PRESCRIBED BURNING

IN ELK ISLAND NATIONAL PARK

BY

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I. BACKGROUND

A. Regional Setting

Elk Island National Park, 76 square miles in area, is in the northern section of Alberta's Beaver Hills. Because it is elevated above the surrounding Aspen Grove (Rowe, 1972), it is considered to be in the Boreal Mixedwood Forest which occurs immediately north. Trembling aspen is the dominant tree species within the Park, while balsam poplar is also common. White spruce is often present under the Aspen canopy and is dominant on the major islands. Common shrubs include chokecherry, pincherry, saskatoon berry, prickly rose, wild gooseberry and beaked hazelnut. These shrubs are often found encroaching on grass meadows interspersed throughout the Park. Black spruce, tamarack, willow, alder, labrador tea and sedges commonly occupy hydric sites in association with the many small lakes, ponds and bogs that occur within the Park.

Soils are primarily grey-wooded, well-drained and stoney with organic soils found on wetter sites.

Thirty species of mammals have been recorded in the Park. Plains bison, elk, moose and white-tailed deer are common ungulates and the Park is an important reserve for a herd of rare Wood Bison located in the southern portion.

Topographically, the Park landscape ranges from slightly undulating (0 - 5% slope) to hilly (30 - 60% slope). Because of the many ridges

and depressions, the area is often referred to as knob and kettle terrain.

The climate is dominated by continental air masses with July temperatures averaging 16.4°C and January temperatures averaging -16.7°C. The mean annual temperature is +1.7°C. Annual mean precipitation is approximately 16" - 18" (40 - 45 cm) most of which falls during the growing season.

B. Fire History, Management and Prescribed Fire

There can be little doubt that fire, either lightning caused or man-caused, has significantly influenced the vegetation of Elk Island National Park (Thomas, 1976; Scace, 1976; Kjorlien, 1976; Nelson and England, 1971). Historically, the Park had been hunted by indigenous peoples and more recently much of the Beaver Hills area was cleared, logged and burned by settlers prior to becoming a National Park (Scace, 1972). The present vegetation mosaic of aspen forest and open grassland or shrubland meadows is a reflection of both past cultural (Indigenous and European) activities and natural factors (including man-caused and lightning-caused fires) as well as present management practices.

The size (relatively small), location (adjacent to private holdings), presence of large ungulates (confined to the Park by an eight-foot fence), and the absence of effective natural predation, as well as recreation uses and other developments in the Park requires that active resource management programs be conducted to meet management objectives as opposed to a more passive approach that may be acceptable in large, remote, northern wilderness parks.

A major management objective of Elk Island National Park is to preserve the natural features and processes occurring in the Park. Currently, grassland meadows are being invaded by several woody species and although this is a natural successional process, the loss of these grasslands will mean a decrease in plant community diversity and loss of a major food source for bison and elk.

Park managers have decided to implement a fire management program to ensure the maintenance of grassland communities and overall plant diversity as well as providing ample grazing for ungulates. Barney (1975) defines fire management as: The integration of all fire-related biological, physical, sociological and technological information into the process of land management in order to meet desired objectives. As a land management activity, fire management includes all the tasks related to the protection of vegetation from unwanted fire, the use of fire to accomplish management objectives and the inclusion of fire considerations in land and resource plans. Thus, fire management still consists of such traditional fire control activities as presuppression, suppression and prescribed fire use. There are really only two kinds of fire; wanted or unwanted (Barrows, 1977). Unwanted fires are those that do not meet land management objectives and should be classed as wildfires and suppressed regardless of ignition source (lightning or man-caused). Conversely, wanted fires meet land management objectives and can be classed as: a) Random Ignition Prescribed Fire (lightning fires) and b) Planned Ignition Prescribed Fire (traditional prescribed fire). Only the latter (b) is currently acceptable in Elk Island National Park because of its size, location, use patterns and structural developments. Planned

ignition prescribed fire is defined as a fire purposely ignited in a prepared area, with a planned rate of spread and intensity, under predetermined fuel, weather and topographic conditions, to achieve certain objectives of land and resource management (SAF., 1977).

II. PRESCRIBED BURNING PLAN

A. Objectives

Prescribed burning in Elk Island National Park is meant to accomplish more than one objective as indicated below:

1) General Objectives:

   a) To determine if fire can be used as an effective management tool for perpetuating plant species diversity.

   b) To determine if fire can be used to maintain and enhance wildlife habitat.

2) Specific Objectives:

   a) To retard or prevent the encroachment of woody plant species onto selected grassland communities.

   b) To provide Park managers with practical methods and procedures necessary to conduct effective prescribed burning programs.

   c) To inform the public about the natural role of fire and to use these findings in the development of interpretative programs.

B. Area Description

1) Location:

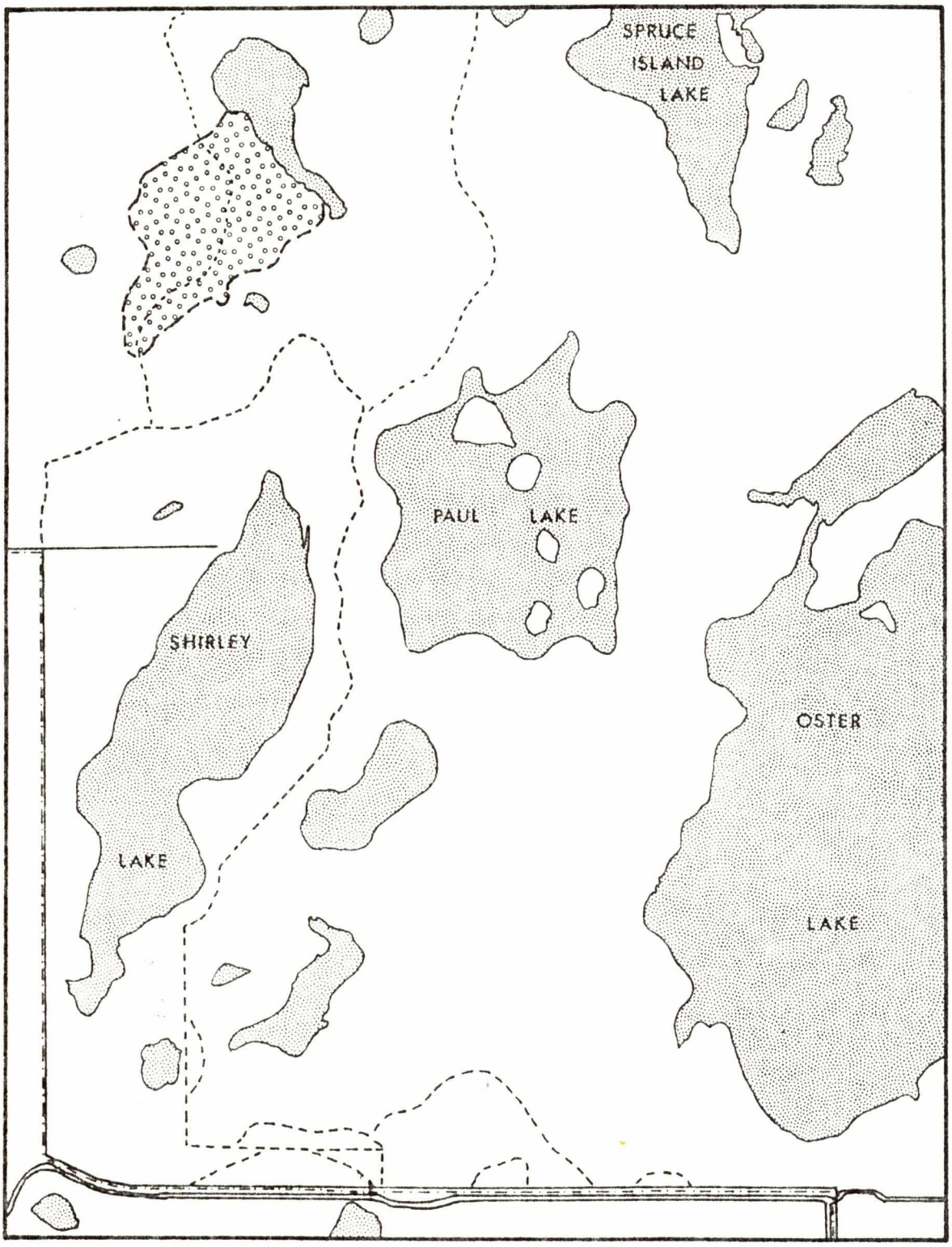
The site selected for prescribed burning is located in the vicinity of Shirley Lake on the north and west side of the Park at approximately 112° 53' W. longitude and 53° 38' 30" N. latitude, SE 1/4, Sec. 9 and NW 1/4, Sec. 4, twp. 54, Rge 20, W. of the 4th meridian. (Figure 1).

2) Size, Topography, Elevation and Soils:

80 - 100 acres (32 - 40 ha) were selected for burning treatment, in an area of gently rolling topography (5 - 9% slope), and orthic gray luvisol/dark gray luvisol soils developed over glacial till. Elevation is 2560' asl. (720 m.)

3) Vegetation:

Two major plant communities are present in the selected treatment area: a) Aspen forest and b) Grassland/shrubland community. Dominant shrubs (stems/ha) within the grassland/shrubland community include beaked hazelnut (Corylus cornuta), snowberry (Symphoricarpos albus), prickly rose (Rosa acicularis), and willow (Salix sp.) (Table 1). Similar species were present under the aspen canopy though not necessarily in the same order of dominance. Interestingly, living aspen regeneration sprouts were not present under the aspen canopy but were common in the open.



Burn area | Open water
Gravel road | Dirt roads
Trails | Park boundary

Figure 1. Location of prescribed burn area, Elk Island National Park, 1979.

TABLE 1. Common shrubs[a] (preburn) in the aspen forest and grassland/shrubland community, Elk Island National Park, 1979.

Species	Grassland/shrubland Stems/ha (thous.)	Grassland/shrubland $\bar{x}$ ht (cm.)	Aspen Forest Stems/ha (thous.)	Aspen Forest $\bar{x}$ ht (cm.)
Corylus cornuta	156	58	86	62
Symphoricarpos albus	131	33	10	29
Rosa acicularis	66	36	49	51
Salix sp.	43	30	2	53
Prunus sp.	30	39	2	53
Amelanchier alnifolia	14	52	10	71
Populus tremuloides	10	109	-	-
Rubus strigosus	5	41	23	65
Symphoricarpos occidentalis	2	64	11	46
Ribes hirtellum	1	115	22	73
Shepherdia canadensis	1	25	4	59
Cornus stolonifera	-	-	2	26
Viburnum edule	-	-	7	31

a. Based on 15 - 2 x 3 ft. plots in each vegetation type.

Common herbs (excluding grasses) in the grassland/shrubland community include strawberry (Fragaria virginiana), dandelion (Taraxacum officinale), aster (aster conspicuus) and yarrow (Achillea millefolium), while bunchberry (Cornus canadensis) and wintergreen (Pyrola sp.) are most common in the aspen forest (Table 2). Grasses (Gramineae sp.) account for 67% of the cover in the grassland/shrubland community and 14% of the cover in the Aspen forest.

TABLE 2. Common herbs[a] (preburn) in the aspen forest and grassland/ shrubland community, Elk Island National Park, 1979.

Species	Grassland/shrubland Stems/ha (thousands)	Aspen forest Stems/ha (thousands)
Fragaria virginiana	136	7
Taraxacum officinale	112	-
Aster conspicuus	23	-
Achillea millefolium	17	-
Gentiana affinis	8	-
Solidago sp.	7	-
Geum triflorum	6	1
Trifolium repens	5	-
Viola adunca	4	-
Lathyrus ochroleucus	4	-
Thalictrum venulosum	2	-
Cornus canadensis	1	48
Agastache foeniculum	1	-
Antennaria nitida	1	-
Pyrola sp.	-	17
Petasites sagittatus	-	1

a. Based on 15 - 2 x 3 ft. plots in each vegetation type.

4) Wildlife:

A quantitative description of wildlife use and distribution within the treatment area is being prepared by Parks personnel. It should be included here when it is completed.

C. Fuel Description

Fuels consisted mainly of cured grass and shrubs in the grassland/ shrubland community (Table 3). Only the weight of down and dead surface woody material was determined under the aspen canopy.

TABLE 3. Preburn fuel loading in prescribed burn area, Elk Island National Park, 1979.

Fuel type	Weight (t/ha)
Aspen Forest	
Surface Dead Woody Fuels	8.80
Grassland/Shrubland	
Surface Dead Woody Fuels	1.40
Shrubs	3.90
Herbs	0.14
Grasses[a]	5.24
TOTAL	10.68

a. Last year's (1978) cured grasses.

Depth of duff in the grassland/shrubland community and in the Aspen forest was nearly the same (Table 4).

TABLE 4. Preburn duff depth[a] in prescribed burn area, Elk Island National Park, 1979.

