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Effects of Grazing Systems on Sharp-tailed Grouse Habitat

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EFFECTS OF GRAZING SYSTEMS ON SHARP-TAILED GROUSE HABITAT

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This thesis is approved as a creditable and independent investigation by a candidate for the degree, Master of Science, and is acceptable as meeting the thesis requirements for this degree, but without implying that the conclusions reached by the candidate are necessarily the conclusions of the major department.

Thesis Advisor

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EFFECTS OF GRAZING SYSTEMS ON SHARP-TAILED GROUSE HABITAT

Abstract

SAMUEL N. MATTISE

Effects of grazing systems on sharp-tailed grouse (*Pedioecetes phasianellus jamesi*) nesting and brooding habitat in the Little Missouri National Grasslands of southwestern North Dakota were evaluated. Three grazing allotments with deferred-rotation grazing systems and three allotments with season-long grazing systems were randomly selected for study. Fifty measurements of vegetation were taken using the height-density pole on line transects in each of three range sites; rolling grasslands, upland grasslands and lowland draws. Vegetation was sampled in late spring, summer and fall of 1976 and early spring of 1977. Average height-density of vegetation for the season-long grazing system was significantly greater than vegetation in the deferred-rotation system ($P < 0.01$). Average visual obstruction readings (VOR) were $1.10 \pm .02$ for the season-long systems and $0.75 \pm .02$ for deferred-rotation systems. Grazing allotments utilizing the season-long grazing system had consistantly higher VOR averages than allotments with the deferred-rotation system in all four sampling periods. Visual obstruction readings increased from late spring

(1.15 ± .03) to summer (1.32 ± .03) and decreased in the fall (0.69 ± .03). The following early spring, VOR average decreased to 0.55 ± .03. Vegetation around six stock ponds in each grazing system was measured on three line transects radiating from each pond. Fifty measurements of vegetation were taken in six 91.4 m segments during the summer and fall 1976. Visual obstruction readings of vegetation around ponds in season-long systems were significantly higher ($P < 0.05$) than VOR of vegetation around ponds in deferred-rotation systems. Height and density of vegetation became uniform beyond 182.8 m from each pond edge. The use of the deferred-rotation grazing system may be detrimental to vegetation cover types used by sharptails for nesting and brooding. A re-evaluation of the range capacity ratings and land management techniques on the grasslands will benefit sharp-tailed grouse habitat in southwestern North Dakota.

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INTRODUCTION

The plains sharp-tailed grouse (*Pediocetes phasianellus jamesi*) is found throughout North Dakota with highest populations in the western part of the state. There are 404,700 ha of public land in western North Dakota (U.S.D.A. 1974). Most of this land is situated in the Little Missouri National Grasslands (357,220 ha) of the Custer National Forest and is administered by the U.S. Forest Service. Approximately 23 percent of these grasslands have planned grazing systems, which are implemented either by the U.S. Forest Service or developed by individual ranchers. The use of grazing systems has been initiated to prevent over-utilization of vegetation and subsequent damage to the grasslands. Over-utilization of vegetation causes a decline in sharp-tailed grouse nesting and brooding habitat (Sisson 1976). Grazing systems that leave areas of taller vegetation are needed to provide cover for nesting and brooding sharptail hens (Kohn 1976).

The objectives of my study were: (1) to evaluate effects of season-long and deferred-rotation grazing systems on sharp-tailed grouse nesting and brooding habitat; and (2) to measure effects of grazing on vegetation near man-made livestock ponds.

STUDY AREA

Billings County, southwestern North Dakota, lies on the gently sloping plain known as the Missouri Plateau and overlies the Fort Union formation of the tertiary period (Edwards and Ableiter 1944). This formation is composed of stratified sand, silt and clay interspersed with beds of lignite with upper layers composed of sandstone and shale. Topography of the area varies from gently rolling grasslands, the dominant vegetational plant community, to badland geologic features.

The climate is semi-arid and continental, characterized by long winters and short summers. Precipitation is light to moderate and tends to be irregular in distribution with an average annual rate of 38 cm with 59 percent falling between May and August (U.S.D.A. 1974). Average annual snowfall ranges from 76 cm to 86 cm, but high winds usually prevent uniform accumulation (U.S.D.A. 1974).

Native vegetation of Billings County consists mainly of short grasses with some tall grass species. Crested wheatgrass (*Agropyron cristatum*), an introduced cool season species, is usually grazed in early spring before native vegetation is utilized.

Common grass species found in the study area include: blue grama (*Bouteloua gracilis*), little bluestem (*Andropogon scoparius*), needle and thread (*Stipa comata*), western wheatgrass

(*Agropyron smithii*), june grass (*Koeleria cristata*), green needle (*Stipa viridula*), side-oats grama (*Bouteloua curtipendula*), buffalo grass (*Buchloe dactyloides*), and big bluestem (*Andropogon gerardi*).

Trees and shrubs are found in draws, creek bottoms, hillsides and shelterbelts. Common tree species are green ash (*Fraxinus pennsylvanica*), Rocky Mountain red cedar (*Juniperus scopulorum*) and American elm (*Ulmus americana*). Common shrubs are buffalo-berry (*Shepherdia argentea*), wolfberry (*Symhoricarpos occidentalis*), sages (*Artemisia* spp.), wild plum (*Prunus americana*), juneberry (*Amelanchier alnifolia*), prairie wildrose (*Rosa arkansana*) and creeping juniper (*Juniperus horizontalis*). Scientific names of plants were taken from Stevens (1963).

Sharp-tailed grouse populations in Billings County have increased in the last 12 years (Table 1). The lowest population occurred in 1970 with 0.96 males/k^2 and the highest population occurred in 1976 with 2.63 males/k^2 (Kobriger 1973, 1976). The average number of males counted on dancing grounds for the 12 years between 1966 and 1977 was 1.82/k^2.

Table 1. Summary of sharp-tailed grouse dancing ground counts in Billings County, North Dakota, 1966-1977 (Kobriger 1973, 1975, 1976, 1977).

Year	No. of males	Males/k^2 [a]
1966	219	1.38
1967	236	1.48
1968	255	1.60
1969	199	1.25
1970	153	0.96
1971	225	1.41
1972	341	2.14
1973	380	2.39
1974	378	2.37
1975	339	2.13
1976	419	2.63
1977	326	2.05
Average		1.82

[a]Values were calculated from data given by author.

METHODS

Grazing Systems Analysis

Three grazing allotments with season-long grazing systems and three allotments with deferred-rotation grazing systems in the Little Missouri National Grasslands were randomly selected for vegetation sampling. Explanation of operating procedures for both grazing systems is in Appendix A. Allotments were grazed using the animal units per month (AUM) rating given each allotment by the U.S. Forest Service.

Pastures within allotments were covermapped by six range sites; rolling grasslands, upland grasslands, lowland draws, terraced areas, hardwood draws, and upland breaks (Appendix C). Of the six range sites, vegetation was sampled in rolling grasslands, upland grasslands and lowland draws These range sites were the most important cover types on the study area for nesting and brooding sharptails (Kohn 1976)

The rolling grassland range site was the dominant range site in the six grazing allotments and occupied more than half of the study area. This range site consisted of gently rolling topography with vegetation consisting primarily of native grass species, such as little bluestem and western wheatgrass, forbs and shrubs

The upland grassland range site was located bordering a hardwood draw It was usually found on a gentle slope with woody plant species, such as buffaloberry, commonly mixed with grasses and forbs.

The lowland draw range site included drainages and brushy draws. The vegetation consisted of brushy species such as prairie wild rose and wolfberry with a mixture of grasses and forbs.

Areas to be measured in the three range sites were selected at random. If duplicate range sites were present in one pasture, the site to be sampled was also selected randomly. The three range sites used for sampling were not found in all pastures.

