

# FIRE ON GRASSLANDS - FRIEND OR FOE?

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Fire is commonly perceived as a destructive force associated with the loss of forests or other material objects. We are schooled in the prevention or suppression of fire, and rightly so. However, not all impacts of fire are negative! Both grasslands and forests evolved with fire as one of the natural agents, resulting in diversity of form and species. This paper discusses grasslands and fire, first historically, then from a wildlife management context, concluding with an example of fire as a potential management tool with some results from a study at Last Mountain Lake.

## Fire in grasslands

Climate and fire are the primary agents affecting the origin and development of native grasslands in North America.<sup>9</sup> Lightning is the only agent of fire, excluding man, which could have had a major role in modifying North American grasslands prior to European settlement. A lengthy and heated debate, on the importance of lightning as a factor in maintaining grasslands, raged amongst ecologists for the first half of this century. Several sources of evidence terminated the debate, including observations from the journals of early explorers and direct evidence found by several ecologists.<sup>8 9 10 11 12 15 18 19</sup>

The historical record for lightning set prairie fires comes from journals like that of Peter Fidler, a Hudson Bay Company trader and explorer, written while he visited southern Alberta in 1792:

"These large plains either in one place or another is constantly on fire and when the grass happens to be long and the wind high, the sight is grand and awful, and it drives along with amazing swiftness. The lightning in the

spring and fall frequently lights the grass. . ."<sup>12</sup>

Recent observations by Rowe and Higgins document the actual frequency and intensity of lightning fires in prairie Saskatchewan and North Dakota, respectively.<sup>15 9</sup> Saskatchewan wild fires set by lightning occurred primarily during September in the range country south and west of Swift Current. Ranchers interviewed from the Fir Mountain and Battle Creek areas indicated that lightning fires were very common. One lightning bolt is reported to have pronged out and started three fires about 7 miles apart.<sup>15</sup> Of the lightning-set fires in North Dakota 73% occurred during July and August with lesser numbers observed in April, May, June and September. The frequency of these fires varied across the state from 6.0 per 10,000 km<sup>2</sup> in the east to 24.7/10,000 km<sup>2</sup> in western North Dakota.<sup>9</sup>

The native peoples started fires accidentally, or they deliberately set them for ceremonial, superstitious or other reasons, such as an offering for fair weather or the return of a war party. Fire was used for war, signalling, hunting and controlling the movement of wildlife.<sup>12</sup> In the 1800s many large prairie fires resulted from the carelessness of cattle outfits.<sup>18</sup>

Collectively, fires, climate and grazing of herbivores like the buffalo, maintained a diverse grassland devoid of the large stands of shrub and matted dead grass which now dominate many of our grasslands. Today even lightning fires are contained by cultural obstacles and practices, such as roads, cultivated fields, heavily grazed pastures, and suppression techniques that European settlers brought to the prairies.



*Prairie with thickly matted dead grass*

*P.S. Taylor*

## Fire as a wildlife management tool

Wildlife managers have begun to use fire as a management technique, which they refer to as "prescribed burning". Prescribed burning can be defined as the skillful application of fire to natural areas under specified conditions of weather and fuel moisture. Properly done, a prescribed burn will allow confinement of the fire to the desired area and at the same time produce sufficient heat and rate of spread to accomplish management objectives. Some of the objectives of prescribed burning are as follows:

- to improve distribution of birds and mammals through habitat diversification;
- to remove accumulated dead plant material or fuel;
- to control the encroachment of undesirable plants and encourage desirable plants such as legumes for forage, soil improvement, etc.;
- to control or destroy insects or disease;
- to improve plant vigor;
- to release nutrients and improve moisture penetration and to remove unpalatable growth remaining from previous seasons.<sup>3 8 19</sup>

## Prescribed burning at Last Mountain Lake

Four 45-acre study plots were established at the north end of Last Mountain Lake in the fall of 1982 and data collection began in the spring of 1983. On these plots the composition of the grassland plants prior to and following the prescribed burns was monitored, as were the populations of eight passerine birds and four small mammal species.

Approximately one-half of each of the study plots was burned by a single burn in the fall under a fixed set of conditions, i.e. winds with a speed close to 16 kph, temperature of 10° C, and relative humidity of 30-50% with a slightly moist litter layer (the layer of dead and detached vegetation and vegetation parts lying on the mineral surface).