Duff Layers	Depth of Duff (cm.) Aspen Forest	Grassland/Shrubland
Litter	18.2	18.7
Fermentation	4.1	2.4
Humus	5.1	5.5
TOTAL	27.4	26.6

a. Based on 15 samples in each type.

Fuel moisture content of major species is provided in Table 5.

TABLE 5. Moisture content of major fuels in prescribed burn area, Elk Island National Park, May 9, 1979.

Species	Moisture Content (%)
Gramineae[a]	8
Corylus cornuta	89
Rosa acicularis	80
Symphoricarpos albus	50

a. Last season's (1978) cured grasses.

Figure 2 provides a series of curves for determining fuel moisture content of cured grass based on relative humidity and air temperature. These can be used to estimate fuel moisture immediately prior to ignition in future burns. It should be noted that temperature is expressed in Fahrenheit in Figure 2.

D. Burning Prescription

The burning prescriptions used are essentially the same as those proposed for the Tawayik Lake prescribed burn of 1978 (Dubé, 1978) which was cancelled due to unfavourable conditions.

1) Date:

Spring, 1979, between April 15 - May 31; probably after April 30. Burning opportunities will tend to decrease with greening of the herbage layer and leafing out of aspen.

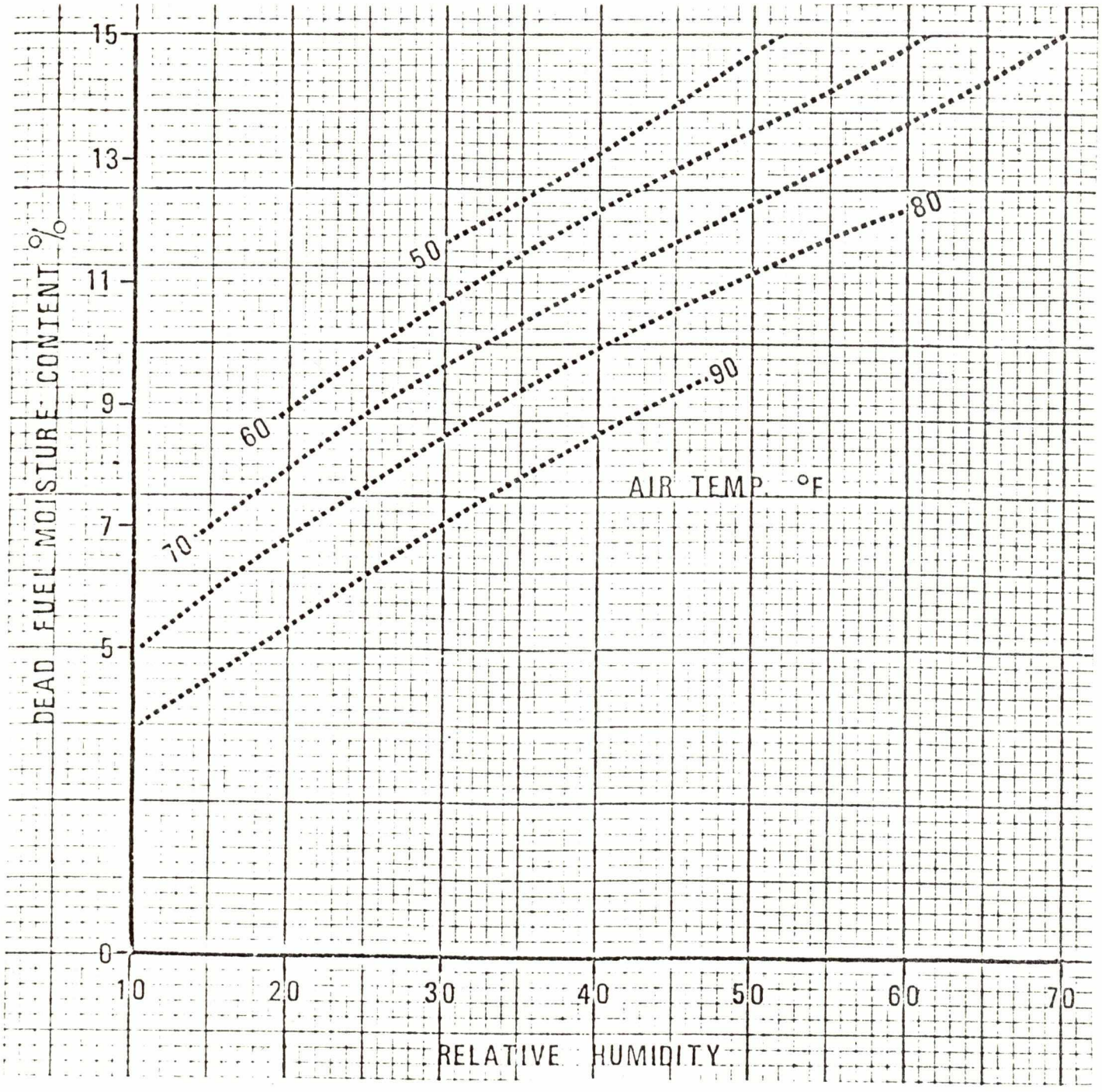


FIGURE 2. The fuel moisture content of cured grass determined from relative humidity and air temperature (adopted from McArthur, 1965).

2) Day:

If possible, no earlier than the fifth day in a continuous series of rainless days. Aspen forest will not be ready to burn as early as the grassland/shrubland community.

3) Time:

Starting between 1200 - 1500, depending on temperature and relative humidity trends. Burning should take place while hazard is essentially stable at its highest level for the day. This level may persist for 2 - 3 hours in the spring.

4) Wind Speed:

15 - 25 k/hr. maximum.

5) Wind Direction:

From the northwest or west initially. Other directions (N, S and E) are acceptable if other weather factors are as prescribed and if the fireline on the leeside of the area to be burned can be held safely.

6) Temperature:

Between 16 - 23° C (60 - 80° F) at ignition.

7) Relative Humidity:

Between 20 - 35%. Wind speeds should not exceed 15 k/h if the relative humidity is under 25%.

8) Fire Weather Index:

Climatic variables equate approximately to the following values for the Fire Weather Index.

F. W. I.	10 - 20
I. S. I.	5 - 12
F. F. M. C.	85 - 95
B. U. I.	> 20

9) Synoptic Weather:

A stable synoptic weather situation should exist in the immediate area. The weather pattern will be confirmed in the morning of the day of the burn.

