# Fire History of Kananaskis Provincial Park — Mean Fire Return Intervals[1]

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Abstract.--Mean fire return intervals for different ecological subzones, aspects and elevations in Kananaskis Provincial Park were described. Comparison of the results from this study with others was not practical because of a number of constraints. A discussion of the mean fire return interval results and park resource management was presented.

## INTRODUCTION

Fire has played an important role in the ecology of northern Rocky Mountain forests (Habeck and Mutch 1973). Fire history studies in Alberta have indicated that fire return intervals, sizes and intensities have varied in different forest ecosystems (Byrne 1968; MacKenzie 1973; Tande 1979). Fire history information is an essential element in describing forest ecosystems, development of resource management alternatives, and implementation of programs in fire management planning and operations (Arno 1976).

Kananaskis Provincial Park (KPP) was selected for this study because intervals, sizes and intensities of fires in high elevation (>1500 metres) forests of the Canadian Rocky Mountains have not been investigated in detail. In addition, the recent creation of KPP provided an opportunity to include the collection of fire history information as part of the overall resource inventory of the Park.

In this paper, I will present only part of the results of this study. The paper will focus on the mean fire return intervals (MFRI) of high elevation forests in KPP. A fire chronology, fire-year maps and a stand origin map are presented in an earlier paper (Hawkes 1979).

The purpose of this paper is to describe the MFRI for different ecological subzones, aspects and elevations in KPP. A discussion will also be included on how this information on MFRI might be utilized by park resource planners in KPP.

## THE RESEARCH AREA

The research area is located approximately 120 kilometres southwest of Calgary, Alberta at the head of the Kananaskis Valley (Figure 1). KPP, in which this study was conducted, encompasses 508 square kilometres, of which 236 sq km is forested. Elevation of the forested land ranges from 1525 metres at the valley bottom to 2300 metres, the approximate treeline.

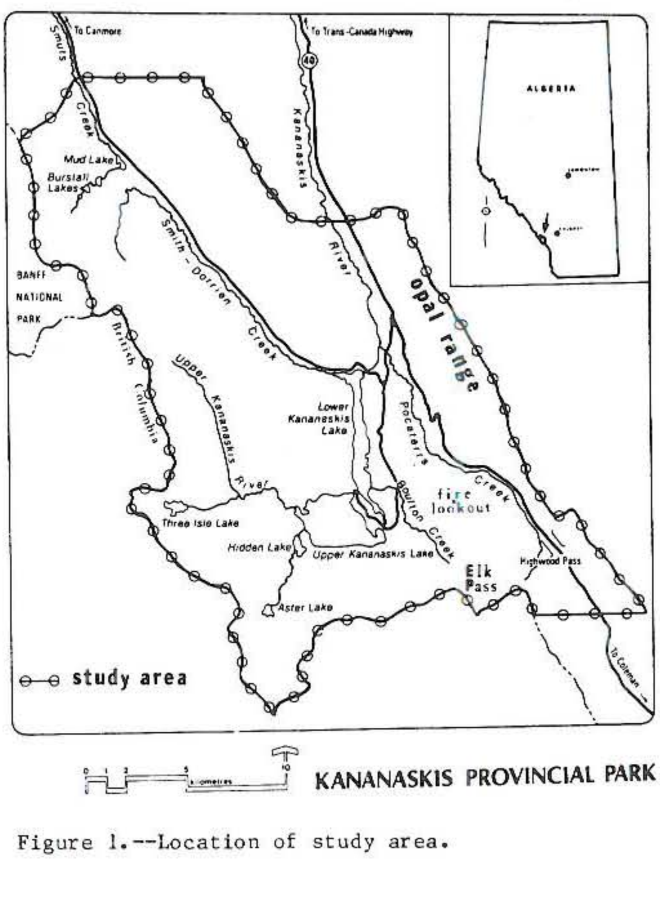


Figure 1.--Location of study area.

[1] Paper presented at the Fire History Workshop, Laboratory of Tree-Ring Research, University of Arizona, Tucson, Ariz., October 20-24, 1980.

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Summer (June to September) temperature and precipitation records are available for Kananaskis Fire Lookout (elev 2072 m), operated by the Alberta Forest Service for the period 1966 to 1975. Figure 2 illustrates the monthly mean temperature and precipitation for the summer at Kananaskis Fire Lookout. Jaques (1977) indicated that the climate within the Park represents a fairly narrow range of the total Rocky Mountain east slopes climatic regime, being skewed toward the moist-cool end of the gradient.

