Effects of Grazing Management Treatment on Grassland Plant Communities and Prairie Grouse Habitat'

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Abstract. --Seasonlong grazing treatments show no benefit to grass basal cover and visual obstruction is not adequate. Pastures with one grazing period in mid season show no positive change in grass basal cover but have better visual obstruction than seasonlong. Deferred grazing decreases basal cover of warm season grasses and visual obstruction reduced to inadequate levels the first growing season after treatment. Pastures with two grazing periods show increase in basal cover and have adequate visual obstruction. Prairie grouse select against use in seasonlong, one period mid season and deferred grazing treatments but select for pastures grazed two periods for display ground and nest locations.

The effects of grazing by domestic livestock on grassland plant communities depend on season of use, intensity of grazing and duration of grazed and ungrazed periods. Differential responses of the vegetation to grazing management treatments affects the prairie grouse populations that depend on grassland plants for habitat. The different affects on the plant communities and prairie grouse habitat by the various types of grazing management treatments were not well understood. The purpose of this project was to determine the effects of selected grazing management treatments on the grassland plant communities and prairie grouse habitat and evaluate prairie grouse use of the different grazing treatments.

STUDY AREA

This study was conducted on the Sheyenne National Grasslands located in southeastern North Dakota in Ransom and Richland Counties on a geologic formation known as the Glacial Sheyenne Delta. The north unit consists of 67,320 acres of federal land and 63,240 acres of private land. Average annual precipitation was 19.6 inches with 79% of this occurring April through September (Jensen 1972). The frost-free period averages 130 days beginning in mid May. Mean monthly temperatures were highest in July and August (70.9° and 69.9°F, respectively) and lowest in January (7.7°F) (Jensen 1972). The vegetation consists of native grassland and woodland and non-native replacement communities (cropland). These were described by Manske and Barker (1981).

The federally owned land on the Sheyenne National Grasslands was purchased as submarginal farm land from private ownership from 1937 to 1939 after the Congress passed the Bankhead-Jones Farm Tenant Act. The administration of these lands was assigned to the Soil Conservation Service in 1940. The federal land was divided into 10 common grazing blocks which were grazed seasonlong. The grazing season was 8 months from 1940 to 1954. In 1954, the administration was transferred to the U.S. Forest Service. The grazing season was changed to 6 months in 1955 and the common grazing blocks were divided into 56 grazing allotments. These allotments were managed by a seasonlong grazing system. Cross fencing of the allotments began in 1967. Twenty-two allotments were managed by rotation grazing systems with one grazing period per pasture in 1968. In 1974, rotational grazing systems were used on 63% of the allotments (84% of the federal land). Twice over rotation systems (two grazing periods per pasture) were started by District Ranger Robert Storch in eleven allotments in 1974 upon the recommendation of Dr. William T. Barker. The number of allotments that had pastures with twice over rotation grazing periods increased

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until 1978 when 54% of the federal land was managed with twice over systems. In 1979, this management trend was reversed with a change in District Rangers and 70% of the federal land was managed with once over and deferred grazing systems and only 20% with twice over rotation systems. Less than 10% of the federal land was managed with a seasonlong grazing system in 1980. Most of the allotments were grazed by one herd managed as a unit.

METHODS

Records from the Sheyenne Valley Grazing Association of grazing management plans for each grazing allotment from 1974 through 1980 were reviewed and each allotment was classified to type of grazing management treatment for each year. The types of management were categorized by the number of pastures in each system, the number of grazing periods for the pasture with the least number of periods and the season when the grazing periods occurred. The grazing treatments consisted of 1, 2, 3 and 4 pastures. The number of grazing periods varied from 1 to 4 periods. Two 5 pasture systems were designed but these were primarily managed as 2 and 3 pasture systems with 2 herds where some exchange of herds between systems occurred.

The one pasture treatments were grazed one period seasonlong for 183 days. Examples of this type were used as the control treatment. The two pasture systems had examples of 1, 2, 3 and 4 grazing periods. Each pasture was grazed for a total of about 90 days. Only the pastures with 3 and 4 grazing periods (switchback system) were included in this study.

The three pasture treatments were primarily grazed 1, 2 or 3 periods (once, twice or thrice over systems, respectively). Most 3 pasture systems had two pastures grazed twice over and the third pasture grazed once over. The pasture with one grazing period was grazed during the mid season period of June to early September or they were deferred until after grass seed development in late August and grazed only during the late season period of September to mid November. These deferred pastures were not grazed from August of the previous year until late August or September of the year of deferment. These pastures were ungrazed for 11 to 13 months prior to the deferred grazing period. This one year period of ungrazing was included in this study as a treatment. The pastures with two grazing periods were grazed during three season of use categories; early season (May - mid June), mid season (June - early September) or late season (September - mid November). Two grazing periods in three season of use categories resulted in four possible combinations; early - late, early - mid, mid - mid and mid - late. Each pasture was grazed for a total of about 60 days.

Four pasture grazing management treatments were used in 6 allotments which was about 20% of the federal land. These were generally managed as 3 pasture systems with the fourth pasture used for herd splitting for breeding or other purposes or to maintain separation between old cows and heifers. None of these 4 pasture treatments were true one herd 4 pasture rotation systems and were not evaluated as such in this study.

Basal cover was determined in August, 1976 - 1978, by sampling along permanent transect segments on identical slope position in the upland, midland and lowland plant communities with the inclined ten-pin point frame (Levy and Madden 1933, Tinney, Aamodt and Ahlgren 1937, Heady and Rader 1958, and Smith 1959). Fifteen hundred points were read for each plant community per sample stand. Relative changes in basal cover between pretreatment and post treatment were estimated in each pasture for both grazed and ungrazed paired plots, The effects of the different grazing treatments on these relative changes were analyzed with a standard paired plot t test (Mosteller and Rourke 1973).

Visual obstruction was sampled by the height-density method developed by Robe1 et al. (1970a), and modified by Kirsch (1974). The ability of the grassland vegetation to obstruct vision was considered to be a very important factor in the evaluation of prairie grouse habitat (Hamerstrom et al. 1957, and Robe1 et al. 1970b). Mean 100% visual obstruction measurements of 1.5 decimeters was considered to be the minimum level for good nesting success and roost cover for prairie grouse Manske and Barker (1981) and Higgins and Barker (1982). The _____ virgatum (switchgrass) portion of the midland grassland community located on the foot slope was the primary prairie grouse concealment cover on the Sheyenne National Grasslands (Manske and Barker 1981). This switchgrass area was selected as the key vegetation to evaluate the effects of different grazing treatments on prairie grouse habitat. Readings to the nearest 0.5 decimeters (2 inches) were made for the 0% and 100% visual obstruction measurements (VOM) of the height-density pole at four major compass directions. Twenty-five pole sets with an interval of 12 paces were made in homogenous vegetation along a transect of about 270 meters (900 feet). Permanent transects were established in 17 pastures with 5 different grazing treatments. These permanent transects were read spring and fall of 1979 and 1980. Nonpermanent transects were sampled during the spring of 1979 or 1980 in 40 pastures with 8 grazing treatments. Fall data from nonpermanent transects collected on deferred pastures prior to the grazing period were also included. The data collected on the permanent and non-permanent transects were treated separately and analysed using an unbalanced AOV (Mosteller and Rourke 1973).

