled fire was legitimate.

The Bush Fire Act was amended over the years, giving rise to the modern features of: a close season, fire districts, campfire regulations, precautions when using fire to clear land, railway fire prevention, fire prevention at logging operations, fines for infractions and fire permits. In 1911, the Bush Fire Act became the Forest Fires Act (RSBC 1911, 2 Geo. 5, Ch. 91) and the next year was incorporated into the Forest Act (SBC 1912, 2 Geo. 5, Ch. 17).

The Forest Act contained sections dealing with: fire prevention, the close season, fire permits, debris disposal, fire patrols, spark arrestors, as well as cooperative forest protection through the establishment of a Forest Protection Fund. This fund was jointly financed by the owners, lessees and licencees of forested land, as well as the provincial government. The proceeds paid for outfitting and maintaining a fire prevention force and the construction of trails, lookouts and telephone lines.

The Forest Act of 1912 empowered the Forest Branch to: "declare any inflammable material which endangers life or property a public nuisance" and force the land owner, or occupant, to: "remove or abate" the nuisance. Mandatory burning of logging slash was not within the powers of the Forest Branch at that time.

Early Prescribed Burning

Settlers and early loggers employed controlled fire to clear land of debris to enable agricultural use or to abate the fire hazard of logging slash. The members of the first Royal Commission of Enquiry on timber and forestry noted the destruction of young forest growth by fire on areas of currently regenerating forest land, as well as the need for preventing the destruction of mature forests (Fulton et al. 1910).

Debris remaining after logging operations was identified as an "unnecessary risk" and a recommendation was made (Fulton et al. 1910) that:

"In all logging operations upon timber lands in the Province of British Columbia the persons responsible shall dispose of the top, branches and other debris, in such a way as to prevent, as far as possible, the danger of fire; such disposal being made to the satisfaction of the officers of the Department of Forests."

Clyde Leavitt, of the federal Commission of Conservation, considered the "slash menace" to be the greatest single problem associated with forest fire protection. He felt that the debris from "old-style lumbering operations" was certain to catch fire eventually (Leavitt 1912). Destruction of merchantable timber adjacent to logged over lands, as well as delayed regeneration, were considered to be the undesirable consequences of slash fires. Methods suggested for brush and slash disposal were: broadcast burning, lopping and piling followed by burning, lopping and scattering or lopping and piling.

Compulsory disposal of logging slash was not imposed upon the woods operators in 1912 or 1913 because the Forest Branch considered the added cost a burden which the industry could not support. It was clear that more information was required with respect to the most cost efficient methods of slash disposal in the various regions of the province.

Nevertheless, the serious fire hazard created by logging in the coastal Douglas-fir type convinced many loggers to carry out broadcast burns to abate the hazard and create a Douglas-fir seedbed. Snags were also felled and firelines constructed. In 1912, slash burning was primarily carried out on the coast:

"Fortunately, a majority of the lumbermen are thoroughly convinced by past experience that slash is bound to burn sooner or later, and that it is the best policy to burn it at a safe season under proper safeguards."

"It is felt that, if a definite plan of burning slashings twice a year is adopted by the loggers, the slash evil, which has been the cause of a great number of disastrous fires in the past, will be overcome." (Report of the Forest Branch for 1912).

R.E. Benedict, Assistant Forester of the British Columbia Forest Branch, described how the heavy accumulations of debris on logged over lands were the result of the variable nature of the standing timber, as well as the economic conditions. Lumber markets and logging costs were such that only stems at least 16 feet long and 8" in diameter, of good quality wood, could be profitably harvested. Therefore, the unsound, undersized and dead trees had to be left in the forest, along with the tops and branches of the harvested trees (Benedict 1915).

In 1915: "Over 20 per cent of the area burned was grazing range, the damage on which is naturally small, being only temporary, and affecting the forage for only one season." (Report of the Forest Branch for 1915).

The slash disposal provisions of the Forest Act had not been widely enforced, although a clause requiring slash disposal was written into timber sale contracts (Whitford and Craig 1918). Loggers on the coast found that slashburning in the fall or spring was not prohibitively expensive and served to effectively reduce the fire risk to adjacent timber. In the interior forests, it was sometimes necessary to pile the slash to enable burning where the fuel accumulations were not too great.

An amendment to the Forest Act in 1919 enabled the Department of Lands to instruct operators to dispose of slash: "by burning or otherwise" on demand (SBC 1919, c.45, s.10). If slash disposal operations were not carried out after being requested, the Forest Branch could carry out these activities and bill the negligent person or company for the expenses incurred.

