Winter Ecology of the Greater Prairie Chicken on the Sheyenne National Grasslands, North Dakota[1,2]

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Abstract.--Twenty radio-tagged prairie-chickens (6 cocks, 14 hens) were followed during the winter of 1984-85 on the Sheyenne National Grasslands in North Dakota. A total of 3,945 (2,879 day and 1,066 night) locations were obtained from 9 December to 15 March. Winter survival was high at 58.8%. Mean winter home range size was 8.4 km^2 and slightly larger for hens than cocks (8.8 km^2 vs 7.7 km*). Mean winter to spring movements were 4.4 km for cocks and 6.4 km for hens. All locations were within 6700 m of a known booming ground; 64% were within 2400 m with a mean of 2078 + 980 m. Cocks remained closer to boomimg grounds than hens (Mean = 1797 + 709 vs 2327 + 1178 m). Mean movements from day areas to night roosts were 1085 + 778 and were greater for cocks than hens (1358 vs 1035 m). Mean within day movements were less at 992 m for cocks and 899 for hens. When possible, radioed birds did not use the same roosting area on successive nights as the mean distance between successive night locations was 922 m. Agriculture and grass made up 71.3% of all the winter habitat types used by radioed birds (Agriculture 41.7%, Grass 29.6%). Picked corn made up 70.8% of the agricultural use. Habitat used at night was dramatically different from that used during the day; 66.7% of the night locations were in grassland habitat and 11.8% in shrubs, primarily snowberry. Lowland grass and sedges accounted for 64% of the night use. A breakdown by vegetation height classes showed that 78% of all locations were associated with 9 cm or taller vegetation; 59% with 25-50 cm cover. Over 75% of the night use was in 25 cm or greater vegetation and 77.9% in cover undisturbed within the past 8 months. Within these undisturbed areas night roosting prairie-chickens selected the taller available cover.

INTRODUCTION

Since the 1960's, winter ecology of the greater prairie chicken (Tympanuchus cupido pinnatus) has been largely ignored. Past studies that dealt with winter were limited with regard to movements and habitat use (Schmidt 1936, Grange 1948, Hamerstrom and Hamerstrom 1949, Baker 1953, Ammann 1957, Hamerstrom et al. 1957, Robe1 et al. 1970a and Horak 1985).

This study was initiated to examine the winter ecology of the greater prairie chicken on the Sheyenne National Grasslands (SNG) and to explore the effects of grazing practices on winter habitat of this bird. Radioed hens were monitored from mid-December 1984 until incubation which provided movement patterns from winter to spring.

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STUDY AREA

The Sheyenne National Grasslands (SNG) is located 36 kilometers (km) south of Fargo, North Dakota. The north unit of the SNG contains 52,488 ha of which 48.4% is private and 51.6% is public land managed by the U.S. Forest Service in association with the Sheyenne Valley Grazing Association.

The terrain varied from level to rolling hills referred to locally as sandhills. The area is relatively open, but dotted with scattered solitary trees and small clumps of cottonwood (Populus deltoidies), aspen (Populus spp.) and Oak (Ouercus spp). The grassland areas vary from level to rolling with grass-covered sand dunes 1.5-3 meters (m) above the level lowlands, which vermiculate between and through the higher uplands.

Manske (1980) divided the grasslands into 3 major communities: Upland (mixed grass prairie dominated by blue gramma (Boutelous gracillis) and Kentucky bluegrass (Poa pratensis); Midland (tall grass prairie) dominated by big bluestem (Andropogon gerardii), little bluestem (Schizachyrium scoparium), Kentucky bluegrass and switchgrass (Panicum virgatum); Lowland (sedge meadow) dominated by sedge (Carex spp. and Carex lanuginosa), blue grass, reed grass (Calamogrostis spp.) and switch grasses (Panicum spp.).

The SNG was managed using a multiple pasture system (1,2,3 or 4 pastures), primarily 3 pasture units. All 2,3 or 4 pastures were grazed at least once during the period May - November. One of the 3 or 4 pastures was usually deferred during the peak of the growing season. Most level lowlands were mowed once every 3 years to stimulate growth and encourage cattle to graze the lowlands.

METHODS

Trapping

Prairie chickens were captured in traps constructed of lengths of welded wire (approximately 0.7 X 3 m) with 2.5 cm mesh. The wire was staked to the ground in a circle forming a funnel on one side and covered with fish netting. Three to 5 traps were placed in known feeding areas and baited with cobbed corn. Age, adult or immature, was determined by primary feather molt and wear (Petrides 1942, Wright and Hiatt 1943, and Ammann 1944) and by depth of the bursa (Gower 1939, and Kirkpatrick 1944).

Movements

Radio transmitters (SM1 Type, 12-16 g. and SB2, 19-22 g AVM Instrument Company, Dublin, California) were in the 150-151MHz frequency range. Transmitters were powered by solar panels connected to a NiCad battery that stored power. The units were attached to the bird using a bib system similar to that used by Amstrup (1980). The larger units had a reduced antenna (16 cm) to prevent them from slapping the bird's wings inflight. The smaller units had full length antennas (25 cm) held forward at a 45 degree angle by a spring to avoid wing slapping. Two birds were radioed with back pack units (Dumke and Pils, 1973).

Radioed birds were located by triangulation with an AVM, LA12 receiver connected to a single 3.4 m high, 8 - element yagi antenna mounted on a vehicle. Ground to ground range of the system was respectively. Average accuracy using signal nulls for known transmitter locations (night roosting birds) with angles of intersection of between 60 and 120 degrees was 27.8 + 15.4 (n = 78) from 262-1016 m (Mean = 479.8 + i89.2)^m. At night, birds were located by approaching with a vehicle to within 5-20 m, marking the line and locating the roosts the next day for detailed analysis.

Each location was recorded as to date, time (CST), straight line distance to the last location, distance to the nearest booming ground, home or regular booming ground, nearest sharptail dancing ground, type of movement, habitat, disturbance type, vegetation height class and activity. The distances between locations were stratified into 2 types of daily movements: (1) the distances between a daytime and a subsequent night location (daylight to night move) and (2) distance between consecutive night locations. The distance to the nest was measured to the first known nest. The home booming ground for cocks was the one on which they displayed and for hens the one nearest their first nest. Home range is that defined by Burt (1943) and its area calculated by enclosing the outer perimeter (Hayne 1949).

Habitat Use

Habitat types were classified using cover type maps of the areas drawn from aerial photographs. Ocular percentage estimates were used to place cover into 7 general categories: Grass, Forbs, Agricultural, Shrubs, Wetland, Trees, and Other. Paired combinations of these categories i.e. Grass 80-100% equaled Grass, whereas a mixture of 5O-75% Grass and 25-50% Forbs equaled Grass/Forbs. A shift in composition favoring Forbs (greater than 50%) was classified as Forbs/Grass habitat. These general categories were then visually classified according to the dominant plant specie(s). Disturbances were classified as to the type of disturbance within the last 8 months (undisturbed, agricultural, grazed, mowed). Vegetation height classes were established relative to the height of a standing prairie chicken. Class I up to the belly of a bird (O-8 cm), Class II up to the eye of a bird (9-25 cm), Class III above the birds head (26-50 cm) , Class IV (51-100 cm) Class V (l-2 m) and Class VI (over 2 m). In addition to the major categories, habitat, disturbances and height were classified as an edge type when a location was within 55 m of a different habitat or disturbance; This compensated for the limitations in the accuracy of the radio locations and reduced the possibility of placing the location in the wrong habitat type.

Night Roost Analysis

The following data were collected at each roost: Robe1 pole (Robe1 et al. 1970b), snow depth, last disturbance, height class, distance nearest roost, maximum distance between roosts, depth of roost in snow, distance to nearest edge, type and disturbance of edge, and distance to feeding area. Random measurements were taken at points one meter apart along a line parallel to where the birds roosted.

Other

Maximum and minimum temperatures and depth of snow were recorded daily. Official precipitation records were obtained from the U. S. Weather station 2 miles east of McLeod. Winter was that period when 7 cm of snow had accumulated covering most ground level foods (15 December - 17 February) and early spring the period after the snow was gone (18 February - 15 March). In addition to the winter period, data were stratified into weekly periods.

The day was divided into two periods, daylight and dark. Daylight hours were stratified into 3 equal periods (AM, MIDDAY, PM) begining 1 hour before sunrise and ending 1 hour after sunset.

We emphasize that statistical or mathematical differences may or may not be biologically significant and that they are largely guides to possible differences. Our personal observations of prairie grouse suggest that they exist within ranges limited by their biological and physiological capabilities, individual experiences, and conditions at a given point in time. Therefore we have chosen to primarily identify common trends and patterns from which management decisions can be made. Means and ranges are presented in parentheses and the ± symbol represents 1 standard deviation.

RESULTS AND DISCUSSION

Weather

The winter of 1984-85 on the SNG can best be described as having average temperatures, below normal snowfall and an early spring. Mean temperature for winter was 3.9F (SD + 12.3) and ranged from 29-33. At times the wind chill factor reached 40 to 50 below, 80 below on 19 January. Snow remained on the ground 64 days from 15 December to 17 February. Snowfall during the study period was 18 cm (7 in) during winter and 22.9 cm (9 in) in early spring. Average annual snowfall is 91.4 cm (36 inches) and average snow on the ground during winter ranges from 13-18 cm (5-7 in) for 80 days (DTP Background Report, 1979).

