Prairie Fires and Wildlife

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INTRODUCTION

THE Woodworth Station, a field research facility under the Northern Prairie Wildlife Research Center, was established by the Bureau of Sport Fisheries and Wildlife in 1963 to provide a sizeable area for conducting controlled studies of the relationships between land use practices and wildlife populations. An important part of these studies concerns the effects of prescribed burning on prairie wildlife. This paper presents some preliminary results from these studies, preceded by a review of historical information concerning the influence of fires and wildlife populations on the north-central prairies of the United States.

INFLUENCES OF FIRE AND WILDLIFE ON GRASSLANDS

A review of the historical documentation of wildlife-fire-grassland relationships, primarily on the great plains, indicates that some profound influences and interactions existed before the first white settlers moved into the prairies.

The vast herds of buffalo and other big game on the plains during the first half of the nineteenth century were virtually undescribable. Reid and Gannon (1928) quoted from the journals of Alexander Henry, a fur trader in North Dakota during the period 1800–1808, "I had seen almost incredible numbers of buffalo in the fall, but

nothing in comparison to what I now behold. The ground was covered at every point of the compass, as far as the eye could reach, and every animal was in motion." Lewis (1814) recorded numerous sightings of large herds of buffalo, elk, and antelope. Lewis estimated seeing 20,000 buffalo at one time and mentioned seeing multitudes of antelope and buffalo on the "new grass" of an area burned by a prairie fire.

The impact of big game activities on prairie vegetation was reported by Larson (1940) who felt that, on dryer portions of the plains, buffalo and other big game animals maintained the grassland in the shortgrass stage of plant succession. Bird (1961) reached a similar conclusion. There is direct evidence that big game herds, especially buffalo, had a tremendous effect upon prairie vegetation. Reid and Gannon (1928) tell of horses starving on the North Dakota prairie because buffalo herds passing ahead of them had eaten all the grass. Lewis (1814) reported areas where the grass was laid flat by the great numbers of buffalo, and Audubon (1960) wrote of the tremendous impact buffalo had on the prairie in South Dakota.

Fires were always a part of the prairie environment. Lewis (1814) mentioned prairie fires 12 times during his journey from Council Bluffs, Iowa, to the Grand River in South Dakota. Reid and Gannon (1928), DeTrobriand (1951), Taylor (1889), and Shields (1883) further document occurrences of fires on the prairies.

Man and lightning were the chief sources of prairie fires. Sauer (1956) reported that primitive man apparently turned fire loose on the landscape wherever the opportunity presented itself and that only civilized societies have undertaken control of fires. DeTrobriand (1951) reported that Indians in North Dakota used fire to direct big game herds for harvest. Grange (1948) pointed out that Indians in Wisconsin used fire to maintain open conditions in wooded areas, and Bird (1961) reported that plains Indians used fire for communication. Lightning as a source of prairie fire was discussed by Komarek (1967). The senior author witnessed four fires started by lightning in the Sandhills of Nebraska during a single afternoon in 1958.

Without fire most native grasslands are rapidly colonized by woody species. Our observations of woody plant increases in grasslands in North Dakota support this statement. Sauer (1950) pointed out

that suppression of fire results in the invasion of woody species in almost every grassland, and Stewart (1956) pointed out that fire was the factor keeping woody species from most grasslands in America. Bird (1961) reported that prairie fires in Saskatchewan maintained a prairie subclimax, where in the absence of fires aspens would have grown. Hall (1971) found that, in Kansas, fire kept woody vegetation from invading virgin prairie. Tester and Marshall (1962) recommended use of periodic fire to maintain prairie areas in Minnesota.

Big game herds apparently kept the prairie vegetation shorter than it would have been without them. This may explain why Reid and Gannon (1928) found no mention of prairie grouse and very little mention of prairie ducks except during the migration season in Henry's journals, and why Audubon saw few sharp-tailed grouse and no prairie chickens above the Big Bend of the Missouri River in South Dakota where he saw large numbers of big game animals, especially buffalo, almost daily. The harmful effects of heavy grazing on duck nesting was documented by Anderson (1957), Drewien (1968), Furniss (1938), Glover (1956), Johnson (1957), Kirsch (1969), Munro (1963), and Sowls (1955). Grazing can also adversely affect prairie grouse populations (Brown 1966; Christisen 1969; Frary 1958; Lehmann 1963; and Podoll 1955). Perhaps grazing pressure by big game herds kept most of the prairie in North and South Dakota unsuitable for large populations of prairie grouse and nesting ducks until the herds were depleted.