Location of spring display grounds (Manske and Barker 1981) were classified according to the type of grazing treatment the pasture received the previous year. Use index (% of display location/% of study area) as described by Robe1 et al. (1970b) was used to evaluate display ground-management interactions. An index value greater than 1.0 indicates selection for that grazing treatment, a value less than 1.0 indicates use less than would be expected if the grouse exhibited no preference. A value of zero indicates avoidance of that treatment category.

Prairie chicken and sharp-tailed grouse nest locations (Manske and Barker 1981) were classified according to the type of grazing treatment the pasture received the previous year. Statistical analysis was not done on the nest location data.

RESULTS AND DISCUSSION

Seasonlong grazing treatments were used on the Sheyenne National Grasslands from 1940 through 1967. The prairie grouse population was very low (less than 25 males) during this period and did not show any increase. In 1968, rotation grazing treatments were started. By 1973, 75% of the federal land was managed by some type of multiple pasture rotation system with one grazing period per pasture. Eighteen pastures in 15 allotments had two grazing periods in 1971. Prior to this, pastures were grazed for one period. There was a large increase in prairie grouse population between 1971 and 1972. During the period of 1968 to 1974 the population of prairie chicken and sharptailed grouse increased appreciably. Management with two grazing periods on multiple pastures within an allotment started in 1974. There was a very large increase in the prairie grouse population in the spring census of 1975. Management with twice over grazing periods increased from 10% of the federal land in 1974 to 54% in 1978. The prairie grouse population increased substantially during this 5 year period. The increasing trend for management with multiple grazing periods on pastures was changed to single grazing periods and deferred type grazing management in 1979. Seventy and seventy-one percent of the federal land was managed by treatments with single grazing periods in mid season or deferred until late season in 1979 and 1980, respectively. The prairie grouse population responded negatively to these changes in management and greatly declined in the spring census of 1981.

Acreages and percentages of federal land managed with 1, 2, 3, and 4 pasture treatments from 1974 through 1980 are shown in table 1. Mean annual acreage for 1, 2, 3 and 4 pasture treatments was 7,369 (11.0%), 11,518 (17.2%), 34,759 (52.0%) and 13,224 (19.8%) acres, respectively. Mean stocking rate of all allotments was 0.88 AUM's/acre. Mean stocking rate for one, two, three (once over) and three (twice over) pasture treatments were 0.75, 1.08, 1.17, 1.07 AUM's/acre respectively (Table 2). The one pasture seasonlong treatments were stocked below ($P<0.05$) the two and three pasture treatments. The stocking rates for the two pasture, switchback; three pasture, once over; and three pasture, twice over treatments were not significantly different ($P>0.05$).

Basal cover data of individual species were grouped as warm season, cool season and sedges (Tables 3, 4 and 5, respectively). The major species of each plant community were evaluated individually. Data for Panicum virgatum (switchgrass) and Poa pratensis (Kentucky bluegrass) were reported in Table 6.

Basal cover of the warm season grasses (Fig. 1) was significantly reduced by the deferred grazing treatment (#4) in the midland plant community ($P<0.05$). Warm season basal cover (Fig. 1) was reduced ($P<0.05$) in the lowland plant community of the two pasture, thrice over grazing treatment (#2). Changes in basal cover for the warm season grasses in the upland plant communities for the ten treatments were not significant ($P>0.05$). Basal cover of the warm season grasses on the lowland community decreased significantly ($P<0.05$) on the two pasture, thrice over treatment (#2) compared to the seasonlong treatment (#1).

Basal cover for the cool season grasses (Fig. 2) did not change significantly ($P>0.05$) in the upland, midland and lowland plant communities for the ten grazing treatments.

Basal cover for the sedges (Fig. 3) in the lowland community were significantly ($P<0.1$) increased on the three pasture, twice over grazed early and late season treatment (#7). Sedges did not change ($P>0.05$) in the upland and midland communities for the ten grazing treatments. Basal cover of the sedges on the lowland community increased significantly ($P<0.05$) on the three pasture, twice over grazed early and late season treatment (#7) compared to the seasonlong treatment (#1).

Basal cover for Panicum virgatum (Fig. 4) was significantly reduced in the midland ($P<0.05$) and lowland ($P<0.1$) plant communities of the deferred grazing treatment (#4). The three pasture, twice over, grazed early and late treatment (#7) reduced the basal cover of Panicum virgatum (Fig. 4) in the lowland plant community ($P<0.05$). The two pasture thrice over treatment (#2) reduced the basal cover of Panicum virgatum ($P<0.05$), and increased the basal cover of Poa pratensis ($P<0.05$) in the lowland plant community (Fig. 4). Basal cover of Panicum virgatum in the midland community decreased significantly ($P<0.05$) on the three pasture, once over deferred treatment (#4) compared to the seasonlong treatment (#1). Panicum virgatum

Table 1. Annual acreage and percentage of federal land managed with 1, 2, 3 and 4 pasture treatments.

Treatment		Year 1974	1975	1976	1977	1978	1979	1980
One Fasture								
Seasonlong	acres	10,977	6,867	6,867	6,926	6,926	6,566	6,457
	%	16.4	10.3	10.3	10.4	10.4	9.8	9.7
Two Pasture								
Once Over,								
Mid Season	acres	4,658	6,595	5,273	3,404	3,404	5,766	6,450
	%	7.0	9.9	7.9	5.1	5.1	8.6	9.7
Switchback	acres	4,466	4,147	5,469	9,336	9,336	6,974	5,348
	%	6.7	6.2	8.2	14.0	14.0	10.4	8.0
Three Pasture								
Deferred,								
Late Season	acres	4,384	11,021	5,572	3,072	3,512	21,360	17,041
	%	6.6	16.5	8.3	4.6	5.3	31.9	25.5
Once Over,								
Mid Season	acres	26,698	18,679	18,569	13,416	11,887	7,133	12,557
	%	39.9	27.9	27.8	20.1	17.8	10.7	18.8
Twice Over,								
Early, Mid, Late	acres	2,248	5,596	12,623	18,219	19,308	5,236	5,182
	%	3.4	8.4	18.9	27.3	28.9	7.8	7.8
Pour Fasture								
Deferred,								
Late Season	acres	0	0	0	0	0	2,572	3,456
	%						3.9	5.2
Once Over,								
Mid Season	acres	13,439	12,720	11,252	5,090	5,090	10,018	7,900
	%	20.1	19.0	16.8	7.6	7.6	15.0	11.8
Twice Over,								
Early, Mid, Late	acres	0	1,245	1,245	7,407	7,407	1,245	2,479
	%		1.9	1.9	11.1	11.1	1.9	3.7

Table 2. Total number of days grazed per pasture and stocking rate for 1, 2 and 3 pasture grazing treatments. Means of same column followed by the same letter are not significantly different (P<0.05).

