Pronghorn range use and relation to livestock in southeastern Montana
by James Samuel Freeman

A thesis submitted to the Graduate Faculty in partial fulfillment of the requirements for the degree of
MASTER OF SCIENCE in Fish and Wildlife Management
Montana State University

Abstract:
A study of pronghorn range use and relation to livestock was conducted in Carter County, Montana during the fall of 1969, and winter of 1970. A total of 1,014 observations of pronghorns during fall indicated a population composition of 26, 45, and 29 percent males, females, and fawns, respectively. Respective densities of 2.6 and 2.1 per square mile before and after the hunting season, together with an increase in the ratio of females per 100 males from 188 to 230 for the same periods, indicated a decrease in the population during the hunting season weighing heavier on males. None of four female fawns examined were pregnant but all four females older than fawns carried twins. Fat content of femur marrows, kidney fat indexes, and ratios of hog-dressed to whole weights for 12 animals examined from October to March indicated animals were in best condition during mid-winter. A Chi-square goodness of fit test was applied to a total of 4,478 observations of pronghorns, evaluated on the basis of habitat types used, indicated distribution was dependent on habitat types. Percent use of the Agropyron-Artemisia habitat type by pronghorns in relation to other habitat types increased from 75 in early fall to 100 by winter. Pronghorns used areas of progressively denser sagebrush from early fall through winter. Group size of pronghorns increased progressively from 6 to 55 for these seasons. Home range sizes determined for 11 individual pronghorns showed female home ranges were significantly larger than those of males. Fence types, classified according to penetrability by pronghorns, did not appear to hamper pronghorn distribution. A total of 39, 19, and 17 feeding sites of pronghorns, cattle, and sheep, respectively were examined and 19 rumen samples from pronghorns were analyzed to obtain food habits data. Browse was the major component of the diet of pronghorns, with forbs and grasses of little importance in fall and winter. Grass was the most important item in the diet of cattle and sheep, with browse a distant second. Artemisia tridentata and A. cana were important items in the browse component of the diets of all three species. Food habits data indicated forage competition between pronghorns and either sheep or cattle was minor, but use of pastures indicated an incompatability between pronghorns and sheep that could result in notable land use competition. Data suggested that pronghorns and cattle were compatible, and that joint use of range by these species in this area could possibly result in better overall forage use than use by either species alone.

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Date July 8, 1971

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by

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A thesis submitted to the Graduate Faculty in partial fulfillment of the requirements for the degree

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ABSTRACT

A study of pronghorn range use and relation to livestock was conducted in Carter County, Montana during the fall of 1969, and winter of 1970. A total of 1,014 observations of pronghorns during fall indicated a population composition of 26, 45, and 29 percent males, females, and fawns, respectively. Respective densities of 2.6 and 2.1 per square mile before and after the hunting season, together with an increase in the ratio of females per 100 males from 188 to 230 for the same periods, indicated a decrease in the population during the hunting season weighing heavier on males. None of four female fawns examined were pregnant but all four females older than fawns carried twins. Fat content of femur marrows, kidney fat indexes, and ratios of hog-dressed to whole weights for 12 animals examined from October to March indicated animals were in best condition during mid-winter. A Chi-square goodness of fit test was applied to a total of 4,478 observations of pronghorns, evaluated on the basis of habitat types used, indicated distribution was dependent on habitat types. Percent use of the *Agropyron-Artemisia* habitat type by pronghorns in relation to other habitat types increased from 75 in early fall to 100 by winter. Pronghorns used areas of progressively denser sagebrush from early fall through winter. Group size of pronghorns increased progressively from 6 to 55 for these seasons. Home range sizes determined for 11 individual pronghorns showed female home ranges were significantly larger than those of males. Fence types, classified according to penetrability by pronghorns, did not appear to hamper pronghorn distribution. A total of 39, 19, and 17 feeding sites of pronghorns, cattle, and sheep, respectively were examined and 19 rumen samples from pronghorns were analyzed to obtain food habits data. Browse was the major component of the diet of pronghorns, with forbs and grasses of little importance in fall and winter. Grass was the most important item in the diet of cattle and sheep, with browse a distant second. *Artemisia tridentata* and *A. cana* were important items in the browse component of the diets of all three species. Food habits data indicated forage competition between pronghorns and either sheep or cattle was minor, but use of pastures indicated an incompatability between pronghorns and sheep that could result in notable land use competition. Data suggested that pronghorns and cattle were compatable, and that joint use of range by these species in this area could possibly result in better overall forage use than use by either species alone.

INTRODUCTION

Southeastern Montana is very important for the production of pronghorn antelope (*Antilocapra americana*). Beer (1944) listed Carter, Powder River, Custer, and Fallon Counties of this area as maintaining nearly one-third of the total population in Montana, with Carter County supporting the highest resident population in the State. More recent figures verify the importance of Carter County for pronghorns; e.g. Campbell (1970) reported densities as great as three per square mile in summer. Southeastern Montana is primarily a livestock producing area. It has been extensively fenced, often with sheep-tight fences. Stock ponds for watering livestock have been constructed. These activities and others for the benefit of livestock had not been critically evaluated from the standpoint of their effects on the ecology of pronghorns.

Despite an early study by Buck (1947) which suggested little competition betwen pronghorns and livestock in this part of the State, and several studies concerning various phases of the ecology of the pronghorn in this and other parts of the State, little was known about pronghorn-livestock relations. The studies of Couey (1946), Cole (1956), Martinka (1967), Wentland (1968), and Bayless (1969) conducted in various parts of the State indicated a clearcut relationship between pronghorns and Sagebrush-Grassland vegetation types but data on interspecific relations of pronghorns and livestock were generally lacking.

With game management becoming more critical, the shortage of infor-

mation on pronghorn-livestock relationships in this important area of Montana's pronghorn production lead to a year-long study. Food habits and range use were recorded for pronghorns, cattle (*Bos taurus*), and sheep (*Ovis aries*) on a common use range. Use of range by pronghorns was related to livestock use as well as characteristics of fences and vegetation types of pastures. Bruce Campbell and I worked on this project together, but he concentrated on the spring and summer seasons and reported his findings separately (Campbell 1970). I concentrated on fall and winter, spending full time in the field from October, 1969 through mid-March, 1970. The results of my studies are presented here.

DESCRIPTION OF STUDY AREA

The study area, including the vegetation, has been described in detail by Campbell (1970). A brief resumé is presented here for reference in this paper. The area consisting of approximately 96,000 acres, of which 57 percent is privately owned, is in extreme southeastern Montana (Figure 1). The economy is agricultural, primarily livestock oriented.

Physiographic features center around broad sloping plains sporadically dissected by coulees. The north and west sides of the area are bordered by shale hills and buttes. Exposed rock formations are sedimentary in origin ranging in age from Jurassic to present. Little crustal disturbance is indicated by the rock formations which dip very gently if at all.

Soils are primarily shallow and poorly developed. Most are fairly heavy resulting from the underlying shale formations. The exceptions are soils of flood plains of major drainages where some fairly deep soils are quite well developed, and where sandstone outcrops in the extreme northeastern part of the area have produced the only sandy or loamy soils present. Clay pan spots are scattered through the flats. Around the bases of hills and buttes on the west and north edges of the area are numerous solonchaks or puff spots resulting from soluble salt percolation in poorly drained silty clay loam soil.

The vegetation was classified according to six habitat types: *Agropyron-Artemisia; Agropyron*-Leguminosae-*Gutierrezia, Agropyron-*