The regular presence of strong winds (l-60 mph) caused snow to drift. Some habitat types (lowlands, brush, windrows and fencelines) accumulated drifted snow, while ridges and parts of agricultural fields were often blown free of snow.

Radio-tagging

Eight cock and 15 hen prairie chickens were radio-tagged, 14 of which (4 cocks and 10 hens) received the larger, more powerful SB2 transmitters. In addition 3 hens radio-tagged the spring of 1984 were followed through the winter 1984-85.

Radio Locations

Twenty radioed prairie chickens (14 hens and 6 cocks) yielded 2879 day and 1066 night locations. The distribution of the radio locations were evenly distributed throughout the day (AM, Midday, PM, Night) (ChiSq. P = 0.47, df **3**).

Flocking

On the SNG in winter and early spring 89% of 335 prairie chicken observations were of groups of 2 or more. Mean flock sizes for radioed and non-radioed prairie chickens were comparable (Mean = 7.9 + 9.3, n = 154 vs Mean = 6.1 ± 8.0, n = 151). In the winter, mean flock size during the day was 13.8 ± 12.5, (n = 250), while at night only 5.5 ± 5.5, (n = 91) based on roost counts. The same pattern was observed in the spring, 5.8 ± 5.0 (n = 60) during the day versus 3.9 ± 2.6, (n = 15) at night. This difference in flock sizes between day and night is thought to be the result of small flocks coming together in common feeding areas during the day. The largest number of birds found roosting together in winter was 19.

The degree of integrity of smaller night groups is not clear. There was some shifting between groups as radioed individuals roosted together for several nights, but were apart on others. If social grouping existed it likely occurred in the smaller roosting flocks; however our data suggested that winter flocks appeared to be loosely bound.

Survival

Survival of prairie chicken cocks and hens was 66.6 (4 of 6) and 54.5% (6 of 11) respectively. Only individuals radioed as of 7 January were used to calculate winter survival. Of the 7 radioed prairie chickens found dead, 6 were fed upon by predators (5 by raptors and 1 by a mammal).

Home Range

Home ranges were calculated for all birds, but means only for those followed from the first week of January to 17 February. The mean winter home range for radioed prairie chickens was 8.4 km^2 (3.2 mi^2). Hens had slightly larger ranges than cocks and the ranges of immatures were larger than adults (Table 1).

Table 1. Mean home range sizes (sq km) for radio-tagged prairie chickens during winter, 15 December-17 February, Sheyenne National Grasslands, 1984-85.

Adult Hens	n= 7	8.7+4.6
Immature Hens	n= 2	9.3+3.2
Total Hens	n= 9	8.8+4.0
Adult Cocks	n= 4	7.2+3.2
Immature Cocks	n= 1	9.8+ -
Total Cocks	n= 5	7.7+4.1
TOTAL	n=14	8.4+3.6

Agriculture (private) and grassland (public) were represented in all home ranges. The ratio of grassland to agriculture was variable and ranged from 20:80 to 80:20 A mean of these ratios would be meaningless since each home range was a function of the distance between night roosting sites in grassland and feeding sites in agriculture. This distance varied for many individuals during the winter as snow conditions altered the availablity of food. Thus the proximity of available food to roosting areas controlled sizes of winter home ranges for prairie chickens on the SNG.

Individual birds moved most extensively in late December with the first snowfall, apparently searching for food sources. Once available food was located, birds established a regular pattern of use within the total winter home range. However, when new snow covered current source(s) of food, a shift in use pattern occurred. Some birds fed in only 1 or 2 fields all winter, but roosted in several areas.

MOVEMENTS

Winter to Spring

The mean maximum distance that radioed prairie chickens moved from winter to spring ranges (cocks to home booming ground hens to nest) was 4.4 km for cocks and 6.4 km for hens (Table 2). That cocks remained closer than hens to their home ground was also shown by the mean minimum distances moved (0.2 km for cocks and 3.2 for hens). Adult cocks, required no long seasonal movements as all remained within 5.0 km of their home booming ground.

Table 2. Mean distance moved (km) by radio-tagged prairie chickens from winter range (hens to nest and cocks to home booming ground), Sheyenne National Grasslands, 1984-85.

		Maximum	Minimum
Adult Hens	n=12	6.4+2.4	3.2+2.5
Immature Hens	n= 3	6.1+2.3	3.2+2.2
Total Hens	n=15	6.3+2.4	3.2+2.3
Adult Cocks	n= 4	4.0+0.3	0.2+0.1
Immature Cocks	n= 1	0.6+ -	0.3+ -
Total Cocks	n= 5	3.3+0.9	0.2+0.2
TOTAL	n=20	5.6+3.1	2.5+2.4

One immature cock moved 6.9 km (4.3 mi) from his eventual home booming ground, while covering a large area between three booming grounds in early March. He was known to have visited all three grounds, apparently in an effort to establish a territory. However, his home booming ground was only .6 km from his winter range.

Hens exhibited two general movement patterns in shifting from winter to spring range. Several hens wintered within 0.8 to 1.6 km of their spring ranges, while other hens moved considerable distances to eventual nest sites. Those which wintered close to spring ranges were in winter areas with more agriculture than grassland. Those which moved greater distances had spring areas characterized by large amounts of grass with little agriculture. It was felt the more extensive movements were related to winter food, with birds either returning to traditional food sources or moving until they found an adequate food source. More extensive moves made by adult hens suggested homing to the previous years nesting area. Two hens, followed during two springs, nested within 100 m of their previous years nests. Four other hens had nests which were found 2 years in a row (1 three) and all but' one returned to nest near the same booming ground.

Movements made from winter to spring by adult hens were made quickly (1-2 days), were directional with no wandering, and each hen localized very soon near their eventual nest site. Three immature hens followed to nests showed no rapid movements that suggested homing. They also localized later and more slowly than adult hens.

Relationship to Booming Grounds

Winter distribution of prairie chickens on the SNG coincided closely with that of the booming grounds; for the most part, all birds remained within 3 km of a display ground. No radio-tagged prairie chickens were known to have left the SNG during the winter of 1984-85. All non-booming ground radio locations (n = 2444) and observations (n = 1985) of prairie chickens were within 6500 m (4 miles) of a known booming ground. The mean distance from radioed bird locations to nearest booming ground was 2007 ± 980 m in winter with 64.8% within 2400 m. The mean for non-radioed birds was 1921 ± 1001 m, with 68.1% within 2400 m. Radioed cocks in the winter were closer to booming grounds than hens (Table 3, Fig. 1),reflecting a strong association to their home ground. Evidence indicated that cocks attempted to stay as close to home ground as winter conditions and surrounding habitats permit. Hamerstrom et al. (1957) and Hamerstrom and Hamerstrom (1973) reported similar findings. Schwartz (1945) felt there was a "sphere of influence around each booming ground".

Hens showed much less association to a particular booming ground in winter than cocks, as only 49.5% of their locations were within 4000 m (2.5 miles) of their home booming ground (Mean = 4072 m, Table 3). Hens as a group showed little

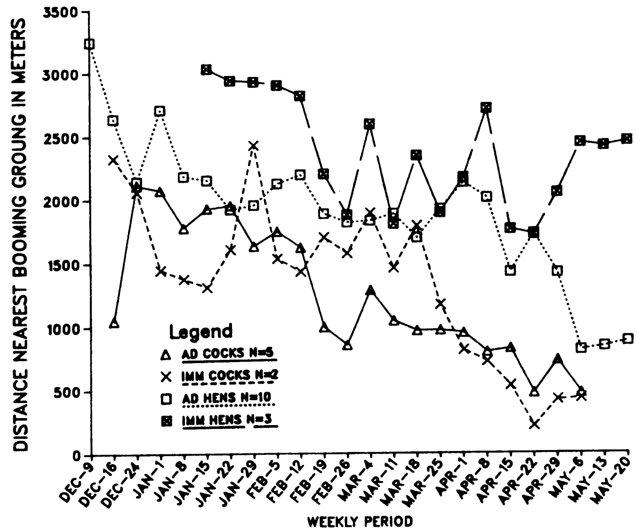

Figure 1.--Weekly mean distances to the nearest booming ground for radio-tagged prairie chickens, Sheyenne National Grasslands, 9 December-20 May, 1984-85.

affinity for their nest sites during the winter, with only 54.9% of the observations within 4000 m (2.5 mi). The mean distance to home booming ground decreased in early spring with cocks being closer than hens (1302 m vs 2004 m, Table 3). Both adult cocks and hens were closer than their immature counterparts (Table 3). No relationship was demonstrated between prairie chickens and the nearest sharptail dancing ground (Fig. 2).

The cocks returned to booming grounds in February, 1 radioed cock was observed on 5

Table 3.--Mean distance to nearest and home booming ground and nest for radio-tagged prairie chickens, Sheyenne National Grasslands, 1984-85. Number of locations in parentheses.