In 1920, the Commissioner of Grazing commented on the intentional burning of forested range:

"Any burning undertaken must be of a light character; that is to say, it must take place early in the season when the soil is damp enough to resist the injurious effect of heat action and when only the surface debris, brush, and small seedlings will be destroyed. All burns must be under absolute control. Burning should only be undertaken when necessary, as there is generally sufficient feed for all the stock likely to be grazed on the summer ranges for years to come." (Report of the Forest Branch for the year 1920).

The next year, 1921, the Commissioner of Grazing stated that:

"For the past three years this office has been making a study of the effect of fires on the forage-growth of Crown ranges. Growth conditions of timber and forage following fires indicate that it is inadvisable to permit fires to run over range country." (Report of the Forest Branch for 1921).

Studies were underway in 1921 to determine rates of successful grass re-establishment following wildfires or controlled burns. Two areas, one near Nicola and one near Lillooet, were selected for investigation into the following:

- burning to remove young conifers growing on the range,
- fire effects on forage both in the open and in the timber, and
- the success of grasses sown on burned and unburned areas.

During 1922, studies in ponderosa pine forests determined that the open nature of those stands was due to fire. Two percent of the pine in merchantable stands were badly fire scarred, which lessened their vigour and seeding capacity. It was also determined that duff removal resulted in less favourable conditions for germination and growth and that it was desirable to perpetuate ponderosa pine rather than Douglas-fir, which was encroaching into the moister pine sites.

However, recognition that fire would be needed to perpetuate ponderosa pine was overshadowed by the statement that: "the general opinion that ground fires do little damage to our pineries is an economic misfortune." (Report of the Forest Branch for 1922).

A resolution on forest protection from the 1923 British Empire Forestry Conference is most interesting:

"The widespread damage to timber, property, and life resulting from uncontrolled forest fires is a menace to the economic well-being of the British Empire, and constitutes the greatest single deterrent to the practice of forest management." (British Empire Forestry Conference 1927)

In 1925, the Commissioner of Grazing reported on some seeding trials:

"The experimental reseeding of cultivated grasses on burns which have accidentally occurred and on areas which were burned over with a view to determining whether the burning-over of timbered range will permanently improve such ranges, and to ascertain if cultivated grasses or clovers will replace the native vegetation, has not developed successfully to date. There is every evidence that all experiments will fail." (Report of the Forest Branch for 1925).

Amendments were made to section 113A of the Forest Act in late 1937, dealing with the mandatory disposal of logging slash in the Vancouver Forest District. Effective January 1, 1938, operators would have to annually - or as instructed - dispose of slash by "burning or falling, as the case may be, to the satisfaction of the Chief Forester."

While it is true that the Campbell River - Comox fire of July and August of 1938 emphasised the soundness of this policy, that particular fire was not the reason for the policy, as many assume to this day. The policy predated the fire by 7 months. Still, only 9% of the area burned in that fire was unburned logging slash (2727 out of a total of 30 148 ha).

In 1940: "...a great many of the Interior ranges are being obstructed by the falling of beetle-killed timber. As a result there have been many fires set by irresponsible people trying to clear the ranges of this material. In an endeavour to meet the situation in such a way that fires could be controlled, the Forest Service agreed with the ranchers to conduct burning experiments, hoping this would obviate the indiscriminate fires." (Report of the Forest Branch for 1940).

"Experience with various conditions resulting from summer burns has not led to any reliable conclusion that benefits result, while there are innumerable examples of complete elimination of valuable forage from vast areas because of fire."

By 1949: "stockmen have continuously advocated burning as means of improving forage. This is a highly complex and controversial matter as numerous factors are involved. In order to obtain more scientific data, a series of experimental burns is being carried out by the Dominion Range Experiment Station and this Service in cooperation with several other agencies. The effect of fire on various types and under different conditions is being studied." (Report of the Forest Service for 1949).

In 1960: "one significant statistic is that the acreage broadcast-burned exceeds the acreage spot-burned. This is partly due to the current practices on some tree-farm licences of broadcast burning to ensure prompt natural regeneration in pulp-salvage areas. Experience seems to indicate that broadcast burning is necessary to keep many such areas productive, and to prevent invasion by brush and non-commercial cover." (Report of the Forest Service for 1960).

By 1961: "...the acreage abated by broadcast burning exceeded that abated by spot burning. To some extent this trend is due to burning for silvicultural purposes, preparing high-site areas for regeneration and to delay the invasion of deciduous cover and other undesirable species. It is hoped that this trend will continue in order to combat the increasing acreage of insufficiently stocked high-site land." (Report of the Forest Service for 1961).

