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FIRE HAZARD CLASSIFICATION FOR PRINCE ALBERT NATIONAL PARK, SASKATCHEWAN

by A.D. Kiil, R.J. Lieskovsky, and J.E. Grigel

NORTHERN FOREST RESEARCH CENTRE
EDMONTON, ALBERTA
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A. D. Kiil*, R. J. Lieskovsky**, and J. E. Grigel***

ABSTRACT

A fire hazard classification, in the form of maps with overlays and color coded, was prepared to serve as a planning and operational aid in fire management decision-making in Prince Albert National Park. The hazard classification scheme consists of a fuel type map and rate of spread and resistance to control ratings for each of nine fuel types in a range of burning conditions. The nine fuel types were delineated on the basis of implied differences in fire behavior between 13 forest cover types. For each season, fuel type and fire danger index class, rate of spread and resistance to control (available fuel for burning) were rated as Low, Moderate, High or Extreme. Application of the fuel type map and the fire hazard ratings in fire management planning, day-to-day decision-making on aspects of fire control and prescribed burning are described.

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INTRODUCTION

The attainment of fire management objectives depends on sound planning and an adequate level of operational capability. One of the main requirements for the implementation of an operational plan is information about type and extent of vegetation (fuel), potential fire behavior in a range of fire weather conditions and short and long-term fire effects on the resources being protected. This type of information can conveniently be included on fuel type maps and fire hazard indicators for the appropriate vegetation (fuel) type.

This report presents a fuel type map and fire hazard classification for major fuel (vegetation) types in Prince Albert National Park in the Province of Saskatchewan. It is the second such project carried out by the Canadian Forestry Service at the request of the National and Historic Parks Branch of the Department of Indian Affairs and Northern Development. The approach used in the present study was similar to that developed for the first fire hazard classification for Waterton Lakes National Park in southwestern Alberta (Grigel et. al., 1973). As previously, the overriding consideration was the need to keep the classification reasonably simple in content and format in order to encourage and facilitate its use by fire planners and operational personnel in aid of fire management decision-making in the Park. The necessary background information including forest cover type maps was made available by the Forest Management Research Institute, Canadian Forestry Service, Department of the Environment (Gimbarzevski, 1973).

GENERAL DESCRIPTION OF AREA

Prince Albert National Park is near the geographical centre of Saskatchewan, about 36 miles north of the City of Prince Albert. The Park lies within the sub-Arctic climatic region, with cool, short summers and only one to three months with a mean temperature above 50°F. Much of the annual precipitation of 18 inches falls during the 160-day growing season. It is therefore a relatively dry forested region with periodic droughts being responsible for severe fire hazard conditions.

The bedrock is made up mainly of shales, sandstones and conglomerates buried beneath thick deposits of glacial till left by the glaciers when they receeded about 10,000 years ago. Left undisturbed by man-made projects (roads, trails, etc.), the glacial deposits are relatively stable with patterns of drainage along wide valleys. The northern half of the Park lies within the Saskatchewan River watershed. The northern half is characterized by several large lakes. The main soil types are made up primarily of grey wooded and degraded black soils. Jack pine is often found growing on sandy soils, white spruce on the loamy till plains and black spruce on the heavy clays.

The Forest Regions of Canada (Rowe, 1959) places the Park in the Mixedwood Section of the Boreal Forest Region. The predominant forest associations on the well-drained uplands include aspen (Populus tremuloides), balsam poplar (P. balsamifera), white spruce (Picea glauca) and balsam fir (Abies balsamea). Jack pine (Pinus banksiana) generally occurs on sandy areas but is also found in mixtures with black spruce (Picea mariana). Wetter sites support black spruce and tamarack (Larix laricina). The spruce-dominated stands have a forest floor of mosses

with shrubs and herbs such as alder (Alnus crispa (Ait.) Pursh), prickly rose (Rosa acicularis Lindl.), horsetail (Equisetum sylvaticum L.), bunchberry (Cornus canadensis L.) and twin-flower (Linnea borealis L.) rooted in the moss. The aspen-dominated mixedwood has a mixture of leaf litter and moss on the forest floor. Predominant shrubs and herbs include Saskatoon berry, hazel (Corylus cornuta Marsh.), buffaloberry (Shepherdia canadensis (L.) Nutt), honeysuckle (Lonicera canadensis Bartr.), twin-flower, bunchberry and wintergreen (Gaultheria procumbens L.).