Measurements were made in late spring, summer and fall of 1976 and early spring of 1977 using a visual obstruction pole similar to one developed by Robel et al. (1970). The pole was made from a 4 cm pipe 183 cm in length with alternating 7.5 cm black and white sections. The midpoint of each section was marked with a red stripe. A rod, marked at 1.0 m and attached to the pole with a string 4.0 m long, was used to standardize observation heights. The pole was placed vertically in the vegetation and observed from a height of 1.0 m and at a distance of 4.0 m. The lowest 7.5 cm section or half section on the pole completely covered by vegetation was the visual obstruction reading (VOR).

Fifty measurements were taken along 29 transects during each of the four sampling periods. Transects were established on randomly selected bearings from a reference point in each selected range site. Visual obstruction readings were recorded every 10.0 m in the rolling grasslands range site and every 5.0 m in the upland grassland and lowland draws range sites.

Analysis of Vegetation Around Ponds

Visual obstruction readings were made in vegetation around six livestock watering ponds selected from allotments with season-long grazing systems and six ponds in allotments with deferred-rotation systems to estimate utilization of vegetation around watering areas. Three line transects were established in an outward direction from each pond along randomly selected bearings.

A maximum of 300 VOR was recorded per transect. Some transects were shortened because of obstructions such as hardwood draws and fences. Measurements were taken in increments of 50 readings per 91.4 m for a distance of 548.4 m. Over 18,000 measurements of vegetation were taken during the summer and fall of 1976.

RESULTS AND DISCUSSION

Grazing Systems Analysis

Hierarchal analysis of VOR indicated significant differences ($P < 0.01$) among grazing systems and among seasons (Table 2). In both deferred-rotation and season-long grazing systems, the summer season had the highest VOR and the early spring season the lowest (Table 3). The season-long grazing system exhibited significantly higher ($P < 0.01$) VOR than the deferred-rotation system through all seasons. The overall VOR means for the season-long system was $1.10 \pm .02$, while the average VOR in deferred-rotation system was $0.75 \pm .02$. The higher means indicated better sharptail nesting and brooding habitat in season-long systems than in deferred-rotation systems.

Allotments with the season-long system had consistently higher VOR than allotments with the deferred-rotation system (Table 4). The lowest average recorded in the season-long system was $0.93 \pm .04$ (Allotment F), while the highest average recorded in the deferred-rotation system was $0.88 \pm .03$ (Allotment C). Differences of VOR in allotments indicated that over-utilization was detrimental to sharptail nesting and brood habitat. The use of the deferred-rotation grazing system may cause uniform grazing through the entire allotment. Intensely grazing three or four smaller pastures in an allotment, as in the deferred-rotation system, may result in a loss of cover

Table 2. Hierarchal analysis of variance for vegetation measurements taken in allotments with deferred-rotation and season-long grazing systems.

Source	DF	SS	MS
Grazing Systems (G)	1	17,096.63	17,096.63**
Seasons (S)	3	54,945.34	18,315.12**
G x S	3	729.48	243.16
Operators (O) /GS	16	13,349.51	843.35
Pastures (P) /OGS	42	64,887.58	1,544.94
Range Sites (R) /POGS	39	195,321.91	5,008.25**
Transects /RPOGS	18	16,063.25	892.40**
Residual	6027	433,748.88	71.97

**($P < 0.01$)

Table 3. Average VOR for deferred-rotation and season-long grazing systems by seasons.

	Average VOR ($\bar{X} \pm SD$) by seasons	
Seasons	Deferred-rotation	Season-long
Late Spring	1.00 ± .04	1.29 ± .04
Summer	1.18 ± .04	1.45 ± .05
Fall	0.46 ± .04	0.92 ± .05
Early Spring	0.36 ± .05	0.74 ± .05
Average	0.75 ± .02	1.10 ± .02**

**($P < 0.01$)

Table 4. Average VOR in deferred-rotation and season-long grazing systems by seasons.

Allotments	Average VOR ($\bar{X} \pm SD$) by Seasons				
	Late Spring	Summer	Fall	Early Spring	Average
			Deferred-rotation		
A	1.09 ± .06	1.33 ± .06	0.45 ± .06	0.31 ± .06	0.79 ± .03
B	0.85 ± .08	0.96 ± .08	0.29 ± .08	0.23 ± .08	0.58 ± .04
C	1.07 ± .05	1.26 ± .05	0.66 ± .05	0.54 ± .05	0.88 ± .03
			Season-long		
D	1.32 ± .07	1.57 ± .07	1.17 ± .05	0.89 ± .09	1.24 ± .03
E	1.30 ± .07	1.59 ± .08	1.08 ± .08	0.61 ± .08	1.14 ± .04
F	1.28 ± .09	1.20 ± .09	0.50 ± .09	0.72 ± .09	0.93 ± .04

in some parts of a pasture which normally would only be lightly grazed in the one large pasture of the season-long system.

Visual obstruction readings for allotments by seasons (Table 4) indicated that allotments with the season-long system had consistently higher VOR in all seasons than allotments under a deferred-rotation system. All allotments with the season-long system had average VOR above 1.25 in late spring. Visual obstruction readings in Allotments D and E increased in the summer to above 1.5 while Allotment F decreased. During the fall, there was a 0.7 VOR difference between the high and low VOR means with Allotments D and E still above 1.0. Allotment F was the only allotment to increase in the early spring suggesting that it was productive land but was more heavily grazed than the other allotments during the grazing season.

Another indication of over-utilization of the vegetation by grazing may be seen in pastures of Allotment A (Table 4). Visual obstruction readings for all allotments increased in the summer with VOR means in Allotments A and C above 1.25. From the summer sampling period to the early spring sampling period, VOR in Allotment A decreased at a greater rate than VOR in the other two allotments, dropping from a 1.33 in the summer to a 0.3 in the early spring. This decrease suggests a mismanagement of the land resource.

Analysis using multiple regression was conducted on VOR collected in the fall and early spring to predict nesting habitat the following spring from vegetation measurements taken in the fall. The quadratic equation gave the best estimate (P 0.05) for the deferred-rotation system and the linear equation gave the best estimate (P 0.01) for the season-long system (Table 5).

Estimates from correlation coefficients indicated that 18 percent of the variability of the vegetation height-density in the spring was explained by quadratic regression equation of spring vegetation VOR on fall vegetation VOR in allotments with a deferred-rotation system. For the season-long grazing system only 12 percent of the variability could be explained.

With only one fall-spring interaction available, a definite estimate could not be made. The analysis did indicate that height-density of vegetation in the fall had an affect on nesting habitat in the spring.

Range Site Analysis

The VOR for range sites within an allotment were significantly different because of the combinations of plant species associated with each range site. All allotments contained at least two of the range sites sampled, but no allotment contained all three.

The highest average VOR (1.60) within range sites occurred in the upland grassland range site (Table 6). This range site also had the highest average (1.59) for range sites in the

Table 5. Regression of spring vegetation VOR on fall vegetation VOR for grazing systems sampled in the project.

Grazing System	Degree of Polynomial	Intercept	$b_{y.x}$	$b^2_{y.x}$	R^2
Deferred-rotation	1	0.21	0.37	--	0.17
	2	0.18	0.54	-0.10*	0.18
Season-long	1	0.37	0.36**	--	0.12
	2	0.36	0.38	0.01	0.12

*(P 0.05)

**(P 0.01)

Table 6. Average VOR for range sites in deferred-rotation (D.R.) and season-long (S.L.) grazing systems.