	Total number days grazed	Stocking rate AUM/acre
1 Pasture, Control		
Seasonlong	183.7 ± 0.5	0.75 ± 0.01a
2 Pasture, Switchback		
3 Grazing Periods	87.3 ± 4.5	1.08 ± 0.01b
4 Grazing Periods	92.5 ± 4.3	1.08 ± 0.01b
3 Pasture, Once Over		
Deferred, Late	58.2 ± 5.3	1.15 ± 0.09b
Ungrazed	11-13 months (Sep-Sep)	1.17 ± 0.09b
Mid Season	60.3 ± 6.7	i.18 ± O.Ob
3 Pasture, Twice Over		
Early - Late	59.7 ± 0.5	1.10 ± 0.06b
Early - Mid	57.9 ± 2.8	1.10 ± 0.10b
Mid - Mid	59.7 ± 2.6	1.04 ± 0.04b
Mid - Late	59.8 ± 3.2	1.03 ± 0.03b

Table 3. Basal cover of warm season grasses pretreatment and post treatment for ten grazing treatments.

Treatment	Treatment number	Grazing status	Upland		Midland		Lowland	
			Pre treatment	Post treatment	Pre treatment	Post treatment	Pre treatment	Post treatment
One Pasture, Control								
Seasonlong	1	Grazed	20.1	14.8	11.3	9.1	0.3	0.4
n = 2		Ungrazed	30.2	28.3	16.0	16.0	0.3	0.3
Two Pasture, Switchback								
3 Grazing Periods	2	Grazed	26.7	22.5	17.6	14.3	1.5	0.2
n = 2		Ungrazed	32.8	27.7	20.7	15.6	0.1	0.6
4 Grazing Periods	3	Grazed	28.5	20.7	19.7	13.7	0.5	1.6
n = 2		Ungrazed	28.0	23.5	25.1	14.7	0.8	0.6
Three Pasture, Once Over								
Deferred	4	Grazed	9.6	11.2	18.9	14.0	4.0	9.4
n = 4		Ungrazed	25.4	13.7	12.4	20.0	2.1	7.2
Ungrazed	5	Grazed	11.8	0.4	31.9	21.1	10.9	7.7
n = 3		Ungrazed	14.8	2.4	25.5	18.4	4.7	4.3
Mid Season	6	Grazed	29.2	39.6	13.8	18.6	1.0	9.4
n = 1		Ungrazed	29.8	38.0	17.8	20.0	1.4	5.6
Three Pasture, Twice Over								
Early - Late	7	Grazed	27.6	31.9	17.5	24.3	2.8	4.8
n = 3		Ungrazed	24.9	28.5	19.9	23.1	1.3	5.8
Early - Mid	8	Grazed	35.5	25.0	27.1	22.3	7.9	6.3
n = 6		Ungrazed	35.8	20.6	31.9	22.2	6.1	3.0
Mid - Mid	9	Grazed	24.6	23.7	16.2	16.6	3.0	4.8
n = 5		Ungrazed	22.7	18.9	20.8	18.5	1.8	2.6
Mid - Late	10	Grazed	20.5	17.8	28.1	16.5	3.8	3.5
n = 5		Ungrazed	21.2	17.2	29.4	18.4	4.8	2.9

Table 4. Basal cover of cool season grasses pretreatment and post treatment for ten grazing treatments.

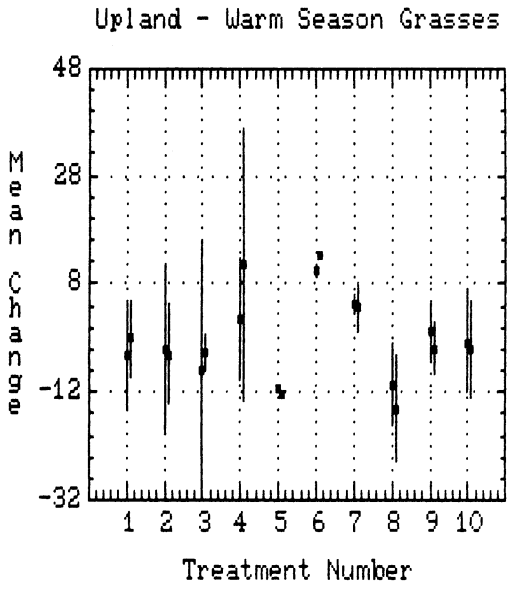
Treatment	Treatment number	Grazing status	Upland		Midland		Lowland	
			Pre treatment	Post treatment	Pre treatment	Post treatment	Pre treatment	Post treatment
One Pasture, Control								
Seasonlong	1	Grazed	13.3	11.9	18.1	13.3	4.1	9.4
n = 2		Ungrazed	15.2	5.4	13.5	9.9	6.2	10.7
Two Pasture, Switchback								
3 Grazing Periods	2	Grazed	14.9	5.8	15.4	13.7	1.9	6.6
n = 2		Ungrazed	10.0	4.5	18.0	11.2	1.6	5.8
4 Grazing Periods	3	Grazed	7.6	6.5	16.7	11.9	4.2	8.0
n = 2		Ungrazed	8.9	7.0	15.5	12.1	1.5	7.3
Three Pasture, Once Over								
Deferred	4	Grazed	18.7	11.9	17.1	13.2	3.5	11.9
n = 4		Ungrazed	9.5	7.7	17.0	12.7	5.4	12.2
Ungrazed	5	Grazed	34.2	10.2	11.1	8.3	6.2	9.1
n = 3		Ungrazed	32.4	9.6	15.1	9.3	6.3	11.1
Mid Season	6	Grazed	3.0	7.2	6.6	15.2	10.2	21.6
n = 1		Ungrazed	8.2	8.2	7.8	17.6	6.4	10.6
Three Pasture, Twice Over								
Early - Late	7	Grazed	2.7	4.9	8.0	8.9	6.9	14.3
n = 3		Ungrazed	3.3	6.7	9.7	11.2	3.7	10.3
Early - Mid	8	Grazed	17.7	2.8	15.9	7.6	7.1	9.7
n = 6		Ungrazed	15.1	4.5	11.8	8.4	6.6	7.4
Mid - Mid	9	Grazed	7.7	8.7	14.8	14.6	10.1	15.6
n = 5		Ungrazed	9.9	11.2	11.2	14.9	7.2	15.2
Mid - Late	10	Grazed	19.6	9.8	15.4	15.7	11.2	13.2
n = 5		Ungrazed	22.0	11.6	15.6	11.9	11.7	14.8

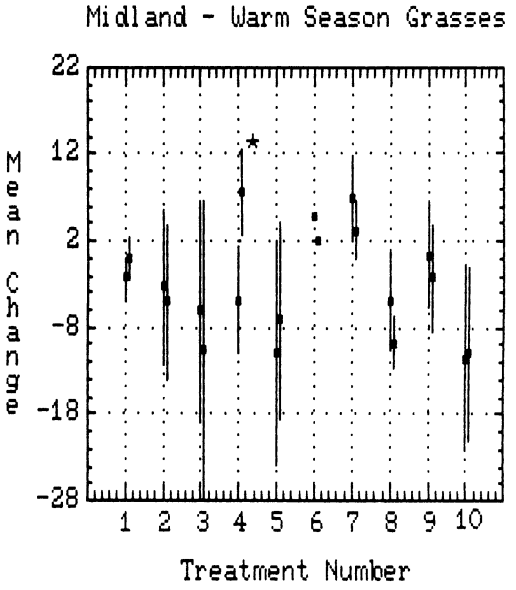
Table 5. Basal cover of sedges pretreatment and post treatment for ten grazing treatments.