In general, three major vegetation zones - grassland, aspen parkland and the boreal - are found within the Park boundaries. The grassland area is confined to the southwest corner of the Park and is interspersed with patches or stringers of aspen. The remainder of the southern half of the Park has extensive aspen stands but spruce and pine occur throughout. The northern half of the Park comprises primarily of conifers such as spruce, pine and fir.

The forested parts of the Park occupy 91% of the total land area of 1496 square miles. Of the forested area, coniferous (softwood) cover types occupy 46%, decidous (hardwoods) 28% and mixedwoods 26% (Gimbarzevski, 1973). White spruce, black spruce and jack pine are dominant in the coniferous cover types, while poplar (trembling aspen and balsam poplar) is dominant in the hardwood cover types.

As elsewhere in the boreal forest of western Canada, fire has played a dominant role in determining the types, extent and distribution of vegetation. Recent fire history is shown in Figure 1 and is highlighted by several large burns during the 10-year period

from 1941 to 1950. About one-third of the total Park area of 1496 square miles has burned over since 1930. The absence of large fires during the past 20 years has favoured the encroachment of aspen into grassland areas and an increase in the proportion of conifers in the older mixedwood stands. While there is little doubt about the decrease in the extent of grassland in the southwestern portion of the Park, it is conceivable that the existence of this vegetation type is in fact attributable to land-clearing operations during the main period of settlement around the late 1800's and the early years of the 20th century.

