

THE EFFECT OF FIRE ON BIRD AND SMALL MAMMAL COMMUNITIES
IN THE GRASSLANDS OF WIND CAVE NATIONAL PARK

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Objectives

Specifically, the objectives of this research project were to: 1) Census burned and unburned grassland areas for breeding populations of birds and small mammals. Population censuses have been made on areas prescribed burned between 1973 and 1978 as well as the areas burned in the spring of 1981; 2) Analyze study transect vegetation to determine the impact of burning treatments on prairie vegetation and its relationship to bird and small mammal densities; 3) Provide usable management recommendations that will aid not only in vegetation maintenance but also with the animal populations associated with the grasslands.

Methods

The detailed discussion of the research methodology included in the proposal will not be repeated here. Only the central themes of the methodology as they relate to the objectives stated above will be summarized.

The first objective has been completed using a number of sampling techniques. Estimates of breeding bird densities were calculated using the line transect method developed by Emlen (1971, 1977), foregoing the determination of a cue frequency. A sharp-tailed grouse (*Pediacetes phasianellus*) lek was located within a 1981-burned area and 10-day censuses of the lek in May and June made determination of the effects of burning on booming ground location possible. Two techniques were used to evaluate the effects of fire on small mammal populations: the snaptrap removal method and the capture-recapture method. Insect surveys were conducted on burned and unburned areas to determine if food, primarily insects, was more the cause of vertebrate population changes rather than vegetational differences.

The second objective was addressed by a vegetative analysis and then a multiple regression analysis to relate these vegetation properties to the bird communities. The canopy-coverage method as described by Daubenmire (1959) and the quadrat method of clipping described by Kershaw (1973), Mueller-Dombois and Ellenberg (1974), and Goldsmith and Harrison (1976) were used for the vegetative analysis.

The third objective was completed by developing a conceptual model of the

grassland-fire interactions observed in this study and determining if the Park's management goals were being met.

Results

The vegetative analysis showed immediate reductions in perennial species and the amount of dead material present after burning with a resulting increase in both 2 years later. Bare ground-coverage increased immediately after the fire, indicating a loss of protective cover for birds and small mammals. However, the estimates 2 years after the burn were below the 1980-81 levels.

Twenty-two species of birds were observed on the Wind Cave National Park grasslands during the breeding bird census. Thirteen were considered to be breeding on the grasslands by the territorial behavior exhibited by males of that species. Two species, the grasshopper sparrow (Ammodramus savannarum) and the western meadowlark (Sturnella neglecta), accounted for the majority of observations during the census work. The grasshopper sparrow was the only bird significantly affected ($P < 0.05$) by the burning treatments, decreasing in numbers immediately after the fire. The western meadowlark and upland sandpiper (Bartramia longicauda) generally decreased after the burns while the vesper sparrow (Pooecetes gramineus) was positively affected (Table 1). Reasons for the reductions in singing males include loss of nesting cover (removal of dead material and important plant species) and loss of food source (reduction in insects and seeds). Duration of the reduced numbers appears to last no longer than two or three breeding seasons after treatment. The 1983 density estimates indicating the long term benefits of prescribed burning. The sharp-tailed grouse population using a lek in a 1981-burned area showed no adverse effects as a result of spring burning.

Two small mammal trapping techniques were used in the Park. The prairie deer mouse (Peromyscus maniculatus bairdii) and thirteen-lined ground squirrel (Spermophilus tridecemlineatus) were the dominant species present. Prescribed burning resulted in immediate increases in deer mice densities while ground squirrel densities generally decreased (Table 2). The resulting increased amount of exposed seeds from the fire's partial removal of the litter layer may have benefitted the prairie deer mice. The increased deer mice density lasted only one season dropping below pre-burn figures by 1983. The lack of seed-eating insects in the burned areas would indicate that seeds were scarce in the area and may have contributed to the decline of the mice. Prairie voles (Microtus ochrogaster) became the most common species in 1983 which was the peak year of their 3 to 4 year cycle. The loss of dense vegetation for cover from burning caused prairie voles to migrate to the control sites, thus increasing their densities.

Conclusions

The results from this 4-year study show that bird and small mammal populations adjust to the fire-altered habitat and that these adjustments appear temporary and will continue to change as the vegetation recovers from the burn. The

Table 1. Estimates of breeding bird densities for the Wind Cave National Park study transects (singing males per hectare, n = 5).