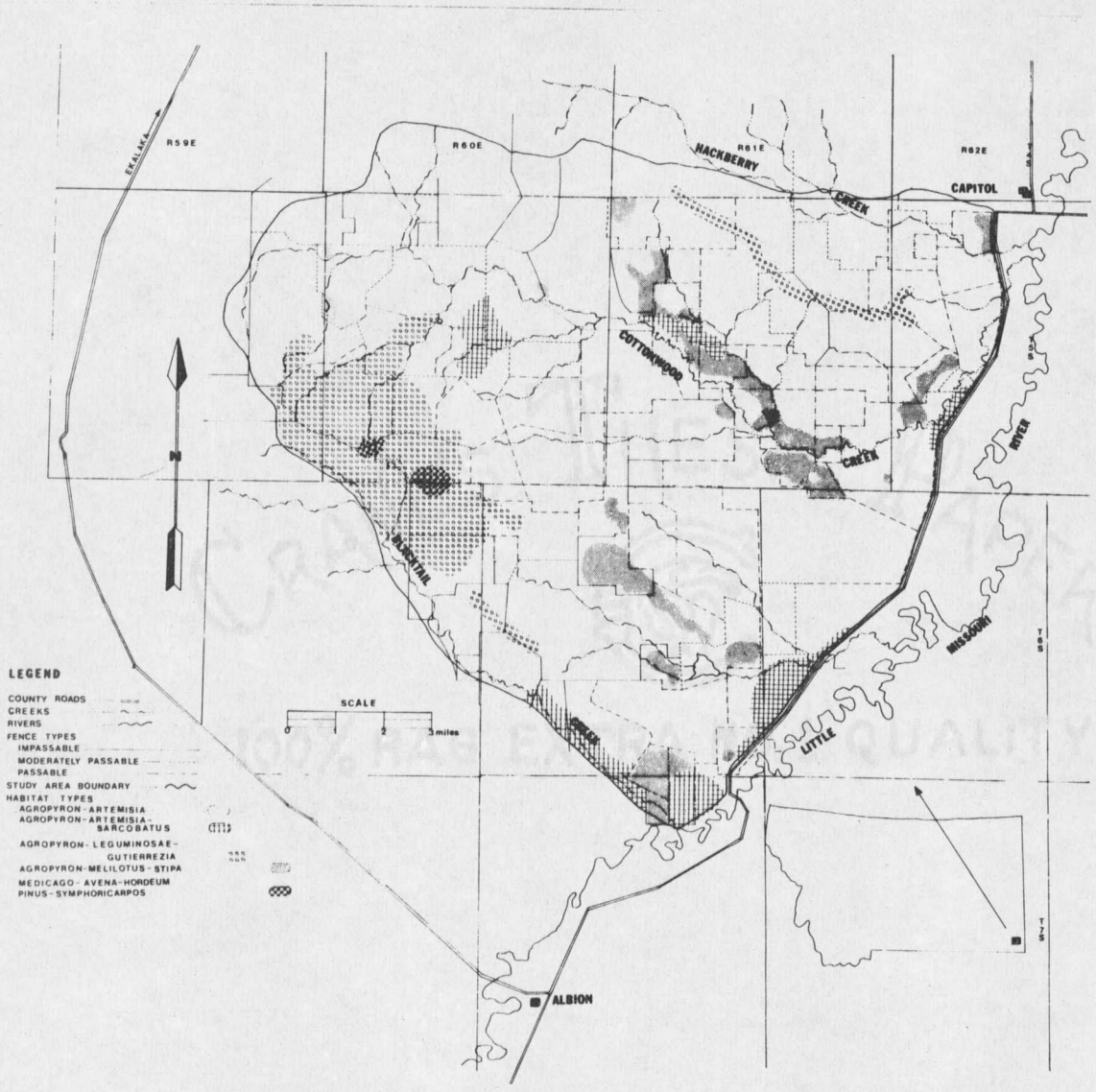

Figure 1. Map of study area showing types of fences and distribution of habitat types.

Melilotus-Stipa, Agropyron-Artemisia-Sarcobatus, Pinus-Symphoricarpos, and *Medicago-Avena-Hordeum*. The first type was further sub-divided according to density aspect of woody sagebrush (*Artemisia* spp.) as determined by crown intercept along 100-foot lines. Less than 1, 1-5, 6-20, and 20+ percent line intercept were considered rare, scattered, common, and dense, respectively.

The *Agropyron-Artemisia* type is by far the most important type, covering approximately 79 percent of the area (Figure 1), primarily the broad flatlands. *Agropyron smithii* is the most characteristic grass. Others are *Schedonnardus paniculatus, Koeleria cristata, Poa* spp., and *Stipa viridula*. Important forbs include: *Achillea millefolium, Artemisia-frigida, Aster falcatus, Iva axillaris, Lomatium foeniculaceum, L. macrocarpum, Phlox hoodii, Sphaeralcea coccinea, Taraxacum officinale,* and *Vicia americana*. The dominant shrub is *Artemisia tridentata* followed in importance by *Gutierrezia sarothrae* and *Atriplex nuttallii*. *Artemisia tridentata* displays a wide variety of growth forms, apparently related to past grazing history, soils, and topography. Its association with forbs and grasses changes considerably within short distances, probably related in part to sagebrush density. Fewer grass species are present in the dense sagebrush aspect as compared to other aspects. The greatest number of forb species is present in the scattered aspect. Total canopy coverage and frequency for shrubs increase as the sagebrush becomes progressively denser. Sheep use on this type reduces the number of forbs by species, frequency of occurrence, and canopy coverage.

The *Agropyron*-Leguminosae-*Gutierrezia* habitat type covers approximately 9.4 percent of the area, occurring in places of greatest relief with accompanying solonchak spots, shale outcrops, and impermeable soils. *Agropyron smithii* is the dominant grass followed in importance by *Buchloe dactyloides* and *Muhlenbergia cuspidata*. The dominant shrub is *Gutierrezia sarothrae*, with *Artemisia tridentata* and *Atriplex nuttallii* secondary. Among important forbs are many species of legumes including *Melilotus officinalis*, *Petalostemon candidum*, and *P. purpureus* in the more mesic sites. Other important forbs include *Artemisia frigida* and *Iva axillaris*.

The *Agropyron-Melilotus-Stipa* type covers 6.6 percent of the area, primarily areas of past cultivation seeded to *Agropyron smithii*. It is found mainly along major drainages and other areas of increased moisture. Dominant grasses are *Agropyron smithii*, *Stipa viridula*, and *Poa* spp.. Important forbs are *Melilotus officinalis*, *Iva axillaris*, and *Polygonum ramosissimum*. Along the edges, *Artemisia tridentata* and *Atriplex nuttallii* are invading.

The *Agropyron-Artemisia-Sarcobatus* type covers 3.6 percent of the area, occurring primarily on dense, heavy soils. The dominant grass is *Agropyron smithii*. Primary shrubs are *Sarcobatus vermiculatus* and *Artemisia tridentata*. Most frequent forbs are *Artemisia frigida*, *Phlox hoodii*, *Achillea millefolium*, and *Haplopappus multicaulis*. Grasses and forbs have the lowest canopy coverage in this type as compared to

other types, while shrubs and cactus have the highest.

6 The *Pinus-Symphoricarpos* type occurring on rugged hill tops in the western part of the area and the *Medicago-Avena-Hordeum* type occurring on small harvested plots in the northern part of the area, together account for only 1.3 percent of the area.

Monthly climatological data for the months of my study were obtained by averaging the records from the United States Department of Commerce Weather Stations at Albion, 5 miles south of the area, and Ridgeway, about 8 miles northwest of the area (Table 15, Appendix). The average temperature during the fall, October, November, and December, was 31.0 F which was 2.8 percent below the 1960-70 average. The average temperature in winter, January, February, and March, was 20.5 F, which was 7 percent below the average. Precipitation in fall and winter was 1.61 and 1.62 inches, respectively. This was 13.5 and 49 percent above the average, respectively. Summers are hot and dry. Winters are severe with long cold spells and infrequent blizzards.

METHODS

Habitat Analysis

An analysis of the vegetation by forage classes in each habitat type used by pronghorns was made in the fall of 1969 by a method similar to that of Daubenmire (1959) to determine changes in availability of green forage as compared to spring and summer (Campbell 1970). A 2 x 5 dm plot frame was placed at 10-foot intervals along two, 50-foot lines, one of which extended north, and the other south from a central point at each of several feeding sites. In each plot, the canopy coverage of each taxon was visually estimated according to one of six classes. Canopy coverages for the forage classes, grasses, forbs, and shrubs, were estimated independent of individual species. Percent coverages for litter, rocks, bare ground, and lichens were likewise estimated. Classes I to VI represented coverages of 0-5, 5-25, 25-50, 50-75, 75-95, and 95-100 percent, respectively. Mid-points of the cover classes were used in data analyses.

At each feeding site of pronghorns, sagebrush density, as indicated by crown coverage, was estimated along a straight line of 100 paces. Less than 1, 1-5, 6-20, and over 20 percent line coverage were recognized as rare, scattered, common, and dense, respectively.

Plant nomenclature followed Booth (1950) and Booth and Wright (1966).

Distribution and Movements

Forty pronghorns were individually marked with neck bands and/or ear tags prior to the beginning of my observations.

An 111-mile vehicle route which traversed all parts of the study area was traveled at slow speeds approximately every 2 weeks from late September through November. After this date many of the roads became impassable to vehicle travel, but I was able to visit each portion of the area approximately every 2 weeks via the roads remaining open. For each pronghorn observed, group associates, locations to quarter section, sex, whether fawn or adult, habitat type, including sagebrush density occupied, whether marked, and its occurrence with livestock were recorded. Observations were aided by the use of a 6 x 30 binocular and a variable power 15-60X spotting scope.

Fall and winter home ranges were calculated by a method similar to that described by Hayne (1949) for individuals observed a minimum of five times.

Pasture occupancy by livestock was recorded.

Food Habits Analysis

Food habits were determined for both pronghorns and livestock by feeding site examinations supplemented by analysis of the contents of at least two rumen samples per month from pronghorns and one from a steer butchered in December. Both procedures of analysis followed methods similar to Cole (1956) as well as several others. The aggregate percentage method of Martin *et al.* (1946) was used in tabulating monthly and seasonal food habits for both methods.