On the study plots over the past four years, 106 species of vascular plants were found (approximately one-third of the species listed for Last Mountain Lake).<sup>5</sup> There were 9 species of trees and shrubs, 4 sedges, 23 grasses and 70 forbs.

The north end of Last Mountain Lake lies at the interface of the Mixed Prairie to the southwest and the Fescue Prairie to the northeast.<sup>4 6 7 14</sup> The Last Mountain Lake grassland is dominated by Rough Fescue (*Festuca scabrella*) and Spear Grass (*Stipa comata*) with associated species including Northern Wheatgrass (*Agropyron dasystachyum*), Slender Wheatgrass (*A. trachycaulum*), Sand Grass (*Calamovilfa longifolia*), Blue Grama (*Bouteloua gracilis*), June Grass (*Koeleria cristata*) and Kentucky Blue Grass (*Poa pratensis*). The most common forbs of the area are Pale Comandra (*Comandra pallida*), Field Chickweed (*Cerastium arvense*), Prairie Crocus (*Anemone patens*), Silverleaf Psoralea (*Psoralea argophylla*), Goldenbean (*Thermopsis rhombifolia*), Northern Bedstraw (*Galium boreale*), Early Blue Violet (*Viola adunca*), sage (*Artemisia frigida* and *A. ludoviciana*) and goldenrod (*Solidago canadensis* and *S. missouriensis*), with Western Snowberry (*Symphoricarpos occidentalis*) as the most common shrub.

The two most common birds inhabiting the study plots are Clay-colored and Savannah sparrows. Associated with them in somewhat diminishing order of abundance are Baird's Sparrow, Eastern Kingbird, Brown-headed Cowbird, Red-winged Blackbird, Western Meadowlark, Sprague's Pipit, Horned Lark, Yellow Warbler, Wilson's Phalarope, Upland Sandpiper, and duck species including Mallard, Northern Pintail, Blue-winged Teal, Lesser Scaup and White-winged Scoter. Several raptors nest on the study plots or adjacent to them, including Northern Harrier, Short-eared Owl and Swainson's Hawk.



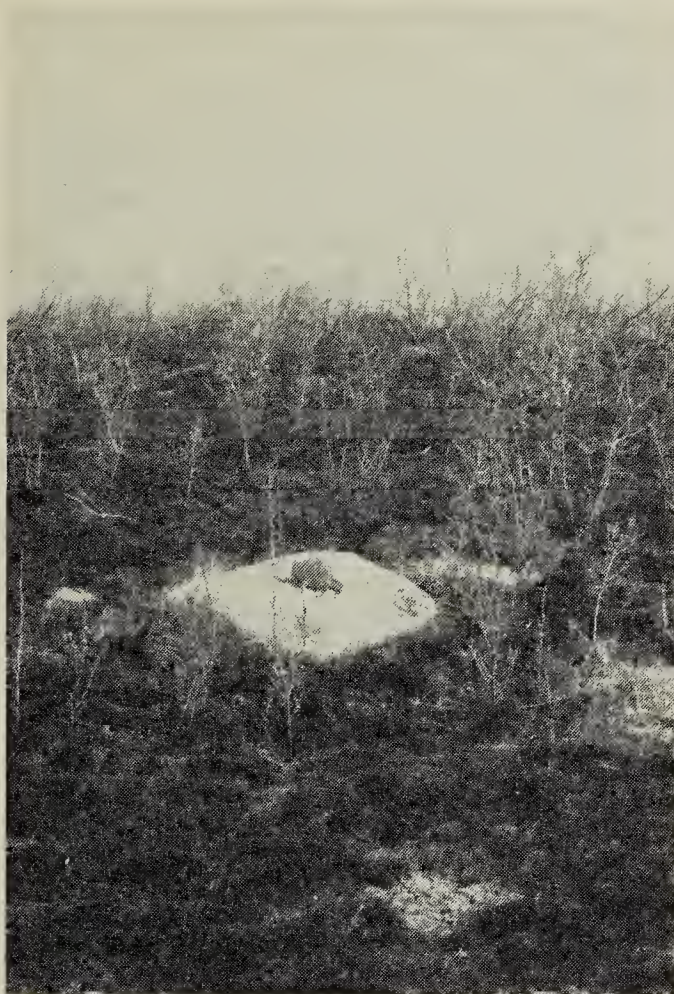
*Fire guards for prescribed burning*

*P.S. Taylor*



*Prescribed burning plots under favorable conditions*

*P.S. Taylor*



Plot following burn

P.S. Taylor



Crocus Anemone on burned plot

P.S. Taylor

The small mammal community is moderately diverse. The Deer Mouse and the Meadow Vole are the most common species. Other small mammals observed on the study plots include the Red-backed Vole, Western Jumping Mouse, Thirteen-lined Ground Squirrel, Richardson's Ground Squirrel and Least Weasel.

