

SOME EFFECTS OF FIRE ON VEGETATION AND
WILDLIFE IN PONDEROSA PINE FORESTS OF THE
SOUTHERN BLACK HILLS*

Jane H. Bock
Carl E. Bock
E.P.O. Biology Dept., Box 334
University of Colorado, Boulder 80309

This progress report summarized our findings in three years of research at Wind Cave National Park.

Effects of prescription burns upon vegetation, birds, rodents, and bison were studied for three years in ponderosa pine forest and pine-grassland ecotone of Wind Cave National Park, South Dakota. We established study plots and analyzed vegetation in summer 1979, prior to fall 1979 and spring 1980 burning. Vegetation and wildlife populations were studied in 1980 and 1981, through two post-fire growing seasons.

The prescription fires were cool and largely restricted to understory vegetation and fuels. Fire effects upon vegetation cover and density were modest (Table 1). Prescription burns reduced densities of immature pines and slightly increased herbaceous ground cover. Graminoid cover was generally unaffected. Shrub densities and cover were somewhat reduced through 1980, but largely returned to pre-burn levels after two years of post-fire succession. These results contrasted with effects of a 1974 crown fire, in which pine canopy was lost and shrub cover dramatically increased (Table 2).

Birds, rodents, and bison showed strong positive responses to the prescription burns, but only through the first year of post-fire succession (Tables 2, 4, and 5). This suggests that the prescription fires caused short-term changes in the quality of vegetation which were more substantial and important than the comparatively subtle effects upon vegetation cover. These results indicate a need for further research on nutrient and energy content of post-fire vegetation.

This study showed that cool prescription fires can be used in the Black Hills as a management tool for reducing fuels in ponderosa pine forests and temporarily improving them as wildlife habitat. To the degree that patches of more substantial browse plants (e.g., raspberry) represent a natural part of the Black Hills environment and a desirable management objective, we recommend further experimentation with prescription fires of greater intensity than those of the present study.

* This work received support from the Eisenhower Consortium, U.S. Forest Service (Grant No. RM-80-105-GR) in addition to the National Park Service support.

Table 1. Ground cover and pine canopy measured in June on eight prescription burned and six unburned control plots, expressed as percent of total points sampled (burn = 3300, unburned = 3600). Chi-square values were calculated using actual data, not percentages. Experimental plots were burned between 1979 and 1980 sampling periods. Species (or groups) shown are those comprising the largest amount of cover, in decreasing order.

Item	Treatment	Percent Cover			Chi-square
		1979	1980	1981	
A. Common Species					
<u>Pinus ponderosa</u> canopy	Exp.	56.2	48.3	47.3	10.44 ^a
	Cont.	57.4	57.2	56.5	
trunks and immatures	Exp.	3.3	1.2	1.2	22.26 ^a
	Cont.	2.5	2.3	2.4	
<u>Carex</u> spp.	Exp.	8.6	9.3	13.3	8.28 ^a
	Cont.	8.7	9.0	10.1	
<u>Andropogon gerardii</u>	Exp.	6.0	7.8	7.9	0.35
	Cont.	4.4	5.8	5.4	
<u>A. scoparius</u>	Exp.	6.5	4.3	6.1	12.53 ^a
	Cont.	6.0	6.6	6.8	
<u>Poa sandbergii</u>	Exp.	4.5	4.9	5.5	14.94 ^a
	Cont.	2.2	3.3	5.3	
<u>Bouteloua curtipendula</u>	Exp.	1.6	2.0	3.9	0.63
	Cont.	1.2	1.8	3.4	
<u>B. gracilis</u> , <u>B. hirsutum</u>	Exp.	2.7	2.1	2.1	2.10
	Cont.	2.2	2.1	2.4	
<u>Stipa</u> spp.	Exp.	0.6	1.4	3.5	26.52 ^a
	Cont.	1.3	0.8	1.6	
<u>Agropyron</u> spp.	Exp.	1.5	1.3	1.8	0.62
	Cont.	1.1	1.0	1.1	
<u>Amorpha canescens</u>	Exp.	0.6	1.0	2.1	1.95
	Cont.	0.1	0.4	0.6	

Table 1. (cont.)