In 1962: "...a series of broadcast burns has been initiated in the Interior with the object of either preparing the site for planting or facilitating natural regeneration. Broadcast burning appears to hold considerable promise in the decadent cedar-hemlock type, both as a means of reducing the hazard and encouraging a higher stocking of the more desirable species such as fir, spruce, and larch." (Report of the Forest Service for 1962).

The next year, 1963, saw: "...considerable activity and interest in disposal of slash by burning prevailed in the other four districts. Experimental slash burns have been carried out during the past few years in the Interior, and concern has been mounting over increasing slash hazards, which have complicated the control of recent costly and extensive fires." (Report of the Forest Service for 1963).

In 1964: "interest in prescribed burning in the Interior districts has accelerated with the rapid maturing of an integrated forest industry. Many experimental burns have been conducted, and valuable information and experience gathered. Some 9,000 acres of slash were disposed of by burning in 1964...." (Report of the Forest Service for 1964). In comparison, the area slash-burned in the Vancouver Forest District was 44,600 acres.

By 1965: "expansion of the Interior pulp harvest will greatly accelerate the increase of clear-cut areas of extremely hazardous slash. Broadcast burning is the most effective method of reducing this hazard, and a greatly expanded burning programme is required in the Interior if the large and costly fires, similar to those which originated in slash in recent years, are to be avoided." (Report of the Forest Service for 1965).

In 1966 special range trial projects: "...included the use of fire in an effort to control both sagebrush and bitter-brush." (Report of the Forest Service for 1966).

Most importantly, in 1967, Section 116 of the Forest Act, regarding regulations requiring slash disposal by burning, was amended to cover the entire province (SBC 1967, Chap. 19, s.7). It should be noted that many interior operators were inexperienced in burning at that time.

In September of 1967, escaped slash burns in the Vancouver Forest District covered 8400 hectares. These burns cost the Forest Service \$70,000 and the industry \$636,000 to suppress. In response to this situation, the Truck Loggers Association presented a brief to the Select Standing Committee on Forestry and Fisheries of the provincial legislature. The Select Standing Committee appointed three foresters to examine the question of slash burning in the Vancouver Forest District. They submitted a report in 1969 which made recommendations regarding policy, assessment of areas to be burned, timing of burns and proper burn execution. It was concluded that slash burning would likely continue for some time because it represented the best and most cost-effective treatment available (MacBean, Smith and Stokes 1969).

In 1969: "prescribed burns were made on 28,500 acres in the Peace River area to suppress range brush, and 50 acres were similarly treated in the East Kootenay Valley in an effort to control bitterbrush." (Report of the Forest Service for 1969).

In 1970: 3,445 acres were prescribed burned to clear brush and scrub trees from rangelands. For the period from 1961 to 1970, an average of 125 wildfires resulted from range burning each year. The average number of wildfires from brush burning was 100. In comparison to the previous years, in the interior forest districts, the amount of prescribed burning went up by factors of four in the Kamloops Forest District and two in the Nelson Forest District (Smith 1973).

The September 11, 1973, escape in the Fly Hills above Salmon Arm became known as the Eden Fire, which resulted in further burning being suspended for most of September and part of October. The Eden Fire may have been responsible for some backlash against - and increased emphasis for - slashburning. Interestingly, the report of the consultant who analysed the Eden fire did not directly address prescribed burning: as to whether slashburning should decrease, continue as is or increase (Turner 1974). Total provincial silvicultural prescribed burning declined from about 60 000 ha per year in the early 1970's to approximately 17 000 ha per year in the late 1970's and early 1980's. The annual report data are, however, contradictory and inconsistent so definitive values cannot be assigned.