Physical Characteristics

Twelve pronghorns were collected at the rate of two per month from October, 1969 through March, 1970. Physical characteristics such as standard measurements, whole and hog-dressed weights were taken. Uteri were examined for embryos. A gross examination was conducted for the presence of internal and external parasites. The age class was determined by dentition (Dow and Wright 1962). Femur marrow compression (Greer 1968), and kidney fat index (Ransom 1965), were calculated as indicators of physical condition.

RESULTS AND DISCUSSION

Pronghorn Population Characteristics

From late September, 1969 through mid-March, 1970, a total of 2,150 observations of individual pronghorns were classified according to sex and age (Table 1). The highest individual count for any period was 386 in early October giving a density of 2.6 per square mile. In late fall and winter, following the mid-October to mid-November hunting season, the density was found to be 2.1 per square mile which compared favorably with the spring density reported by Campbell (1970). The 64 fawns per 100 females in the fall was very close to that found for early fall by Campbell (1970). By November fawns were no longer classifiable with accuracy during field observations. All animals were then classed as adults. Early fall showed a ratio of 188 females to 100 males. In late fall, following the hunting season, this ratio increased to 230 females per 100 males. This possibly shows a greater vulnerability of males to hunting pressure which may be due to selectivity of the hunters.

Of eight females collected during fall and winter, four were fawns and four were 2 years old or older. Although female fawns have been known to breed (Wright and Dow 1962) and (O'Gara 1968), none of the fawns was pregnant. All of the older females were carrying twins.

Fawn males are apparently infertile, at least during the regular breeding season in September and October (Wright and Dow 1962). No direct evidence was found to the contrary. However, during the second

TABLE 1. SEX, AGE, FEMALES PER 100 MALES, AND FAWNS PER 100 FEMALES FOR PRONGHORNS AS DETERMINED FROM OBSERVATION COUNTS.

Date	ADULTS				Number Fawns	Percent	Total Classified	Fawns Per 100 Females	Females Per 100 Males
	Number Males	Percent	Number Females	Percent					
EARLY FALL:									
September (late)	100[1]	33[2]	133	43	72	24	305	54	133
October (early)	107	28	168	43	111	29	386	67	157
October (late)	57	18	155	48	111	34	323	72	274
Total or Average	264	26	456	45	294	29	1,014	64	188
LATE FALL:									
November (early)	87	27	235	73			322		270
November (late)	44	29	106	71			150		241
December	19	36	34	64			53		179
Total or Average	150	31	375	69			525		230
WINTER:									
January	120	39	189	61			309		157
February	30	28	76	72			106		254
March	61	31	135	69			196		222
Total or Average	211	33	400	67			611		211

[1] Number of observations of individuals for each time period in each category. (In September and October fawns were classified separately, but in subsequent months they were included as adults.)

[2] Percent of the total number of observations of individuals for each period in each category.

and third weeks in October many female-fawn groups were observed in which all of the fawns were females, while several male fawns were observed alone, apart from any group. On October 9, one male fawn was observed being chased away by an older male. This could indicate the coming of sexual maturity to the male fawns albeit after most of the rutting activity of the population was over.

Pronghorn Physical Characteristics

Kidney fat indexes for 12 pronghorns of both sexes and various ages including fawns tended to be highest December through February (Table 2). Femur marrow compression tended to show the same trend. There was no compression during mid-winter, but two animals showed very low compression values in fall. One male fawn showed the highest compression found when killed in mid-February. The compression value of 12 percent would indicate a femur fat value in the range of 50 percent (Greer 1968) but the kidney fat index was well above the critical level of 30 percent. Ransom (1965) determined that kidney fat decreased to an index of 30 without appreciable changes in fat content of femur marrow. The ratios of hog-dressed weights to whole weights did not indicate poor condition. This ratio for males tended to be lower than in spring and summer as found by Campbell (1970). Female fawns, all of which were non-pregnant, tended to have a higher ratio than the older females, all of which were pregnant. The highest ratio of 75.5 was found in a fe-

TABLE 2. SUMMARY OF PRONGHORN BODY CONDITION DATA FOR 12 PRONGHORNS COLLECTED AT THE RATE OF TWO PER MONTH FOR THE PERIOD OCTOBER, 1969 THROUGH MARCH, 1970.

Collection Date	Assigned Age[1]	Sex	Kidney Fat Index[2]	Whole Weight	Hog-Dressed Weight[3]	Dressing Percentage[4]	Percent Femur Marrow Compression[5]
10/16/69	1	Male	0.272	106	75	70.6	5
10/18/69	2	Male	0.575	108	73	67.5	0
11/16/69	0	Female	0.305	68	45	67.1	0
11/21/69	7	Female	0.260	94	62	66.0	<1
12/13/69	2	Female	0.775	99	69	69.8	0
12/16/69	0	Female	0.529	53	40	75.5	0
1/13/70	1	Male	0.983	104	72	69.1	0
1/17/70	0	Female	0.697	80	55	68.8	0
2/12/70	4	Female	0.826	92	58	63.0	0
2/12/70	0	Male	0.710	66	46	68.5	12
3/6/70	0	Female	0.453	72	52	72.3	0
3/13/70	2	Female	0.560	108	74	68.5	0

[1] Determine by dentition, Dow and Wright (1962).
[2] Calculated by dividing the weight of the kidney with fat and capsule removed into the weight of the kidney fat and capsule.
[3] Head and feet intact but visera and external genitalia removed.
[4] Calculated by dividing hog-dressed weight by the whole weight.
[5] Determined by a method similar to that of Greer (1968).

male fawn collected in December. The lowest ratio involved a 4-year-old pregnant female collected in February.

Other physical characteristics for the 12 animals are shown in the Appendix (Table 16).

Winter tick (*Dermacentor albipictus*) was found in light numbers around the vulva of one, 2-year-old female collected on March 13.

Vegetational Analysis of Habitat Types

Quantitative measurements for forage classes by habitat type and season are given in Table 3. Species for the habitat types listed in order of importance for forage classes are shown in Table 4.

There were changes in availability of green forage by forage classes from spring and summer to fall. There was a general decrease in the availability of green grasses and forbs in all habitat types as shown by frequency of occurrence, canopy coverage, and number of species represented. A general increase in shrub coverage was indicated. This was probably due to a bias introduced by sampling only at feeding sites, since pronghorns tended to use areas of greater sagebrush density as fall and winter progressed. This is discussed later.

Habitat Use and Distribution

Distribution of individual and group observations of pronghorns by season according to habitat types is presented in Tables 5 and 6. A Chi-square goodness of fit test was performed to test whether the

TABLE 3. AVAILABILITY OF GREEN FORAGE BY FORAGE CLASSES IN FALL OF 1969 AS COMPARED TO SPRING AND SUMMER OF 1969.[1]

Habitat Type and Sample Size	GRASS		FORBS		SHRUBS	
	Spring & Summer	Fall	Spring & Summer	Fall	Spring & Summer	Fall
Spring & Summer 47/940[2] Fall 10/100[2]						
Agropyron-Artemisia	99/67[3]	25/16	83/23	22/9	45/13	53/20
Number of Species	13[4]	3	12	6	3	4
16/320 3/30						
Agropyron-Leguminosae-*Gutierrezia*	94/57	23/5	92/29	40/12	32/7	55/28
Number of Species	9	2	17	7	4	3
11/220 2/20						
Agropyron-Melilotus-Stipa	90/70	10/5	90/40	50/8	3/2	5/1
Number of Species	9	1	15	3	1	1
8/160 2/20						
Agropyron-Artemisia-Sarcobatus	82/39	35/17	52/8	25/3	64/19	55/24
Number of Species	4	3	8	3	3	3

[1] Data for spring and summer are from Campbell (1970).
[2] Number of stands/Number of plots.
[3] Frequency or percent occurrence among plots/Canopy, or percent areal, coverage.
[4] Includes only those species which had a canopy coverage of greater than 1 percent.

TABLE 4. OCCURRENCE OF SPECIES IN HABITAT TYPES. NUMBERS INDICATE RANK OF IMPORTANCE WITHIN FORAGE CLASSES.

Taxon	*Agropyron-Artemisia*	*Agropyron-Leguminosae-Gutierrezia*	*Agropyron-Artemisia-Sarcobatus*	*Agropyron-Melilotus-Stipa*
GRASSES:				
Agropyron smithii	1	1	1	1
Buchloe dactyloides	2		2	
Koeleria cristata			3	
Muhlenbergia cuspidata	3	2		
FORBS:				
Achillea millefolium	5		3	
Artemisia frigida	2		2	
Aster falcatus	1			
Aster spp.	6			
Eriogonum spp.		1		
Grindelia squarrosa		3		2
Iva axillaris	3	5		3
Meliolotus officinalis		4	1	
Opuntia polycantha	4	6		
Oxytropus spp.		2		
Polygonum spp.				1
SHRUBS:				
Artemisia cana	3			
Artemisia tridentata	1	2	2	
Atriplex nuttallii	2		3	1
Chrysothamnus nauseosus		1		
Gutierrezia sarothrae		3		
Rosa spp.	4			
Sarcobatus vermiculatus			1	

TABLE 5. ACTUAL AND "EXPECTED" DISTRIBUTION OF 4,478 INDIVIDUAL PRONGHORN OBSERVATIONS BY SEASON ON THE VARIOUS HABITAT TYPES.