	Cocks			Hens		
	Adult N=4	Immature N=2	Total	Total	Adult N=12	Immature N=3
Distance Nearest Booming Ground						
Winter	1845± 713(582)	1661± 679(203)	1797± 709(785)	2327±1178(1659)	2140±1150(1251)	2900± 586(408)
Early Spring	1102± 689(185)	1631± 579(112)	1302± 697(297)	2004± 898(1116)	1886± 930(789)	2287± 745(327)
Distance Home Booming Ground						
Winter	2755±1127(582)	2030±1322(203)	2568±1222(785)	4072±1975(1373)	4282±2125(965)	3575± 967(408)
Early Spring	1424±1124(185)	1941±1078(112)	1619±1133(297)	3662±1974(1104)	3889±2140(777)	3122±1373(327)
Distance Nest						
Winter				4299±2144(1283)	4426±2383(875)	4026±2001(408)
Spring				3932±1960 (986)	4075±2374(659)	3643±1546(327)

February and 2 others on 10 February. Hens returned to home booming ground and nest areas in late March, and early April. Adult hens moved towards nests earlier and remained closer than immatures (Fig. 3).

A strong tendency existed for prairie chickens to remain in areas near a booming ground. During winter hens were nearer a booming ground than their nests (2327 m vs 4299 m). This suggests that the area within 3.2 km of any given booming ground is the key to prairie chicken habitat management. This area could serve as an

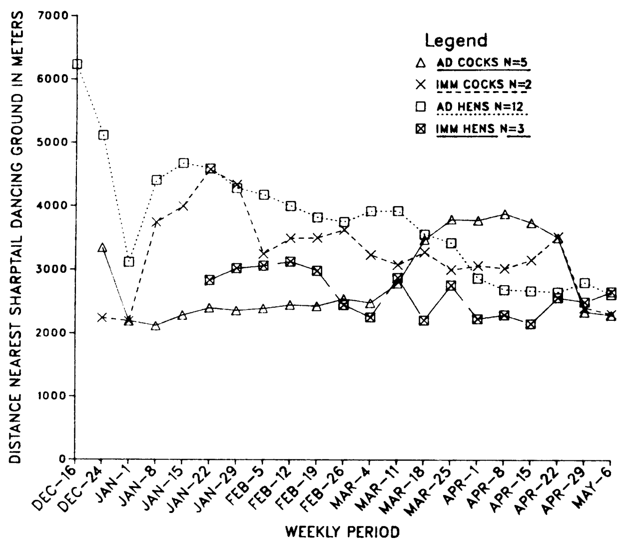

Figure 2.--Weekly mean distances to the nearest sharptail dancing ground for radio-tagged prairie chickens, Sheyenne National Grasslands, 16 December- 6 May, 1984-85.

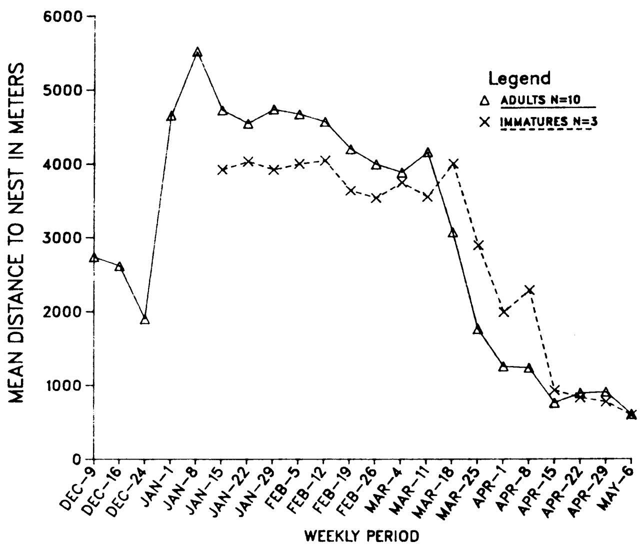

Figure 3.--Weekly mean distances to nest for radio-tagged prairie chicken hens, Sheyenne National Grasslands, 9 December-20 May, 1984-85.

effective management unit or a group of grounds as a complex in which management could focus its activities.

Daily Movements

An index to daily movements was calculated by measuring the distance between day to night locations (DN), and the distance between consecutive night locations (NN). The DN distances, were close approximations of the distances moved between feeding and roosting areas and NN distances showed relative fidelity to the previous night's location.

DN Distance in winter were 1085 $\pm$ 778 m, (n = 852) and were greater for cocks than hens (1358 $\pm$ 909 m, n = 132 vs 1035 $\pm$ 855, n = 720). The greater DN movements for cocks is a result of morning visits to their booming grounds in the late winter. Conversely, hens centered their movements near feeding areas and showed no interest in booming grounds or nest sites during winter and early spring. The maximum distance moved from day to night in winter was 4 km (2.5 mi) for a cock and 4.4 km (2.7 mi) for a hen. Although DN movements were basically a measure of distances between feeding and roosting areas, not all birds used either the nearest available feeding area or the nearest roost.

After snow melted in early spring the DN movements for both cocks (1074 $\pm$ 938 m, n = 74) and hens (709 $\pm$ 584 m, n = 121) declined as food and cover became more available (Fig. 4). These early spring mean distances were 21% less for cocks and 32% less for hens than their respective winter means. The greater movements of cocks in early spring were due to their twice daily visits to booming grounds, plus flights to the agricultural areas to feed. Hamerstrom and Hamerstrom (1949) and Ammann (1957) also indicated that prairie chickens were most mobile during winter.

In early spring hens were not yet associated with a particular booming ground or their eventual nest areas and their movements were localized near their feeding areas. All radioed hens spent the first 4 weeks after snow melt moving only from roosting areas to feeding areas (less than 600 m) (Fig. 4). This reduction in movements may have allowed hens to recover lost weight.

Mean NN distances were 922 $\pm$ 770 (n = 445) in winter for hens and 949 $\pm$ 816 (n = 174) for cocks. With one exception, prairie chickens did not use the same roosting area on successive nights, the closest being 60 m. The exception involved 2 radioed birds which used the same roost area 3-4 nights in a row. These 2 birds spent most of the winter on private land and had only 3 undisturbed roost sites near their feeding areas. Their patterns were irregular, but they too shifted between 3 available roosting areas. This tendency to use several roost areas in the winter points out the need for a good distribution of roosting cover.

Once snow melted, individuals began to use the same areas on successive nights (Fig. 5). Use of the same roost area on successive nights in spring may be due to an increase in security due to more available cover. Some of the same roosting areas used only once in the winter were used regularly on successive nights in the early spring.

Distances (NN) became less for cocks and hens as their activities become concentrated near their

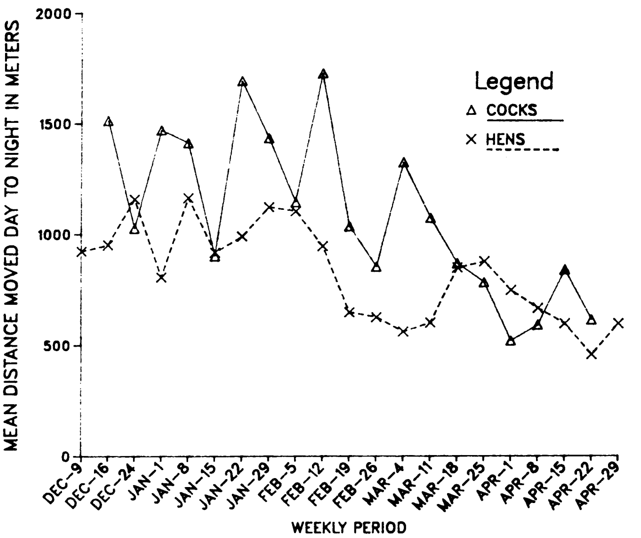

Figure 4.--Weekly mean distances moved from day to night for radio-tagged prairie chickens, Sheyenne National Grasslands, 9 December-5 May, 1984-85.

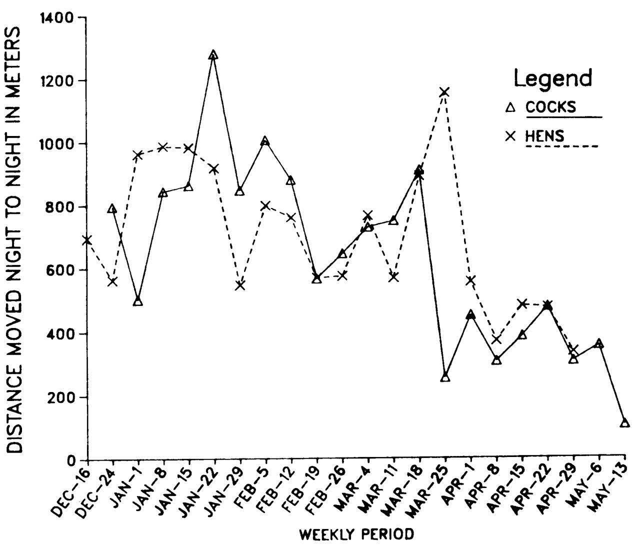

Figure 5.--Weekly mean distances between successive night locations for radio-tagged prairie chickens, Sheyenne National Grasslands, 16 December-13 May, 1984-85.

booming ground and nests in early April. The greatest NN distance for hens occurred during the last week in March when they moved from winter to spring areas (Fig. 5).

Cold and snow had the greatest influence on the daily movement patterns of prairie chickens. Fresh snow caused individuals to increase their within day movements when normal food sources were covered. Snow also caused abandonment of roost areas as new snow altered cover.

Prairie chickens responded to long periods of sub-zero temperatures by reducing activity. They remained in their roosts longer in the AM, fed in the agriculture later or during midday, flew to their roosts earlier than normal, (as early as 1400 hours) and remained in roost areas until the following day (15-17 hrs.). Visual documentation was obtained of individuals in snow burrows several hours before they would have gone to roost in milder weather or at other times of the year. Reduced activity during cold temperatures was thought to be an energy conservation mechanism. Hamerstrom and Hamerstrom (1949) observed similar behavior in prairie chickens during very cold or stormy weather in Wisconsin.