	Average VOR by Seasons					
Range Site	Late Spring	Summer	Fall	Early Spring	Average	
Rolling Grasslands						
D.R.	0.37	0.44	0.26	0.19	0.31	
S.L.	1.02	1.01	0.65	0.49	0.79	
Combined Average						0.56
Upland Grasslands						
D.R.	2.25	2.41	0.99	0.74	1.59	
S.L.	1.67	2.13	1.59	1.05	1.61	
Combined Average						1.60
Lowland Draw						
D.R.	2.35	2.55	0.39	0.54	1.46	
S.L.	2.14	2.20	0.80	1.43	1.64	
Combined Average						1.55

deferred-rotation system. It had a late spring VOR of 2.25 and a summer VOR of 2.41. Average VOR was 1.61 for the upland grassland ranges in the season-long system. Visual obstruction readings stayed above 1.0 through all seasons in the season-long system but decreased below 1.0 in the fall for allotments with the deferred-rotation system.

The lowland draw range site was found in only one allotment per grazing system. The highest average VOR (1.64) for this range site was in the season-long system with a late spring average VOR of 2.14 and a summer average VOR of 2.20 (Table 6). The lowland draw range site had higher VOR (2.35 and 2.55) for the late spring and summer in the deferred-rotation system than in the season-long system, but lower VOR in the fall sampling period.

The rolling grassland range site had the lowest overall average VOR (0.56) for range sites (Table 6). In the season-long system it had VOR over 1.0 both in the late spring and summer sampling periods. In the same periods, the deferred-rotation system had VOR of 0.37 for late spring and 0.44 for the summer.

Analysis of Vegetation Around Ponds

Least squares analysis indicated that height-density of vegetation around ponds located in season-long grazing systems was significantly greater (P 0.05) than height-density of

Average VOR for ponds in the season-long system were higher than averages recorded for ponds in the deferred-rotation system in both sampling periods (Table 7). The lowest average VOR (0.24 ± .005) for the season-long system was recorded in the fall and was higher than the highest average (0.15 ± .005) recorded for the deferred-rotation system.

Hierarchal analysis of variance of VOR around ponds indicated that the vegetation in the two grazing systems was significantly different (P 0.05) (Table 8). There were also highly significant differences (P 0.01) among ponds within grazing systems (Table 8). Ponds located in season-long grazing systems had total average VOR ranging from 0.54 ± .01 to 0.08 ± .008, while ponds in deferred-rotation systems had total averages ranging from 0.19 ± .008 0.07 ± .01 (Table 7). Average VOR for pastures in which ponds were located were higher than VOR averages for vegetation around ponds in the same pasture (Table 9 and Appendix B).

Hierarchal analysis of variance (Table 8) indicated that the interaction of distances within ponds was highly significant (P 0.01). Vegetation height-density around ponds in the deferred-rotation system showed an increase in VOR up to 457.0 m (Table 10). Range for the means was from 0.08 at 91.4 m to 0.18 at 457.0 m. Height-density of vegetation seemed to show uniformity from 182.8 m to the 365.6 m after which VOR increased.

Table 7. Average VOR for vegetation around ponds sampled in allotments with deferred-rotation and season-long grazing systems by seasons.

	Average VOR ($\bar{X} \pm$ SD) by Seasons		
Pond No.	Summer	Fall	Average
		Deferred-rotation	
1	0.09 ± .01	0.09 ± .01	0.09 ± .008
2	0.12 ± .01	0.09 ± .01	0.10 ± .008
3	0.17 ± .01	0.18 ± .01	0.18 ± .009
4	0.06 ± .01	0.09 ± .01	0.07 ± .01
5	0.17 ± .01	0.19 ± .01	0.18 ± .008
6	0.25 ± .01	0.15 ± .01	0.19 ± .008
Average	0.15 ± .005	0.13 ± .005	0.14 ± .003
		Season-long	
1	0.29 ± .01	0.15 ± .01	0.22 ± .009
2	0.06 ± .01	0.10 ± .01	0.08 ± .008
3	0.17 ± .01	0.17 ± .01	0.17 ± .008
4	0.34 ± .01	0.26 ± .01	0.29 ± .008
5	0.22 ± .01	0.17 ± .01	0.19 ± .008
6	0.51 ± .02	0.57 ± .02	0.54 ± .01
Average	0.26 ± .005	0.24 ± .005	0.25 ± .004*

*($P < 0.05$)

Table 8. Hierarchal analysis of variance for vegetation around ponds sampled in allotments with deferred-rotation and season-long grazing systems.

Source	DF	SS	MS
Grazing Systems (G)	1	5,499.52	5,499.52*
Seasons (S)	1	180.59	180.59
G X S	1	27.26	27.26
Ponds (P) /GS	20	15,098.23	754.91**
Transects (T) /PGS	48	7,182.92	149.64**
Distance /TPGS	312	15,901.36	50.97**
Residual	17,930	182,171.03	10.16

*(P < 0.05)

**(P < 0.01)

Table 9. Comparison of VOR averages of vegetation around ponds to VOR averages in pastures where the ponds were located.

Pond No.	VOR Averages	
	Pond	Pasture
	Deferred-rotation	
1	0.09	0.19
2	0.10	0.19
3	0.18	0.52
4	0.07	0.20
5	0.18	0.47
6	0.19	0.47
	Season-long	
1	0.22	0.44
2	0.08	0.25
3	0.17	0.84
4	0.29	0.54
5	0.19	0.49
6	0.54	1.04

Table 10. Average VOR of vegetation at six distances from ponds in season-long and deferred-rotation grazing systems by seasons.

Seasons	Distance in Meters 91.4	182.8	274.2	365.6	457.0	548.4
			Deferred-rotation			
Summer	0.09	0.14	0.14	0.15	0.19	0.18
Fall	0.07	0.12	0.13	0.15	0.18	0.16
Average	0.08	0.13	0.14	0.15	0.19	0.17
			Season-long			
Summer	0.14	0.26	0.23	0.27	0.27	0.31
Fall	0.12	0.25	0.23	0.20	0.17	0.26
Average	0.13	0.26	0.23	0.23	0.22	0.28

The VOR of vegetation at different distances from ponds in the season-long grazing system exhibited an increase from 0.13 at 91.4 m to 0.26 at 182.8 m (Table 10). The range of means was from 0.13 at 91.4 m to 0.28 at 548.4 m. The deferred-rotation system did not reach a mean of 0.13 until 182.8 m. The reason for the high VOR at 182.8 m in the season-long system was the 0.7 VOR mean recorded at this distance by pond 6 (Appendix B).

The difference in VOR for distance by seasons for ponds in the deferred-rotation system was 0.02 between the summer and fall sampling periods (Table 10). Visual obstruction readings seemed to become uniform between 182.8 m and 457.0 m for the summer sampling period. This pattern was also observed in the fall sampling period. Visual obstruction readings for the summer sampling period ranges from 0.09 to 0.19 while the fall period VOR ranged from 0.07 to 0.18.

Visual obstruction readings means for distance by season for ponds in the season-long grazing system ranged from 0.14 to 0.31 for the summer sampling period (Table 10). Vegetation height-density seemed to become uniform at 365.6 m with a mean of 0.27, but then increased to 0.31 at 548.4 m.

The pattern of VOR for fall was similar to the pattern for summer up to 274.2 m. A decrease occurred at 365.6 m which continued through the 457.0 m. The decrease was from 0.23 to 0.17 with an increase to 0.26 occurring at 548.4 m. The range of the fall sampling period was from 0.12 to 0.26 with almost all means in the season-long system higher than the deferred-rotation system at corresponding distances in both seasons.

CONCLUSIONS

The primary objective of any grazing system is to graze the range without causing detrimental effects to pasture vegetation. When excessive grazing occurs, maintenance of vegetation density is impossible (Weaver 1954). Over-stocking of a grassland ecosystem leads to destruction of vegetation used by nesting sharp-tail hens and also damages the woody cover used by sharptail broods. Declines of sharp-tailed grouse populations caused by intensive grazing have been noted by Brown (1963), Pepper (1972), Kohn (1976), Sisson (1976) and Yde (1977).