Habitat Type and Percent Areal Coverage	EARLY FALL Number Pronghorns Obs./ Percent[1]	EARLY FALL Expected[2]	LATE FALL Number Pronghorns Obs./ Percent	LATE FALL Expected	WINTER Number Pronghorns Obs./ Percent	WINTER Expected
Agropyron-Artemisia 79.1	765/75.4	802	975/87.7	879	2,354/100	1,861
Agropyron-Leguminosae-*Gutierrezia* 9.4	94/9.3	95	68/6.3	104	0/0	222
Agropyron-Melilotus-Stipa 6.6	81/8	67	67/6.0	73	0/0	155
Agropyron-Artemisia-Sarcobatus 3.6	74/7.3	37	0/0	40	0/0	85
Medicago-Avena-Hordeum and *Pinus-Symphoricarpos* 1.3	0/0	13	0/0	14	0/0	31
TOTAL 100.0	1,014/100.0	1,014	1,110/100.0	1,110	2,354/100.0	2,354
Chi-square Values		(52.5)		(78.2)		(623)

[1] Total pronghorn observations/Percent of total observations.

[2] Expected individual observations determined by multiplying percent areal coverage of a habitat type times the total number of individuals observed during the season.

TABLE 6. ACTUAL AND "EXPECTED" DISTRIBUTION OF OBSERVATIONS OF GROUPS OF PRONGHORNS BY SEASON ON THE VARIOUS HABITAT TYPES.

Habitat Type and Percent Areal Coverage	EARLY FALL Number of Groups		LATE FALL Number of Groups		WINTER Number of Groups	
	Obs./ Percent[1]	Expected[2]	Obs./ Percent	Expected	Obs./ Percent	Expected
Agropyron-Artemisia 79.1	93/71.5	102	68/89.5	60	49/100	39
Agropyron-Leguminosae-*Gutierrezia* 9.4	20/15.4	12	5/6.6	7	0/0	4
Agropyron-Melilotus-Stipa 6.6	9/6.9	9	3/3.9	5	0/0	3
Agropyron-Artemisia-Sarcobatus 3.6	8/6.2	5	0/0	3	0/0	2
Medicago-Avena-Hordeum and *Pinus-Symphoricarpos* 1.3	0/0	2	0/0	1	0/0	1
Total 100.0	130/100	130	76/100	76	49/100	49
Chi-square Values	(9.9)		(6.5)		(12.6)	

[1] Total group observations/Percent of total observations.
[2] Expected number of groups determined by multiplying the percent areal coverage of a habitat type times the total number of groups observed during each season.

distribution was effected by preference for habitat types. The tests were performed separately for each category and season at the 5 percent level of significance and 4 degrees of freedom. The resulting Chi-square values for the distribution of individuals (Table 5) required that the distribution be considered as dependent on habitat type. Group distribution (Table 6) appeared to have less meaning than distribution of individuals. Despite the fact that all of the pronghorn use was limited to one habitat type in winter, the resulting Chi-square value did not show a highly significant difference. One reason for this might be that the group sizes varied considerably between habitat types during fall (see group sizes). Another important reason is that group size increased many times with a corresponding decrease in the number of groups.

In early fall, numbers of individual pronghorns, as well as numbers of groups using the *Agropyron-Artemisia* habitat type, were below that which was expected from the areal coverage of this type. Use of the *Agropyron*-Leguminosae-*Gutierrezia* habitat type by individual pronghorns was about as expected while the number of groups showed a greater value than expected. This could be related to the fact that group size in this type was smaller than in any other type at this season. The *Agropyron-Melilotus-Stipa* habitat type showed a greater number of individuals than expected. The number of groups about equaled the expected, but the group size was largest on this type which probably obscured the

relationship shown by individuals. In the *Agropyron-Artemisia-Sarcobatus* type both number of individuals and number of groups showed use greater than expected. These findings coincide with those of Wentland (1968), Roberts (1970), and Campbell (1970) who reported a decrease in use on sagebrush-grassland types in late summer and an increase in use on the other types which was related to earlier desiccation of vegetation on the sagebrush-grassland types than on the other types.

During late fall, use increased on the *Agropyron-Artemisia* type to levels greater than expected in both individual and group tallies. Use on the other types declined during this period, and both individual and group counts showed values below the expected.

During the winter, pronghorns used exclusively *Agropyron-Artemisia* areas. Bayless (1969) showed a high use of this type in winter also.

In general, use of the *Agropyron-Artemisia* type tends to increase in fall as vegetation on other types becomes desiccated and pronghorns shift either out of preference for or in necessity of (Martinka 1967) shrubby sagebrush in the diet.

Sagebrush density aspect was recorded for 4,107 individual observations of pronghorns on the *Agropyron-Artemisia* habitat type (Table 7). Use of the common aspect increased throughout the study with a coincident decrease in use of areas with rare or scattered sagebrush. In general, pronghorns used areas with progressively greater densities

of sagebrush through fall and winter.

TABLE 7. AVERAGE SEASONAL USE OF SAGEBRUSH BY DENSITY CLASSES AS DETERMINED BY 4,107 INDIVIDUAL OBSERVATIONS OF PRONGHORNS DURING FALL AND WINTER.

Season	SAGEBRUSH DENSITY ASPECT				Canopy Coverage[1]
	Rare	Scattered	Common	Dense	
Early Fall	37/3.6[2]	255/24.6	632/61.0	112/10.8	9.0
Late Fall	--/--	100/14.0	514/71.8	103/18.2	12.2
Winter	--/--	146/6.2	2,128/90.4	80/3.4	14.5
Total or Avg.	37/.9	501/12.2	3,274/79.7	295/7.2	12.5

[1] Percent areal coverage of sagebrush determined at 39 feeding sites of pronghorns during fall and winter.
[2] Number of individual observations of pronghorns/Percent of the total number of observations during each period.

Livestock distribution on the *Agropyron-Artemisia-Sarcobatus* type may have effected both use of this type by pronghorns in early fall and non-use in late fall and winter (Figures 1, 2, and 3). Many areas of this type were not used by livestock in early fall, but most were used during late fall and winter.

Livestock distribution was determined not by animal preference alone, but also by the desires of the rancher (Figures 2 and 3). During fall, livestock were fairly well distributed over the area, but as the season progressed many were removed from the area and the remainder were concentrated near home ranches and along open roads. Cattle use was confined to 23 percent of the pastures while sheep used only 20