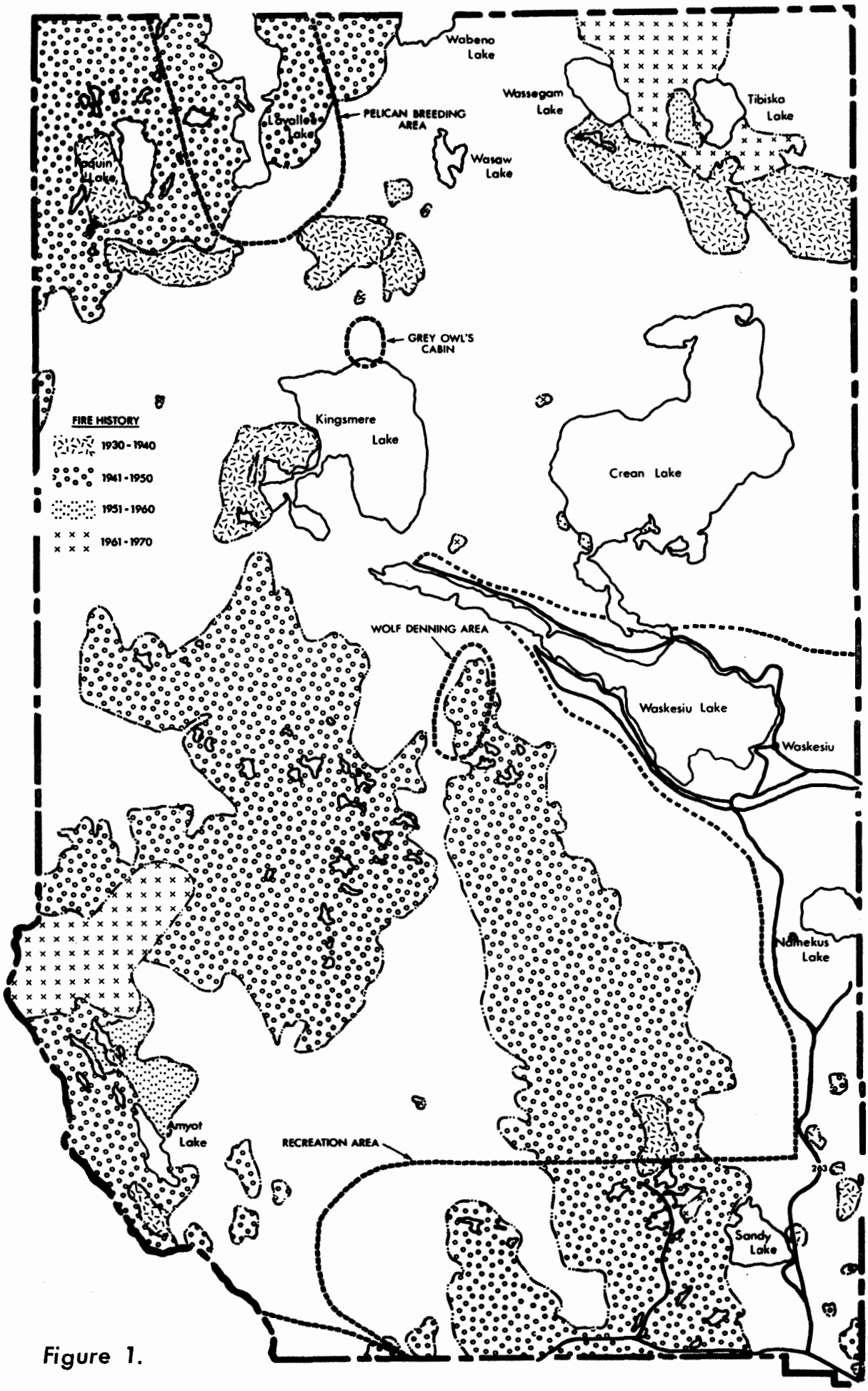

Wabeno Lake
Wassegam Lake
Tibiska Lake
PELICAN BREEDING AREA
Loyalles Lake
Wasaw Lake
Joquin Lake
GREY OWL'S CABIN
FIRE HISTORY
1930 - 1940
1941 - 1950
1951 - 1960
1961 - 1970
Kingsmere Lake
Crean Lake
WOLF DENNING AREA
Waskesiu Lake
Waskesiu
Namekus Lake
Amyot Lake
RECREATION AREA
Sandy Lake

Figure 1.

DEVELOPMENT OF THE FIRE HAZARD CLASSIFICATION

The approach to the development of the fire hazard classification was based on experience gained in conducting a similar study in Waterton Lakes National Park, discussions with Park personnel, a field reconnaissance, and a review of relevant information. The decision which led to the development of the fire hazard classification scheme for Prince Albert National Park was based on the following assumptions:

1) It should be easy to apply and factual. Thus the large number of forest cover types had to be reduced to about 10 fuel types.
2) The proposed classification should satisfy two types of use, namely (i) identification and interpretation of important vegetation (fuel) types in aid of fire, vegetation and wildlife management activities in the Park and (ii) as an aid in decision-making relative to the planning and operational aspects of fire control.
3) The classification scheme should reflect different land uses in different parts of the Park. Proposed land-use zones, prepared as part of a provisional master plan for the Park, were used as a basis for establishing minimum size of individual fuel types.
4) Rate of fire spread and resistance to control are of primary interest to the fire manager in aid of decision-making pertaining to fire-fighting tactics and requirements for men, supplies and equipment.

The fire hazard classification enables the prediction of these parameters for different combinations of fuel and weather factors.

The final results would therefore be in the form of: (1) a fuel-type map on a scale of 1.25 inches = 1 mile, (2) rate of spread and resistance to control charts by fuel type, season and fire danger indices, (3) a wall chart with color photographs of the fuel types, and (4) a written statement outlining data important to interpretation of the maps and charts.

Fuel Type Map

A two-man study team conducted an extensive ground and aerial reconnaissance of the Park to familiarize itself with the main forest cover types. Stands in each forest cover type known or believed to contain fuels likely to cause important differences in fire behavior were identified on the ground and described in detail. Commonly-used stand and forest-floor fuel descriptors included age, height, density, crown form, lesser vegetation, horizontal and vertical distribution of fuels, moisture regime, and seasonal variation in fuel condition. These fuel descriptors were then related to probable differences in fire behavior and formed the basis for a breakdown of forest cover types into nine major fuel types. These basic differences in fire behavior between fuel types were assessed in terms of high fire danger rating indices, i.e. ISI of 10 and ADMC 50 to 100 (Anon., 1970).

The final fuel type map classification for Prince Albert National Park consists of the following:

1) Grassland
2) Shrubs - deciduous
3) Shrubs - coniferous
4) Deciduous
5) Mixedwood
6) Jack pine
7) Black spruce
8) Mixed conifer
9) Disturbance (natural and artificial).

Photographs of the fuel types are presented in Appendix I.