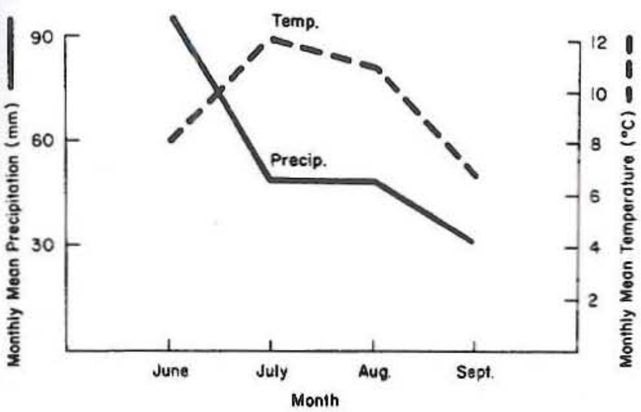


Figure 2.--Monthly mean temperature and precipitation for the summer at Kananaskis Fire Lookout (based on data for the period 1966-1975).

The vegetation of KPP is classified in the subalpine ecological zone according to the ecosystem classification described in Walker et al. (1978). This zone is divided into upper and lower subalpine subzones based on the occurrence of certain vegetation types and differences in vegetation physiognomy which reflect macroclimate. The lower subalpine subzone occurs generally below 2000 metres' elevation. The upper subalpine subzone ranges from 2000 to 3000 metres.

Mature Engelmann-white spruce hybrid[3] (Picea engelmannii Parry x P. glauca (Moench) Voss.) - subalpine fir (Abies lasiocarpa (Hook.) Nutt.) forests occur in the higher elevational areas of the lower subalpine subzone. Successional lodgepole pine (Pinus contorta Loudon var. latifolia Engelm.) forests dominate the rest of the lower subalpine subzone.

The upper subzone is transitional between the lower subalpine subzone and the treeless alpine zone. Engelmann spruce, subalpine fir and alpine larch (Larix lyallii Parl.) are common in this subzone. Closed forests are common at the lower elevational areas of the subzone. Tree islands are common, with heather (Phyllodoce sp.) meadows occurring between them at the higher elevational areas of the subzone.

For at least 8,000 years man has occupied the Kananaskis Lakes area, with most early use concentrated between 5,000 B.C. and 200 A.D. (Aresco Ltd. 1977). The Stoney Indians moved to the Kootenay Plains and Morley area in the early 1800s. They travelled through the Kananaskis Valley on hunting trips to British Columbia.

The Kananaskis Lakes area had seen relatively light use by man and had escaped extensive development until the recent construction of the facilities for KPP. Recreation use was limited until the improvement of the Kananaskis trail to facilitate the construction of dams in the 1940s at the lakes. Paved access to the Park (completed in 1978) resulted in a marked increase in the number of visitors to the lakes area.

## METHODS

The fire history of KPP was documented, using a fire-scar analysis, a stand age-class inventory, examination of historical and Alberta Forest Service fire records, and interpretation of aerial photographs.

The approach used in the field to document the fire history of KPP varied from that suggested by Arno and Sneck (1977). A network of reconnaissance transects were not used. Sample points for the fire history study were established along the stand edge and within remnant stands which provided the best source of fire history information. Many stands which contained fire history information were a hectare or less in size, perhaps because of the high intensity of past fires.

Snags provided a secondary source of information which extended the fire chronology to earlier fires than could be dated from fire scars on living trees. Data were collected from standing snags and dead down logs on the forest floor. Four problems were encountered when snags were used to obtain fire history data.

These were:

1. Weathering of the tree's exterior caused fire dates to be incorrect up to 10 years.
2. Determining which fire killed the snag was sometimes difficult; cross-dating to other living and dead fire scar information was necessary.
3. Sometimes the snag died a number of years after a fire scorched its crown.
4. Trunk rot added to aging problems.

The large expanse of young, even-aged stands in KPP made it necessary to use snags if historic fire years were to be determined.

[3] Called Engelmann spruce in this paper.

A "master fire chronology" of KPP was developed from fire-scarred tree wedges, age-class data and Alberta Forest Service records according to the procedure in Arno and Sneck (1977). A total of 142 fire scars and 705 increment cores were taken on 117 fire history plots to establish the fire chronology. This information was used to estimate the MFRI for each fire history sample site in KPP.

## RESULTS AND DISCUSSION

Mean fire return interval (the average number of years between fires) has been expressed in the literature in two different ways. The first is based on the average number of years between fires for a given study area (e.g. KPP, Jasper National Park or a particular watershed). The second is based on the average number of years between fires for a given point or stand (usually less than 100 ha) within a study area. The first expression of MFRI is area-dependent, because it will shorten if the size of the study area is increased. The point expression of MFRI is more useful for comparing results from one study area to another.