Transect	Status	1980		1981		1982		1983	
		\bar{x}	SD	\bar{x}	SD	\bar{x}	SD	\bar{x}	SD
Bison Flats Control									
	Grasshopper Sparrow	.71	.45	.78	.36	.58	.41	.33*	.45
	Western Meadowlark	.67	.82	.33	.42	.55	.50	.29*	.50
	Upland Sandpiper	.06	.46	.15	.28	.04	.42	.10	.44
	Vesper Sparrow	.12	.35	.00	.00	.06	.40	.16	.22
	TOTAL	1.70	.28	1.26	.27	1.23	.30	1.55	.30
Bison Flats April 1981 Burn									
	Grasshopper Sparrow	.63	.36	.15*+	.30	.16+	.47	.45+	.30
	Western Meadowlark	.30	.39	.13+	.39	.20	.50	1.00+	.44
	Upland Sandpiper	.24	.30	.15	.14	.06	.00	.06	.54
	Vesper Sparrow	.00	.00	.08	.47	.12	.00	.08	.35
	TOTAL	1.51+	.20	.81*+	.14	.60+	.27	1.87+	.22
Red Valley Control									
	Grasshopper Sparrow	.67	.35	.99	.37	.64	.42	.43	.37
	Western Meadowlark	.73	.45	.48	.39	.60	.46	.42	.40
	Upland Sandpiper	.04	.57	.00	.00	.00	.00	.00	.00
	Vesper Sparrow	.06	.40	.00	.00	.00	.00	.00	.00
	TOTAL	1.50	.28	1.47	.30	1.26	.32	.93	.27
Red Valley April 1981 Burn									
	Grasshopper Sparrow	.68	.36	.10*+	.32	.71*	.47	.36+	.36
	Western Meadowlark	.31	.39	.28	.46	.68*	.45	.46	.36
	Upland Sandpiper	.00	.00	.00	.00	.00	.00	.04	.00
	Vesper Sparrow	.00	.00	.00	.00	.00	.00	.00	.00
	TOTAL	.99+	.28	.38*+	.33	1.41*+	.36	.88+	.25

*Density is significantly different (P<0.05) from the previous year's density.

†Density is significantly different (P<0.05) from the control transect for that year.

Table 2. Estimates of small mammal densities for the Wind Cave National Park study transects (individuals per hectare, n = 5).

Transect	Status	1980		1981		1982		1983	
		\bar{x}	SD	\bar{x}	SD	\bar{x}	SD	\bar{x}	SD
Bison Flats	Control								
	Prairie Deer Mouse	1.23	0.80	0.00	0.00	5.93*	1.02	0.00	0.00
	Thirteen-lined Ground Squirrel	1.70	1.02	4.10*	2.71	0.31*	0.63	1.20	0.80
	Prairie Vole	0.00	0.00	0.00	0.00	0.62*	0.51	27.71*	3.37
	TOTAL	2.93	2.18	4.10	2.71	6.86	0.80	28.91*	2.96
Bison Flats	April 1981 Burn								
	Prairie Deer Mouse	0.62+	0.62	3.26**	0.62	1.54*	0.95	0.00	0.00
	Thirteen-lined Ground Squirrel	0.00	0.00	0.00	0.00	0.00	0.00	0.30**	0.62
	Prairie Vole	0.00	0.00	0.00	0.00	0.00	0.00	3.92**	1.90
	TOTAL	0.62+	0.62	3.26*	0.62	1.54**	0.95	4.22+	1.87
Red Valley	Control								
	Prairie Deer Mouse	0.00	0.00	0.00	0.00	0.62*	0.51	0.00	0.00
	Thirteen-lined Ground Squirrel	1.03	0.51	0.62	0.62	0.62	0.51	0.00	0.00
	Prairie Vole	0.00	0.00	0.00	0.00	0.00	0.00	0.30*	0.62
	TOTAL	1.03	0.51	0.62	0.62	1.24	1.08	0.30*	0.62
Red Valley	April 1981 Burn								
	Prairie Deer Mouse	0.83+	0.95	3.99+	1.29	0.62*	0.51	0.00	0.00
	Thirteen-lined Ground Squirrel	0.62+	1.02	0.00	0.00	0.62*	0.51	0.60+	1.02
	Prairie Vole	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	TOTAL	1.45+	2.33	3.99+	1.29	1.24*	0.62	0.60	1.02

*Density is significantly different ($P < 0.05$) from the previous year's density.†Density is significantly different ($P < 0.05$) from the control transect for that year.

grassland species have been historically subjected to fire and wind Cave National Park is encouraged to continue with its fire program using controlled burns to maintain the grassland-forest habitat typical of the Black Hills.

Literature Cited

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