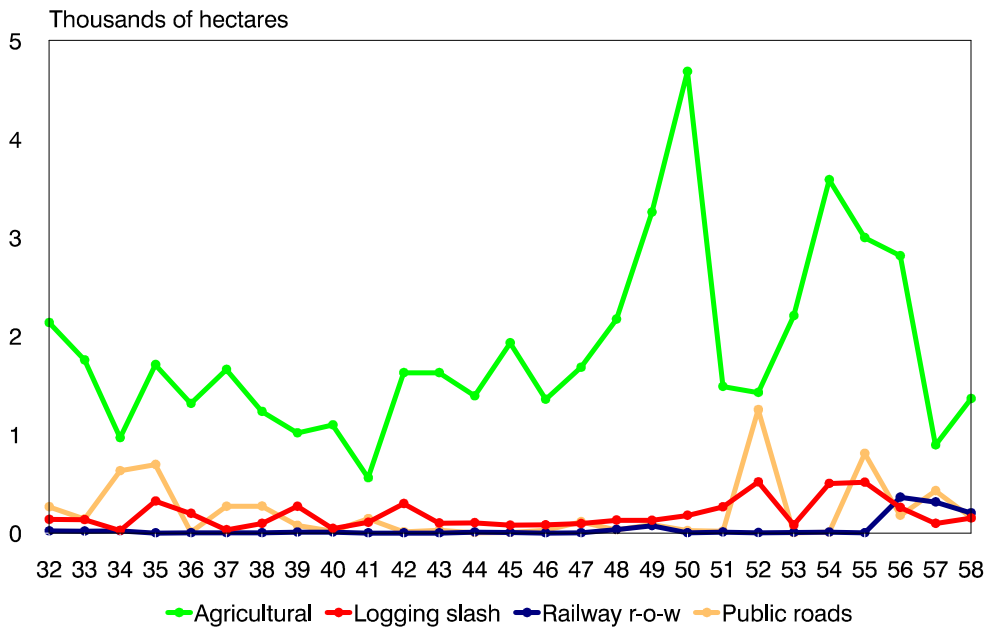
Kamloops and Nelson Forest Regions

Data for areas burned under permit between 1932 and 1958 in the Kamloops and Nelson forest regions, formerly districts, are shown in Figure 1. Boundary changes limit the analysis to this time period. For both regions, the area burned for clearing agricultural land greatly exceeded that burned for logging slash disposal, clearing of railway right of ways and public road right of ways combined. More recently, the areas burned for logging slash disposal in the Kamloops and Nelson forest regions are shown in Figure 2.

However, data are not available for the period from 1975 to 1979. Fluctuations in the annual area burned are a function of harvesting activities, utilisation standards, fire hazard abatement requirements and site preparation needs. The number of suitable burning days, equipment and crew availability and attitudes towards prescribed burning on the part of the Forest Service, forest companies, general public and special interest groups are other factors.

KAMLOOPS BURNING PERMITS

From annual reports



NELSON BURNING PERMITS

From annual reports

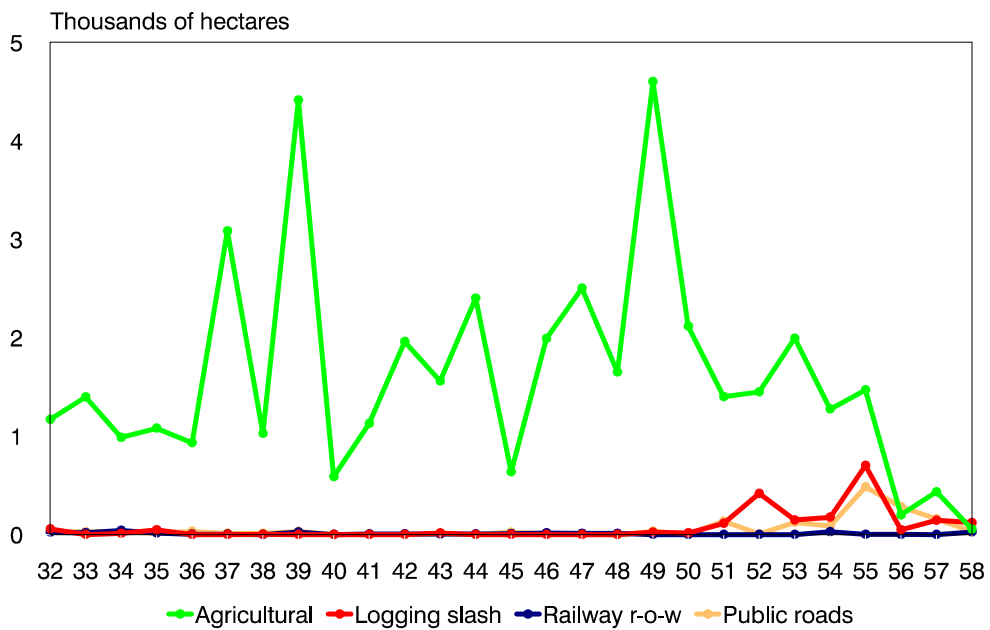


Figure 1. Areas burned under permit in the Kamloops and Nelson forest regions, 1932-1958.