Treatment	Treatment number	Grazing status	Upland		Midland		Lowland	
			Pre treatment	Post treatment	Pre treatment	Post treatment	Pre treatment	Post treatment
One Pasture, Control								
Seasonlong	1	Grazed	8.4	3.6	14.7	6.1	24.0	18.1
n = 2		Ungrazed	3.6	3.6	14.4	6.8	25.6	20.7
Two Pasture, Switchback								
3 Grazing Periods	2	Grazed	6.2	4.6	20.4	7.2	35.7	16.2
n = 2		Ungrazed	6.8	3.3	15.1	7.0	27.5	14.4
4 Grazing Periods	3	Grazed	7.1	4.4	17.3	7.8	23.3	16.1
n = 2		Ungrazed	7.3	4.6	15.2	7.6	22.7	20.0
Three Pasture, Once Over								
Deferred	4	Grazed	12.6	6.9	10.7	5.6	23.0	12.9
n = 4		Ungrazed	11.3	8.4	13.2	8.3	23.9	14.2
Ungrazed	5	Grazed	5.2	6.4	10.0	5.1	24.7	10.8
n = 3		Ungrazed	20.8	8.0	12.1	6.7	24.9	12.6
Mid Season	6	Grazed	1.6	2.0	5.0	9.6	13.8	13.2
n = 1		Ungrazed	1.0	1.2	3.0	10.8	19.0	25.4
Three Pasture, Twice Over								
Early - Late	7	Grazed	2.8	3.4	4.9	5.1	10.8	17.1
n = 3		Ungrazed	3.5	3.7	6.3	6.5	14.3	17.5
Early - Mid	8	Grazed	5.4	3.7	11.6	4.4	27.7	12.7
n = 6		Ungrazed	3.8	3.4	8.6	6.1	28.4	16.6
Mid - Mid	9	Grazed	2.8	3.5	6.6	5.5	15.1	15.1
n = 5		Ungrazed	4.5	5.6	5.1	4.6	16.0	13.2
Mid - Late	10	Grazed	5.5	3.3	6.1	5.3	23.4	13.4
n = 5		Ungrazed	8.8	4.3	6.4	4.8	19.2	13.6

Table 6. Basal cover of Panicum virgatum and Poa pratensis pretreatment and post treatment for ten grazing treatments.

Treatment	Treatment number	Grazing status	Panicum virgatum				Poa pratensis	
			Midland		Lowland		Lowland	
			Pre treatment	Post treatment	Pre treatment	Post treatment	Pre treatment	Post treatment
One Pasture, Control								
Seasonlong	1	Grazed	1.1	1.1	0.0	0.1	0.2	0.2
n = 2		Ungrazed	2.2	2.4	0.0	0.0	0.0	0.0
Two Pasture, Switchback								
3 Grazing Periods	2	Grazed	0.5	3.2	0.2	0.1	0.3	1.4
n = 2		Ungrazed	0.6	2.2	0.1	0.6	0.2	0.2
4 Grazing Periods	3	Grazed	2.1	1.1	0.4	0.2	0.7	3.2
n = 2		Ungrazed	1.1	1.2	0.7	0.4	0.1	3.0
Three Pasture, Once Over								
Deferred	4	Grazed	6.4	2.1	2.0	1.6	2.2	7.1
n = 4		Ungrazed	3.3	3.9	0.4	2.1	2.8	5.8
Ungrazed	5	Grazed	5.5	2.7	7.9	2.9	2.1	5.7
n = 3		Ungrazed	2.7	2.5	3.7	1.7	2.1	3.7
Mid Season	6	Grazed	1.2	1.6	0.4	7.4	5.8	11.4
n = 1		Ungrazed	1.8	0.4	0.0	0.0	1.0	0.4
Three Pasture, Twice Over								
Early - Late	7	Grazed	0.9	0.9	0.5	2.6	6.2	12.5
n = 3		Ungrazed	2.1	2.7	0.7	4.3	1.1	4.8
Early - Mid	8	Grazed	2.0	1.2	2.7	2.7	4.2	5.6
n = 6		Ungrazed	4.2	3.0	2.5	1.8	2.4	1.4
Mid - Mid	9	Grazed	0.9	1.2	1.4	2.5	7.2	10.3
n = 5		Ungrazed	1.6	1.1	0.8	1.3	2.8	6.9
Mid - Late	10	Grazed	1.4	1.4	2.0	1.9	6.2	9.0
n = 5		Ungrazed	1.7	1.3	2.1	1.6	4.8	4.8





LEGEND

1. One Pasture, Seasonlong, Control
2. Two Pasture, Switchback, 3 Grazing Periods
3. Two Pasture, Switchback, 4 Grazing Periods
4. Three Pasture, Once Over, Deferred
5. Three Pasture, Once Over, Ungrazed
6. Three Pasture, Once Over, Mid Season
7. Three Pasture, Twice Over, Early-Late Season
8. Three Pasture, Twice Over, Early-Mid Season
9. Three Pasture, Twice Over, Mid-Mid Season
10. Three Pasture, Twice Over, Mid-Late Season