Other mammals such as White-tailed Deer, Coyote, Red Fox and Muskrat have been observed on or near the study plots.

### Some Observations from the Prescribed Burn Study

The composition of the plant community on the burned sites was not dramatically altered by fire. Very few species observed in 1983, prior to the prescribed burns, were absent in 1986. Neither Rough Fescue nor Spear Grass, the two codominant grass species, declined with the fire treatment. Other species such as Sand Grass, Slender Wheatgrass and Western

Wheatgrass (*Agropyron smithii*) increased in frequency after the fall burns. Kentucky Blue Grass (*Poa pratensis*) and Graceful Sedge (*Carex praegracilis*) showed minor declines immediately following fire but began to increase several years after the burns. These positive responses resulted from the removal of a heavy layer of dead vegetation which restricted penetration of both light and moisture required by plants for growth. In places, a modestly thick litter layer functions in a similar manner but, with its partial removal by fire, moisture or nutrients once trapped are now available to plants for growth.

The forbs generally flourished the first year following a fire, then either continued to increase or gradually declined to their pre-fire levels. Large increases were recorded for Prairie Crocus, American Vetch (*Vicia americana*), Pygmy-flower (*Androsace septentrionalis*) and Silverleaf Psoralea. Modest gains occurred for Field

Table 1. SMALL MAMMAL POPULATIONS ON THE STUDY PLOTS AT LAST MOUNTAIN LAKE

Year		Plots				Total
		A	B	D	E	
1983	Control Sites	27*(3)**	17 (3)	20 (2)	10 (1)	18.3 (4)
1984		10 (2)	0	2 (1)	0	2.9 (3)
1985		3 (2)	3 (1)	10 (1)	0	4.2 (2)
1986		5 (1)	0	0	0	1.3 (1)
1983	Burn Sites	12 (2)	8 (3)	17 (3)	14 (1)	12.7 (4)
1984		5 (2)	0	0	5 (2)	2.3 (2)
1985		8 (2)	12 (1)	20 (1)	3 (1)	10.8 (2)
1986		6 (1)	3 (2)	2 (1)	2 (1)	3.1 (2)

\* Captures per 100 trap nights

\*\* Number of species captured

■ Number of captures on sites which had been burned

Chickweed, Golden-bean, Many-flowered Aster (*Aster pansus*), and Moss Phlox (*Phlox hoodii*). Smooth Perennial Sow-thistle (*Sonchus arvensis*) and Large-flowered False Dandelion (*Agoseris glauca*) declined after fire. Like grass, the forbs benefited from the removal of massive amounts of dead vegetation and litter. The burning of the dead vegetation increased light, moisture penetration, and seed bed temperature allowing seeds to germinate which were otherwise trapped in the litter layer, and released nutrients.<sup>1 2 18 19</sup>

Small mammal populations have varied considerably from the beginning of the study on both the control and burned portions of the study plots (Table 1). On unburned areas mice were live-trapped at the rate of 16 per 100 trap-nights in 1983 (total number of mice caught divided by total number of trap-nights, multiplied by 100). This declined to 2.6 in 1984, increased to 7.6 in 1985 then decreased to 2.2 in 1986. On the burned areas mice were captured at a rate of 0 to 20 per 100 trap-nights while on these sites prior to burnings the rates varied from 0 to 14 mice per 100 trap-nights.

Meadow Voles and Deer Mice dominated the captures in 1983. In 1984 there were slightly more Western Jumping Mice than Meadow Voles caught. In 1985 and 1986 more than 90 percent of all small mammals caught in the live traps were Deer Mice. Western Jumping Mice replaced Meadow Voles in 1986 as the only other species captured. The majority of captures (65%) were on the burned portions of the plots.

The Deer Mouse is recognized as a pioneering species. Ream indicated that Deer Mice occur in most vegetation types through a broad range of plant succession, but in most sites Deer Mouse populations are never very dense.<sup>13</sup> This species is usually found on disturbance sites such as burned over areas. Deer Mice may flourish on these sites because they eat the seeds exposed after litter is burned away, and feed upon the flush of insects and seeds produced following fire. They appear to need very little litter as cover during midsummer, although during the breeding season the species may confine its activities to areas where sufficient nesting materials, litter and mats of dead grass, are present. Fire may have en-

hanced survival for this species, but apparently for no other small mammal.