E. Preburn Preparation

1) Equipment:

Figure 3 illustrates the location of equipment (pumps and sprinklers) surrounding the prescirbed burn area. The sprinkler system should operate 2 - 3 hours before the burn and during the burn if possible. All equipment used was on site and tested before burning. The equipment present included:

a) 4500 feet of hose

b) 30 sprinklers (Photo 2)

c) 2 slappers

d) 2 drip torches (Photo 1)

e) 2 pulaskis

f) 2 shovels

g) 6 - 4 gal. water bags (w/pump) (Photo 3)

h) 3 Wajax fire pumps

i) 1 large pumper unit

Aspen woodland

Wet grass/shrub lands

Open water

Fire hose-sprinkler line

3 m x 3 m plot

Dry grass/shrub lands

Black spruce

Trail

Pumps

Figure 3. Firing pattern and location of equipment on prescribed burn area, Elk Island National Park, May 9 and 10, 1979.

Photo 1.

Ignition using a drip torch.

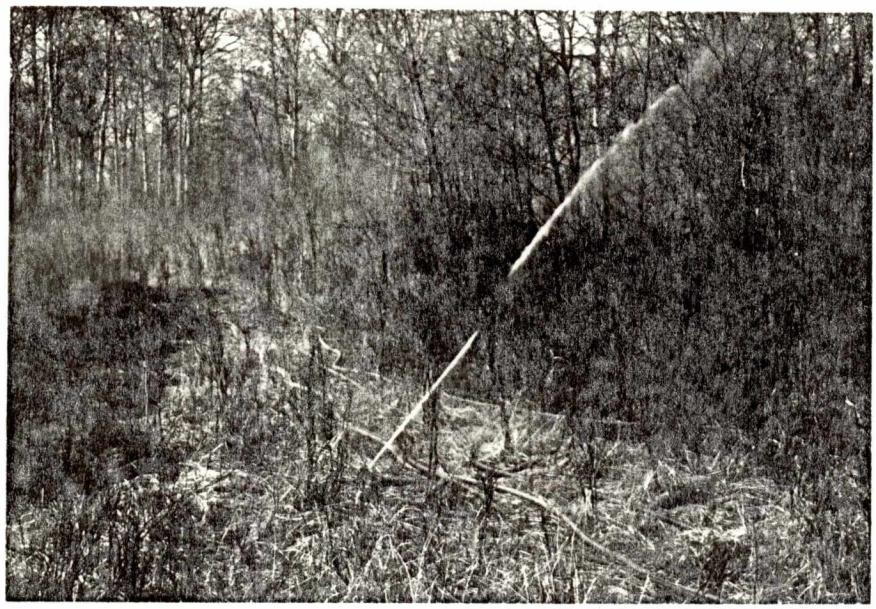


Photo 2.

Operational sprinkler system in Elk Island National Park, spring 1979.

Photo 3.

Four gallon nylon water bags with hand pump.

2) Ignition Techniques and Methods:

Strip head firing will be used to burn the area. One or two drip torches will be used depending on fire behavior, etc. The width of strip fires can be varied at the discretion of the individual in charge but must consider current burning conditions.

3) Briefing and Communication:

A thorough briefing of proposed activities, individual responsibilities, timing and safety considerations is conducted by the individual in charge for all personnel actively involved and other observers. Key personnel must have adequate communication between each other at all times during the burning operation.

III. PRESCRIBED BURN EXECUTION AND EVALUATION

A. Activity Summary

Burning was conducted on May 9th and 10th, 1979, in the grassland/shrubland community and on May 23rd under the aspen forest.

May 9, 1979:

9:00 A. M. - A weather forecast was obtained from the Atmospheric Environment Service. A high temperature of 14° C was forecast for the day with winds of 11 km/h from the SSE. Relative humidity was 49% at 9:00 A. M. A decision was made to proceed with the prescribed burn.

10:45 A. M. - Line A (Figure 3) on the northwest side of the treatment area was backfired. Winds were from the ESE. Ignition was from north to south.

11:20 A. M. - Line B (Figure 3) on the north side of the area was burned out with a headfire lighted 10 - 15' upwind of the sprinkler line. Ignition was from west to east.

1:45 P. M. - A small area around the large pumper unit located at the southeast corner (C) of the treatment area was burned out (Figure 3).

2:20 P. M. - Ignition took place at (D) and extended down to the trail (E) and along it in a northwesterly direction. The fire burned across and upslope in a north-northwest direction to the sprinkler line and burnout area on the north side (B) of the treatment area (Figure 3).

2:45 P. M. - Ignited south of the trail on the west side of the treatment area (F) and allowed the fire to burn to the trail. The previously burned area on the north side of the trail provided an effective firebreak.

Successive blocks, south of the trail, were ignited moving from west to east and under the influence of an east, southeast wind (F, G, H - Figure 3). A backfire was lit along the trail moving from west to east. Then ignition continued on the east and south side of each block, creating a headfire which burned to the trail and the previously burned area adjoining to the west.

May 10, 1979:

8:30 A. M. - A high temperature of 15° C was forecast for today with winds at 6 km/h from the west. Relative humidity was 81%

at 8:30 A. M. A decision was made to continue burning the treatment area.

1:00 P. M. - Wind direction is essentially the same as on May 9th, from the south, southeast contrary to the earlier forecast at 8:30 A. M. Ignition took place at (C) and extended along the lake in a westerly direction and at the bottom of a relatively steep hill with a south exposure (Photos 4, 5, and 6). The top of the hill which was coincident with the trail (Figure 3) was backfired on its south side from east to west. The fire burned upslope to the trail. Burning continued to the northwest on the south side of the trail using a combination of backfires (along the trail) and headfires until yesterday's (May 9th) burned area was reached (I, J).

2:00 P. M. - Successive blocks were ignited on the north side of the trail moving from west to east and using similar burning techniques as described above (K, L). Burning was halted at the eastern edge of the treatment area.

May 23, 1979:

9:00 A. M. - A high temperature of 25° C was forecast with winds of 15 - 25 km/h from the southeast, gusting to 40 km/h. Relative humidity was 54% at 1:00 P. M. A decision was made to burn under the aspen canopy on the eastern edge of the treatment area.

2:15 P. M. - Three blocks were burned. The northern most block was ignited at the northeast corner (M) and ignition continued to the west corner. The west and south sides of this block

Photo 4.

Preburn (May 10, 1979).