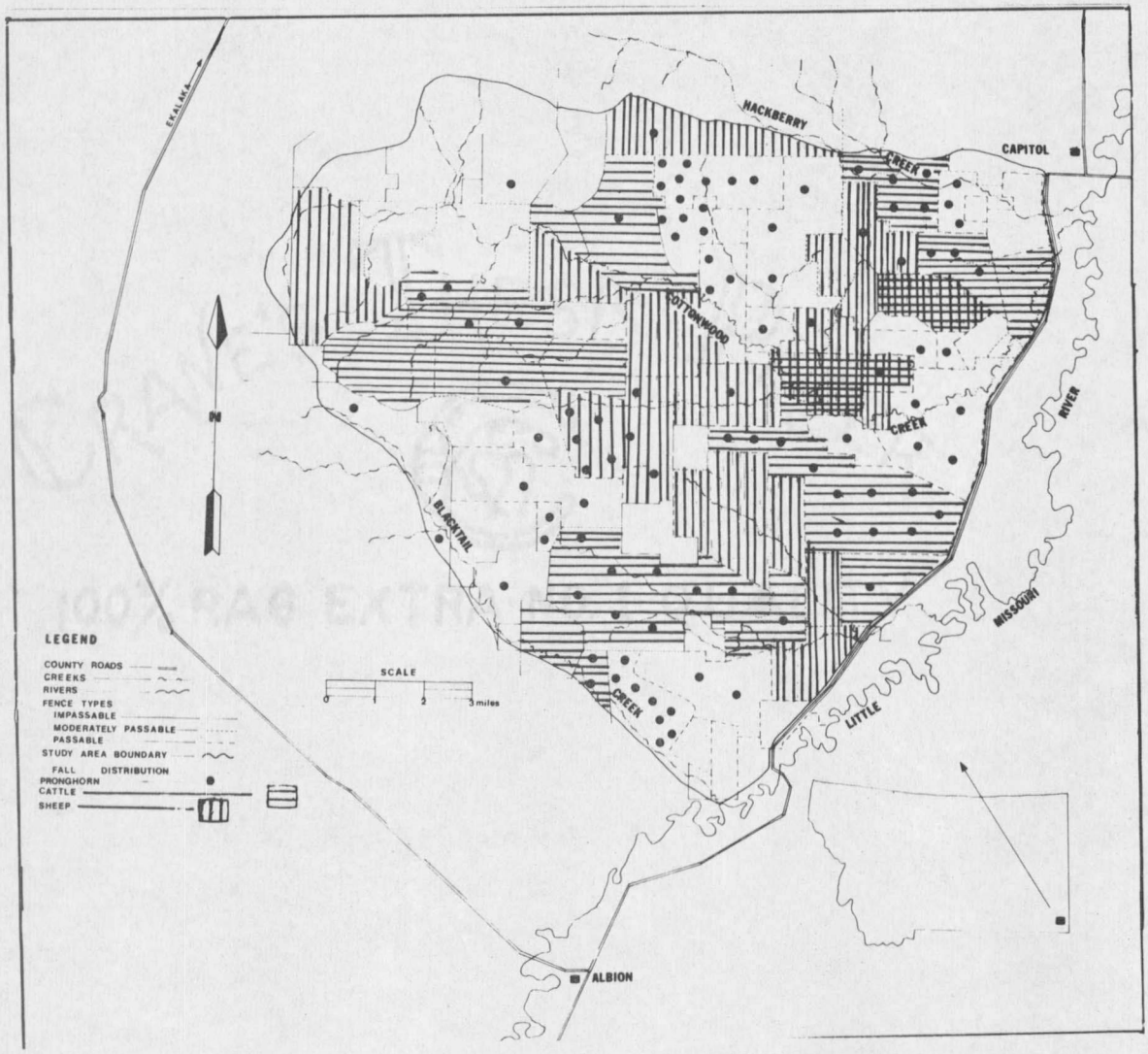

Figure 2. Study area showing fence types and fall pronghorn and livestock distributions. Each circle represents 1 percent of the total pronghorn observations.

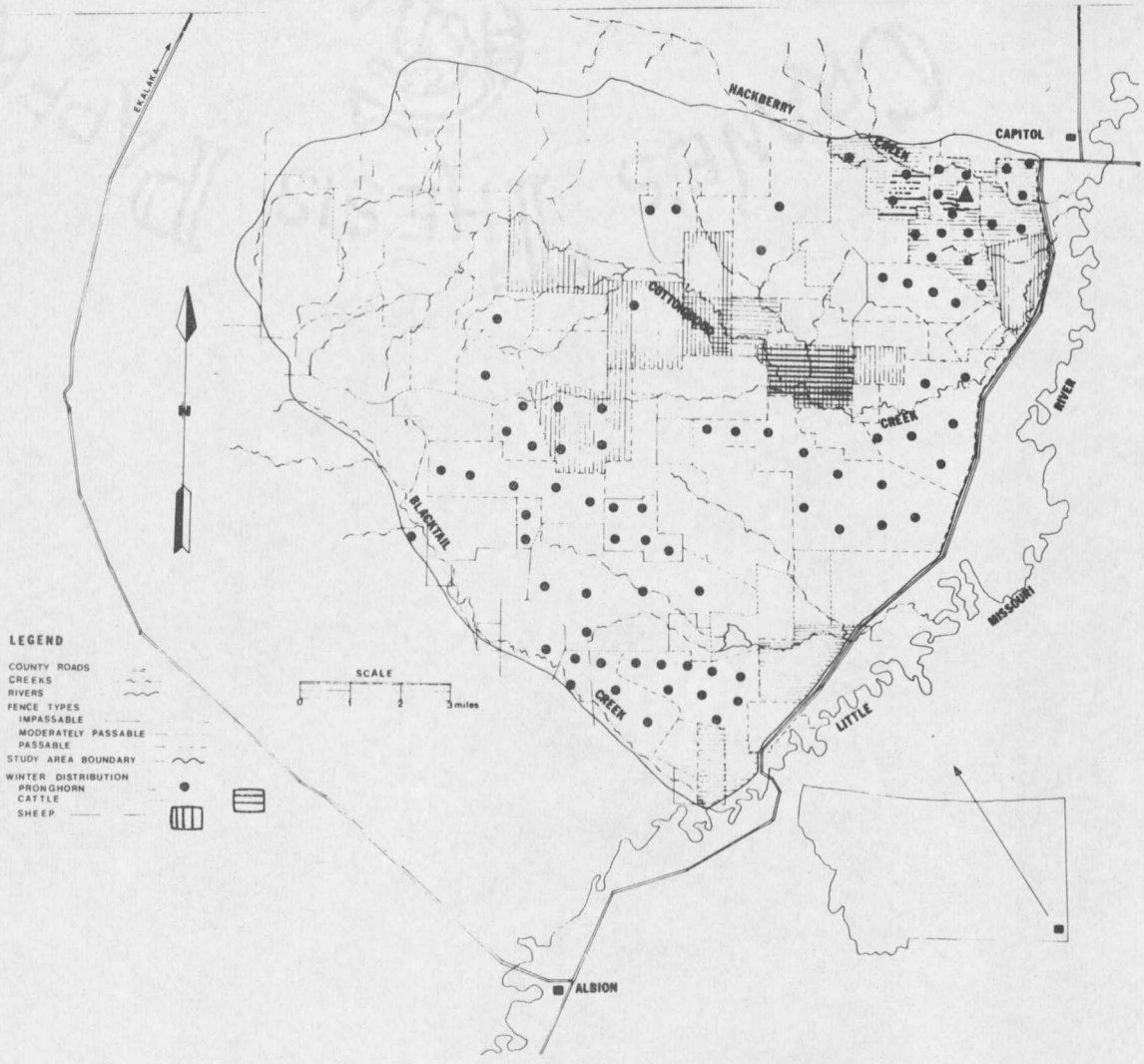

Figure 3. Study area showing fence types and winter pronghorn and livestock distributions. Each circle represents 1 percent of the total pronghorn observations. The large triangle in the upper right hand corner represents 15 percent of the total pronghorn observations.

percent. Joint occupation was observed in only three pastures (Figure 2). In winter, cattle occupied 11 percent of the pastures and sheep were observed on 9 percent with joint occupation of two pastures (Figure 3). Livestock use in both seasons was primarily on the *Agropyron-Artemisia* type due mainly to its greater amount of areal coverage. During winter, use on other types was relatively more important than during fall as the animals were concentrated in much smaller areas.

Lack of use in all seasons by pronghorns of the *Pinus-Symphoricarpos* type was probably due to inaccessability caused by rugged terrain. Lack of use of the *Medicago-Avena-Hordeum* type was probably related to human activities, and/or to a lack of shrubby plants.

During fall, pronghorns were fairly well dispersed over the area with a tendency to form larger groups and limit their movements to certain areas as fall progressed. With the coming of winter, four areas of concentration became apparent (Figure 3). One was south of the lower end of Hackberry Creek, one was south of the mid-section of Cottonwood Creek, another was about in the middle of the study area, and the last was north of the lower end of Blacktail Creek. Distribution was probably tempered by several factors, among them being distribution of food supply (Dirschl 1963), livestock use and distribution, weather and climatic conditions, and interference by humans with their presence or their fences and cropping activities.

Group Sizes of Pronghorns

Group sizes increased steadily from an average of 6 in early fall to an average of 55 in late winter (Table 8). Groups of 90-98 pronghorns were not uncommon. Buechner (1950) also found that after the breeding season large bands were formed. Bayless (1967) showed that there was a steady increase in group size as dry ground became covered with snow.

A total of 290 groups was classified according to habitat type occupied (Table 9). In early fall, group size was largest on the *Agropyron-Melilotus-Stipa* type, and smallest on the *Agropyron*-Leguminosae type. Group size increased throughout the winter on the *Agropyron-Artemisia* and by winter all groups were on this type, but group size on both the *Agropyron-Melilotus-Stipa* and *Agropyron*-Leguminosae-*Gutierrezia* types were larger than those on the *Agropyron-Artemisia* type in late fall.

Pronghorn Home Ranges

Home range sizes were determined from 89 observations of 11 individually recognizable pronghorns observed a minimum of five times each (Table 10). The largest home range size was exhibited by a female fawn. The smallest was shown by an adult male who was seen only in early fall and was killed on opening day of the hunting season. The mean home range for females was nearly two and one-half times that of males.

TABLE 8. TOTAL NUMBER OF OBSERVATIONS (SINGLES AND GROUPS), NUMBER OF PRONGHORNS OBSERVED AND AVERAGE GROUP SIZE.