MFRI was calculated on a point basis to determine the effect of elevation, aspect and ecological subzone on MFRI. A two-way analysis of variance was done for elevation and aspect (Table 1). Twelve plots were randomly picked for each cell for the analysis of variance. The elevational differences were significant at the 95% probability level. The MFRI for the north aspect was significantly different at the 95% probability level from the south, west and east aspect (Table 1). Fire history plots were stratified according to their location (lower (n=88) or upper subalpine (n=13) subzones). A "t" test of the means indicated that the two ecological subzones had significantly different MFRI at the 95% probability level (Table 1). The results for elevation, aspect and ecological subzone were:

| Elevation | MFRI (years) |
|---|---|
| 1525-1830 m | 90 |
| 1830-treeline (Approx. 2300 m) | 153 |

| Aspect | MFRI (years) |
|---|---|
| North | 187 |
| South | 104 |
| West | 101 |
| East | 93 |

| Ecological Subzone | MFRI (years) |
|---|---|
| Lower Subalpine | 101 |
| Upper Subalpine | 304 |

Comparison of MFRI results from different studies is possible if the following conditions are met:

1. MFRI is calculated on a point or stand basis (usually 41-81 ha (100-200 ac) in size).
2. The study areas have the same vegetation communities (e.g. habitat types as described by Pfister _et al._ (1977) for Montana) not just the same vegetation zone or subzone (e.g. forest series as described by Pfister _et al._ (1977)).
3. Arno (1980) mentions the importance of the distribution of forest series on the landscape. Small isolated forest series which are surrounded by a major forest series may have a MFRI similar to the major forest series.
4. The length of record of fires and the study approach are similar for the different studies (Arno 1980).
5. Each area had a similar man-caused fire history (e.g. Indian fires).

Table 1.--ANOVA table for two-way analysis of variance ( elevation and aspect vs MFRI ), Scheffe multiple comparison results for aspect means and "t" test results ( ecological subzone vs MFRI ).

| Source | Sum of Squares | Degrees of Freedom | Mean Square | Computed F | Probability |
|---|---|---|---|---|---|
| Elevation | 96610.50 | 1 | 96610.50 | 6.38 | .025* |
| Aspect | 140989.30 | 3 | 46996.43 | 3.10 | .050* |
| Interaction | 94147.00 | 3 | 31382.33 | 2.07 | >.100 |
| Error | 1332866.75 | 88 | 15147.35 | | |

* significant according to the confidence level set in this study (95%)
Scheffe multiple comparison (95% confidence level) indicated that the difference between aspect means had to be >83.9 to be significant.

"t" Test Results

| | Mean | Variance ($S^2$) | No. of Observations |
|---|---|---|---|
| Upper Subalpine Subzone | 304 | 5768.8 | 13 |
| Lower Subalpine Subzone | 101 | 13329.6 | 88 |

Common Variance ($S^2p$) = 12539.52

Value of t = 6.101

Critical T is ~1.645 at 95% confidence level, therefore t is significant.

Comparison of my MFRI results with other study areas will not be made because of these constraints.

Most fires in the lower elevation sections of KPP (<2000 m) seemed to have been large (>1000 ha), stand-destroying fires of medium to high fire intensities, with low to moderate fire intensities on the edge and backing sections. Development of recreation facilities in the Lower Kananaskis Valley of KPP has led to a policy of total suppression on all fires. To re-introduce the same type of fire to KPP would not be possible now. Prescribed burning on a small scale might be a possible alternative. If so, how large an area of forest and which areas should be burned each year? The reciprocal of the point estimate of MFRI will give the average proportion of the whole area burned annually (Van Wagner 1978). This proportion would give a long-range average to work toward if the MFRI is accepted as the optimum fire cycle. Van Wagner (1978) describes the optimum fire cycle as that which "maintains the forest in question in the best possible ecological state, from the various viewpoints of production, health, and competition with other vegetation types that would tend to supplant it in the absence of fire."

To answer the question of where to burn is also difficult. The historic age-class mosaic would be difficult to maintain because of the constraint on large fires. From the theoretical viewpoint of the fire return interval, the actual number of fires and their individual sizes are unimportant; only the total burned area per year counts (Van Wagner 1978). Many small sized fires will still maintain the age-class distribution. Only after a detailed study of the ecosystems in question throughout their entire age range can we start to answer the question of where to burn and how much (Van Wagner 1978).

These questions on when, where and how much fire will be allowed or can be logistically handled by the resource staff will have to be answered. Only 20 lightning fires out of 126 were allowed to burn in the Selway Bitterroot Wilderness in 1979[4] because of the commitment of fire suppression forces and the prescription limits of fire weather outlined in the fire management plan. This does not allow for the natural fire regime to be totally re-introduced because the fire agency cannot handle the fire load. Perhaps the historic average burned area per year might be set as a long-range goal.

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[4] Mutch, Bob. 1979. Personal conversation. USDA Forest Service, Lolo National Forest, Missoula, Montana.

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