Little has been published concerning the beneficial effects of fire on prairie duck nesting habitat. At the Crex Meadows Wildlife Area in Wisconsin, Norman Stone (personal communication) reports marked increases in nesting waterfowl after burning was used as a regular management practice. A nesting population of sandhill cranes also became re-established on the area. The beneficial effects of prescribed burning on prairie grouse habitat has been widely documented by Ammann (1957), Gross (1928), Jenkins (1946), Lehmann (1965), Miller (1963), Viehmeyer (1941) and Westemeier and Vance (1971).

The lack of prairie grouse observations by Reid and Gannon (1928) and Audubon (1960) in areas of heavy big game use con-

trast with those of Catlin (1965) who reported that almost the entire garrison at Fort Leavenworth, Kansas, subsisted on prairie chickens during part of August and September in the 1830's. Catlin wrote of grass 8 feet high, made no mention of heavy grazing by big game and pointed out that prairie fires were almost annual in occurrence. Thus, prairie chickens were tremendously abundant on the unsettled prairies around Fort Leavenworth, Kansas, when fire was the principal factor influencing the vegetation. Conversely, in areas where big game herds were abundant, prairie chickens were not mentioned and sharp-tailed grouse were not plentiful. In the Dakotas both species became abundant after the big game herds were decimated and before prairie fires were effectively controlled.

Johnson (1964) indicated that the prairie chicken followed agriculture into North Dakota. He presents a great deal of supporting evidence. In spite of the fact that this theory has been widely discussed, we believe other ecological factors should be considered. There is strong circumstantial evidence that the prairie vegetation changed markedly when the big game herds were removed. It seems reasonable to suspect that this change may have had a beneficial effect on prairie chickens. There are areas in North Dakota where the prairie chicken arrived before farming altered the habitat. Early settlers in the Woodworth area confirm this. Albert Hanson (personal communication) who was one of the first homesteaders in the Woodworth area told us that prairie chickens were more abundant than were sharp-tailed grouse when he arrived in 1903. Don Williams (personal communication) who arrived in the Woodworth area in 1905 told us a similar story. There was little chance for populations of prairie chickens to build as a result of farming by 1903 or 1905 because the first homestead in Strong Township where the Woodworth Station is located was filed in 1901 (Mason 1938). There is reference to prairie chickens in Montana much earlier than this. Shields (1883) mentioned shooting prairie chickens along the Little Bighorn River in 1881. Shields also mentioned shooting sharp-tailed grouse in that area, and since he was familiar with both species, there is no reason to dispute his identification. If small numbers of prairie chickens were present over much of North Dakota before agriculture, they may have been overlooked until

populations increased because of range recovery after removal of the big game herds. On the other hand, if they actually did invade this area later, was it because of agriculture, or because of range recovery, or both? There are large tracts of grasslands interspersed with farmland in the Dakotas today which no longer support prairie chickens because intensive use of the grasslands for grazing and haying has markedly reduced the quantity and quality of habitat.

Early observers could easily have overlooked sparse populations of prairie chickens. The unobtrusiveness of scattered populations is borne out by the fact that the senior author located prairie chicken booming grounds on the J. Clark Salyer National Wildlife Refuge and within 400 feet of the Arrowwood National Wildlife Refuge in 1953 and 1956, respectively, when it was believed breeding prairie chickens were no longer present. He also located prairie chickens on two booming grounds in McPherson County, South Dakota, in 1952 after it had been reported there were none surviving. Without previous experience or special assistance, we would be surprised if most biologists could locate prairie chickens in North Dakota today, although a few scattered breeding flocks remain.

It seems logical to speculate that during the past 200 years in the Dakotas, the highest populations of prairie nesting ducks and prairie grouse occurred about 1880. This was after the big game herds had been decimated and the grasslands had recovered from the effects of intensive grazing, but before extensive settlement in the 1890's exerted much influence on prairie vegetation or prairie fires.