All forest cover types were included in one of the nine fuel types. The fuel types are admittedly based on somewhat arbitrary criteria but believed to be indicative of relative differences in fire behavior between types. For the final fuel type map, minimum area of a separate type to be mapped was set as 300 acres. The exception to this general rule was for areas adjacent to roads, campsites and historical sites and wildlife breeding areas, where the minimum was set as 10 acres; these areas are identified in Figure 1. The final colored map was prepared according to criteria in Appendix II and III. A small-scale colored reproduction of the fuel type map is shown in Figure 2.

Fire Hazard Classification

To extend the potential application of the fuel type map, we decided to develop rate of spread and resistance to control ratings to reflect differences in these parameters between fuel types, seasons, and past and present weather conditions. In effect, the hazard-rating scheme refines the fuel type map to enable the fire manager to predict fire behavior throughout the fire season on a day to day basis by using standard fire behavior indices such as the Initial Spread Index (ISI) and the Adjusted Duff Moisture Code (ADMC). The rating scheme

Figure 2.

FUEL TYPE MAP FOR PRINCE ALBERT NATIONAL PARK

- GRASSLAND
- SHRUBLAND DECIDUOUS
- SHRUBLAND CONIFEROUS
- DECIDUOUS
- MIXEDWOOD
- JACK PINE
- BLACK SPRUCE
- MIXED CONIFER
- NATURAL & ARTIFICIAL DISTURBANCES (BLOWDOWN, SALVAGE AREAS)
- LAKES, RIVERS
- HIGHWAYS, SECONDARY & ACCESS ROADS
- RECREATIONAL & SPECIAL INTEREST AREAS

was to assign values of 1 to 10 to different combinations of fuel types, season and four classes of ISI or ADMC. This was subsequently modified by incorporating individual point ratings into descriptive classes of Low, Moderate, High and Extreme. Each descriptive rating was arrived at by using the general criteria shown in Appendix IV.

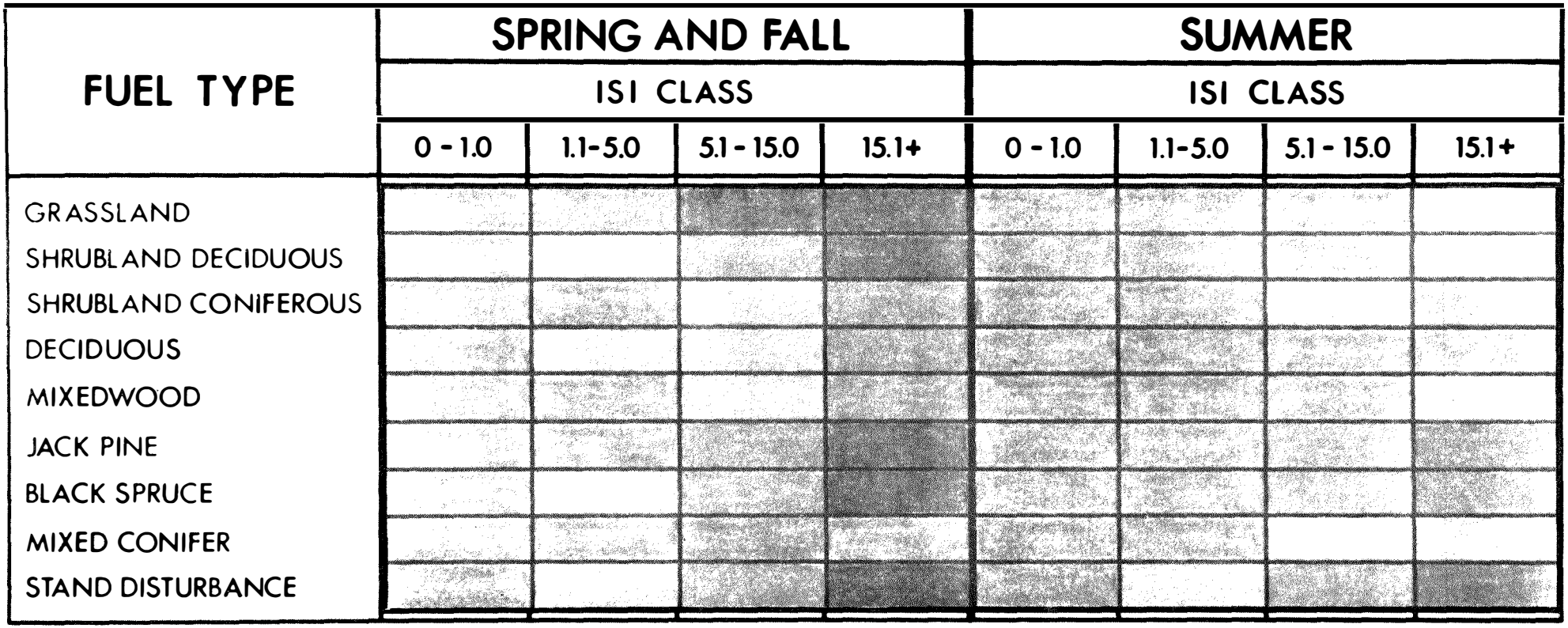
The fire hazard classifications are shown in Figures 3 and 4. For each of ISI and ADMC, Low, Moderate, High and Extreme ratings can be expected to occur about 25, 40, 30 and 5 per cent, and 30, 30, 30 and 10 per cent of the time respectively during the average fire season in the Park. A comparison of these frequencies with corresponding ones for Waterton Lakes National Park indicates that the fire climate is more severe in Prince Albert National Park. For example, days with High and Extreme ADMC rating can be expected to occur 40 per cent of the time in Prince Albert National Park compared to 20 per cent of the time in Waterton Lakes National Park. Given the same fire risk in both Parks, the total fire load is likely to be higher in Prince Albert National Park.