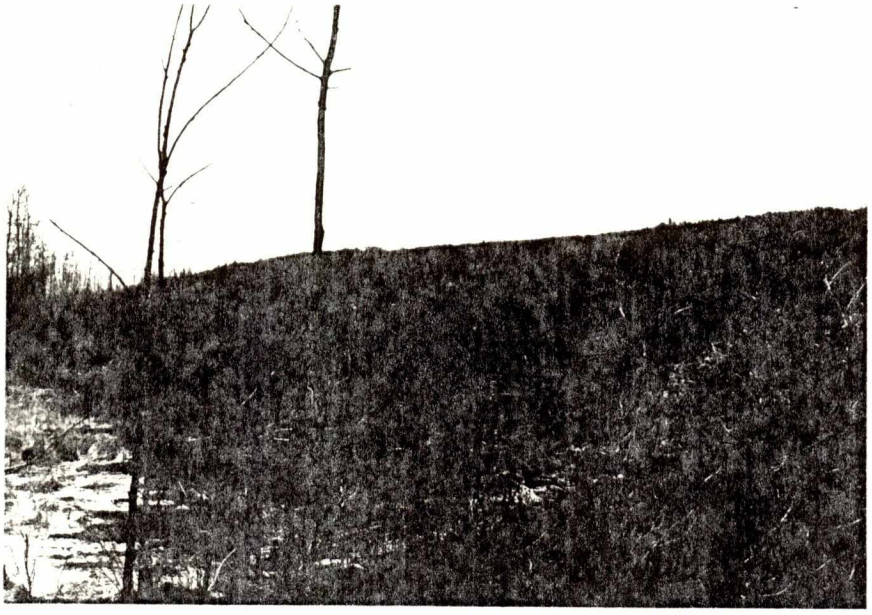


Photo 5.

Immediately following burn (May 10, 1979).

Photo 6.

Postburn (August 3, 1979).

were then ignited under generally southwest winds. The fire burned to the sprinkler line and into the previously ignited backfire (M). Each successive block, moving south, was ignited on its west and south sides and burned into the previously burned area. Burning was terminated at 3:15 P. M. as erratic winds developed.

B. Fire Behavior

1) Fire Weather:

The fire weather index was not calculated on May 9 and 10 due to technical difficulties at the weather station located approximately 5 miles to the south. On May 23 the following codes and indicies were determined at 1:00 P. M.:

FFMC	-	83
DMC	-	19
DC	-	42
ISI	-	4
BUI	-	20
FWI	-	6

Temperature (^{o}C), relative humidity (%), wind speed (K/hr.), direction and gusts (K/hr.) were recorded approximately every 3 minutes during the burning period on May 9 and 10. Tables 6 and 7 provide summaries of this information.

TABLE 6. Temperature (°C), relative humidity (%), and wind factors recorded on-site during prescribed burning at Elk Island National Park, May 9, 1979.

Time (P.M.)	May 9, 1979 Temp. (°C)	R. H. (%)	Wind Speed (K/hr.)	Wind Gusts (K/hr.)	Direction
14:10	16.5	29	6	19	SSE
14:22	16.0	32	5	13	SSE
14:32	19.0	28	-	-	-
14:37	17.0	30	6	26	SSE
14:49	16.0	32	3	13	SSE
14:59	18.5	30	6	16	SSE
15:09	18.5	27	3	19	SSE
15:20	17.0	30	1	5	SSE
15:30	17.0	30	5	13	SSE
15:39	20.0	28	6	19	SSE
15:49	18.0	29	3	14	SSE
16:00	16.0	36	2	3	SSE

TABLE 7. Temperature (°C), relative humidity (%) and wind factors recorded on-site during prescribed burning at Elk Island National Park, May 10, 1979.

Time (P. M.)	May 10, 1979 Temp. (°C)	R. H. (%)	Wind Speed (K/hr.)	Wind Gusts (K/hr.)	Direction
13:02	15.5	39	0	0	-
13:07	14.5	29	0	0	-
13:18	15.5	35	0	0	-
13:28	18.5	30	5	5	SSE
13:38	15.0	30	6	6	SSE
13:48	15.0	30	5	10	SSE
14:00	15.0	38	5	10	SSE

Generally the weather factors were within the stated fire prescription. Wind speed was lower than anticipated but this was acceptable particularly because the wind was from the opposite direction specified in the prescription and thus provided an additional safety margin.

2) Fire Intensity:

Rate of fire spread and flame length (Figure 4) were recorded continuously throughout the burning period. Dead cured grasses (5.24 t/ha) and living herbaceous herbs (0.14 t/ha) were nearly entirely consumed by the fire. Other fuel categories (shrubs and surface dead woody fuels) were partially consumed though no accurate estimate or measurement of consumption was determined. For this reason only those fuels that were clearly consumed as determined ocularly were used to calculate frontal fire intensity and total heat release. Rate of spread ranged from 2 feet per minute to 50 feet per minute and averaged 14.8 feet per minute. Flame length ranged from 1 foot to 10 feet and averaged 5.2 feet (Table 8). Frontal fire intensity varied considerably from 30 Btu/sec/ft. to 750 Btu/sec./ft. and averaged 222 Btu/sec/ft. (Table 8). Frontal fire intensity was calculated using the formula: $I = Hwr$ (Byram, 1959) where,

I = frontal fire intensity (Btu/sec/ft.)

H = heat of combustion (Btu/lb - 8100 used)

w = fuel consumed (lb/ft^2; 5.38 t/ha = .1112 lb/ft.)

r = rate of spread (ft/sec; 14.8/60)