Left Point. Grazed Paired Plot

Right Point. Ungrazed Paired Plot

* P<0.05

\+ P<0.1

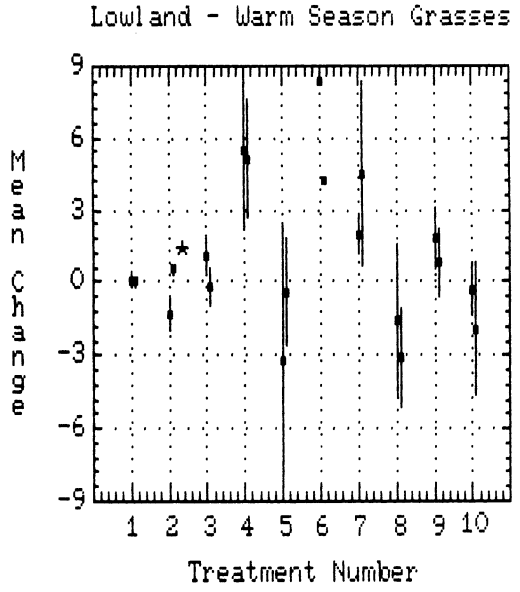
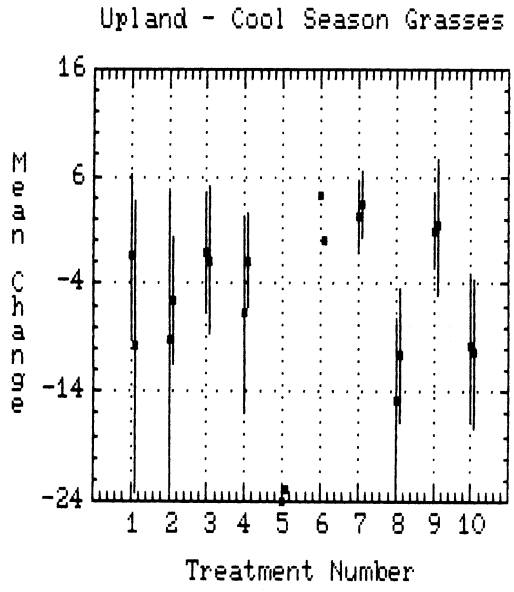
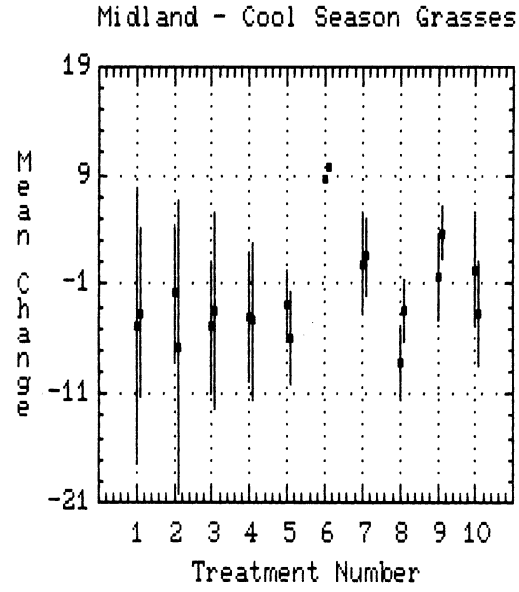


Fig. 1 Mean changes for warm season grasses in absolute basal cover between pretreatment and post treatment for ten grazing management treatments comparing grazed (point on left) and ungrazed (point on right) paired plots.





LEGEND

1. One Pasture, Seasonlong, Control
2. Two Pasture, Switchback, 3 Grazing Periods
3. Two Pasture, Switchback, 4 Grazing Periods
4. Three Pasture, Once Over, Deferred
5. Three Pasture, Once Over, Ungrazed
6. Three Pasture, Once Over, Mid Season
7. Three Pasture, Twice Over, Early-Late Season
8. Three Pasture, Twice Over, Early-Mid Season
9. Three Pasture, Twice Over, Mid-Mid Season
10. Three Pasture, Twice Over, Mid-Late Season

Left Point. Grazed Paired Plot

Right Point. Ungrazed Paired Plot

* P<0.05

\+ P<0.1

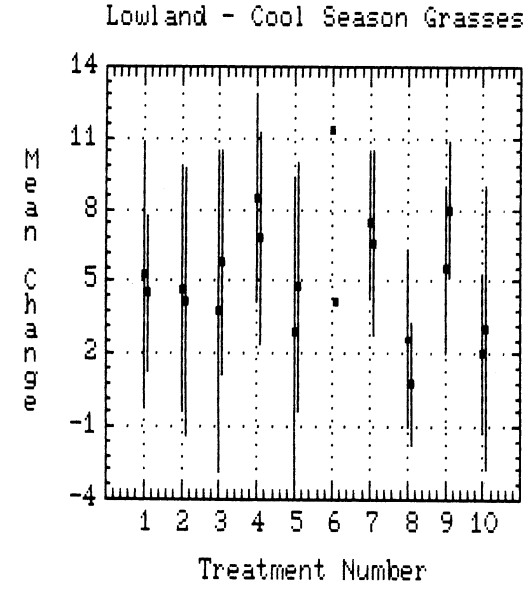
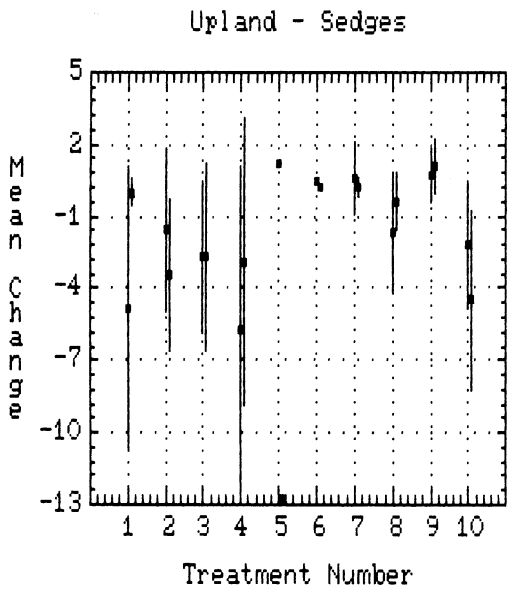
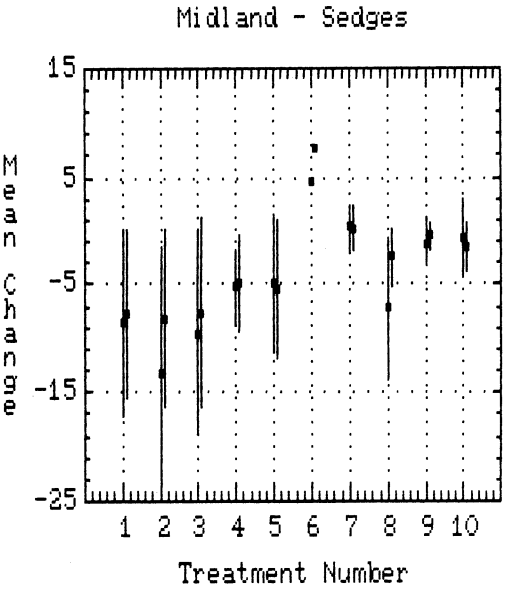


Fig. 2 Mean changes for cool season grasses in absolute basal cover between pretreatment and post treatment for ten grazing management treatments comparing grazed (point on left) and ungrazed (point on right) paired plots.