Habitat Use

Four major habitat components appear to determine the quality of prairie chicken habitat: type, height (form), disturbance and space (open treeless areas). All 4 are closely related to one another and most are more closely associated with cover structure than species composition. Height or form appeared to be the critical component as it creates the structure that prairie chickens actually use. This is not new, but is based on the life form concept as applied to prairie chickens by Hamerstrom et al. (1957) and Jones (1963). From a management perspective, disturbance is the key factor as it determines height, and influences the amount and distribution of cover.

A total of 3674 radio locations of prairie chickens from 15 December - 15 March were used in habitat analyses. Booming ground observations and unknown habitat types were excluded. Tree(s) were not included in the analysis of height and disturbances. No effort was made to analyze habitat use relative to the amount available in the study area. Observations in the field showed that the total amount of a habitat type available did not determine use and was not a valid index to what prairie chickens preferred. These indicies or importance values relate only to conditions under which they were collected and do not take into account the habitat needs of animals during other critical times (nesting, brood rearing). To be effective management must relate winter use to the habitat used at other times of the year.

Overall, the agriculture and grass habitat types totaled 71.3% of the habitat used by radio-tagged prairie chickens in the winter of 1984-85, on the SNG. Other studies indicated similar habitat use patterns (Schwartz 1945, Grange 1948, Hamerstrom and Hamerstrom 1949, Baker 1953, Ammann 1957, Hamerstrom et al 1957, Mohler 1963, Robel et al. 1970a, and Horak, 1985). A breakdown by habitat type showed that agriculture made up 41.7% of the total use, grass 29.6%, followed by trees and shrubs at 9.0 and 7.6%. (Table 4).

Corn (picked and silage) made up 70.8% of the agricultural types followed by oats and sunflowers at 8.6 and 8.0%. These difference are misleading as not all birds had all of the agricultural types available within or near their ranges. Some individuals used corn all winter, while others used corn and/or sunflowers.

Habitat use varied with time of day (Fig. 6). Use of agriculture by prairie chickens occurred primarily during the AM and PM and was associated with feeding and loafing. Habitat used for night roosting was dramatically different from daytime use as there was a complete shift away from the agricultural habitat types. Night roosting occasionally occurred in agriculture, but was not common. The majority of night locations occurred in grassland followed by shrubs, and wetlands (Table 4). The lowlands received the greatest use, followed by reed canary (*Phalaris arundinacea*), midland grasses, primarily little bluestem, and quackgrass (*Andropyron repens*). All of these grasses are tall in form, and stand up well against winter conditions. Almost all of the

Table 4.--Habitat type use by time of day (%) for radio-tagged prairie chickens, winter (9 December-17 February) and early spring (18 February-15 March), Sheyenne Grasslands, 1984-85. Number of locations in parentheses.

	Winter					Early Spring				
	Time of Day						Time of day			
Habitat Type	AM	Midday	PM	Night	Total	Total	AM	Midday	PM	Night
Agriculture	78.9(491)	31.0(215)	50.8(229)	3.8 (20)	41.7 (955)	43.6 (603)	78.1(250)	23.8 (88)	70.4(236)	8.1 (29)
Picked corn	47.4(234)	67.9(146)	57.2(131)	60.0 (12)	54.8 (523)	47.9 (289)	48.0(120)	37.5 (33)	55.1(130)	20.7 (6)
Silage corn	16.7 (82)	13.5 (29)	18.3 (42)	0	16.0 (153)	11.8 (71)	15.2 (38)	6.8 (6)	11.4 (27)	0
Oats	10.2 (50)	4.7 (10)	7.9 (18)	20.0 (4)	8.6 (82)	1.7 (10)	2.0 (5)	1.1 (1)	1.7 (4)	0
Sunflowers	10.0 (49)	3.3 (7)	8.7 (20)	0	8.0 (76)	18.2 (110)	24.4 (61)	17.0 (15)	14.4 (34)	0
Soybeans	9.0 (44)	0.9 (2)	5.7 (13)	0	6.2 (59)	0.3 (2)	0.4 (1)	0	0.4 (1)	0
Alfalfa	3.5 (18)	5.1 (11)	1.3 (3)	20.0 (4)	3.6 (36)	20.1 (121)	10.0 (25)	37.5 (33)	16.9 (40)	79.3 (23)
Haystack	2.9 (14)	4.7 (10)	0.9 (2)	0	2.7 (26)	0	0	0	0	0
Grass	9.3 (58)	25.5(177)	21.1 (95)	66.7(350)	29.6 (680)	37.6 (520)	12.2 (39)	37.8(140)	18.2 (61)	78.4 (280)
Lowland	39.7 (23)	35.6 (63)	45.3 (43)	64.0(224)	51.9 (353)	52.1 (271)	38.4 (15)	25.0 (35)	31.1 (19)	72.1 (202)
Grass Forbs	13.8 (8)	17.5 (31)	10.5 (10)	6.6 (23)	10.6 (72)	13.5 (70)	0	22.9 (32)	18.0 (11)	9.6 (27)
Reed Canary	17.2 (10)	23.7 (42)	15.8 (15)	13.7 (48)	16.9 (115)	9.2 (48)	5.1 (2)	8.6 (12)	4.9 (3)	11.1 (31)
Midland	6.9 (4)	8.5 (15)	5.3 (5)	7.4 (26)	7.4 (50)	13.8 (72)	35.9 (14)	30.9 (43)	16.4 (10)	1.8 (5)
Upland	8.6 (5)	6.2 (11)	18.9 (18)	1.2 (4)	5.6 (38)	4.0 (21)	12.8 (5)	2.9 (4)	19.7 (12)	0
Prairie Hay	3.4 (2)	2.8 (5)	3.2 (3)	0	1.5 (10)	2.9 (16)	7.7 (3)	5.7 (8)	8.2 (5)	0
Quackgrass	10.3 (6)	5.6 (10)	1.1 (1)	7.1 (25)	6.2 (42)	4.2 (22)	0	4.3 (6)	1.6 (1)	5.4 (15)
Edge type	2.6 (16)	14.6(101)	6.9 (31)	1.0 (5)	6.8 (153)	6.6 (91)	3.4 (11)	15.1 (56)	4.5 (15)	2.5 (9)
Fencelines	81.3 (13)	72.3 (73)	61.3 (19)	80.0 (4)	71.3 (109)	57.8 (52)	36.4 (4)	69.6 (39)	46.7 (7)	22.2 (2)
Railroad	6.3 (1)	16.8 (17)	16.1 (5)	20.0 (1)	17.0 (24)	31.9 (29)	54.5 (6)	23.2 (13)	53.3 (8)	22.2 (2)
Upland Shrub	12.5 (2)	10.9 (11)	22.5 (7)	0	9.2 (20)	11.0 (10)	9.1 (1)	7.1 (4)	0	55.6 (5)
Trees & edges	6.1 (38)	15.7(109)	10.6 (48)	2.3 (12)	9.0 (207)	7.8 (108)	4.3 (14)	17.0 (63)	5.7 (19)	3.4 (12)
Shelterbelts	18.4 (7)	28.4 (31)	12.5 (6)	0	43.5 (44)	75.9 (82)	64.3 (9)	85.7 (54)	63.2 (12)	58.3 (7)
Sandhills	47.4 (18)	17.4 (19)	50.0 (24)	100.0 (12)	35.3 (73)	14.8 (16)	28.6 (4)	6.3 (4)	21.1 (4)	33.3 (4)
Tree(s)	34.2 (13)	54.1 (59)	37.5 (18)	0	43.5 (90)	9.3 (10)	7.1 (1)	7.9 (5)	15.8 (3)	8.3 (1)
Shrubs	1.9 (12)	10.2 (71)	6.7 (30)	11.8 (62)	7.6 (175)	2.7 (37)	1.6 (5)	4.1 (15)	0.3 (1)	4.5 (16)
Snowberry	58.3 (7)	39.4 (28)	86.7 (26)	95.2 (59)	68.6 (120)	59.5 (22)	0	40.0 (6)	0	100.0 (16)
Misc Shrubs	41.7 (5)	42.6 (30)	13.4 (4)	3.2 (2)	23.4 (41)	16.2 (6)	20.0 (1)	26.7 (4)	100.0 (1)	0
Shrub Grass	0	18.3 (13)	0	1.6 (1)	8.0 (14)	24.3 (9)	80.0 (4)	33.4 (5)	0	0
Forbs	0.5 (3)	1.2 (8)	0.7 (3)	7.6 (40)	2.4 (54)	0.1 (1)	0	0.3 (1)	0	0
Misc Forbs	100.0 (3)	87.5 (7)	33.3 (1)	27.5 (11)	40.7 (22)	0	0	0	0	0
Sweet Clover	0	12.5 (1)	66.6 (2)	72.5 (29)	59.3 (32)	100.0 (1)	0	100.0 (1)	0	0
Wetland	3.3 (2)	0.9 (6)	1.6 (7)	6.7 (35)	2.2 (50)	0.9 (12)	0.3 (1)	0.8 (3)	0.3 (1)	2.0 (7)
Other	0.3 (2)	1.0 (7)	1.8 (8)	0.2 (1)	0.8 (18)	0.7 (10)	0	1.1 (4)	0.6 (2)	1.1 (4)
Total	100.0(622)	100.0(694)	100.0(451)	100.0(525)	100.0(2292)	100.0(1382)	100.0(320)	100.0(370)	100.0(335)	100.0(357)

shrub use occurred in snowberry (Symphoricarpos occidentalis).