Fire suppression and the absence of deliberate use of fire to control vegetational succession has done untold damage to prairie wildlife. In parts of Minnesota, Wisconsin and Michigan where grassland habitat was created by logging, farming and slash burning, the grasslands reverted to woodlands when fires were suppressed. In Wisconsin alone, millions of acres of prairie chicken habitat were lost because of regrowth of forests (Westemeier 1971). Local examples of this are found on Agassiz National Wildlife Refuge in Minnesota, Necedah National Wildlife Refuge in Wisconsin and Seney National Wildlife Refuge in Michigan, all of which once supported prairie chickens but no longer do. Sharp-tailed grouse populations have also decreased markedly on these refuges (Refuge narrative reports). In

contrast, on the Crex Meadows Area in Wisconsin, where fire is used extensively in vegetation management, sharp-tailed grouse increased from less than 10 birds in 1947 to huntable numbers in 1954 (Norman Stone, personal communication). Mr. Stone reported that about 400 sharp-tailed grouse were harvested at Crex Meadows in 1971.

Woodworth Study Area

The Woodworth Study Area comprises 3040 acres of former diversified agricultural land located on a glacial stagnation moraine in the mid-grass prairie vegetation zone of eastcentral North Dakota. More than 500 shallow ponds and lakes varying from a fraction of an acre to 53 acres in size are scattered over the area. About half of the land has a history of cultivation and the remainder is unplowed, degraded prairie grassland.

METHODS

Sharp-tailed grouse (*Pedioecetes phasianellus*) population estimates were obtained by counting male grouse on dancing grounds during the spring (Janson 1950).

Three 160 acre blocks having similar soils, terrain, vegetation, and pond distribution were used for comparative studies of nesting ducks, 8 other species of birds and white-tailed deer (*Odocoileus virginianus*) on burned and unburned grasslands. One of the 160 acre blocks was used as a control, and the other two were burned on 26 May 1970.

During the period May-July 1971, the study blocks were searched four times using the cable-chain drag as described by Higgins et al. (1969). Nests of sharp-tailed grouse, ring-necked pheasants (*Phasianus colchicus*), upland plover (*Bartramia longicauda*), American bittern (*Botaurus lentiginosus*), willet (*Catoptrophorus semipalmatus*), killdeer (*Chadrius vociferus vociferus*), mourning dove (*Zenaidura macroura*), and eight species of ducks were located during these searches; the nests were revisited to determine their fate. Sightings of broods of sharp-tailed grouse, Hungarian partridge (*Perdix perdix perdix*) and fawns of white-tailed deer were recorded.

Plant species composition and areal coverage were recorded before

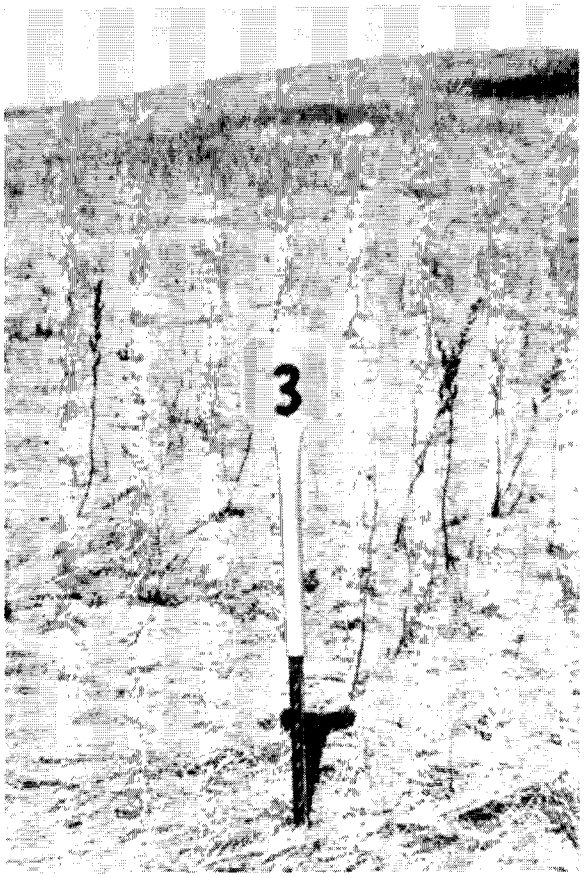

FIG. 1. Station 3; unused North Dakota prairie, May 1970.