LEGEND

1. One Pasture, Seasonlong, Control
2. Two Pasture, Switchback, 3 Grazing Periods
3. Two Pasture, Switchback, 4 Grazing Periods
4. Three Pasture, Once Over, Deferred
5. Three Pasture, Once Over, Ungrazed
6. Three Pasture, Once Over, Mid Season
7. Three Pasture, Twice Over, Early-Late Season
8. Three Pasture, Twice Over, Early-Mid Season
9. Three Pasture, Twice Over, Mid-Mid Season
10. Three Pasture, Twice Over, Mid-Late Season

Left Point. Grazed Paired Plot

Right Point. Ungrazed Paired Plot

* P<0.05

\+ P<0.1

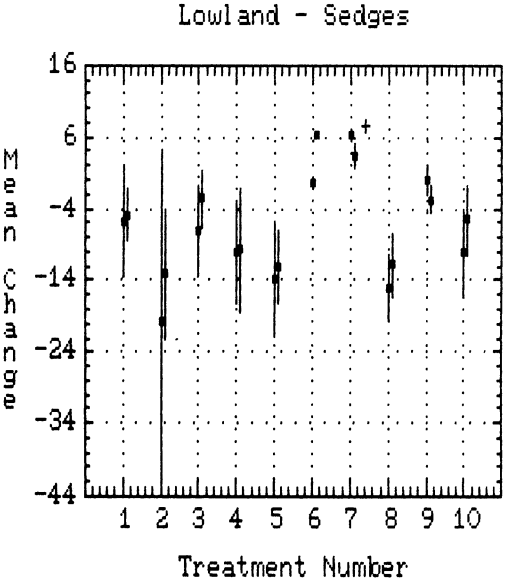
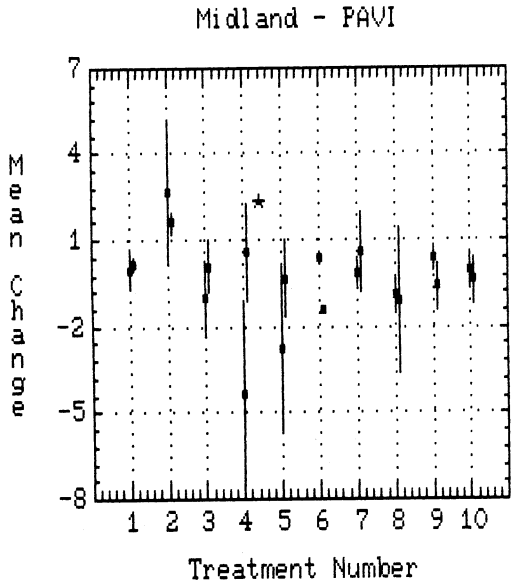


Fig. 3 Mean changes for sedges in absolute basal cover between pretreatment and post treatment for ten grazing management treatments comparing grazed (point on left) and ungrazed (point on right) paired plots.



LEGEND

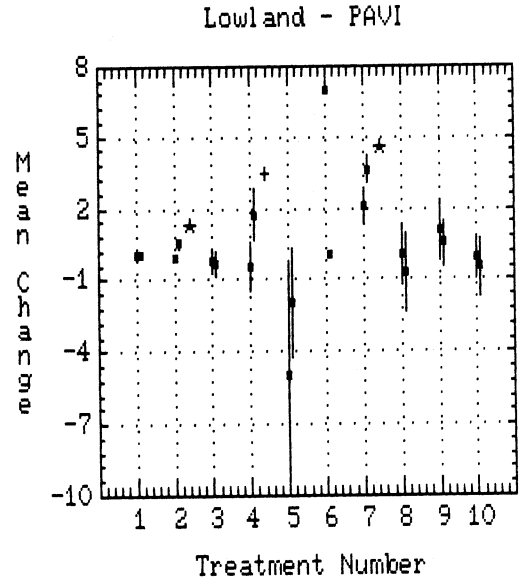
1. One Pasture, Seasonlong, Control
2. Two Pasture, Switchback, 3 Grazing Periods
3. Two Pasture, Switchback, 4 Grazing Periods
4. Three Pasture, Once Over, Deferred
5. Three Pasture, Once Over, Ungrazed
6. Three Pasture, Once Over, Mid Season
7. Three Pasture, Twice Over, Early-Late Season
8. Three Pasture, Twice Over, Early-Mid Season
9. Three Pasture, Twice Over, Mid-Mid Season
10. Three Pasture, Twice Over, Mid-Late Season

Left Point. Grazed Paired Plot

Right Point. Ungrazed Paired Plot

* P<0.05

\+ P<0.1



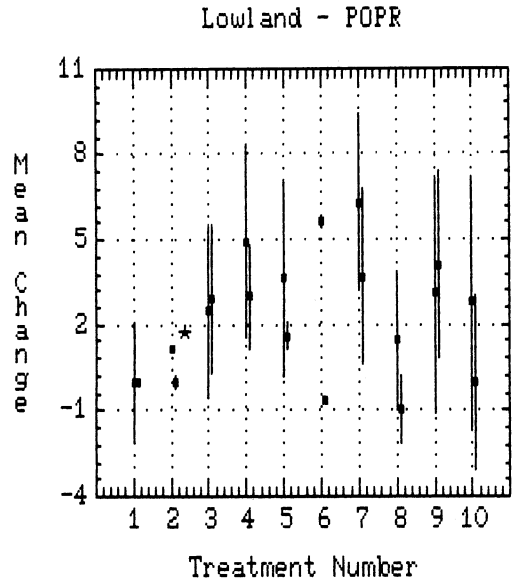


Fig. 4 Mean changes for Panicum virgatum (PAVI) and Poa pratensis (POPR) in absolute basal cover between pretreatment and post treatment for ten grazing management treatments comparing grazed (point on left) and ungrazed (point on right) paired plots.

basal cover in the lowland community decreased significantly (P<0.05) on the two pasture, thrice over treatment (#2) compared to the seasonlong treatment (#1). Basal cover of Panicum virgatum was significantly (P<0.05) increased in the lowland community on the three pasture, twice over grazed early and late season treatment (#7) compared to the seasonlong treatment (#1). Basal cover of Andropogon gerardi (Big bluestem), Andropogon scoparius (Little bluestem), Bouteloua gracilis (Blue grama), Calamagrostis inexpansa (Northern reedgrass), Koeleria pyramfdata (Prairie junegrass), Stipa comata (Needleandthread), Stipa curtea (Porcupine grass), Carex heliophila (Sun sedge), Carex lanuginosa (Woolly sedge) and Juncus balticus (Baltic rush) did not change significantly (P>0.05) for the ten grazing treatments.

Relative changes in basal cover on management treatments comparing grazed and ungrazed paired plots showed no significant changes in vegetation after one year of treatment on the seasonlong treatments (Ul) at significantly (P<0.05) lower stocking rates; or on two pasture, four times over (f3); three pasture, ungrazed (#5) three pasture, twice over grazed early-mid (#8); mid-mid (#9); and mid-late (#10) season treatments. Significantly negative effects on basal cover were shown by two pasture, thrice over (#2) and three pasture, once over, deferred (#4) treatments. Significantly positive effects on basal cover after one year of treatment was shown by the three pasture, twice over grazed early-late season (#7) treatments.

Visual obstruction measurements (VOM) were read spring and fall for 2 yearsalong permanent transects in 17 pastures with 5 grazing treatments (table 7). The grazing management of the previous year (1978) for these pastures were the same as 1979 and 1980 for each treatment except one replication of the three pasture, once over grazed mid season treatment. It was grazed for two periods in 1978. The replications in the 3 pasture, deferred category were deferred until September only in 1979. In 1978, each pasture was grazed for two periods with the second period ending in early or mid September. These pastures were ungrazed from September 1978 until September 1979. The one period of deferred grazing occurred during the late season from September to mid November 1979. In 1980, these pastures were again grazed two periods.