In this project, pastures grazed with a season-long grazing system produced better grassland habitat for sharp-tailed grouse than pastures with a deferred-rotation grazing system. The pasture vegetation in a season-long system had significantly higher ($P < 0.01$) VOR than vegetation in a deferred-rotation system with overall VOR means of $1.10 \pm .02$ for the season-long system and $0.75 \pm .02$ for the deferred-rotation system. Kohn (1976) stated that average VOR at sharptail nesting and brooding sites was directly related to the average VOR in pastures in which the sites were located. He found only 9 percent of sharp-tail nests and 3 percent of brood sites in pastures with average VOR of less than 1.0.

The three allotments with season-long grazing systems had average VOR over 1.25 for the late spring sampling period and over 1.50 for two of three allotments in the summer period. Allotments with deferred-rotation systems had average VOR of 1.25 until the summer sampling period. Kohn (1976) found most sharptail nests in pastures where grassy areas had average VOR of 1.25.

Uniform grazing was observed in most pastures utilizing the deferred-rotation system but was not as noticeable in pastures using the season-long system. Usually cattle are topographically selective in grazing a pasture and areas not easily accessible are lightly grazed or not grazed at all. In a deferred system, because of smaller pastures, cattle are forced to graze areas that would normally be left untouched in a season-long system.

Allotment permittees using a deferred-rotation system tend to abuse the grassland by uniformally grazing their pastures. Cattle movement between pastures in a deferred-rotation system must be based on vegetation utilization and not calender dates as they are in the allotments I studied. When utilization of vegetation reaches approximately 50 percent, cattle should be rotated to the next pasture. The season-long grazing system may be more applicable to the area because rotation is not necessary and uniform grazing is less likely to occur.

An estimate of spring nesting cover could not be predicted from vegetation measurements taken in the fall with the data available. Analyses indicated that the variability of height and density of vegetation in the spring can be explained by the variability of height and density of vegetation in the fall.

Spring and summer are the most critical seasons to have quality nesting and brood rearing cover for sharptails. Kohn (1976) stated that nesting hens utilized whatever cover was available and that anything affecting nesting cover also affected brood rearing cover.

The upland grassland range site had the highest average VOR for all range sites. It had VOR averages above 2.0 in both the summer and late spring in the deferred-rotation system. In the season-long system, the average VOR for the range sites were above 2.0 only for the summer sampling periods.

In lowland draw range site, both grazing systems had VOR averages over 2.0 in late spring and summer sampling periods. Both lowland draw and upland grassland range sites had concentrations of woody plant species. Kohn (1976) stated that woody cover was more important to sharptail broods than nesting hens.

Rolling grassland was the dominant range site of the study area. It had the lowest VOR averages for all range sites sampled.

In the season-long grazing system, VOR in this range site in both the late spring and summer sampling periods were considerably higher than VOR in the deferred-rotation system. Rolling grassland is the most important range site and is used most frequently by nesting and brooding sharptails. Kohn (1976) found 38 of 43 sharptail nests in the rolling grassland range site. Bernhoft (1969) and Christenson (1971) also observed that nesting sharptails favored the rolling grassland range site. Kohn (1976) also observed that sharptail broods favored this range site with 76 of 93 broods flushed from rolling grasslands.

The season-long grazing system provided better habitat for nesting and brooding sharptails than the deferred-rotation system. Pastures with deferred-rotation systems had uniform grazing and therefore provided less sharptail habitat.

Water is sometimes difficult to obtain and its sporadic distribution may cause range utilization problems in semi-arid regions. When available watering points are infrequent, a large number of animals using a single watering point results in widespread erosion (Stoddart et al. 1975). Intensive use also results in deterioration of forage resources near the water supply and reduces utilization of forage at longer distances from water (Vallentine 1974).

Visual obstruction readings around ponds located in season-long systems were significantly higher ($P<0.05$) than VOR around ponds located in deferred-rotation systems. The average VOR for each pond in both grazing systems was below 1.0 and over-utilization of vegetation was prevalent around all ponds.

Lange (1969) found that during the grazing season, livestock in a semi-arid area had an effect on vegetation around watering areas. He stated that these areas were usually over-grazed and exhibited land damage due to deep ruts cut into the soil by traveling animals. In my study, the area between pond edge and 182.8 m exhibited nearly 100 percent utilization. Studies in eastern Montana, (Holscher and Woolfolk 1953) indicated that forage utilization reached 100 percent around water but declined gradually as distance from water increased.

Martin and Ward (1970) noted that average utilization was higher near water than for areas 0.8 k or more from water. They stated that utilization of perennial grasses 91.4 m to 457.0 m from water varied with production of perennial grasses and topography. Vegetation around ponds started to achieve a uniform VOR at 182.8 m, but VOR averages for vegetation at distances from pond edge through 548.4 m were all below 1.0. Henderson (1964) stated that ponds in the grasslands of western South Dakota resulted in increased grazing and reduction of growth of vegetation in the area of the dam.

In both pond vegetation measurements and pasture vegetation measurements the season-long grazing system proved to be the most suitable grazing system for this grassland ecosystem. The grasslands of southwestern North Dakota would benefit from a re-evaluation of range capacity and land management techniques. Land allotments utilizing a deferred-rotation system on public lands should be reviewed to observe whether uniform grazing is present and to record the effects that over-utilization has on the grassland habitat.

In the northern Great Plains, sharp-tailed grouse depend upon the grassland ecosystem for nesting and brooding habitat. If this habitat is destroyed by over-utilization of the vegetation by grazing or other agricultural practices, the sharptail grouse population will vanish.

RESEARCH RECOMMENDATIONS

Estimates of spring nesting cover from fall vegetation measurement would be an asset in managing sharp-tailed grouse. The one season of data I collected did not permit a reliable estimate. Visual obstruction readings could be taken in areas of high grouse concentrations in the fall and again in the spring. An estimate of the nesting cover available might permit the biologist to estimate the fall grouse population.

Further research on the effects of grazing systems upon sharp-tailed grouse habitat should include measuring allotments with a rest-rotation grazing system as well as the deferred-rotation and season-long systems. A comparison could be made to find the differences in cover availability between the three systems. Pastures with the season-long system could also be compared with pastures in allotments with the deferred-rotation system that are deferred in the spring. Allotments to be used in this type study should be managed under close supervision. It is imperative that the number of cattle grazed complies with the AUM rating given each allotment and that the movement of these cattle complies with the dates set forth on the grazing plan. Research might also be conducted to find a plant species or plant community common to the area that could be used as an indicator of good sharptail habitat.

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APPENDICES

Appendix A. Grazing Systems.