APPLICATIONS

Fire Management Planning

The relatively small size (1496 sq. mi.) of Prince Albert National Park dictates against the establishment and maintenance of a fire control capability to handle the more serious fire outbreaks. However, much can be done in the areas of prevention, detection and pre-suppression planning to reduce the number of man-caused fires, to discover fires in their infancy and to take quick, albeit limited initial action.

RATE OF SPREAD RATING FOR PRINCE ALBERT NATIONAL PARK



RATE OF SPREAD

Low

Moderate

High

Extreme

Use Spring and Fall Table when at least 50 per cent of minor vegetation is cured.

Use Summer Table when at least 50 per cent of minor vegetation is cured.

Rating does not reflect length of a diurnal burning period.

Figure 3.

RESISTANCE TO CONTROL RATING FOR PRINCE ALBERT NATIONAL PARK

FUEL TYPE	SPRING AND FALL				SUMMER			
	ADMC CLASS				ADMC CLASS			
	0 - 20	21 - 40	41 - 75	76+	0 - 20	21 - 40	41 - 75	76+
GRASSLAND								
SHRUBLAND DECIDUOUS								
SHRUBLAND CONIFEROUS								
DECIDUOUS								
MIXEDWOOD								
JACK PINE								
BLACK SPRUCE								
MIXED CONIFER								
STAND DISTURBANCE								

RESISTANCE TO CONTROL

Low

Moderate

High

Extreme

The Resistance to Control Rating is based on the available fuel for burning and fuel distribution.

Use Spring and Fall Table when at least 50 per cent of minor vegetation is cured.

Use Summer Table when at least 50 per cent of minor vegetation is cured.

Rating does not reflect length of a diurnal burning period.

Figure 4.

The fire hazard classification should be useful to the fire planner and manager for: (i) assessing the fire problem in the Park, (ii) isolating potentially hazardous fuel complexes, (iii) predicting the changes in the vegetation mosaic over the next several decades, and (iv) aiding the day-to-day operational activities of Parks fire control personnel. Since the enjoyment of National Parks is closely tied to the makeup of the vegetation and wildlife population, much attention needs to be placed on fire management (fire control, prescribed burning, historical role of wildfires) to ensure the preservation and/or protection of representative Park areas and features.

The fuel type map indicates the size and extent of major fuel (vegetation) types and facilitates an assessment of the successional stage of each type. The map, used in conjunction with the rate of spread and resistance to control ratings, should be used as a basis for planning and conducting pre-suppression activities such as detection patrols and assignment of duties to Parks personnel on the basis of potential fire activity. Travel restrictions and cancellation of any fire permits should be regulated on the basis of a systematic scheme for assessing fire risk and potential. Up-to-date roadside signs informing the public of potential fire danger and travel restrictions while in the Park are helpful in developing an awareness of fire hazard and an appreciation of the need for fire management.

Specific Applications

Fire is a natural disturbance and its prescribed application deserves careful consideration in the context of the Park's environment.