The general trend for the visual obstruction measurements (table 7) was for the readings of spring 1979 to be the starting value with an increase due to growth for the fall of 1979. The readings of spring 1980 were below fall 1979 readings primarily because of fall grazing after the readings were taken and snow pack. The fall 1980 readings again increased above spring readings due to plant growth.

The readings on the permanent transects (table 7) of the one pasture, seasonlong treatments were generally below the other treatments. The 100% VOM of the one pasture treatments were significantly (P<0.05) below the two pasture, switchback; three pasture, mid season; and three pasture, twice over in spring 1979, the three pasture, deferred in fall 1979, and the three pasture, deferred; three pasture, mid season; and three pasture, twice over in spring 1980. The one pasture, seasonlong treatment was significantly (P<0.05) above the three pasture, deferred in fall 1980. The 100% VOM of the one pasture, seasonlong treatments were below the minimum of 1.5 decimeters in both spring 1979 and 1980. The 100% VOM of the three pasture, deferred treatment was not significantly different (P>0.05) from the other rotation treatments in spring and fall 1979 and spring 1980. The 100% VOM for the deferred treatment was significantly below (P<0.05) the one pasture, seasonlong; three pasture, mid season; and three pasture, twice over treatments in fall 1980. The 100% VOM fall 1980 for the three pasture, deferred treatment was below the minimum of 1.5 decimeters. The 100% VOM for the two pasture, switchback; three pasture, once over mid season; and three pasture, twice over were not significantly different (P>0.05) for spring and fall 1979 and 1980.

The 0% VOM (table 7) for the three pasture, deferred treatment was significantly greater (P<0.05) than the other treatments in fall 1979 and spring 1980. The 0% VOM were very similar (P>0.05) for all other treatments.

Visual obstruction measurements from the permanent transects of the seasonlong treatments had 100% readings significantly below other treatments during the spring and below the minimum of 1.5 decimeters required to provide adequate concealment cover. The three pasture, once over deferred treatments had vegetation that was significantly taller but not significantly denser in the fall prior to the deferred grazing period than the rotation treatments that had been grazed. In the spring after the deferred grazing, the 0% VOM was still significantly taller and-the 100% VOM was not significantly different than the rotation treatments. At the end of the first growing season after deferred grazing, the 0% VOM was not significantly different and the 100% VOM was significantly below the readings from the rotation grazing treatments and below the minimum 1.5 decimeters. The visual obstruction readings for the two pasture, switchback, three pasture, once over mid season and three pasture, twice over treatments were not significantly different, and the 100% VOM's were above the minimum 1.5 decimeter level. The seasonlong grazing treatment and the three pasture, deferred treatment did not satisfactorily provide adequate concealment cover for prairie grouse.

Table 7. Visual obstruction measurements in decimeters from permanent transects read spring and fall of 1979 and 1980 for 1, 2 and 3 pasture grazing treatments. Means of same column followed by the same letter are not significantly different (P<0.05).

Treatment	Percent visual obstruction	1979		1980	
		Spring	Fall	Spring	Fall
1 Pasture, Control					
Seasonlong	0%	3.45 ± 0.15z	5.20 ± 0.10z	4.30 ± 0.0z	4.95 ± 0.25z
n = 2	100%	1.15 ± 0.15a	1.65 ± 0.25a	1.30 ± 0.0a	2.00 ± 0.10a
2 Pasture,					
Switchback	0%	5.10 ± 0.44y	5.63 ± 1.22z	4.90 ± 1.39zy	4.55 ± 1.06z
n = 4	100%	1.75 ± 0.23b	1.85 ± 0.56ab	1.45 ± 0.21ab	1.48 ± 0.47ab
3 Pasture, Once Over					
Deferred, Late	0%	4.97 ± 0.26y	7.93 ± 0.12y	5.83 ± 0.72x	4.08 ± 0.87z
n = 4	100%	1.50 ± 0.29ab	2.17 ± 0.17b	1.65 ± 0.11b	1.20 ± 0.25b
Mid Season	0%	5.05 ± 0.15y		4.97 ± 0.80zy	4.90 ± 0.88z
n = 3	100%	1.80 ± 0.40b		1.80 ± 0.43b	1.80 ± 0.29a
3 Pasture, Twice Over					
Early-Mid-Late	0%	4.57 ± 0.83y	5.28 ± 0.82z	4.68 ± 0.36y	4.95 ± 0.65z
n = 4	100%	1.53 ± 0.05b	1.83 ± 0.18ab	1.73 ± 0.22b	1.85 ± 0.30a

Table 8. Visual obstruction measurements in decimeters from nonpermanent transects read spring of 1979 or 1980 for 1, 2, and 3 pasture grazing treatments. Means of same column followed by the same letter are not significantly different (P<0.05).

Treatment	0% Visual Obstruction	100% Visual Obstruction
1 Pasture, Control		
Seasonlong	3.87 ± 0.43z	1.20 ± 0.12a
n = 4		
2 Pasture,		
Switchback	5.00 ± 1.03zy	1.60 ± 0.26b
n = 8		
3 Pasture, Once Over		
Deferred, Late	5.58 ± 0.71yx	1.64 ± 0.10b
n = 5		
Ungrazed (Fall)	7.10 ± 1.03x	2.12 ± 0.17c
n = 5		
Mid Season	4.73 ± 0.53zy	1.62 ± 0.23b
n = 6		
3 Pasture, Twice Over		
Early - Late	4.80 ± 0.50y	1.55 ± 0.05b
n = 2		
Early - Mid	4.88 ± 0.56y	1.44 ± 0.33b
n = 5		
Mid - Mid	5.00 ± 0.70y	1.70 ± 0.16b
n = 6		
Mid - Late	4.10 ± 0.42zy	1.68 ± 0.15b
n = 4		

The 0% and 100% VOM from the nonpermanent transects (table 8) were read in the spring of 1979 or 1980 in 40 pastures with 8 treatments. The nonpermanent transects in the deferred treatment were also read in the fall after one year of ungrazed treatment prior to the deferred grazing period in mid September. The 100% VOM for the one pasture, seasonlong treatment was significantly below ($P<0.05$) all other treatments. It was the only nonpermanent transect reading below the minimum of 1.5 decimeters. The fall 100% VOM for the three pasture, ungrazed was significantly greater ($P<0.05$) than all other treatments. The spring readings on the deferred treatments were significantly reduced ($P<0.05$) from the fall readings on the same transects in the ungrazed treatment. The spring 100% VOM of the three pasture, deferred treatment were not significantly different ($P>0.05$) than the other rotation grazing treatments. The 100% VOM spring readings for the two pasture, switchback; three pasture, once over, midseason; three pasture, twice over, grazed early-late; early-mid; mid-mid; and mid-late season were not significantly different ($P>0.05$)

The 0% VOM for the three pasture, ungrazed treatment was significantly taller ($P<0.05$) than all other treatments in the fall. It did not retain this height in the following spring after fall grazing. The three pasture, deferred treatment was not significantly different ($P>0.05$) from the other rotation grazing treatments (table 8).