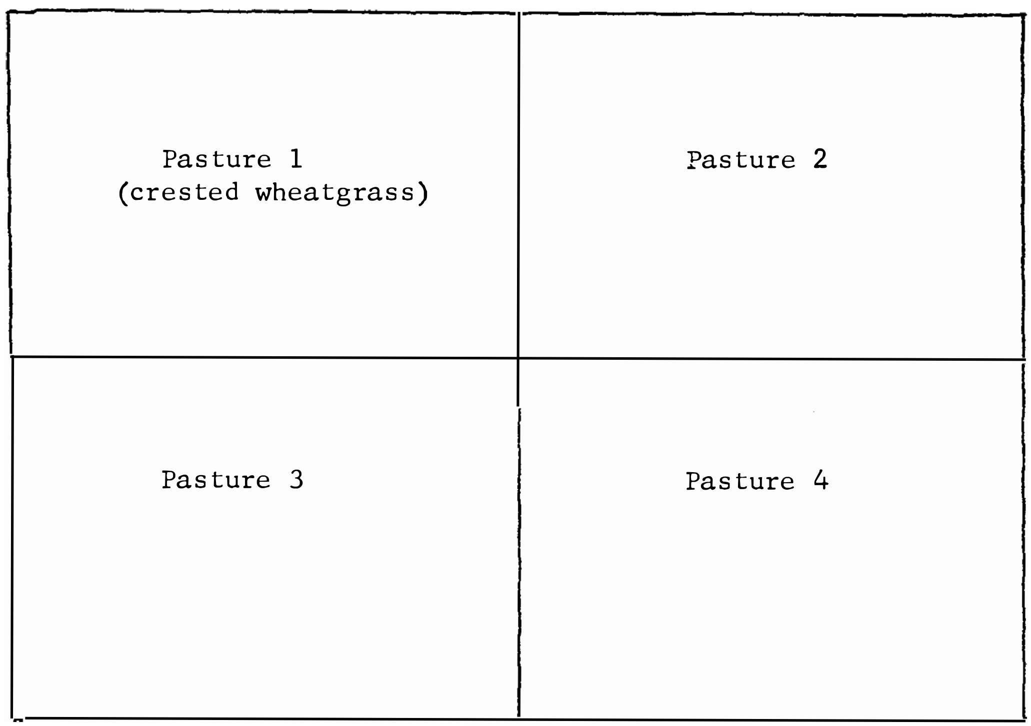
In a deferred-rotation grazing system, pastures are grazed in a different sequence each year (Fig. 1). The first pasture grazed one year is usually the last pasture to be grazed the next year.

The exception to this occurs when one of the pastures is dominated by crested wheatgrass (Agropyron cristatum). Crested wheatgrass is a cool season grass species and is used as a substitute for native grass species in early spring grazing. Planting a pasture to this species allows time for the warm season, native species to attain sufficient growth to sustain life in spite of heavy grazing.

In a season-long grazing system, cattle are grazed continuously in one pasture the entire grazing season. Pastures are usually larger in season-long systems than in deferred-rotation systems.

Fig. 1. An example of a deferred-rotation grazing system.

	May 1 - June 1	June 1 - Aug. 1	Aug. 1 - Oct. 1	Oct. 1 - Dec. 1
1978	Past. 1	Past. 2	Past. 3	Past. 4
1979	Past. 1	Past. 3	Past. 4	Past. 2
1980	Past. 1	Past. 4	Past. 2	Past. 3



Appendix B. VOR means for distance on vegetation around ponds in both the season-long and the deferred-rotation grazing system.

Table 1. VOR means for distance on vegetation around ponds in the season-long grazing system.

	Distance in meters					
Pond No.	91.4	182.8	274.2	365.6	457.0	548.4
1	0.07	0.22	0.29	0.30	0.20	0.25
2	0.03	0.07	0.11	0.11	0.11	0.07
3	0.06	0.13	0.15	0.12	0.20	0.43
4	0.14	0.24	0.38	0.36	0.33	0.34
5	0.05	0.18	0.22	0.29	0.22	0.28
6	0.43	0.70	0.31	0.32		

Table 2. VOR means for distance on vegetation around ponds in the deferred-rotation grazing system.

	Distance in meters					
Pond No.	91.4	182.8	274.2	365.6	457.0	548.4
1	0.03	0.08	0.12	0.09	0.12	0.08
2	0.05	0.15	0.12	0.10	0.11	0.08
3	0.14	0.17	0.16	0.16	0.25	0.27
4	0.04	0.05	0.07	0.14	0.10	0.03
5	0.12	0.14	0.17	0.18	0.22	0.27
6	0.11	0.18	0.19	0.24	0.24	0.21

Appendix C. Covermapping of grazing allotments used in the rpoject.

Covermapping was completed on all six grazing allotments to show the distribution of the six range sites common to the study area. The rolling grasslands, upland grasslands and lowland draws are the most important cover types for nesting and brooding sharptails.

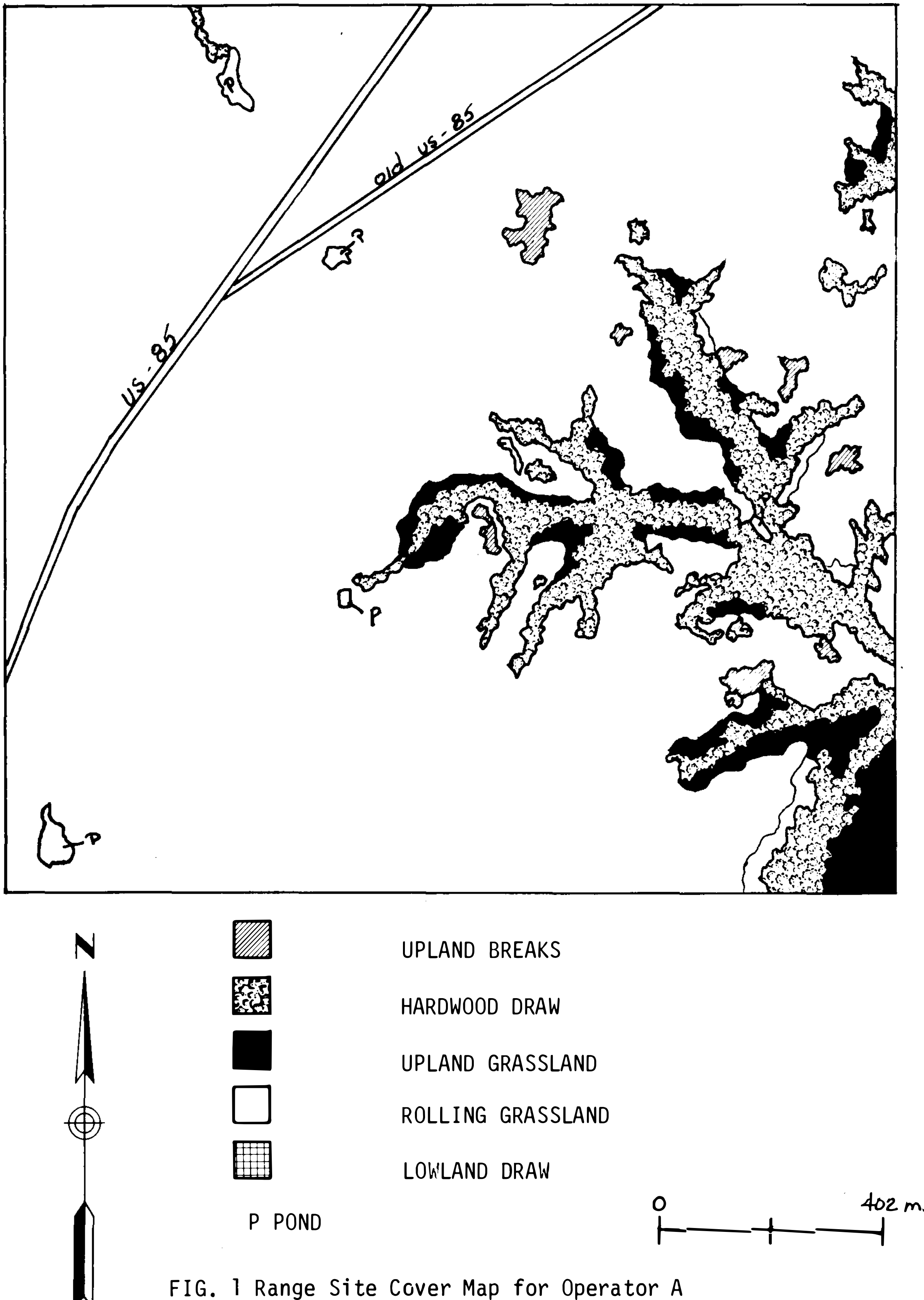


FIG. 1 Range Site Cover Map for Operator A Using Deferred Rotation.