(Figs. 1,3, and 5) and after burning (Figs. 2,4, and 6) on 38, 2¼ m^2 plots located along four line transects. Six classes of cover were established based on areal coverage (percent of area shaded by a given species): (1) < 5 percent, (2) 5–25 percent, (3) 25–50 percent, (4) 50–75 percent, (5) 75–95 percent, (6) 95–100 percent. Species showing an average increase in cover of 100 percent or more from all plots were designated as "increasers". Species showing an average decrease in cover of 50 percent or more were designated as "decreasers". Those species falling between these ranges were designated as "no change."

FIG. 2. Station 3; same area as in Fig. 1, May 1972, after a burn on 8 August 1970. Shows improvement in vegetative cover resulting from burning.

RESULTS AND DISCUSSION

The number of nests on burned and unburned grassland was similar, but a greater variety of species was found nesting on the former (Table 1). White-tailed deer fawns and broods of upland game birds were more abundant on burned than on unburned grasslands.

Hatching success for 743 duck nests found on the Study Area is shown in Table 2. Fifty-two percent of 118 duck nests were successful on burned grassland habitat whereas 33 percent of 417 nests were successful on undisturbed grassland habitat and 23 percent of 208 nests were successful on grazed grassland habitat.

Duck production, expressed as the number of broods hatched per 100 acres, was 8.1 on burned grasslands (during the second growing season after the fire), whereas it was 6.3 on undisturbed grasslands and 2.5 on grazed grasslands. Similar data for sharp-tailed grouse indicate that production from burned grasslands was 0.45 broods

per 100 acres, whereas it was 0.22 on undisturbed grassland. No evidence of sharp-tailed grouse production was noted on grazed grassland.

Nesting data for upland plover indicate that 3.5 broods were produced per 100 acres of burned grassland, whereas 2.1 broods per 100 acres were produced on unburned grassland and 1.6 on grazed grassland.

Of 18 sharp-tailed grouse broods observed on the Study Area during 1969–1971, 12 were on burned grassland, whereas 5 were on undisturbed grassland and one was on grazed grassland.

FIG. 3. Station 4; unused North Dakota prairie buckbrush clump, May 1970.

FIG. 4. Station 4; same area as in Fig. 3, May 1972 after a burn on 8 August 1970. Shows effect of burning on buckbrush.

TABLE 1. COMPARISON OF WILDLIFE PRODUCTION POTENTIAL ON BURNED AND UNBURNED GRASSLANDS, WOODWORTH STUDY AREA, 1971.

	Unburned	Burned	(5/26/70)
	124 ac.	135 ac.	121 ac.
Nests:			
All ducks	25	32	18
Sharp-tailed grouse	1	2	3
Pheasant	1	0	0
Upland plover	2	7	4
American bittern	1	1	0
Willet	0	0	1
Killdeer	0	0	3
Mourning dove	0	0	1
Total nests	30	42	30
Percent hatched	37	76	67
Other Observations:			
White-tailed deer fawns	0	4	4
Sharp-tailed grouse broods	2	6	1
Hungarian partridge broods	0	0	3

FIG. 5. Station 10; unused North Dakota prairie, May 1970. Shows unattractive condition of vegetative cover for ground nesting birds.

TABLE 2. DUCK NESTING SUCCESS ON BURNED, UNDISTURBED AND GRAZED GRASSLANDS, WOODWORTH STUDY AREA, 1966–1971.

Nests	Grassland Treatment		
	Burned	Undisturbed	Grazed
Hatched	61	137	48
Destroyed	57	280	160
Total	118	417	208
Percent Hatched	52	33	23