Small tracts of "Grassland Wilderness" are a special feature of Prince Albert National Park but complete fire exclusion over the next several decades will contribute to the virtual dissappearance of this vegetation type. Periodic application of fire in this fuel type is a safe and economical procedure for the preservation of the grassland community. The fuel type map and hazard ratings are intended to serve as a basis for identifying the need for fire treatment and for writing the appropriate fire prescription to achieve stated objectives. Similarly, prescribed fire may have application for hazard reduction in problem areas, to manipulate vegetation in aid of wildlife management and for training of fire fighters.

The rate of spread and resistance to control ratings are indicative of relative differences in fire behavior between fuel types and in a range of weather conditions. The isolation of fuel types and season represent a refinement in the ability of the Canadian Fire Behavior Rating System (Anon., 1970) to accurately reflect fire behavior and effects in diverse vegetation types. The rate of spread ratings are indicative of relative length of fire perimeter and should be of particular value to the fire manager in dispatching of men and equipment to ensure prompt fire containment. On a larger fire, the fuel type map and rate of spread ratings should prove useful in deciding on the appropriate tactic to take advantage of natural fuel breaks or less flammable fuels. The resistance to control ratings are indicative of fuel consumption and extent of smouldering; hence, they provide the fire manager with a measure of expected suppression and mop-up difficulty. Prior to a fire, the resistance to control ratings

should be a primary planning aid to ensure that pre-suppression preparedness is adequate to cope with the potential fire activity.

To facilitate comparison, ISI and ADMC classes for both Waterton Lakes and Prince Albert National Parks were kept identical. Furthermore, 7 of the 9 fuel types are common for both Parks; hence most of the fuel types in both Parks received similar hazard ratings. It is important to recognize, however, that the potential fire load (number of fires and fire intensity) may vary considerably depending on the ignition sources and the distribution of days by ISI and ADMC classes. For example, Prince Albert National Park can expect to have twice the number of High and Extreme days likely to occur in Waterton Lakes National Park during the average fire season. Also, fuel types such as jack pine and black spruce are believed to be more flammable in summer than similar types in Waterton Lakes National Park, owing to a general lack of live lesser vegetation and the abundance of explosive fuels such as Labrador tea and Cladonia mosses. Familiarization with the fuel type map and hazards ratings will enable the fire manager to interpret these in terms of local conditions and will enable him to prepare operational guidelines in aid of all fire management activities.

REFERENCES

Anon. 1970 - Canadian Forest Fire Weather Index, Canadian Forestry Service, Dept. of Fisheries and Forestry.

Gimbarzevski, P. 1973 - Personal communication and preliminary draft - Forest types and vegetation of Prince Albert National Park, Saskatchewan, 1973. Canadian Forestry Service, Forest Management Institute, Ottawa.

Grigel, J. E. et. al. 1971 - Fire hazard classification for Waterton Lakes National Park. Canadian Forestry Service, Northern Forest Research Centre, Information Report NOR-X-7, September 1971.

Rowe, J. S. 1959 - Forest regions of Canada. Can. Dept. of Northern Affairs and Natural Resources, Forestry Br., Bull. No. 123.

APPENDIX I

Pictures of Fuel Types

1) Grassland (U-1)

2) Shrubland deciduous (M-2)

3) Shrubland coniferous (1bS2)

4) Deciduous (5PO2)

5) Mixedwood (7PO25wS2)

6) Jack pine (7P2)

7) Black spruce (5bS2)

8) Mixed conifer (7SwP2)

9) Disturbance (blowdown)

1) Grassland (U-1)

2) Shrubland deciduous (M-2)

3) Shrubland coniferous (1bS2)