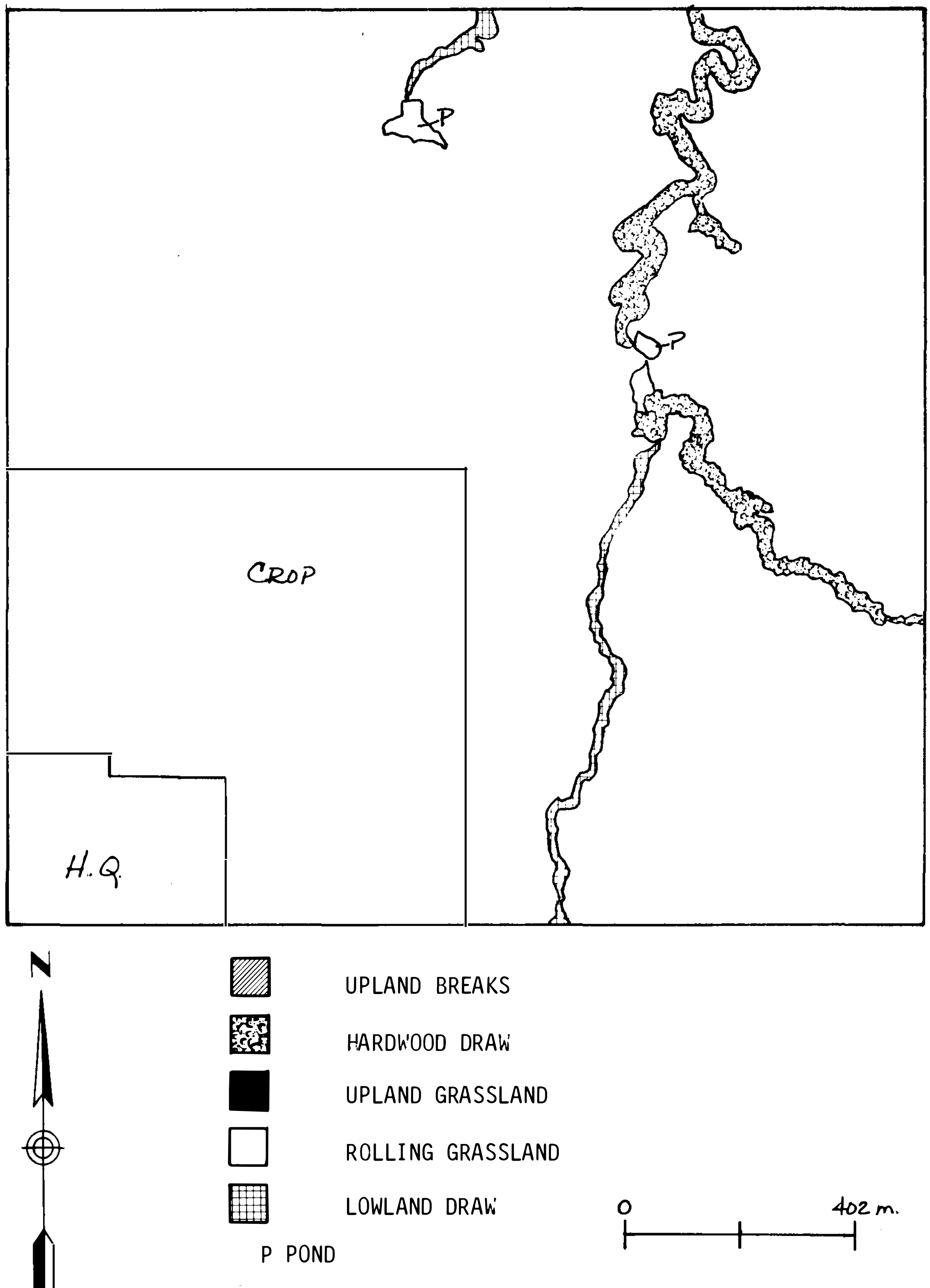


FIG. 2 Range Site Cover Map for Operator B Using Deferred Rotation.

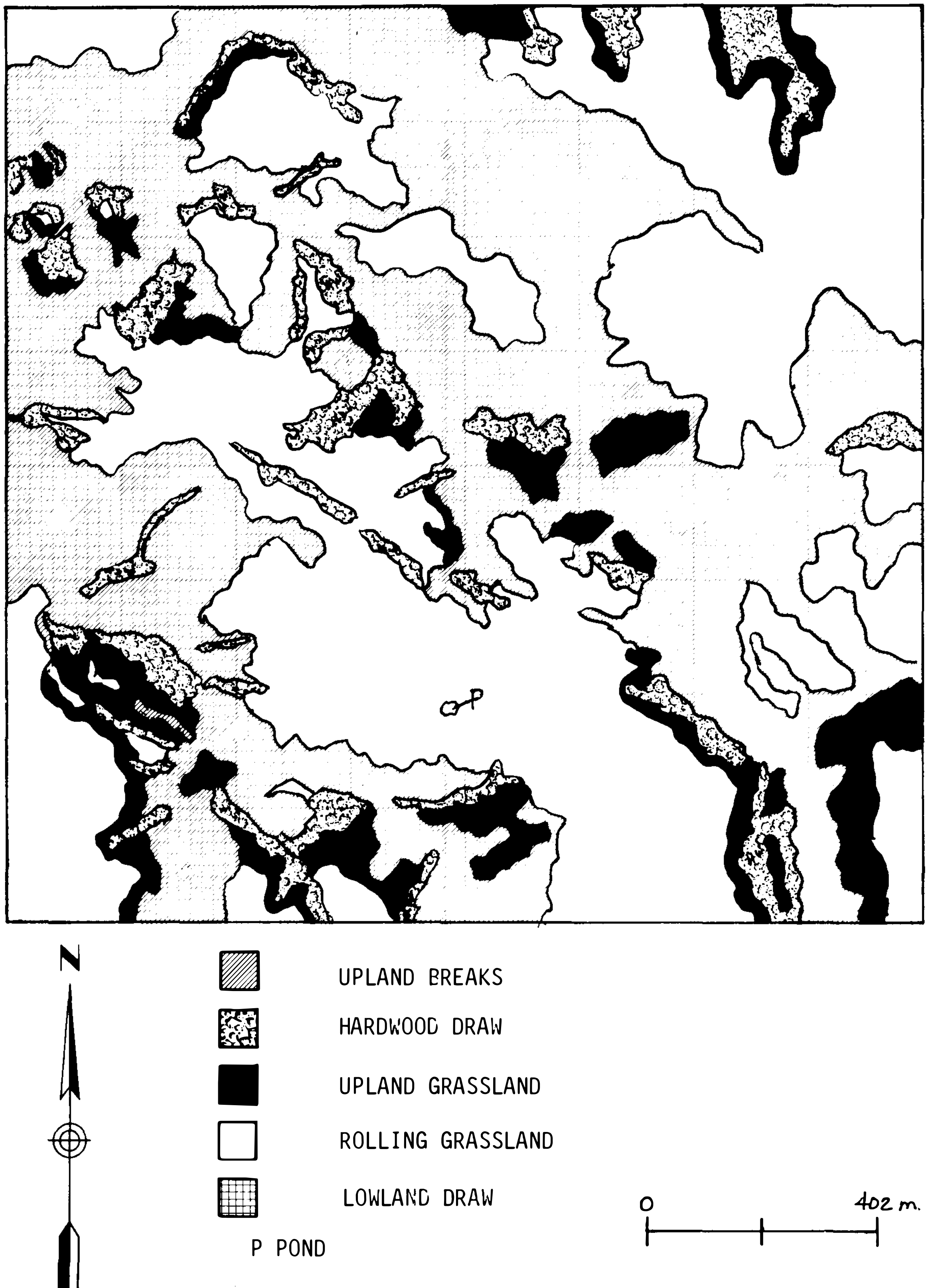


FIG. 3 Range Site Cover Map for Operator C
Using Deferred Rotation.