Manske and Barker (1981) reported budding by prairie chickens in shelter belts on the SNG in 1980. In this study budding was rarely observed and the primary use of trees appeared to be for loafing before the birds moved into or after they left the agricultural fields. The main food source on the SNG for prairie chickens in winter was provided by agriculture on private land. There was no agricultural land on the SNG public land.

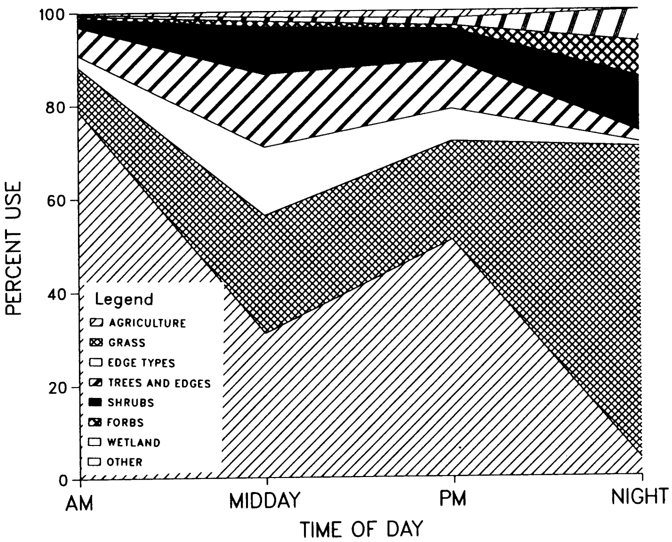

Figure 6.--Use of habitat types by time of day for radio-tagged prairie chickens during winter, 15 December-17 February, Sheyenne National Grasslands, 1984-85.

Height

Of all the radio locations in winter, 78% were associated with Class II or taller vegetation. Class III vegetation (25-50 cm) dominated the usage at 60%. The pattern of use, like that for habitat type, varied between the periods of the day (Fig. 7). The shorter forms, Class I and II were used primarily during the AM (51.4%) with slightly lower use during the PM (47.2%). The taller Classes (III and IV) were used for day roosting during the midday period (59.6%). Robel et al. (1970a) indicated that density (visual obstruction) was not a "significant factor in habitat usage in prairie chickens". However, their density data were collected from vegetation transects and not from the specific sites used by prairie chickens. Most other researchers have pointed out, the importance of taller undisturbed cover (Hamerstrom and Hamerstrom 1949, Baker 1953, Ammann 1957, Hamerstrom et al. 1957, Horak, 1985).

The edge habitats between shorter and taller vegetation classes were used equally through the day. This edge type was important and probably used more than our data indicates as it provided simultaneous access to 2 vegetation forms. This occurred along the borders of agricultural fields, and edges between lowland and upland and upland and midland grasses. Feeding was observed most in the lower height classes, particularly Class I (81.8%). Day roosting was primarily associated with Classes III and IV (greater than 25 cm), with most occurring in Class III (63.0%). The high use of the lower classes reflected the bias that activity must be observed to be documented and birds were more easily seen in the shorter vegetation types. However, telemetry data showed the same general pattern of use and indicated that birds were most active, primarily feeding in the AM and PM. The day roosting observations were based on birds flushed or examination of sign after birds moved and was thought to accurately represent day roosting habitat and height use. The increased use of the taller classes during the PM period coincides with observations of prairie chickens going to roost early during periods of cold weather.

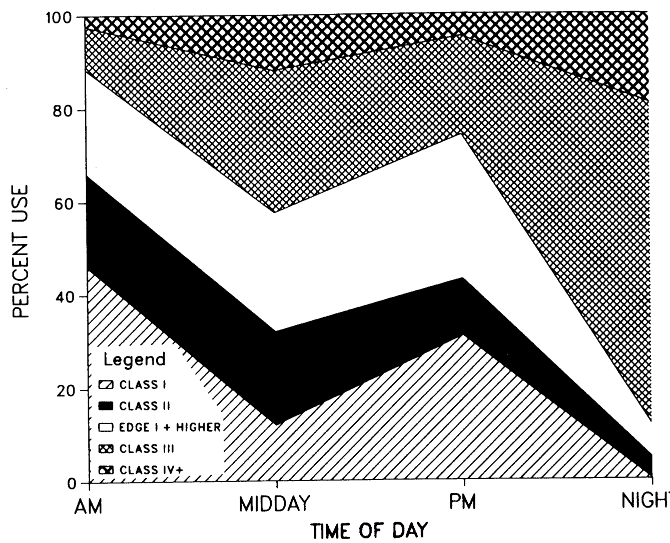

Figure 7.--Use of cover by height classes (I=0-8 cm, II=9-25 cm, III=26-50 cm, IV+ greater than 50 cm) by time of day for radio-tagged prairie chickens during winter, 15 December-17 February, Sheyenne National Grasslands, 1984-85.

Disturbance

Disturbance has its greatest influence on vegetation height. The taller height classes were used most by prairie chickens, yet shorter forms were used for feeding. A mixture of tall and short, or undisturbed and disturbed, is an important aspect of prairie chicken habitat. The amount and distribution of each will strongly influence the number of prairie chickens in a given area. Large amounts of disturbed short vegetation will reduce the amounts available for roosting and nesting. The most difficult component of prairie chicken habitat to maintain is the undisturbed open grassland, since this is the type of habitat most commonly converted to cropland or pastureland.

Use by prairie chickens of disturbed or undisturbed habitat also varied during the day and showed a strong similarity in pattern of use to type and height data. Disturbed agricultural areas were used most during the AM (82%) and less during PM (58.5%) (Fig. 8). This high use of agricultural habitats with their shorter height classes reflected a concentration of available food. Open low vegetation provided easier access to food on the ground and agricultural activities increased both the distribution and amount present. This use of disturbed areas has also been reported by (Yeatter 1943, Ammann 1957, and Drobney and Sparrowe 1977).

Use of undisturbed cover was highest at night (77.9%, Fig. 8). Unmowed lowlands (38.7%) and lightly grazed lowlands were used most often at night for roosting. Hamerstrom et al. (1957) suggested that prairie chickens when night roosting have a preference for grass and sedges over woody cover. Snowberry was used 11.2% and classified as undisturbed even though areas between stems were heavily grazed. The structure and height created by snowberry was similar to undisturbed grassland but was used only for snow roosting when it trapped enough snow to permit burrowing.

All of the unmowed lowlands were at least lightly grazed since cattle were in all pastures at sometime during the grazing season. These lowlands were also classified as undisturbed as use by cattle on the SNG rarely reduced structure. By contrast mowing of lowlands in the summer eliminated all structural cover from these areas until the following June.

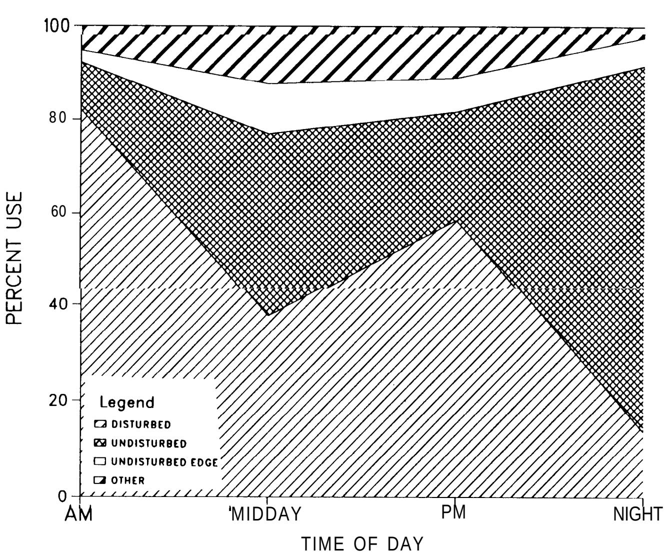

Figure 8.--Use of habitat by disturbance types by time of day for radio-tagged prairie chickens during winter, 15 December-17 February, Sheyenne National Grasslands, 1984-85.

Land Ownership

Habitat use based on land ownership showed that 76.4% of all radio locations occurred on private land, due primarily to high use (52.9%) of agriculture during the day. Night roosting favored public land (56.2% vs 43.8%). The use of private and public land emphasized the importance of both to winter survival of prairie chickens on the SNG. The recorded use of private land for roosting was the result of 2 radioed prairie chickens that used private lands for both feeding and roosting. These roosting areas, like those on the SNG, were lowland pasture areas that were undisturbed, Class III and IV vegetation, a habitat not common on private land. The typical pattern of 17 of 20 radioed birds was to feed on private agricultural land and roost at night on public land.

Early Spring

Habitat use relative to type, height and disturbance patterns in early spring were only slightly different from those observed during winter. The use of grass increased from 29.6% in winter to 37.6% in early spring. The use of edge types remained the same and the use of shrubs declined (Table 4). Changes in the daily pattern of habitat use occurred in the PM period, where the incidence of agriculture increased from 50.8% in the winter to 70.4% in the spring. The use of the lower height classes in the PM also increased in early spring (63.1% vs 81.7%) as did the use of disturbed habitat (58.5% vs 77.3%). These changes were the result of longer warmer days and prairie chickens spent more time feeding in the PM.