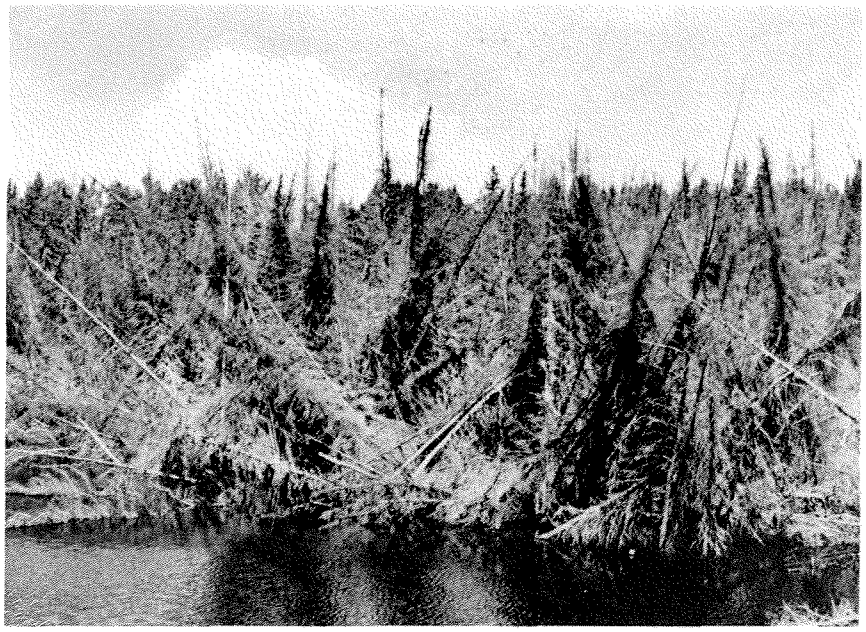
4) Deciduous (5P02)

5) Mixedwood (7P025wS2)

6) Jack pine (7P2)

7) Black spruce (5bS2)

8) Mixed conifer (7SwP2)



9) Stand Disturbance (blowdown)

APPENDIX II

Definition of abbreviations and stand descriptors used to describe stands and subtypes (after Gimbarzevski, 1973)

FOREST COVER TYPES

Species

P	Jack Pine
wS	White Spruce
bS	Black Spruce
bF	Balsam Fir
L	Larch
Po	Poplar (Trembling Aspen and Balsam Poplar)
wB	White Birch

In mixed species stands, the predominant species is shown first (PbS). Species that are estimated to comprise less than 20% of the total volume of the stand are not shown in the symbol.

Height and Density

Height in feet	Code	Canopy Density in Per Cent
1-20	1	1-30 (open)
	2	31-60 (moderate)
21-40	3	61+ (dense)
41-60	5	
61+	7	

NON-FORESTED AREAS

Upland (dry site)

U-1 Herbs and grasses
U-2 Shrubs, deciduous (brush)

Lowland

M-1 Sedges and herbs
M-2 Shrubs

APPENDIX III

Guidelines for Fuel Type Mapping

	Fuel Type	Color Code
(1)	Grassland - all stand types U-1 and M-1	Yellow
(2)	Shrubland, deciduous - Stand types U-2, M-2, 1 Po 1 & 2, 3Po1, 1PowSx (if 50/50 coverage for 1bS2 and M-2, type as M-2).	Light Green
(3)	Shrubland, coniferous - all height class 1 and stands with conifers dominant (1P1, 1P2 & 3, 3P1, 1PPo2, 1PoP2, 1wS1, 1bS1 & 2 & 3, 1bSwS1, 1LbS2, 1bSP2).	Dark Green
(4)	Deciduous - 3Po2 and higher, 5Po1 and white birch.	Red
(5)	Mixedwood - all mixedwood stands with height class 3 and higher, e.g. 3PosWx, 3sWPo2 & 3, 3PobS2, 3bSPo.	Dark Blue
(6)	Jack Pine - all pure jack pine stands 3P3 and higher, 5PbS2 & 3.	Pink
(7)	Black Spruce - all black spruce stands and mixtures of black spruce with height class 3 and higher: 3bSP2 & 3, 3bS1 & 2 & 3, 5bSwS2, 3L2.	Orange
(8)	Mixed Conifer - all mixed conifer stands with height class 3 and higher and density class 2 and higher, including pure white spruce stands, 5PwS2, 7wSP2, 5wSbS2.	Brown
(9)	Disturbance (Natural and artificial) - refers to blowdown.	Purple
	Lakes and flooded areas	Light Blue

APPENDIX IV

Guidelines for Fire Hazard Rating

(1)	Low	- Fire spread possible in open but ignition unlikely in stands. Fuel consumption minimal.	Green
(2)	Moderate	- Fire spread high in open but very slow in forests. Fuel consumption low but smouldering may be persistent when ADMC exceeds 40.	Yellow
(3)	High	- Fire spread rapid in open and may be fast in forest for short periods of time. All litter and part of duff layer may be consumed. Crowning likely to be spotty.	Orange
(4)	Extreme	- Ignition can occur from sparks, rate of spread extreme through dry and continuous fuels. Duff consumption complete in shallow duff stands with persistent smouldering in deep duff sites. Crowning may be extensive.	Red