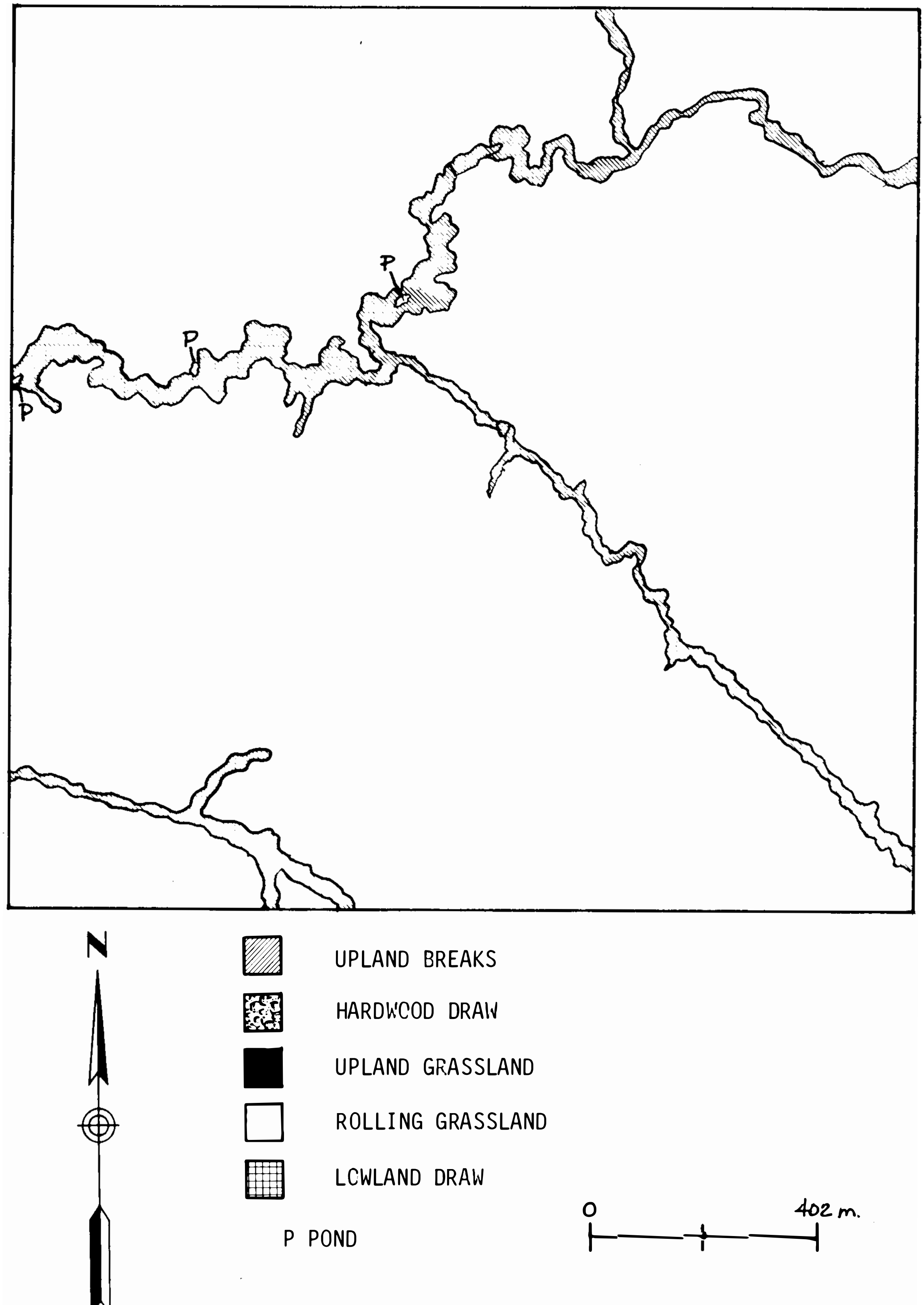


FIG. 4 Range Site Cover Map for Operator D
in Season Long.

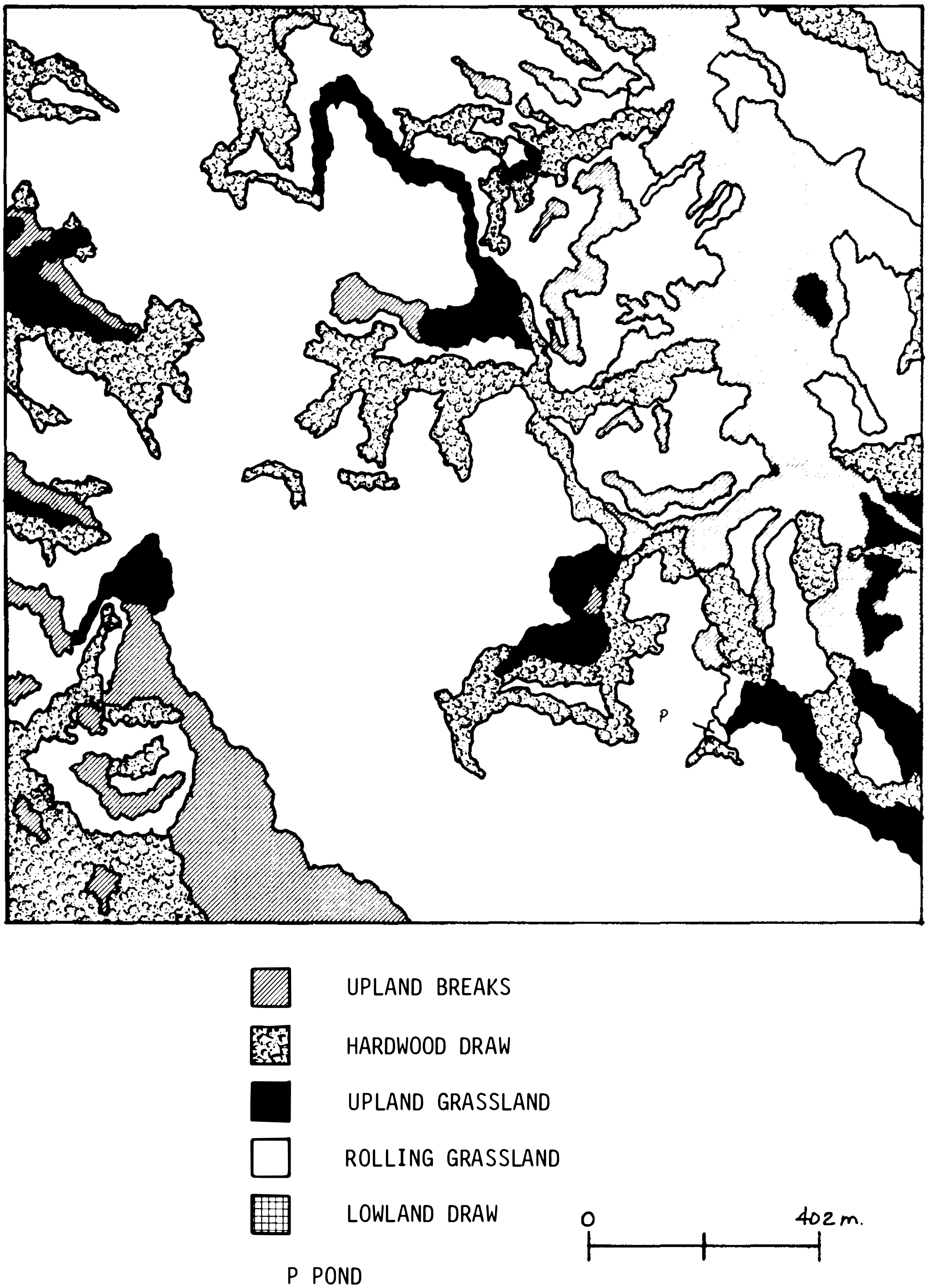


FIG. 5 Range Site Cover Map for Operator E
Using Season-long.