Use of night roosting habitat in spring was similar to winter, as the lowlands and Class 111 vegetation still dominated (71% vs 66%). Overall use by land ownership remained the same except for a reduction in use of public land in the PM, a reflection of the longer feeding periods in agriculture in the PM.

Within the agricultural types, the use of alfalfa and sunflowers increased from winter to spring from 3.6-20.1% and from 8-18.2% respectively. The disappearance of snow made food in these 2 types available. Prairie chickens showed a preference for sunflowers when both corn and sunflowers were in the same feeding field. In winter, harvested sunflowers were only available where snow was blown clear.

Alfalfa was used for both feeding and roosting in spring. The alfalfa fields used for roosting (both day and night) were fields where only 2 crops were taken and regrowth in late summer produced cover of 8-15 cm. Short-cropped alfalfa was used for feeding as the growing green vegetation was apparently attractive to prairie chickens, particularly hens.

Winter and early spring habitat data presented here should not be taken out of context. The high use of agriculture was important to the survival of the prairie chicken on the SNG, but it must be related to the bird's year-long needs. Management must provide a combination of agriculture and grass that will provide the necessary year-long requirements. The grass component must be of the right height and type for nesting and roosting, and occur in proximity to winter food. From early spring on there is a decided decrease in the use of agricultural types and a corresponding increase in the use of grassland. Over 70% of all nests and over 90% of all booming grounds were located on the public grasslands. Although this phase of the study was concerned primarily with winter habitat, a decided change in use was noted between winter and late spring. Habitat use by type, height class disturbance and landownership on a weekly basis, by day and night, are presented in Figures 9-16. After the first week of April, a day time shift in habitat use was recorded, from agriculture to grassland. Night roosting continued to be centered in the undisturbed lowlands.

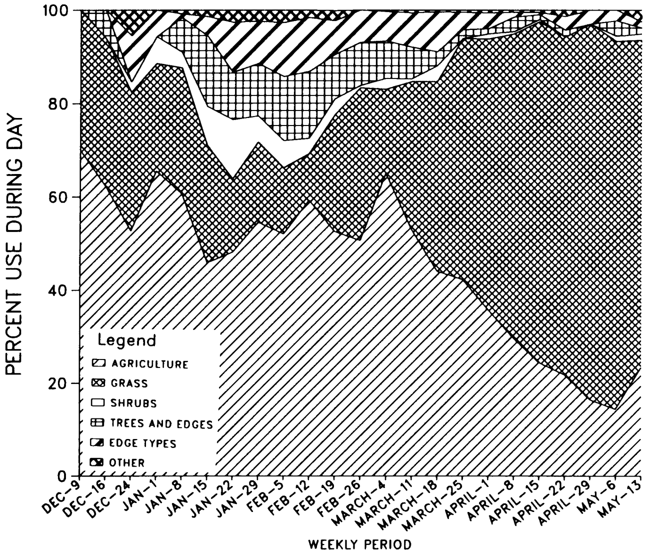

Figure 9.--Weekly use of habitat types during the daytime for radio-tagged prairie chickens Sheyenne National Grasslands, 9 December-19 May, 1984-85.

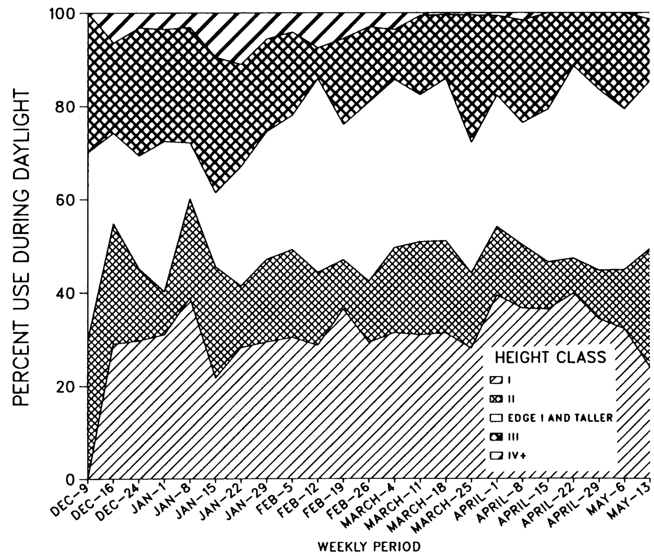

Figure 11.--Weekly use of cover by height classes (I=0-8 cm, II=9-25 cm, III=26=50 cm, IV+= greater than 50 cm) during the daytime for radio-tagged prairie chickens, Sheyenne National Grasslands, 9 December-19 May, 1984-85.

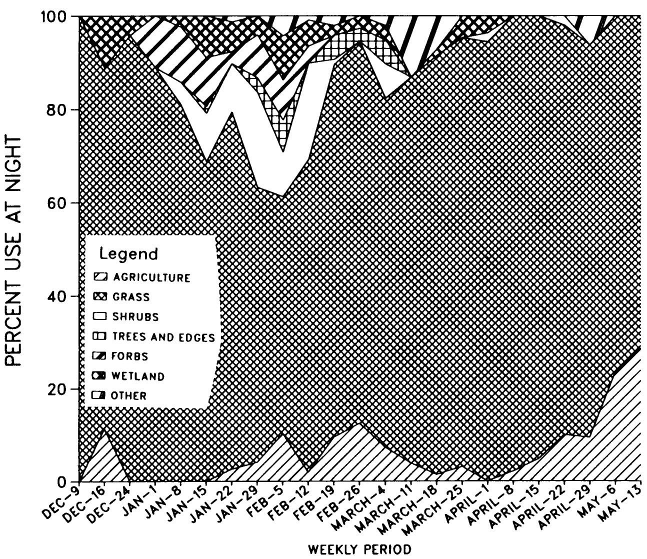

Figure 10.--Weekly use of habitat types at night for radio-tagged prairie chickens, Sheyenne National Grasslands, 9 December-19 May, 1984-85.

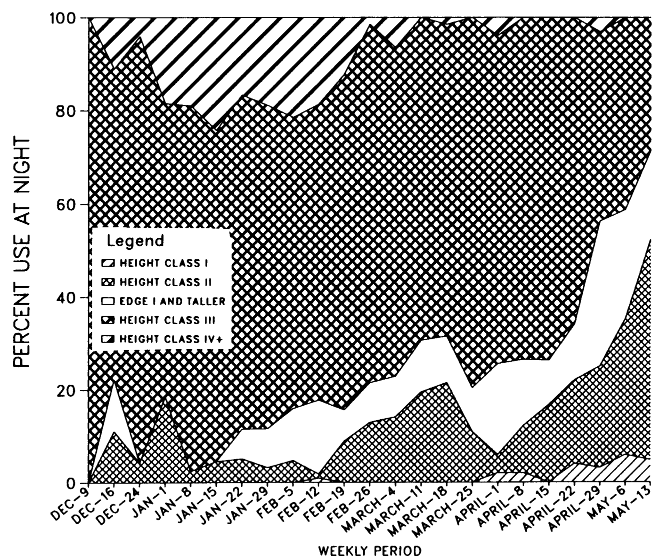

Figure 12.--Weekly use of cover by height classes (I=0-8 cm, II=9-25 cm, III=26=50 cm, IV+= greater than 50 cm) at night for radio-tagged prairie chickens, Sheyenne National Grasslands, 9 December-19 May, 1984-85.

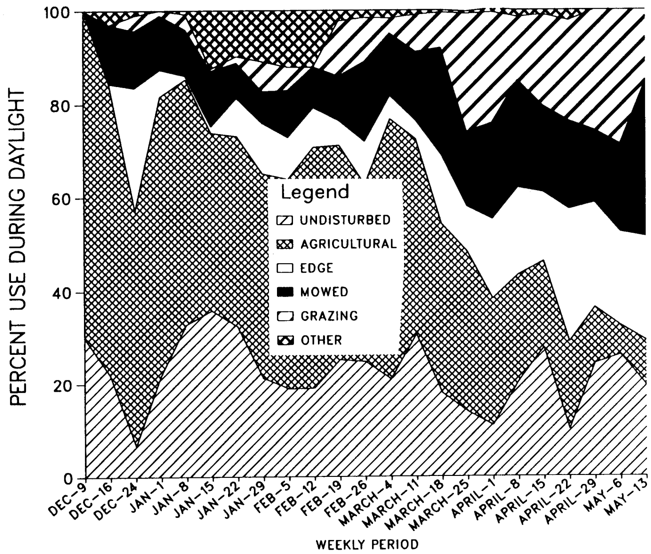

Figure 13.--Weekly use of habitat by disturbance types during the daytime for radio-tagged prairie chickens, Sheyenne National Grasslands, 9 December-19 May, 1984-85.