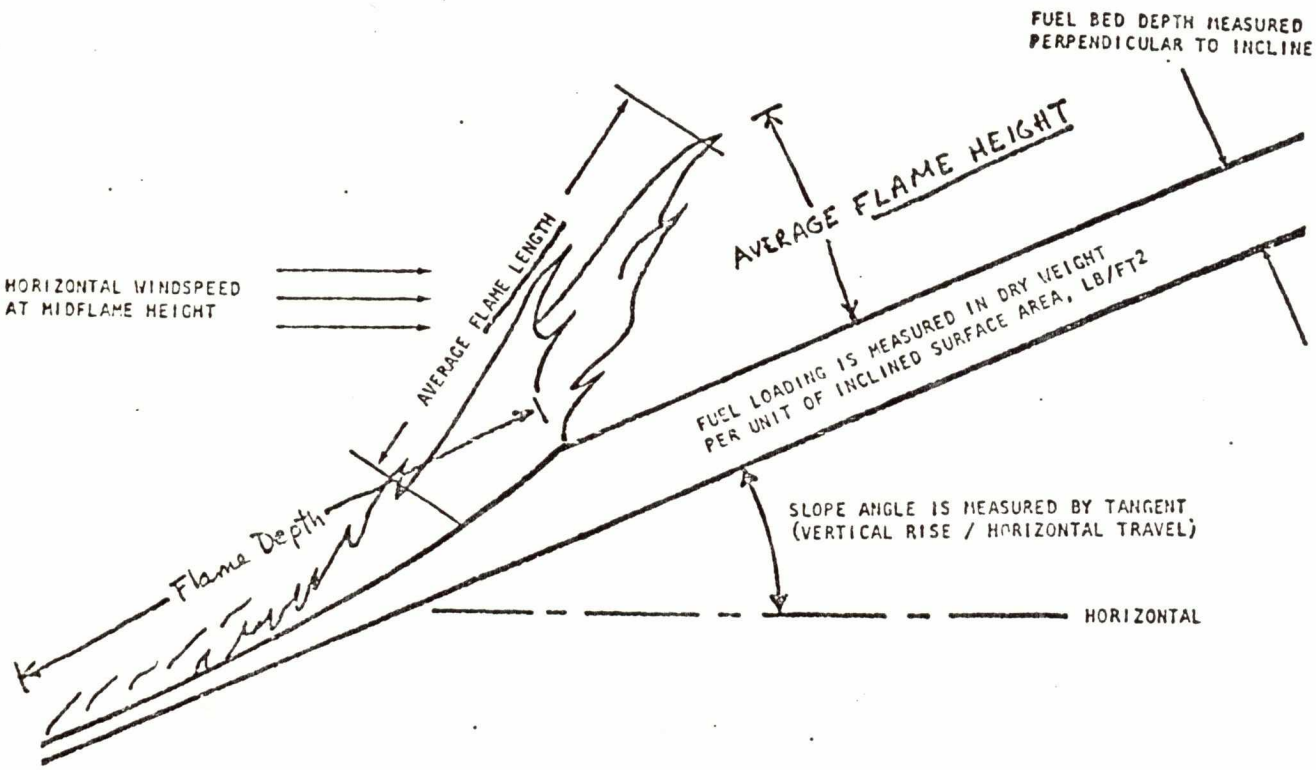


FIGURE 4. Flame front characteristics (from Albini, 1976).

TABLE 8. Fire behavior characteristics[a] from prescribed burning area, Elk Island National Park, May 9, 1979.

	Fire behavior characteristics		
	Rate of spread	Flame length	Frontal fire intensity
Minimum	2 (ft./min.)	1 (ft.)	30 (Btu/sec/ft)
Maximum	50 (ft./min.)	10 (ft.)	750 (Btu/sec/ft)
Mean	14.8 (ft./min.)	5.2 (ft.)	222 (Btu/sec/ft)

a. Expressed in English units for ease of understanding.

Conversion of frontal fire intensity to metric units is as follows:

30 (Btu/sec/ft.) = 104 kw/m

750 (Btu/sec/ft.) = 2595 kw/m

222 (Btu/sec/ft.) = 768 kw/m

Total heat release (Btu/ft^2) was calculated to be 900 Btu/ft^2 or 10221 KJ/m^2.

Albini (1976) has provided an estimate of frontal fire intensity, if the flame length is known (Figure 5). Flame lengths and frontal fire intensities, measured from Elk Island National Park, when plotted on the graph, agree reasonably well with it. However, this graph should be used only as a guideline when planning future burns. Photos 7 and 8 illustrate visually minimum and maximum frontal fire intensity.

C. Postburn Evaluation

1) Fire Effects:

Visually the spring, 1979 burn does not appear to have had any

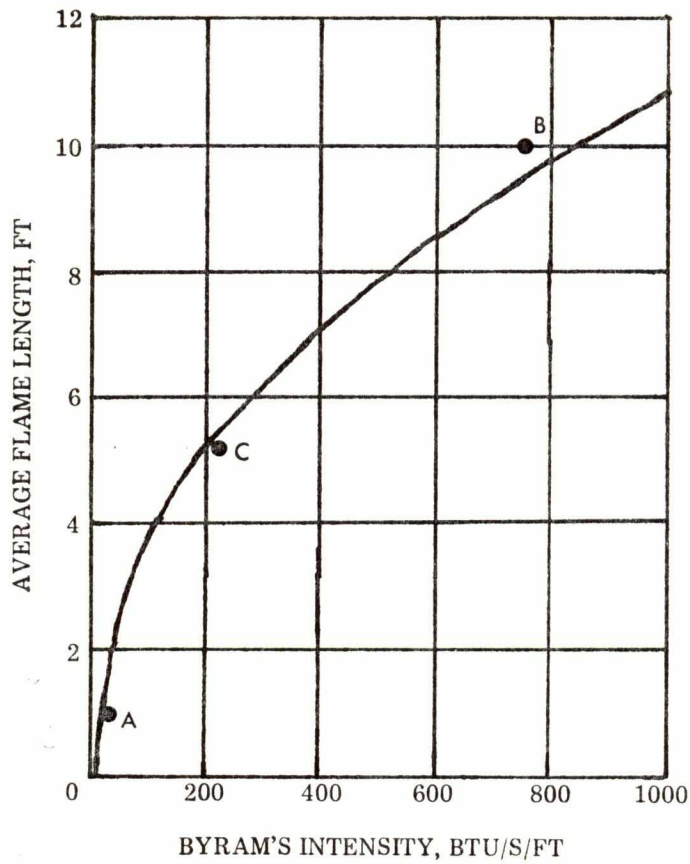


Figure 5. Flame length versus Byram's intensity (from Albini 1976).

A. Minimum frontal fire intensity, 30 Btu/s/ft
B. Maximum frontal fire intensity, 750 Btu/s/ft
C. Mean frontal fire intensity, 222 Btu/s/ft

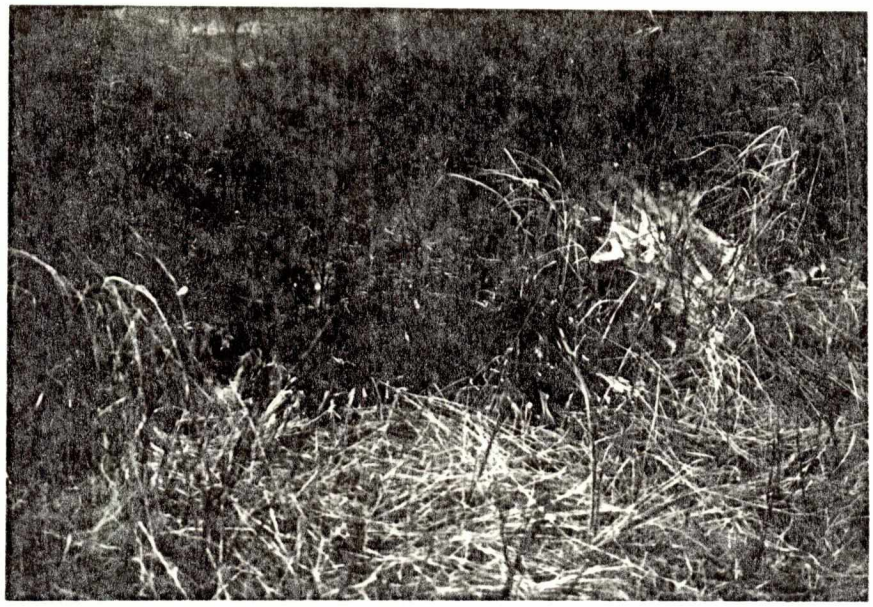


Photo 7. Minimal frontal fire intensity of approximately 30 Btu/sec/ft (104 kw/m). (ROS 2 ft/min; Flame length 1 ft).