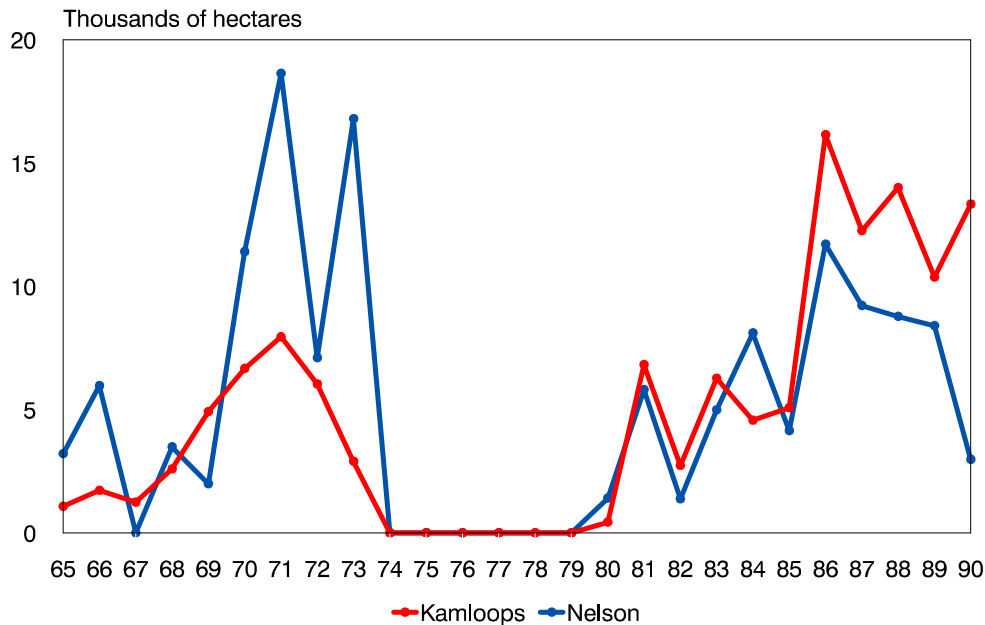


Figure 2. Slash burning in the Kamloops and Nelson forest regions, 1965-1990. Data unavailable for 1974 to 1979.

Historical Summary

Prescribed burning within the context of forest management has been carried out to:

- abate the fire hazard,
- meet silvicultural site treatment objectives by:
 - removing material which hinders planter access,
 - creating plantable spots,
 - preparing a seedbed,
 - reducing duff depths to warm the soil,
 - shortening the regeneration delay,
 - converting tree species by eliminating advanced regeneration of undesirable species and permitting planting of desirable ones,
- maintaining stocking control by increasing the availability of plantable spots and thinning young stands in the Interior Douglas-fir and Ponderosa Pine biogeoclimatic zones,
- sanitizing sites against certain insects and diseases, and
- reducing levels of competing vegetation.

The advantages of using prescribed fire are:

- fire is a natural component of the environment but prescribed fire cannot be wholly equated with wildfire due to some important differences,
- historically, prescribed fire has been the most cost effective treatment, and
- fire can be used where certain alternatives cannot:
 - in heavy fuels or inoperable slopes and terrain conditions, or
 - on sites sensitive to machinery.

Prescribed burning for wildlife habitat, as well as domestic range manipulation and improvement has been carried out to manipulate species composition to:

- remove unwanted vegetation, and
- encourage wanted vegetation,
- improve the quantity and/or quality of forage and browse,
- create or improve access, and
- change cover characteristics.

Alternatives to Prescribed Burning

Alternatives to the use of prescribed burning in forest management may involve:

- doing nothing,
- manual treatments,
- mechanical treatments,
- chemical treatments:
 - herbicides, and
 - fertiliser,
- biological treatments:
 - planting larger stock,
 - removing competing vegetation, and
 - controlling insects and diseases.

While these alternatives may reduce the fire hazard and permit reforestation, the question remains about whether some of fire's beneficial effects will be missed by the ecosystem. Alternate site treatments for wildlife habitat and domestic range manipulation and improvement may be too costly and/or too labour intensive or non-existent.

Conclusion

The evolution of attitudes towards - and procedures for - prescribed burning have been related to abatement of fire hazard and protection of the timber supply. Controlled burning (where fire was simply contained to a particular area) has become prescribed burning (where objectives are set and prescriptions are developed) for silvicultural site treatment, wildlife habitat management and domestic range improvement.

At the same time that our knowledge of ecosystem functioning expands - and our level of expertise in using prescribed fire increases - other factors are limiting or overruling our use of prescribed fire.

If "new forestry" and management for conservation of biodiversity include recognition and inclusion of natural processes in our land management practices, shouldn't we naturally include fire? Given its long history on the landscape, it has been largely responsible for determining the composition, structure and functioning of many of the forest and range types of British Columbia.

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