Factors resulting in the high variability of small mammal numbers may have included the weather, the loss of habitat, and some inherent biological control. In 3 of the last 5 years precipitation has been lower than normal. Low moisture conditions can cause a poor seed crop which may adversely affect small mammal densities. For species other than the Deer Mice, the burned portions of the study plots may not provide sufficient cover while they search for food or attempt to breed. Only one Meadow Vole and one Western Jumping Mouse were captured on burned areas in three years of study.

Another indicator of changes in mouse populations was the number of raptors nesting on or next to the study plots. At the beginning of the study four Northern Harrier nests and one Short-eared Owl nest were found on the plots; subsequently no nesting occurred until this past summer. A harrier nest with three young and an egg was found in late June on one of the plots; its fate is not known although no fledged young were seen in late July. Both Short-eared Owl and Northern Harrier depend on mice as a major food source.

Bird population information from two of the four study plots (Table 2) illustrates the change in bird diversity and density which resulted from burning one-half of each of the study plots. The history of these two plots before the prescribed burns was quite different. Plot B was native grassland which had been lightly grazed. Plot E was partially broken as well as grazed prior to 1945. Thus the plant community of Plot E is a combination of native and non-native species, the prominent non-native being Quack Grass (*Agropyron repens*) with some Smooth Brome Grass (*Bromus inermis*) and native Kentucky Blue Grass and Fowl Blue Grass (*P. palustris*). The first spring following a

prescribed burn young green vegetation was available early in the spring; bird use was restricted to grazing by Canada Geese and various ducks and to nest initiation by Horned Lark and Killdeer. Other species, for example Savannah and Clay-colored Sparrows, occupied these sites briefly (homing to a previously used territory or nest site is common within the passerine group<sup>16 17</sup>) but the majority did not establish territories or commence to nest (Table 2). Two years after the fire, bird numbers and diversity began to increase on the burned sites. The density of the vegetation had increased. Baird's Sparrow which previously had not nested on the site established a territory in the second year and four territories in the third year after burning.

Three summers after the prescribed burns, the bird populations on two of the burned sites were approximately one-half the density and twice the diversity of the pre-fire counts. The live and standing dead vegetation had increased but not yet reached the pre-burn state where mats of dead vegetation and a fairly broad canopy of shrub cover effectively excluded all but two bird species.

### Concluding thoughts

Fire is, at the outset, destructive, eliminating places for birds and small mammals to live, but as the sites recover from burning the benefits to wildlife are many. Grassland vegetation responds to fire through renewed, vigorous growth, providing sufficient structural diversity, coupled with other changes such as higher ratios of bare ground to litter cover, to result in a more complex habitat for both native and non-native grassland areas. These changes in the plant community are then followed by changes in bird populations and, presumably, small mammals also increase in diversity. Even on marginal quality grasslands, viewed by many as waste areas, fire can provide enhancement of habitat which leads to increased bird diversity.

Table 2. PASSERINE TERRITORIES ON TWO STUDY PLOTS AT LAST MOUNTAIN LAKE\*

Species	Plot B				Plot E			
	1983	1984	1985	1986	1983	1984	1985	1986
	<i>Before</i>	<i>After</i>			<i>Before</i>	<i>After</i>		
	1 Year	2 Years	3 Years		1 Year	2 Years	3 Years	
Eastern Kingbird	1	-	-	-	1	-	1	1
Savannah Sparrow	5	1	3	1	16	3	9	9
Baird's Sparrow	-	-	-	2	-	-	1	2
Clay-colored Sparrow	26	2	3	12	18	1	3	3
Western Meadowlark	-	-	2	1	-	-	1	1
Horned Lark	-	1	1	1	-	1	-	1
Bobolink	-	-	-	-	-	-	-	1
Total	32	4	9	17	35	5	15	18

\* Data from the burned portions of the study plots B and E, where the burning took place between the nesting seasons of 1983 and 1984.



*Young Northern Harriers*

*Gary W. Seib*



The frequency of prescribed burns on native and non-native grasslands could be once in 6 or 7 years. A more frequent schedule, especially on light soils, would seriously affect the amount of organic material incorporated into the upper soil.

In conclusion, fire can be viewed as a friend, when used as a tool for rejuvenation and diversification of ecosystems.

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