Photo 8. Maximum frontal fire intensity of approximately 750 Btu/sec/ft (2595 kw/m). (ROS 50 ft/min; Flame length 8-10 ft).

unexpected affects on the grassland/shrubland community. Table 9 is a list of plant species collected in the burned area in the summer of 1979 (August). A series of small plots (9 - 0.2 x 0.5 m) sampled in August, 1979 indicated that aboveground phytomass in the grassland/shrubland community was 7.5 t/ha, made up of 3.1 t/ha of dead shrubs, 1.2 t/ha of living shrubs, 1.2 t/ha of living herbs and 2.0 t/ha of living grasses. Preburn and postburn comparisons have not been made because sampling took place at different seasons of the year (i.e. spring and summer of 1979). Preburn and postburn photos provide some perception of site response to the fire (Photos 9, 10, 11 and 12, 13, 14). Shrub mortality may have reached 90% of the preburn total number of stems; however, sprouting is occurring and a permanent 3m x 3m plot established prior to burning will be sampled in the spring of 1980 for comparative purposes.

Photo 15 illustrates the effect of heavily grazed or trampled areas on the burn pattern. These areas did not burn completely, but they represent a small portion of the total area which was completely burned in the grassland/shrubland community. In early May (9th and 10th), the fire would not carry under the aspen canopy (Photo 16) due principally to higher fuel moisture contents.

A comparison of preburn and postburn use of the prescribed burn area by park ungulates will be completed in the fall of 1980 and should be appended to this report.

TABLE 9. Postburn presence list of plant species collected in August, 1979 on the prescribed burn area, Elk Island National Park.

Scientific Name	Common Name
Achillea millefolium L.	Common Yarrow
Actaea rubra (Ait.) Willd.	Baneberry (white and red)
Agastache foeniculum (Pursh) Ktze.	Giant Hyssop
Agrimonia striata Michx	Agrimony
Agropyron subsecundum (Link) Hitchc.	Bearded Wheat Grass
Agrostis scabra Willd.	Tickle Grass
Allium cernuum Roth.	Nodding Onion
Amelanchier alnifolia Nutt.	Saskatoon Berry
Antennaria neglecta Greene	Pussy-toes
Antennaria nitida Greene	Pussy-toes
Aster conspicuus Lindl.	Showy Aster
Bromus ciliatus L.	Fringed Brome
Bromus marginatus Neese	
Calamagrostis canadensis (Michx.) Beauv.	Bluejoint
Cornus canadensis L.	Bunchberry
Cornus stolonifera Michx.	Dogwood
Corylus cornuta Marsh.	Beaked hazelnut
Crataegus chrysocarpa Ashe	Hawthorn
Epilolium angustifolium L.	Fireweed
Erigeron acris L. var. elatus (Hook.) Cronq.	Fleabane
Fragaria virginiana Duchesne var. glauca S. Wats.	Wild Strawberry
Galium boreale L.	Northern Bedstraw
Gentiana affinis Griseb.	Prairie Sentian
Geum triflorum Pursh.	Three Flowered Avens
Koeleria cristata (L.) Pers.	June Grass
Lathyrus ochroleucus Hook.	
Lonicera dioica L. var. glaucescens (Rydb.) Butters	Twining Honeysuckle
Lysimachia ciliata L.	Fringed Loosestrife
Petasites palmatus (Ait) A. Gray	Palmate-leaved Coltsfoot

TABLE 9. (Continued)

Scientific Name	Common Name
Phleum pratense L.	Timothy
Poa compressa L.	Canada Bluegrass
Poa palustris L.	Fowl Bluegrass
Polypodiaceae	
Populus tremuloides Michx.	Trembling Aspen
Prunus pensylvanica L. f.	Pin Cherry
Prunus virginiana L.	Choke Cherry
Pyrola sp.	Wintergreen
Ribes hirtellum Michx.	Wild Gooseberry
Rosa acicularis Lindl.	Prickly Rose
Rubus pubescens Raf.	Dewberry
Rubus strigosus Michx.	Wild Red Raspberry
Salix sp.	Willow species
Sanicula marilandica L.	Snakeroot
Shepherdia canadensis (L.) Nutt.	Canadian Buffalo Berry
Solidago gigantea Ait	Goldenrod
Sonchus sp.	Sowthistle species
Stachys palustris L. var. pilosa (Nutt.) Fern.	Hedge nettle
Stellaria longifolia Muhl.	Long-leaved Chickweed
Symphoricarpos albus (L.) Blake	Snowberry
Symphoricarpos occidentalis Hook.	Buckbrush
Taraxacum officinale Weber	Common Dandelion
Thalictrum venulosum Trel.	Veiny Meadow Rue
Trifolium repens L.	White Clover
Viburnum edule (Michx.) Raf.	Low Bush Cranberry
Vicia americana Muhl.	Wild Vetch
Viola adunca J. E. Smith	Early Blue Violet

Photo 9.

Preburn closeup view of grassland/shrubland community (May 1979).

Photo 10.

Preburn intermediate view of grassland/shrubland community (May 1979).

Photo 11.

Preburn distant view of grassland/shrubland community (May 1979).