Visual obstruction measurements from the nonpermanent transects showed that the seasonlong treatment did not provide adequate prairie grouse concealment cover. The visual obstruction for the three pasture, once over deferred treatment appeared impressive before the grazing period began but was no different than the rotation treatments the following spring after the deferred grazing treatment.

There were 30 active prairie grouse display grounds in the spring of 1975 and 54 in 1980 (Manske and Barker 1981). Twenty-seven grounds were active for the entire six year study period. The location of these grounds changed from the previous year on the average 2.6 $\pm$ 1.4 times in six years. Only two display grounds remained on the same 10 acre area for the duration of the study. These two grounds moved within that area. All 54 display grounds observed during this study changed locations from the previous year 62% of the time.

This high rate of changing locations of display grounds was different from the traditional concept of permanent locations for prairie grouse display grounds. The reasons that the display grounds on the Sheyenne National Grasslands changed locations frequently was primarily due to a relatively young population that was increasing and expanding and had not developed long term traditional locations and location changes as a response to the various grazing management treatments.

Twenty-six (48%) of the display grounds active in 1980 were new after 1974. Thirty-four (63%) were new after 1972 and forty-four (81%) were new after 1968 when rotation type grazing management was started on the Sheyenne National Grasslands. Most of the prairie grouse population increase and expansion occurred after 1968. Large increases in the population occurred between 1968 and 1972, 1973 and 1975, and 1978 and 1979. Large expansions into previously unoccupied habitat occurred between 1973 and 1974, and 1978 and 1979. A large increase in density of males per square mile of occupied habitat occurred between 1978 and 1979.

Use index (Robel et al. 1970b) by display grounds of various grazing management treatments (table 9) indicates that display grounds have preferably moved into pastures of 2, 3 and 4 pasture systems that had been grazed 2, 3 or 4 periods the previous year. Pastures of 3 and 4 pasture systems that had been grazed for only one period in mid season or deferred until September were not preferably used by prairie grouse for courtship display. The one pasture, seasonlong treatment was also not preferably selected for courtship display.

Six prairie chicken and eight sharp-tailed grouse nests (table 9) were found on federal land during this study. Five prairie chicken and six sharp-tailed grouse nests were located in pastures of 3 and 4 pasture systems that had been grazed for 2 or 3 periods the previous year. Three of these prairie chicken and 3 sharp-tailed grouse nests were successfully hatched and 2 prairie chicken and 3 sharp-tailed grouse nests were not successful. One prairie chicken and one sharp-tailed grouse nests were located in pastures that had been deferred from grazing until September the previous year. The sharp-tailed grouse nest was successful but the prairie chicken nest was not hatched. One sharp-tailed grouse nest was located in a one pasture, seasonlong treatment. It was not successfully hatched. The majority (79%) of the prairie grouse nests found during this study were located in pastures that had been grazed for 2 or 3 periods the previous year.

SUMMARY

Grazing by domestic livestock on grasslands effects the plant communities differentially depending on season of use, intensity of grazing and duration of grazed and ungrazed periods. Prairie grouse depend on grassland plant communities to provide for their various habitat requirements. Prairie grouse populations respond to the differential changes in grassland vegetation resulting from various grazing management treatments.

Table 9. Use index for display ground locations and number of nest locations for 1, 2, 3 and 4 pasture grazing treatments.

Treatment	Use Index Display Grounds 1975 - 1980	Number of Nests Prairie Chicken	Number of Nests Sharp-tailed Grouse
1 Pasture, Control Seasonlong	0.72 ± 0.47	0	1
2 Pasture			
1 Over	1.05 ± 0.30	0	0
2, 3, & 4 Over	1.64 ± 0.17	0	0
3 Pasture			
Deferred, Late	0.53 ± 0.45	1	1
1 Over	0.84 ± 0.16	0	0
2 & 3 Over	1.06 ± 0.14	3	6
4 Pasture			
Deferred, Late	0.54 ± 0.54	0	0
1 Over	0.56 ± 0.06	0	0
2 & 3 Over	1.33 ± 0.29	2	0

Seasonlong grazing treatments showed no benefit to grass basal cover even at low stocking rates. Spring 100% visual obstruction measurements (VOM) were below rotation grazing treatments. These readings were below the minimum 1.5 decimeter level and did not provide adequate prairie grouse concealment cover for nesting or roosting. Prairie grouse select against seasonlong grazing treatments for spring courtship display ground and nest locations.

Two pasture systems with three grazing periods showed reduction in basal cover of warm season grasses and switchgrass on the lowland plant community. These decreases were greater on the two pasture, thrice over treatments than on the seasonlong treatments. Basal cover of vegetation on the two pasture, four times over was not significantly changed. Pastures in two pasture treatments should be managed with no less than four grazing periods. Spring 100% VOM readings were greater on two pasture treatments than one pasture, seasonlong treatments and were not different than readings from three pasture rotation treatments for permanent and non-permanent transects. Prairie grouse selected pastures managed with two pasture grazing treatments for courtship display locations but not for nest site locations.

Pastures grazed for one period during mid season, June to September, showed no positive response in grass basal cover but did show significantly greater 100% VOM readings compared to seasonlong grazing treatments. Prairie grouse did not select for pastures managed with one mid season grazing period for display ground and nest locations.

Three pasture, once over deferred grazing treatments had 11 to 13 months of ungrazing prior to the deferred grazing treatment. No changes in basal cover of the vegetation occurred during this one year ungrazed period. The vegetation height did visually appear to be impressive as prairie grouse habitat after one year of ungrazing. The 0% VOM was significantly taller than grazed treatments but the 100% VOM was not different than rotation grazed treatments. After 60 days of grazing during the late season, the 0% VOM was reduced but still taller than the other treatments and the 100% VOM was greatly reduced but not different than rotation treatments in the spring. The deferred grazing treatment was intended to delay grazing pressure on one pasture in a system until after grass seed development which occurrs by late August or early September for the purpose of improving grass plant density but deferred grazing decreases basal cover of warm season grasses and reduces basal cover of switchgrass on the midland and lowland plant communities. The 100% VOM was significantly decreased during the first growing season after deferred treatments and the level fell below the minimum of 1.5 decimeters. Prairie grouse select against pastures managed with deferred grazing the previous year for spring display ground locations. Deferred grazing is not a desirable grazing treatment for grassland vegetation and prairie grouse.

Three pasture, twice over treatments were grazed early-late, early-mid, mid-mid, and mid-late season of use. Warm season grasses and switchgrass on the midland and lowland communities and sedges on the lowland communities increased in basal cover on pastures managed with two grazing periods compared to pastures managed with one pasture, seasonlong treatments. The 100% VOM on pastures with two grazing periods was significantly greater than on pastures grazed seasonlong. Prairie grouse select -for pastures with two or three grazing periods for display

ground and nest locations. Management treatments with the pastures grazed for two periods showed benefit to grassland vegetation, prairie grouse habitat and prairie grouse populations. Treatments with twice over grazing on each pasture should be used to manage the allotments on the Sheyenne National Grasslands.

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