Item	Treatment	Percent Cover			Chi-square
		1979	1980	1981	
<u>Pulsatilla patens</u>	Exp.	0.2	0.4	0.8	3.02
	Cont.	0.6	0.8	1.1	
<u>Artemesia ludoviciana</u>	Exp.	0.5	0.5	0.8	5.83
	Cont.	0.9	0.6	0.5	
<u>Dodecatheon pulchellum</u>	Exp.	0.4	1.3	1.4	8.71 ^a
	Cont.	0.2	0.1	0.3	
<u>Symphoricarpos occidentalis</u>	Exp.	0.8	0.3	0.4	2.54
	Cont.	0.6	0.5	0.3	
B. General Categories					
Graminoids	Exp.	33.4	33.9	44.6	3.08
	Cont.	30.2	31.6	37.7	
Herbs	Exp.	5.6	5.7	9.1	9.66 ^a
	Cont.	5.7	4.1	6.1	
Shrubs	Exp.	3.5	2.2	3.9	10.89 ^a
	Cont.	1.4	1.5	1.2	
Litter, wood, dead vegetation ^b	Exp.	45.2	40.8	39.5	5.92
	Cont.	53.8	49.5	52.6	
Bare soil or rock ^c	Exp.	8.5	13.1	12.2	12.45 ^a
	Cont.	5.3	6.1	4.8	

a $P < .05$

b recorded only when no living vegetation except canopy present.

c recorded only when no litter or live vegetation present.

Table 2. Total numbers of shrubs and trees counted on two study plots prescription-burned in October 1979 (Cone Burn) and two comparable plots burned in October 1974 (Whirlwind Burn). Sample area = 1,336 M² for each site. The Whirlwind Burn was a crown fire, the Cone burn mostly a cool ground fire. Sampling took place in June.

Species	Numbers of Individuals			
	1979 (pre-burn)	Cone Burn 1980	1981	Whirlwind Burn 1979
<u>Amorpha canescens</u>	402	806	548	1279
<u>Arctostaphylos uva-ursi</u>	3	3	2	0
<u>Betula papyrifera</u>	0	0	0	2
<u>Juniperus communis</u>	2	0	0	0
<u>Pinus ponderosa</u>				
mature	325	258	213	0
immature	75	27	21	89
<u>Populus tremuloides</u>	0	0	0	108
<u>Prunus besseyi</u>	3	0	0	133
<u>Prunus virginiana</u>	53	45	45	67
<u>Ribes</u> spp.	55	21	8	144
<u>Rosa</u> spp.	161	168	184	191
<u>Rubus idaeus</u>	0	0	3	4672
<u>Salix amygaloides</u>	0	0	0	3
<u>Sheperdia canadensis</u>	1	0	0	0
<u>Symphoricarpos</u> <u>occidentalis</u>	0	0	0	144
<u>Toxicodendron rydbergii</u>	11	30	10	0
TOTAL	1091	1358	1034	6832

Table 3. Total breeding birds counted on four prescription burned and adjacent unburned control transects in 1980 and 1981. Each transect was censused seven times in June of each year. Transects were approx. 435 x 50 M.

Transect	Number of Individuals Counted			
	1980		1981	
	Burned	Control	Burned	Control
Cottonwood (April 1980) Burn				
Woodland (A) ^a	72	38	66	59
Woodland (B) ^a	111	83	51	113
Savannah	127	76	78	51
Cone (October 1979) Burn				
Savannah ^a	101	39	44	35
TOTAL ^a	411	236	239	258

^a Chi Square $P < .05$, in all cases with a higher number of birds on the burned transects in 1980 than in 1981 compared to unburned transects.

Table 4. Total numbers of Peromyscus maniculatus trapped on three burned and three adjacent unburned lines in 1980 and 1981. Trapping was conducted in late June through early July.

<u>Trapline</u>	Number of Captures			
	1980		1981	
	Burned	Control	Burned	Control
Cottonwood (April 1980) Burn				
Woodland ^b	30	17	20	38
Savannah ^a	15	2	16	14
Cone (October 1979) Burn				
Savanna ^a	27	13	15	23

a Chi-square, $P < .05$

b Chi-square, $P < .005$

Table 5. Total numbers (and percentages) of bison counted from nearby firetower on 38.5 ha of the Cone Burn vs. an adjacent 50.7 ha of control area in summer 1979-1981. Cone was burned between 1979 and 1980 sampling periods. Counts were made on 21 days in 1979, 78 days in 1980, and 45 days in 1981.

		Number Counted Per Year	
		Burn	Control
A. Bulls ^a	1979	290 (34.7)	545 (65.3)
	1980	1,843 (44.4)	2,304 (55.6)
	1981	797 (28.1)	2,037 (71.9)
B. Cow/Calf Herds ^a	1979	2,757 (29.5)	6,577 (70.5)
	1980	15,627 (63.2)	9,082 (36.8)
	1981	1,057 (19.3)	4,425 (80.7)

a highly significant difference between years, Chi-square test, $P < .001$.