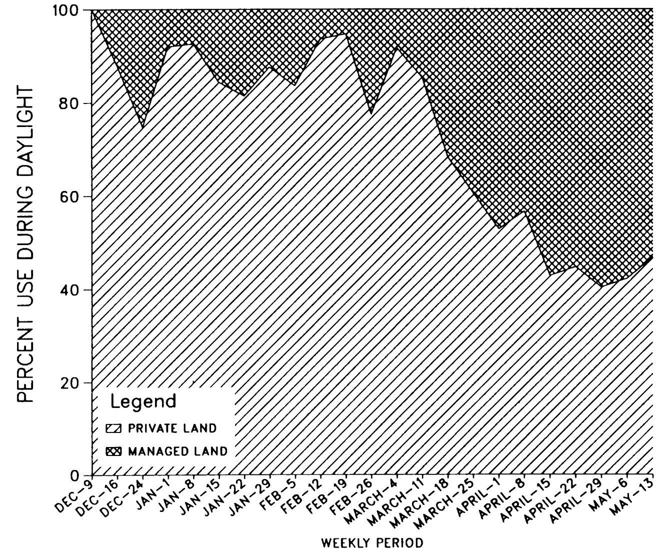

Figure 15.--Weekly use of land types during the daytime for radio-tagged prairie chickens, Sheyenne National Grasslands, 9 December-19 May, 1984-85.

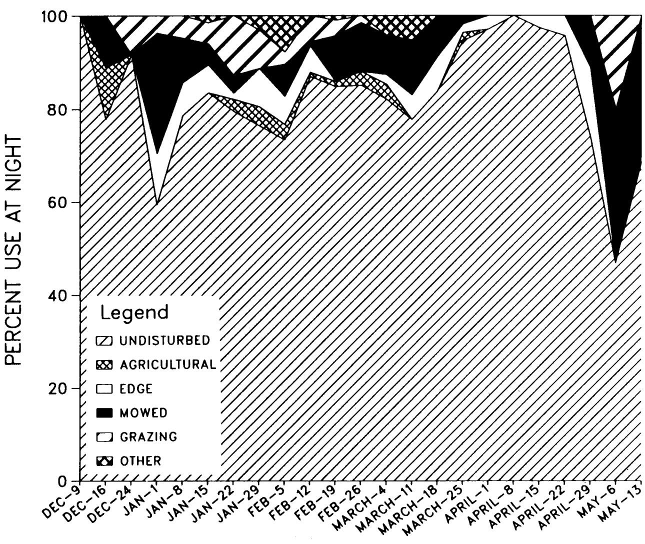

Figure 14.--Weekly use of habitat by disturbance types at night for radio-tagged prairie chickens, Sheyenne National Grasslands, 9 December-19 May, 1984-85.

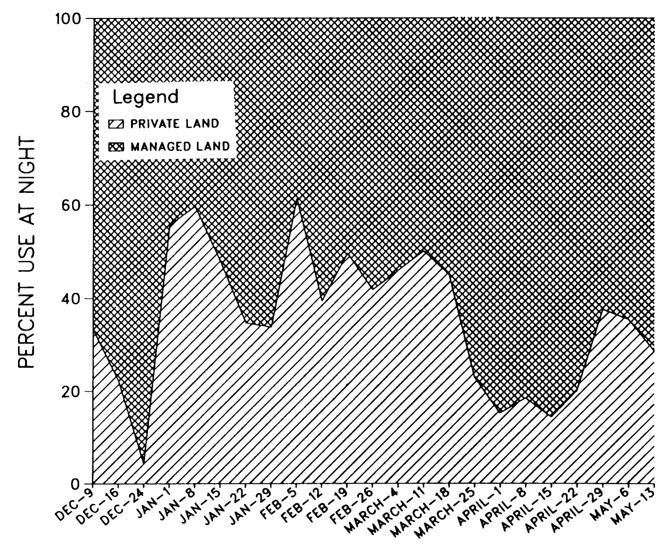

Figure 16.--Weekly use of land types at night for radio-tagged prairie chickens, Sheyenne National Grasslands, 9 December-19 May, 1984-85.

Summary Daily Pattern

The daily tracking of radioed individuals, along with observations in the field, yielded the following general pattern for winter daily movements and habitat use by prairie chickens on the SNG. Prairie chickens left the roost area in small flocks, after sunrise, flew 0.8-1.6 km to agricultural fields where they fed and loafed in low form (Class I or II, 0-25 cm) disturbed vegetation, primarily corn. They walked or flew 0.8-1.6 km to taller, (Class III, 26-50 cm) undisturbed vegetation, where they loafed or day roosted during midday. They returned to short form, disturbed vegetation in the PM, fed and flew to taller (Class III or IV) undisturbed lowlands or snowberry to night roost. Prairie chickens typically made 4 major flights of over 0.4 km (.25 mile) per day, 1 from roosting to feeding, 1 to day roost areas, 1 back to the feeding area and a final flight to a roosting area. Flights to feeding and roosting areas were often made in 2 segments, 1 long and 1 short, making 6 flights a day. Changes in the daily pattern usually occurred only when new snow covered regular feeding areas, or when sub-zero temperatures caused them to spend more time in the roost. This pattern changed for the cocks in late winter as they initiated visits to their booming grounds early in the morning before they fed. Hens reduced their movements and localized near a food source. As spring progressed cocks visited booming grounds in the morning and evening, and eventually abandoned agriculture and began to feed in the grasslands near their booming grounds.

Individual Night Roosts

A total of 372 winter and 52 early spring prairie chicken night roosts were examined and analyzed between 12 January and 15 March in 1985. Four types were documented: a vegetation roost, where vegetation was the only source of cover; a snow depression, where the bird made a bowl in the snow and snow was the main source of cover (Fig. 17); a snow vegetation-roost where both vegetation and snow provided cover; and the snow burrow where the bird made a tunnel and enclosed cavity into soft snow (Fig. 18).

Both the accumlation or the movement of snow by wind created situations that influenced roost site selection. With the exception of several snow burrows in the sandhills where the birds burrowed into snow that had accumulated in drifts of up to 2 meters, all observed roosts were associated with some type of vegetation. The vegetation either served as cover or caused snow to accumulate in a snow fence effect. Terrain served a similar function as blown snow accumulated in the lee of ridges.

Evaluating the cover at individual roost sites was difficult when snow was present, as the birds used both snow and vegetation. Because of the role snow played in providing roost cover, the Robe1 pole was used to evaluate total coverage and coverage by vegetation. Total coverage included snow and vegetation in reading obstruction on the Robe1 pole, while coverage by vegetation included vegetation only. Each roost had 4 Robe1 pole readings, but because of snow, some had from none to 4 for vegetation.

Dominant Cover

No detailed species composition was collected at individual roost sites, as only the dominant species or genus was visually estimated for each roost (Table 5). Grasses and sedges were dominant at 74% of the roosts in winter. Panicum vergatum and Carex lanuginosa and Panicum sp. and Carex sp. either alone or in combination, were dominant at 43.6% of the observed roosts. Snow burrows were associated with the taller species that trapped and accumulated enough snow to permit the birds to burrow. Snowberry, sweet clover, quackgrass, Panicum spp. and Spartina gracilis, all tall, sturdy species dominated at snow burrows.

Figure 17. --Snow depression used for night roosting by prairie chicken, Sheyenne National Grasslands, 1984-85.

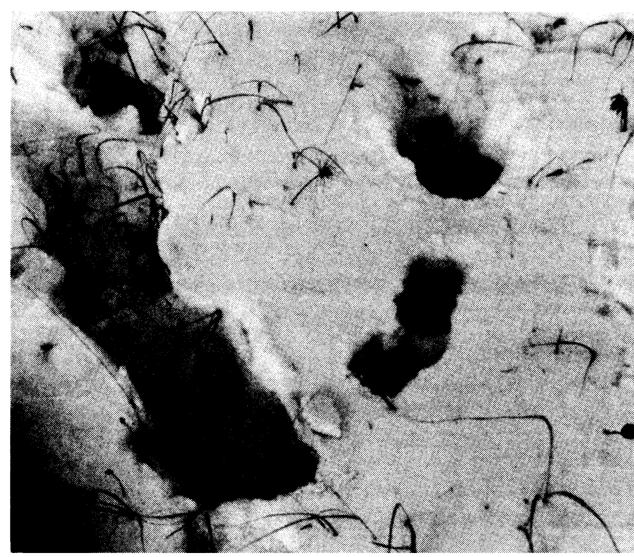

Figure 18. --Snow burrow used for night roosting by prairie chicken, Sheyenne National Grassland, 1984-85.

Dense cover was not used for roosting or burrowing as the density of stems prevented entry into the vegetation. Space between stems is necessary to permit burrowing, but height and structure are also necessary to hold or accumulate snow. Snowberry and sweetclover (Melilotus spp.) were not important dominants in any other roost types as they provided little cover in the absence of deep snow.

To snow burrow the birds actively sought areas where snow had accumlated to the necessary depth. Birds commonly attempted to snow burrow only to have it collapse. Snow burrows were often

Table 5.--Percent occurrence of dominant plant species at prairie chicken night roosts, winter (9 December-17 February) and early spring (18 February-15 March), Sheyenne National Grasslands, 1984-85. Number of roosts in parentheses.