Date	Total Number of Observations	Percent Singles	Percent Groups	Number Pronghorns Observed	Average Group Size (Singles Excluded)
Late September	69	21.7	78.3	319	5.8 (2-17)
Early October	50	12.0	88.0	439	9.8 (2-36)
Late October	36	11.1	88.9	317	10.1 (2-30)
Early November	38	7.9	92.1	357	10.1 (2-33)
Late November	23	8.7	91.3	343	16.2 (3-50)
December	23	0	100.0	586	25.5 (2-73)
January	24	4.2	95.8	787	34.2 (5-96)
February	14	7.1	92.9	675	51.8 (12-90)
March	13	0	100.0	717	55.2 (19-98)

TABLE 9. AVERAGE GROUP SIZE OF PRONGHORNS BY HABITAT TYPE AND SEASON.[1]

Habitat Type	SEASON		
	Early Fall Average Group Size	Late Fall Average Group Size	Winter Average Group Size
Agropyron-Artemisia	8.8 (2-28)	12.7 (2-73)	46.7 (2-98)
Agropyron-Artemisia-Sarcobatus	8.1 (3-18)	---	---
Agropyron-Luguminosae-*Gutierrezia*	5.6 (2-23)	19.0 (2-50)	---
Agropyron-Melilotus-Stipa	9.4 (3-19)	33.0 (9-57)	---

[1] Data from 4,520 observations of pronghorns in 290 groups.

A standard analysis of variance, one way classification, was performed to test the hypothesis that mean home ranges for males and females did not differ significantly in size. The test was run at the 5 percent level of significance with the total degrees of freedom being 10. The resulting F value of 7.4 required that the hypothesis be rejected. Other factors such as group associates, agricultural influences, and varying habitat conditions in different parts of the study area, which were not considered in this analysis, may have been responsible for the apparent differences in home range size between the sexes.

TABLE 10. CALCULATED HOME RANGES AND OTHER MOVEMENT DATA FOR 11 INDIVIDUALLY RECOGNIZABLE PRONGHORNS FOR THE PERIOD OCTOBER, 1969 THROUGH MARCH, 1970.

Sex - Age	No. Obs.	Average Number Days Between Obs.	Distance[1] Between Seasonal Home Ranges[2]	Distance From Center of Range[3] (mean)	(max.)	Maximum Distance Between Successive Obs.	Distance First to Last Obs.	Calculated Home Range in Square Miles
F Fawn	6	27.8	--	.9	2.2	2.9	2.8	4.2
F Adult	10	15.7	--	.8	2.2	1.9	.8	3.5
F Adult	5	15.8	--	2.1	2.8	4.8	4.0	1.7
F Adult	10	16.8	--	.8	2.2	5.2*	5.0	3.4
F Adult	9	27.8	--	1.0	2.1	6.9*	.8	1.2
F Adult	9	10.4	--	.7	1.9	2.2	.5	2.1
AVERAGE	8.2	19.1	--	1.1	2.7	4.0	2.3	2.7
M Fawn	11	8.6	--	1.1	1.8	3.1	2.0	1.5
M Adult	5	34.3	--	1.0	1.9	3.2	2.4	1.4
M Adult	5	7.3	--	.1	.1	.2	.1	.3
M Adult	11	15.1	4.5	.7	1.0	3.9	4.2	1.2
M Adult	8	19.4	--	.6	.9	4.8*	5.0	1.3
AVERAGE	8	20.8		.7	1.1	3.0	2.7	1.1

[1] Distances expressed in miles.
[2] Geometric center to geometric center between fall and winter ranges.
[3] Geometric center of Hayne, 1949.
* Home range shifts were also indicated by the movements of these animals but observations on one or more of the indicated ranges were too few to calculate more than one range and therefore, the distance between ranges is not listed. When plotted on a map of the area the apparent distances between ranges is approximately 5 miles.

Pronghorn Movements in Relation to Fence Types

Fences were classified according to their penetrability by pronghorns (Figures 1, 2, and 3). A fence with four or less strands of barbed wire was considered as passable to pronghorns, with five strands of barbed wire was considered moderately passable, and with six strands of barbed wire or woven wire topped with two or more strands of barbed wire was considered as impassable to pronghorns. Fences on the area did not seem to hamper distribution of pronghorns. This could be due in part to the poor condition of many of the fences on the area, and that many of the gates were left open through the winter following the transfer of stock to their winter pastures. It was also due at least in part, to the pronghorn's ability to go under, through, or over fences. Whenever a group of pronghorns was pursued there were usually some who would jump a fence even though the majority would follow the fence line searching for a weak spot or a hole under the fence. Pronghorns of either sex whether fawn or adult, were observed to jump fences over 40 inches high. This is not to say that all pronghorns jump fences, but to indicate that the ability is present if the need is adequate. Among other studies regarding pronghorns and fences, Spillet *et al.* (1967) reported that in almost all cases of pronghorns jumping fences, the fences were under 34 inches high or else the animal stopped in front of the fence before jumping, and that 32 inches was the maximum height readily crossed by pronghorns. Milek (1966) indicated that extensive fencing with sheep-tight fences may cause a decline in the pronghorn population of an area.

Campbell (1970) found on this area that fences had little influence on pronghorn distribution.

Food Habits

PRONGHORNS

A total of 39 feeding sites were examined and 11,935 instances of use were recorded during fall and winter (Tables 11 and 12). Samples from 19 rumens were also analyzed (Table 13).

Shrubs constituted the most important forage class in the fall and winter diet, averaging 81 percent of the total use at feeding sites and 87 percent by volume of the identifiable material in the rumen samples during fall, and 97 percent of the use at feeding sites and 92 percent of the identifiable rumen contents during winter. Among shrubs, *Artemisia tridentata* was the most important, followed by *Artemisia cana*. Together they made up 72 percent of the use at feeding sites and 73 percent of the identifiable material in the rumen samples during the fall, and 97 percent of the use at feeding sites and 74 percent of the identifiable rumen contents during winter. The use of these species appeared to greatly exceed their abundance in the feeding areas as shown by canopy coverage (Table 3). However, if only green forage or browse is considered, the use is probably related more closely to availability. Many authors have shown the importance of sagebrush in the diet of pronghorns, and Martinka (1967) has indicated its importance in relation to winter survival.

TABLE 11. FOOD HABITS OF PRONGHORNS, CATTLE, AND SHEEP DURING THE AUTUMN OF 1969, BY MONTH AS DETERMINED FROM 3,861, 2,813, and 2,566 INSTANCES OF USE ON 20, 10, AND 9 FEEDING SITES, RESPECTIVELY.

	OCTOBER			NOVEMBER			DECEMBER		
Taxa	Prong.	Cattle	Sheep	Prong.	Cattle	Sheep	Prong.	Cattle	Sheep
SHRUBS:									
Artemisia cana	20/20[1]	--/--	--/--	25/10	35/5	--/--	14/7	67/8	33/6
Artemisia tridentata	60/32	50/4	100/9	100/73	33/5	100/28	86/74	33/7	67/4
Atriplex nuttallii	--/--	25/20	--/--	25/12	67/18	33/16	--/--	33/4	--/--
Chrysothamnus nauseosus	20/11	--/--	33/1	--/--	--/--	--/--	--/--	--/--	--/--
Rosa spp.	20/tr[2]	--/--	--/--	13/2	--/--	--/--	--/--	--/--	--/--
Sarcobatus vermiculatus	--/--	--/--	33/28	--/--	--/--	--/--	--/--	33/2	--/--
Total Shrubs	80/64	50/24	100/38	100/98	67/28	100/43	86/81	100/21	100/10
FORBS:									
Artemisia frigida	20/2	25/1	--/--	25/1	67/4	33/3	29/10	67/4	--/--
Aster falcatus	20/1	25/2	--/--	--/--	--/--	--/--	--/--	--/--	--/--
Aster spp.	--/--	25/4	--/--	--/--	--/--	--/--	--/--	--/--	--/--
Astragalus spp.	20/7	--/--	67/39	--/--	--/--	--/--	--/--	--/--	--/--
Iva axillaris	20/1	25/11	--/--	--/--	--/--	--/--	--/--	--/--	--/--
Medicago sativa	20/5	--/--	--/--	--/--	--/--	--/--	--/--	--/--	--/--
Melilotus officinalis	40/18	25/5	33/2	--/--	--/--	--/--	--/--	--/--	--/--
Polygonum spp.	--/--	50/3	67/6	--/--	--/--	--/--	--/--	--/--	--/--
Sphaeralcea coccinea	--/--	25/2	--/--	--/--	--/--	--/--	--/--	--/--	--/--
Unidentifiable Forbs	--/--	--/--	33/6	--/--	--/--	--/--	--/--	--/--	--/--
Total Forbs	80/36	75/27	67/53	25/1	67/4	33/3	43/10	67/4	--/--

TABLE 11. (continued).