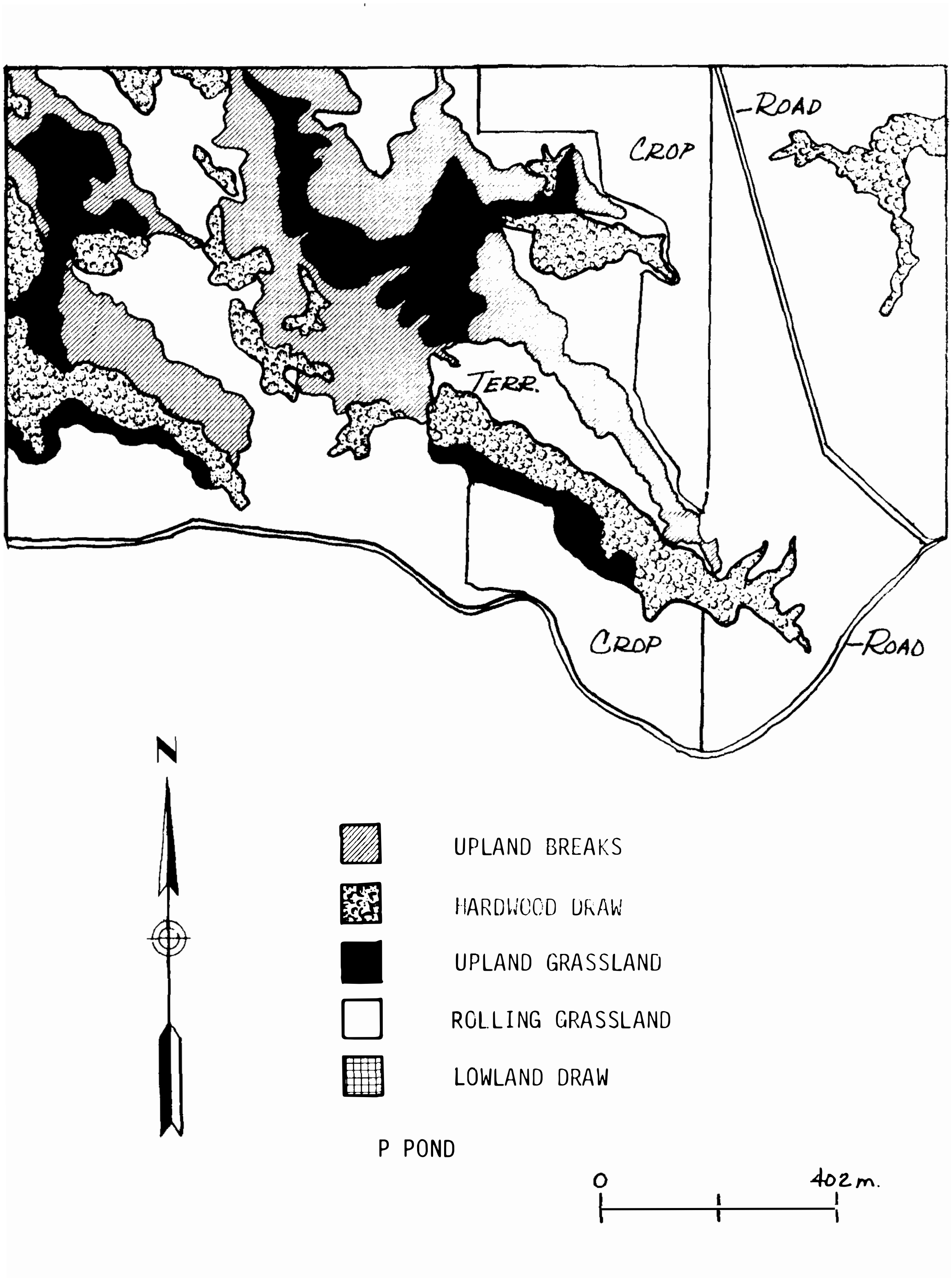


FIG. 6 Range Site Cover Map for Operator F in Season-long.

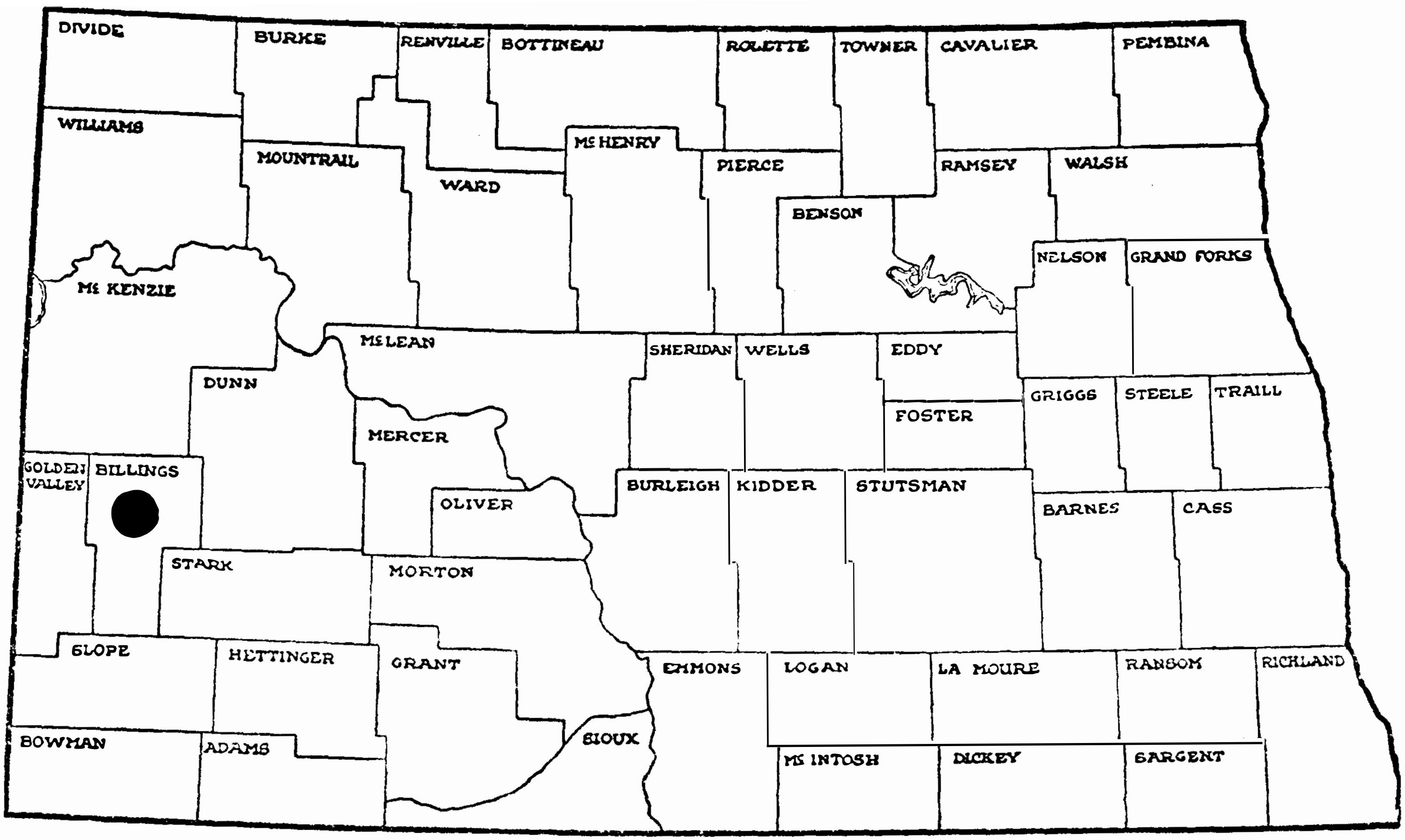


Fig. 7 COUNTIES OF NORTH DAKOTA