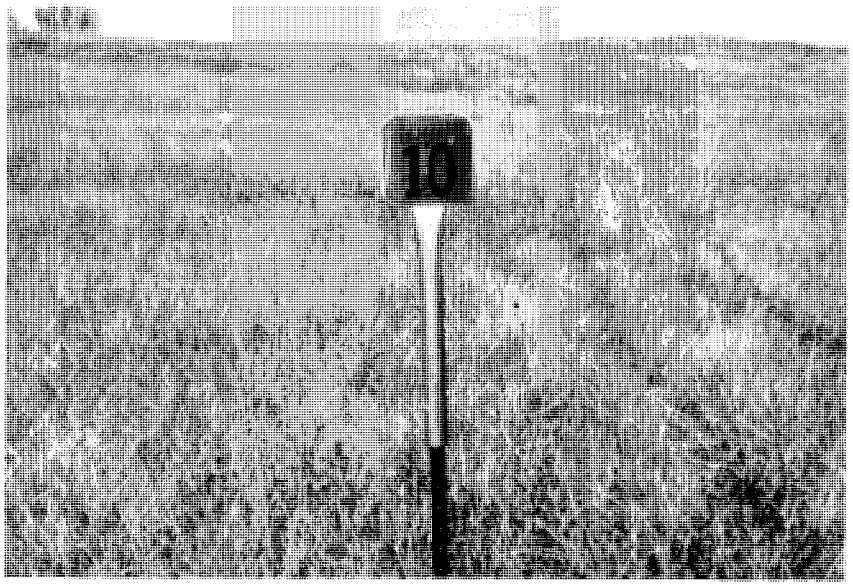

FIG. 6. Station 10; same area as in Fig. 5, May 1972 after burns of 22 May 1970 and 13 May 1971. Shows improved condition of vegetative cover for ground nesting birds and almost complete absence of buckbrush resulting from burning.

The greatest measured change in vegetation after burning was a marked increase in plant variety. Fifty-three species were identified on 38 plots before burning, whereas 69 species were identified after burning. Burning changed the growth form of many plants by increasing flowering, seed production and height. The amount of cover provided by some plants also changed (Table 3).

Similar studies on the Arrowwood National Wildlife Refuge (located 30 miles east of Woodworth) showed that four sharp-tailed grouse dancing grounds established during the past 3 years were on or immediately adjacent to areas burned about 22 months previously.

CONCLUSIONS

Preliminary data from our studies at the Woodworth Station and the Arrowwood Refuge indicate that fire is a valuable tool in managing grasslands for some species of prairie wildlife.

TABLE 3. EFFECT OF BURNING ON PLANT COVER (BY SPECIES) IN 38 PLOTS, WOODWORTH STUDY AREA.

INCREASERS (100% or more)		
Big bluestem (*Andropogon gerardi*)	Maximilian sunflower (*Helianthus maximiliani*)	Silverberry (*Elaeagnus argentea*)
Little bluestem (*Andropogon scoparius*)	Purple prairie clover (*Petalostemum purpureum*)	Northern bedstraw (*Galium boreale*)
Prairie sandreed (*Calamovilfa longifolia*)	Silverleaf scurfpea (*Psoralia argophylla*)	Wild licorice (*Glycyrrhiza lepidota*)
Blue grama (*Bouteloua gracilis*)		Stiff sunflower (*Helianthus laetiflorus*)
Leiberg panicum (*Panicum leibergii*)	NO CHANGE (+ 99% to − 49%)	Prairie rose (*Rosa arkansana*)
Needle and thread (*Stipa comata*)	Quackgrass (*Agropyron repens*)	Tall goldenrod (*Solidago altissima*)
Porcupine grass (*Stipa spartea*)	Bearded wheatgrass (*Agropyron subsecundum*)	Stiff goldenrod (*Solidago rigida*)
Green needlegrass (*Stipa viridula*)	June grass (*Koelaria cristata*)	Western snowberry (*Symphoricarpos occidentalis*)
Western ragweed (*Ambrosia psilostachya*)	Kentucky bluegrass (*Poa pratensis*)	
Meadow anemone (*Anemone canadensis*)	Sedges (*Carex* sp.)	DECREASERS (−50% or more)
Candle anemone (*Anemone cylindrica*)	Western yarrow (*Achillea lanulosa*)	Slender wheatgrass (*Agropyron trachycaulum*)
Spreading pasqueflower (*Anemone patens*)	Fringed sagewort (*Artemesia frigida*)	Smooth brome (*Bromus inermis*)
Heath aster (*Aster ericoides*)	Pasture sage (*Artemesia ludoviciana*)	Prairie cordgrass (*Spartina pectinata*)
Prairie chickweed (*Cerastium arvense*)	Flodman thistle (*Cirsium flodmani*)	Canada thistle (*Cirsium canadensis*)
		Rushes (*Juncas* sp.)

Our work to date with fire and the aforementioned literature present convincing evidence that fire can be an important tool for wildlife management on prairie areas. Complete non-use for 20–30 years or annual grazing and haying do not provide the type of habitat desired. Further research will, hopefully, lead to refinements of techniques for more efficient use of fire, but we have enough basic information now to use fire effectively in the management of prairie habitat for wildlife.

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