Taxa	OCTOBER			NOVEMBER			DECEMBER		
	Prong.	Cattle	Sheep	Prong.	Cattle	Sheep	Prong.	Cattle	Sheep
GRASSES and GRASS-LIKE									
Agropyron smithii	--/--	100/37	100/7	--/--	--/--	--/--	--/--	--/--	--/--
Buchloe dactyloides	--/--	25/6	--/--	--/--	--/--	--/--	--/--	--/--	--/--
Stipa viridula	--/--	25/1	33/2	--/--	--/--	--/--	--/--	--/--	--/--
Carex spp.	--/--	25/5	--/--	--/--	--/--	--/--	--/--	--/--	--/--
Total Grass and Grass-like	--/--	100/49	100/9	--/--	--/--	--/--	--/--	--/--	--/--
CURED MATERIAL[3]	--/--	--/--	--/--	--/--	100/68	100/54	57/9	100/75	100/90

[1] Frequency or percent occurrence among feeding sites/Percent of the total diet.
[2] Tr = trace.
[3] Mostly grasses but includes traces of forbs.

TABLE 12. FOOD HABITS OF PRONGHORNS, CATTLE, AND SHEEP DURING WINTER, 1970 BY MONTH AS DETERMINED FROM 8,074, 3,228, AND 3,272 INSTANCES OF USE ON 19, 8, AND 8 FEEDING SITES, RESPECTIVELY.

	JANUARY			FEBRUARY			MARCH		
Taxa	Prong.	Cattle	Sheep	Prong.	Cattle	Sheep	Prong.	Cattle	Sheep
SHRUBS:									
Artemisia cana	33/18[1]	100/4	33/3	25/7	33/1	33/2	40/12	--/--	50/4
Artemisia tridentata	83/77	33/2	67/12	100/90	67/3	67/4	100/86	50/tr[2]	100/6
Atriplex nuttallii	--/--	--/--	--/--	--/--	33/4	--/--	--/--	50/4	--/--
Populus spp.	--/--	33/4	--/--	--/--	--/--	--/--	--/--	--/--	--/--
Symphoricarpos spp.	--/--	33/2	--/--	--/--	--/--	--/--	--/--	--/--	--/--
Total Shrubs	100/95	100/12	100/15	100/97	100/8	100/6	100/98	50/4	100/10
FORBS:									
Artemisia frigida	--/--	67/8	67/5	63/2	33/2	67/3	60/2	50/1	50/2
Grindelia squarrosa	--/--	--/--	--/--	25/1	--/--	--/--	--/--	--/--	--/--
Total Forbs	--/--	67/8	67/5	75/3	33/2	67/3	60/2	50/1	50/2
CURED MATERIAL[3]	67/5	100/80	100/80	25/tr	100/90	100/91	20/tr	100/95	100/98

[1] Frequency of occurrence among feeding sites/Percent of the total diet.
[2] Tr = trace.
[3] Mostly grasses but includes traces of forbs.

TABLE 13. SEASONAL AND MONTHLY FOOD HABITS OF PRONGHORNS AS DETERMINED FROM 19 RUMENS SAMPLED.

	AUTUMN					WINTER			
	Oct.	Oct.	Nov.	Dec.	Average	Jan.	Feb.	March	Average
Number of Rumen Samples	2	7	2	2	13	2	2	2	6
Taxa	%	%	%	%	fr/%[1]	%	%	%	fr/%
SHRUBS:									
Artemisia cana	27.7	56.4	--	--	69/21.0	13.7	.7	21.7	67/12.0
Artemisia tridentata	42.4	13.6	66.3	65.3	92/47.0	53.4	67.1	64.7	100/61.7
Artemisia spp.	--	--	--	--	---	--	--	7.1	33/ 2.4
Atriplex nuttallii	6.1	3.6	2.1	1.7	85/ 3.4	4.2	11.3	.6	83/ 5.4
Chrysothamnus nauseosus	1.1	1.1	tr[3]	tr	85/ .6	2.8	.6	.9	100/ 1.4
Suaeda fruticosa	--	--	17.0	--	15/ 4.3	--	--	--	---
Unidentified Shrubs	tr	7.2	--	11.6	54/ 4.7	16.1	9.3	tr	83/ 8.5
Total Shrubs	77.5	82.3	85.7	78.7	100/81.0	90.2	89.0	95.0	100/91.4
FORBS:									
Artemisia frigida	tr	1.6	.6	1.2	69/ .9	--	tr	.7	50/tr
Aster falcatus	--	1.0	2.8	.6	23/ 1.1	--	--	--	---
Helianthus spp.	--	tr	--	--	7/tr	.5	4.0	--	67/ 1.5
Medicago sativa	4.1	.8	--	--	15/ 1.2	--	--	--	---
Opuntia polycantha	4.9	2.2	1.1	16.6	38/ 6.2	--	--	tr	33/tr
Total Forbs	9.4	5.8	4.5	18.4	92/ 9.4	.5	4.0	.7	67/ 1.7
GRASS and GRASS-LIKE:	3.9	4.1	2.7	2.9	100/ 3.4	7.2	6.9	2.6	100/ 5.6
Unidentified:									
Leaf Fragments	8.9	10.5	7.1	--	62/ 6.6	1.7	--	1.2	33/ 1.0
Fibers	.5	.9	--	--	23/tr	--	--	--	---

[1] Frequency of occurrence among rumen samples/Aggregate percent by volume of rumen contents.
[2] Includes only those species which contributed .5 percent of the diet for at least 1 month. Those with lesser values are: *Gutierrezia sarothrae*, *Iva axillaris*, *Melilotus officinalis*, *Oxytropus* spp., *Rosa* spp., and *Symphoricarpos* spp..
[3] Tr = trace or less than .5 percent.

Forbs were next in importance, constituting in fall and winter 16 and 2 percent, respectively of the use at feeding sites. Rumen samples showed this same trend. During fall *Melilotus officinalis* and *Artemisia frigida* were most important at feeding sites, while *Opuntia polycantha* was the leading item in rumens. In winter *Artemisia frigida, Opuntia polycantha,* and *Helianthus* spp. were represented in the diet.

Data from both feeding sites and rumen analyses indicated that grass was of minor importance during both fall and winter. The highest value found was 5.7 percent of the identifiable material in the rumen samples during winter. Feeding sites showed lesser amounts due primarily to the difficulty in determining use on semi-cured and cured grasses. Use of cured grasses during these seasons appeared to be accidental consumption while browsing on low-growing sagebrush.

CATTLE

A total of 19 feeding sites were examined involving 6,041 instances of use (Tables 11 and 12). One rumen sample was analyzed.

Grasses or cured material which was primarily grasses were the most important items in the diet of cattle during fall and winter. In fall this use constituted 64 percent of the use at feeding sites and 87 percent by volume of the identifiable rumen contents. *Agropyron smithii* was the most prominent grass. In winter, cured material amounted to 88 percent of the use at feeding sites.

Browse was next in importance during fall, constituting 24 percent

of the use at feeding sites, but showing only 4 percent of the identifiable rumen contents. Use at feeding sites decreased to 8 percent during winter. Important species were *Artemisia cana*, *A. tridentata*, and *Atriplex nuttallii*.

Forbs constituted 14 percent of the use at fall feeding sites but only 8 percent of the diet according to the rumen sample. In winter, forb use at feeding sites dropped to 3 percent. Apparent forb use in late fall and winter was slightly decreased by the aggregation of desiccated plant materials into the one category of cured materials which was primarily grasses but did contain trace amounts of forbs. The diet in winter may also have been modified by the fact that in times of stress supplemental feed was provided in the form of hay and/or grain supplements.

SHEEP

A total of 17 feeding sites were examined involving 5,838 instances of use (Tables 11 and 12).

Grasses or cured material consisting primarily of grasses were the most important part of the diet, constituting 51 and 86 percent of the diet in fall and winter, respectively. *Agropyron smithii* was the primary species. Browse was next in importance amounting to 30 and 10 percent of the diet in fall and winter, respectively. *Artemisia tridentata*, *A. cana*, and *Atriplex nuttallii* were the important species. Forbs were

ranked third with 19 percent of the use in fall and only 3 percent in winter. As with cattle, the apparent use of forbs may be slightly decreased by the aggregation of all desiccated materials into one category. Sheep were also given food supplements during winter.

Pronghorn-Livestock Relationships

In fall and winter pronghorns used greater numbers of pastures without livestock than those used either with cattle or sheep (Table 14). The percent of total pronghorn observations was also greater for these pastures. In both seasons, the percent of pastures unoccupied by livestock was about equal to the percent of pronghorns using pastures unoccupied by livestock. In both seasons the percent of pronghorns using pastures in conjunction with cattle but no sheep was greater than the percent of pastures used by cattle indicating a compatability between cattle and pronghorns as has been pointed out by Buechner (1950) as well as others. The percent of pronghorns using pastures with sheep was just over one-half of the percent of pastures used by sheep. This indicates an incompatability between pronghorns and sheep, which agrees with Campbell (1970) who found an all-season incompatability between these species, but it is in opposition to the findings of Severson *et al.* (1968) who found pronghorns and sheep feeding and watering together often and even resting together.