	Winter					Early Spring
	Type of Roost					Type of Roost
Species	Vegetation	Vegetation and Snow	Snow Burrow	Snow Depression	Total	Vegetation
Panicum vergatum	7.7 (3)	9.2(10)	2.6 (4)	5.5 (7)	5.6 (24)	9.5 (6)
Panicum spp.	12.8 (5)	2.8 (3)	13.6(21)	15.7(20)	11.4 (49)	
Carex lanuginosa	12.8 (5)	3.7 (4)	3.8 (6)	3.1 (4)	4.4 (19)	30.2 (19)
Carex spp.		36.7(40)		13.3(17)	13.3 (57)	9.5 (6)
Panicum/Carex spp.	7.7 (3)	29.4(32)	2.6 (4)	3.9 (5)	10.2 (44)	9.5 (6)
Andopyron repens		3.7 (4)	7.1(11)	10.2(13)	6.5 (28)	7.9 (5)
Phalaris arundinacea	51.3(20)	1.8 (2)		2.4 (3)	5.8 (25)	
Calamagrostis inexpansa	2.6 (1)	3.7 (4)			0.9 (5)	1.6 (1)
Brommus inermis			0.6 (1)	1.6 (2)	0.7 (3)	
Andropogon gerardi						9.5 (6)
Spartina gracilis		6.4 (7)		1.6 (2)	2.1 (9)	
Andropogon scoparius			11.0(17)	5.5 (7)	5.6 (24)	
Melilotus spp.			14.9(23)	7.1 (9)	7.5 (32)	
Symphoricarpos occidentalis			19.5(30)	13.4(17)	11.0 (47)	
Salix spp.	2.6 (1)		4.5 (7)		1.9 (8)	1.6 (1)
Aster sp.			5.8 (9)	1.6 (2)	2.6 (11)	
Solidago spp.			2.6 (4)	1.6 (2)	1.4 (6)	1.6 (1)
Typha sp.				0.8 (1)	0.2 (1)	
Poa sp.	0.6 (1)				0.5 (2)	
Sorghastrum nutans			5.8 (9)	2.4 (3)	2.8 (12)	
Corn		2.8 (3)	1.9 (3)	.8 (1)	1.6 (7)	
Alfalfa				9.5(12)	2.8 (12)	19.0 (12)
Open snow					3.2 (5)	
Total	39	109	150	134	437	63

unsuccessful either because the snow was too shallow or too soft to support a roof (Fig 19).

All successful burrows during the winter 1984-85 were in areas where snow had accumulated due to vegetation or terrain. When a bird failed in its attempt to burrow, it usually walked a short distance and formed a snow depression near some vegetation above the snow. At times both snow burrows and snow depressions were found in the same group of roosting birds.

Unused snow depressions were often found in the tracks leading to eventual night roosts. These depressions contained 1-2 or no droppings and appeared to be temporary or possibly even unsatisfactory roosts as birds left them and moved to a burrow or another depression farther away. At times some birds must have flown to different sites because no tracks were found leading from the unused depression. These depressions may have been loafing forms occupied only until the bird went to roost for the night, although, at times the bird remained for the night in their first and only depression. Back tracking from night roosts has revealed as many as three depressions on the way to the final night roost. The mean distance walked in snow to night roosts was 104 ± 84 m (n = 101).

No evidence was found that prairie chickens ever dove from flight into snow burrows. The usual pattern (based on tracks) was to land in open areas along the edge of vegetation, walk (0.1-20 m) into cover and select a roost site. In the morning birds either flew directly from their roosts or walked a short distance and flew. Tracks indicated that birds did little feeding in roost areas in the morning, although some feeding occurred in the evening prior to roosting.

Figure 19.--Unsuccessful attempt at snow burrowing by prairie chicken, Sheyenne National Grasslands, 1984-85. (E=entrance, P= snow plug sealing entrance).

Fox and coyote tracks were often observed in roost areas and at times they passed within 10 m of roosting birds during the night. Of the 372 winter roosts observed, there was no evidence that any birds were killed or flushed at night.

Effective Cover

The use of snow as cover appears to serve primarily as wind shelter and/or insulation. Mean coverage by vegetation ranged from 1.1-3.8 and total coverage (including snow) varied between the types of night roosts (Table 6). Total coverage and vegetation coverage were higher in the winter than early spring. Analysis of 368 random points in the same habitat as the roosts suggested that roosting prairie chickens selected sites in winter with greater total and vegetation coverage and deeper snow. The selection of taller cover continued into the early spring (Table 7).

Height Class

Class III (25 to 50 cm) or taller residual vegetation was associated with 94.1% of all roost types (Table 7). Comparisons with random height classifications, indicated that prairie chickens selected the taller classes within the areas they used (CSq, P = 0.001, df = 3). A breakdown by disturbance types, shows that 78% of observed roosts were in undisturbed habitat, and 68% of these were in unmowed lowlands. Uplands or mowed lowlands were not used in winter or early spring.

Night roosts were usually located in the open, away from tree(s). Mean distance to the nearest single tree in winter was 320±221 (n = 485) and to nearest trees (woodlot or clump) 353±241 (n = 485). The birds roosted farther from trees in spring than winter. (503±354 m, n = 33 vs 353±241, n = 485). They roosted near the edge of cover in both winter (18.1±20.5 m (n = 405) and spring (14.7± 10.4 m, n = 50). The nearest edge in both spring and winter was typically a lower height Class (91%) and 83% of the edge types were heavily grazed or mowed. Roosting flocks confined themselves to a small portion of a roost area as average maximum distance between roosting birds was 27.9±15.8 (n = 94) in the winter and 11.5± 27.4 m, (n = 24) in the spring. The average distance to nearest bird showed the same pattern as birds roosted closer to each other in spring 1.7±1.3 (n = 36) than in the winter, 3.3±5.6 (n = 261). The greater distances from the edge and between birds in winter was thought to be due to less cover above the snow, causing the birds to spread out over a larger area to find suitable cover or snow.

Size

Even though prairie chickens clustered when night roosting and remained near the edge, they

Table 6.--Mean Robel pole readings by total and vegetation coverage for individual prairie chicken night roosts and random points, during winter (9 December-17 February), and early spring (18 February-15 March), Sheyenne National Grasslands, 1984-85.

	Mean Robel pole reading			
	Total Coverage*	Total Coverage	Coverage by Vegetation	Coverage by Vegetation
Roost Type	Roosts	Random Points	Roosts	Random Point
Vegetation				
Spring	1.6±1.0 (40)	1.2±1.2 (97)	1.6±1.0 (40)	1.2±1.2(97)
Winter	2.1±1.0 (32)	1.5±1.4 (46)	2.1±1.0 (32)	1.5±1.4(46)
Vegetation and snow				
Winter	2.8±1.4(115)	1.7±0.6 (56)	1.1±0.4 (90)	1.5±0.4(38)
Spring	1.9±0.5 (12)	1.3±0.5 (44)	1.9±0.5 (12)	1.3±0.5(44)
Snow Depression	2.1±0.8(120)	1.8±1.1(104)	3.2±0.9 (38)	2.4±1.1(12)
Unused Snow Depression	2.3±0.4 (76)		0 (76)	
Snow Burrow	2.6±0.8(145)	2.4±0.8 (162)	3.8±0.4 (2)	2.8±1.0 (7)
Unsuccessful Snow Burrow	2.2±0.6 (39)		0 (39)	

* Snow or vegetation or a combination of both.

roosted in relatively large undisturbed areas. The size of roost areas as determined by measurements from aerial photographs and in the field, showed that the mean size for 26 winter roost areas was 1.3 ha with a range of .04-5.5 ha; 76% were greater than 0.4 ha (1 acre) in size. Average length was 174±105 m and width 88±38 m. The larger areas were associated with private land or rough areas in the SNG that were not or could not be mowed. The size of the areas used in spring were smaller with a mean of 0.4±.28, (n = 7) (1 acre). Mean length and width were 82±39 m and 45.7±33 m).

Table 7.--Use of vegetation height classes (%) for observed prairie chicken roosts and random points during winter (9 December-17 February), and early spring (18 February-15 March), Sheyenne National Grasslands, 1984-85.

	Vegetation Height Class			
	I	II	III	IV+
Roost Type	0-8 cm	9-25 cm	26-50 cm	>50 cm
Vegetation				
Winter	0	8.8 (3)	76.5 (26)	14.7 (3)
Spring	2.1 (1)	29.2(14)	66.7 (32)	2.1 (1)
Vegetation and snow				
Winter	0	4.7 (5)	77.4 (82)	17.9(19)
Spring	0	0	100.0 (6)	
Snow Depression	.9 (9)	.9 (1)	79.1 (91)	19.1(22)
Unused Snow Depression	1.3 (1)	0	82.5 (66)	16.3(13)
Snow Burrow	2.3 (3)	.8 (1)	73.1 (95)	23.8(31)
Unsuccessful Snow Burrow	0	2.2 (1)	62.2 (28)	35.6(16)
Total winter	3.3(13)	2.6(10)	75.0(294)	19.1(75)
Total spring	3.9 (2)	13.7(17)	80.4 (41)	2.0 (1)
Random Points				
Winter	7.9(12)	23.7(36)	47.4 (72)	21.1(32)
Spring	32.3(32)	26.3(26)	37.4 (37)	4.0 (4)

It is believed that larger areas were selected for winter night roosting because of the greater security provided in the form of cover above the snow. In early spring there is more coverage available in a smaller area.
These roost areas were similar in type, height class and species composition to areas used by radioed prairie chicken hens for nesting. At least 9 of the areas used by prairie chickens for winter night roosting either were or had been used by radioed hens for nesting.

Thus the undisturbed lowland community on the SNG is the critical component for winter night roosting sites and nesting habitat for prairie chickens. These are the 2 places where an individual spends more than a few hours in one spot. The amount and distribution of this lowland cover on the SNG is determined by lowland mowing practices, the pattern of which will be a key factor in maintaining or improving habitat for prairie chickens on the SNG. Nesting and roosting cover along with winter food should serve as focal points for any future management plans for the prairie chickens on the Sheyenne National Grasslands.

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