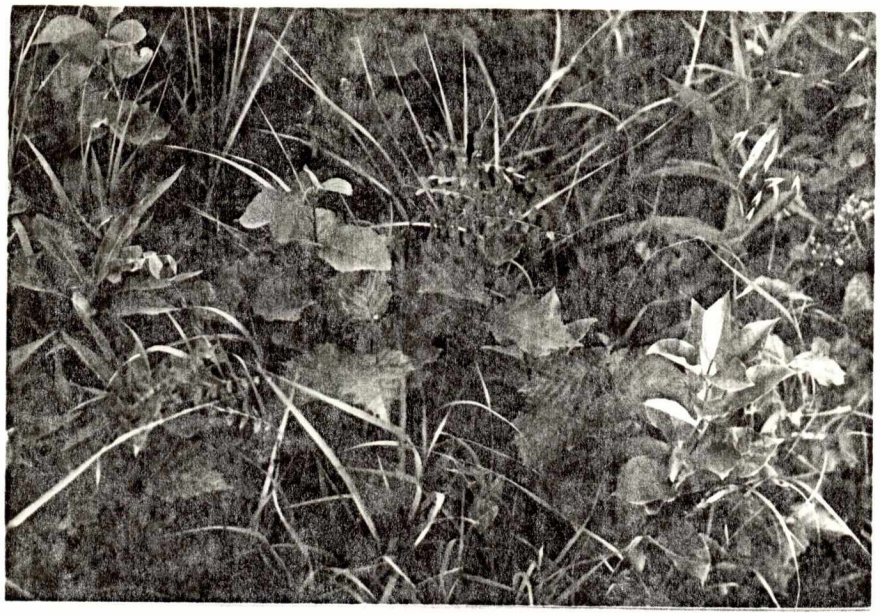


Photo 12.

Postburn closeup view of grassland/shrubland community (August 1979).

Photo 13.

Postburn intermediate view of grassland/shrubland community (August 1979).

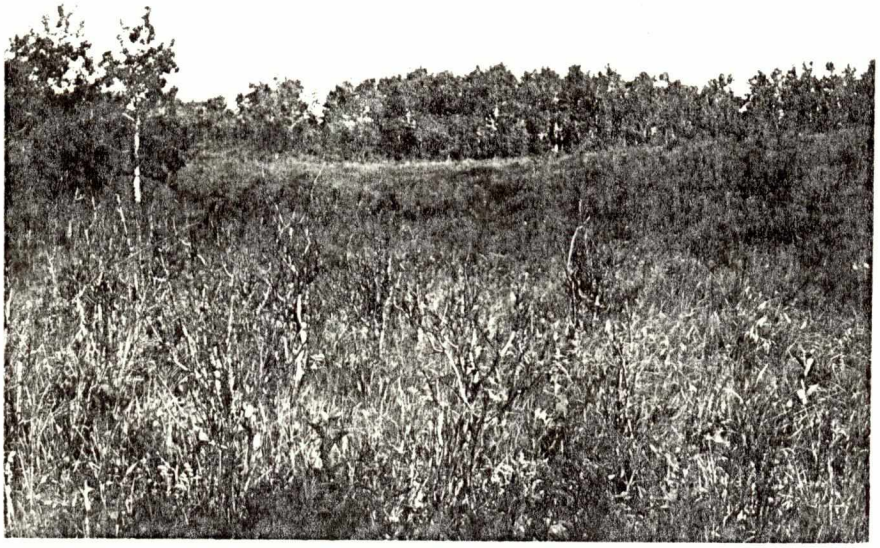


Photo 14.

Postburn distant view of grassland/shrubland community (August 1979).

Photo 15. Illustrates burn pattern in areas that were heavily grazed or trampled.

Photo 16. Fire would not propagate under aspen canopy in early May (9th and 10th).

2) Fire Operations:

Cost of manpower for the prescribed burn was approximately $1,660.00 for three days (Table 10).

TABLE 10. Cost breakdown of prescribed burning in Elk Island National Park, 1979.

Activity	No. of men	No. of hours	Cost per hour	Total
Set-up	2	30	9.29	278.70
Burning	3	22.5	9.29	209.00
Burning & Mop-up	8	168	7.00	1,176.00
TOTAL				1,663.70

This does not include the cost of research staff from the Canadian Forestry Service numbering eight individuals on May 9, five on May 10 and one on May 23. Nor does it include sampling crews (2 - 3 individuals) on days prior to burning and after burning. Total cost (vehicle and per diem rates) for crews (CFS; Prov. wildlife, etc.) not located at Elk Island would further inflate the costs. Using 1,663.70 as a cost figure suggests that this particular burn cost approximately $17.00 per acre assuming 100 acres were burned. With all other costs considered, the cost would likely be $35.00 to $45.00 per acre.

Although these costs may be unacceptably high, it is very likely that future burns will cost much less as crews become more experienced and larger areas are burned. Other factors

associated with the beneficial effects of burning will also deflate per acre costs.

IV. RECOMMENDATIONS

Prescribed burning was conducted safely within the set prescription. Subsequent burning operations should increase efficiency and reduce costs as experienced is gained. For each proposed burn, a burning plan should be developed (i.e. see Martin and Dell, 1978; Fischer, 1978). The burning plan will help the Park manager to define his problem and force him to think about average situations and the worst possible situation that may occur. A map of the selected site should be prepared showing roads and other access points, burn limits and excluded areas, firelines, fuel differences, potential danger points, ignition pattern, water sources, location of crews and equipment, escape routes, topographic factors and other pertinent information.

Weather forecasts should be obtained on a regular schedule prior to burning, and during the burning itself a fire weather forecaster should be on-site to interpret hour-by-hour weather patterns. Fuel type, quantity, size-classes, distribution, arrangement and moisture content should be adequately qualified or quantified.

A personnel organization chart should be prepared and distributed so that each individual is fully aware of line responsibility. Prior to burning, all individuals at the site (active participants and observers) should be thoroughly briefed as to burning objectives, procedures to be followed, personal responsibilities, expected fire behavior and direction,

escape routes and action to be taken in the event of unexpected changes in weather and fire behavior. After burning, a debriefing session should be conducted to discuss the burning operation, problems encountered and ways to improve, etc.

A reliable communication network between holding crews, patrol crews, firing crews, fire weather specialists and the fire boss is essential for reasons of safety and control. It is important to maintain close coordination between firing and holding crews so that the firing crew doesn't start more fire than the holding crew can handle.

The fire boss should have no responsibilities other than to direct the overall burning operation (i.e. he should not be on the firing crew, operating pumps, etc.).

Contingency plans should be thoroughly thought out in advance of burning and "red flag situations" (i.e. high fuel loading, firing crews out of communication or not following direction, weather change, minor escapes more numerous than expected, fire behavior not as expected) identified as well as "stop situations" (i.e. erratic behavior of test or main fire, fuel consumption too high or low, excessive spotting, drastic wind change, smoke dispersal, etc.).

Local residents and the general public should be advised of the burning program in terms of when and where the burning will take place and what is being accomplished.

Permanent photo points should be established in areas selected for prescribed burning. Sampling methods that document preburn and

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