In the fall, about 56 percent of the pastures were devoid of live-

stock but pronghorns used only 43 percent of these. In winter 80 percent of the pastures contained no livestock and pronghorns used only 30 percent of these. Campbell (1970) showed for spring, summer, and fall that pronghorns used only 36 percent of the pastures not occupied by livestock, and mentioned pasture size, human activity, grazing history, and vegetation as possible reasons for the non-use of the other pastures.

TABLE 14. USE OF PASTURES BY PRONGHORNS IN RELATION TO PRESENCE OF CATTLE AND/OR SHEEP AS DETERMINED BY 4,478 INDIVIDUAL OBSERVATIONS OF PRONGHORNS.

	PASTURE OCCUPANCY					
	FALL			WINTER		
Pasture Occupancy	PASTURES Number	PASTURES Percent	Percent of Pronghorn Obs.	PASTURES Number	PASTURES Percent	Percent of Pronghorn Obs.
Pronghorns Only	18	24.0	49.0	18	24.0	77.0
Pronghorns and Cattle	11	14.7	37.0	4	5.3	18.0
Pronghorns and Sheep	6	8.0	13.0	2	2.7	5.0
Pronghorns, Cattle and Sheep	1	1.3	1.0	0	0	--
Cattle Only	6	8.0	--	4	5.3	--
Sheep Only or Sheep and Cattle	9	12.0	--	5	6.7	--
Unoccupied Pastures	24	32.0	--	42	56.0	--
TOTAL	75	100.0	100.0	75	100.0	100.0

For those pronghorns associated with cattle, 43 percent of all individual observations were within one-quarter mile of the cattle. For those pronghorns in association with sheep, only 8 percent were within

one-quarter mile of the sheep. This lends further evidence that a non-compatible relationship exists between pronghorns and sheep.

Pronghorns and sheep showed a basic overlap in their diets for fall and winter seasons amounting to about 49 and 14 percent, respectively, if forage classes alone were considered. Both browse and forbs were significant in fall but only browse was important in winter. When considering individual forage species, this overlap dropped to 26 and 13 percent for fall and winter, respectively. Only 14 and 5 percent of the pronghorns were found in areas with sheep during fall and winter, respectively. Forage competition was actually minor. The possibility for land use competition appeared quite high, particularly since pronghorns exhibited an incompatibility toward sheep. Actual forage competition could also be more severe in areas where sheep are not fed supplementally, and/or where sheep occupy a greater portion of the area for a greater length of time.

The same pattern of diet relationships as shown above was also exhibited by pronghorns and cattle, but to a lesser extent. The overlap in diet between these two species was indicated at 42 and 12 percent for fall and winter by forage class use, with only 12 and 8 percent for fall and winter, respectively, when forage species are considered. This, plus the compatibility shown between pronghorns and cattle, would indicate that pronghorns and cattle could use the same areas without serious conflict or detriment to either species, and with better overall use of the forage available on an area.

APPENDIX

TABLE 15. MONTHLY CLIMATOLOGICAL DATA OBTAINED BY AVERAGING RECORDS FROM THE UNITED STATES DEPARTMENT OF COMMERCE WEATHER STATIONS AT ALBION, LOCATED AT THE SOUTHEAST EDGE OF THE AREA, AND RIDGEWAY, LOCATED AT THE NORTHWEST EDGE OF THE AREA.

		TEMPERATURE IN DEGREES FAHRENHEIT							PRECIPICATION IN INCHES		
Year	Month	Max.	Min.	Avg.	Normal Average 1960-70	Departure From Average	High	Low	Total	Normal Average 1960-70	Departure From Average
1969	October	50.6	27.7	39.2	46.4	-7.2	73.5	6.5	0.77	0.55	+0.22
	November	M	M	M	30.4	M	73.5	0	0.11	0.51	-0.40
	December	36.9	9.6	23.3	18.8	+4.5	60.5	-19	0.73	0.36	+0.27
1970	January	24.3	-3.0	12.9	15.3	-2.3	44.5	-34	0.19	0.29	-0.10
	February	37.5	9.4	23.5	21.8	+1.7	49.5	-5.5	0.73	0.43	+0.30
	March	35.7	13.5	24.6	29.3	-4.7	57.0	-3.0	0.70	0.37	+0.33
Total									3.23	2.51	+0.72

M = Missing.

TABLE 16. PHYSICAL MEASUREMENTS OF 12 PRONGHORNS COLLECTED AT THE RATE OF TWO PER MONTH FOR THE PERIOD OCTOBER, 1969 THROUGH MARCH, 1970.

Collection Date	Sex	Age[1]	Weight[2]	Total Length[3]	Foot[4]	Tail[5]	Chest Depth[6]	Horn Length[7]	Horn Circumference[8]
11/16/69	Female	Fawn	68	46.0	15.0	4.5	13.5	--	--
12/16/69	Female	Fawn	53	49.3	15.0	5.3	10.0	--	--
1/17/70	Female	Fawn	80	51.2	16.0	5.7	13.0	--	--
3/ 6/70	Female	Fawn	72	46.8	15.0	4.5	13.0	--	--
11/21/69	Female	2	99	54.0	15.0	6.0	15.0	--	--
3/13/70	Female	2	108	56.8	16.0	5.5	15.0	--	--
2/12/70	Female	4	92	52.4	15.5	5.4	14.0	--	--
11/21/69	Female	7	94	55.0	16.5	6.0	15.0	--	--
2/12/70	Male	Fawn	66	49.6	15.0	5.6	13.0	--	--
10/16/69	Male	1	106	59.7	16.0	5.9	15.0	8.5	4.9
1/13/70	Male	1	104	53.2	17.0	5.7	14.0	8.0	5.0
10/19/69	Male	2	108	56.3	16.5	5.8	16.0	10.1	5.3

[1] Determined by dentition, Dow and Wright (1962).
[2] Weight to the nearest pound taken immediately after the animal was collected.
[3] Total length to the nearest tenth of an inch.
[4] Length of right rear foot to the nearest tenth of an inch.
[5] Tail length to the nearest tenth of an inch.
[6] Chest depth to the nearest tenth of an inch.
[7] Average outside length of horns, from base to tip, to the nearest tenth of an inch.
[8] Average basal circumference of horns to the nearest tenth of an inch.

LITERATURE CITED

Bayless, S. R. 1969. Winter food habits, range use, and home range of antelope in Montana. J. Wildl. Mgmt. 33(3):538-551.

Beer, J. 1944. Distribution and status of pronghorn antelope in Montana. J. Wildl. Mgmt. 25(1):43-46.

Booth, W. E. 1950. Flora of Montana. Part I -- Conifers and monocots. Research Foundation at Montana State College, Bozeman. 232 pp.

_____ and J. C. Wright. 1966. Flora of Montana. Part II -- Dicotyledons. Montana State College, Bozeman. 305 pp.

Buechner, H. K. 1950. Life history, ecology and range use of the pronghorn antelope in Trans-Pecos, Texas. Amer. Midl. Naturalist. 43(2):257-354.

Campbell, R. B. 1970. Pronghorn, sheep, and cattle range relationships in Carter County, Montana. M. S. thesis, Montana State University, Bozeman. 84 pp.

Cole, G. F. 1956. The pronghorn antelope -- its range use and food habits in central Montana with special reference to alfalfa. Montana Fish and Game Department and Montana Agri. Expt. Sta. Tech. Bull. No. 516. 63 pp.

Couey, F. M. 1946. Antelope foods in southeastern Montana. J. Wildl. Mgmt. 10(4):367.

Daubenmire, R. 1959. A canopy coverage method of vegetational analysis. Northwest Science. 33(1):43-64.

Dirschl, H. J. 1963. Food habits of the pronghorn in Saskatchewan. J. Wildl. Mgmt. 27(1):81-93.

Dow, S. A. and P. L. Wright. 1962. Changes in mandibular dentition associated with age in pronghorn antelope. J. Wildl. Mgmt. 26 (1):1-18.

Greer, K. R. 1968. A compression method indicates fat content of elk (wapiti) femur marrows. J. Wildl. Mgmt. 32(4):295-306.

Hayne, D. W. 1949. Calculation of the size of home range. J. Mamm. 30(1):1-18.

Martin, A. C., R. H. Gensch and C. P. Brown. 1946. Alternative methods in upland game bird food analysis. J. Wildl. Mgmt. 10(1):8-12.

Martinka, C. J. 1967. Mortality of northern Montana pronghorns in a severe winter. J. Wildl. Mgmt. 31(1):159-164.

Milek, B. 1966. Sheep fences or antelope. Field and Stream. 71(5): 10-15.

O'Gara, B. W. 1968. A study of the reproductive cycle of the female pronghorn antelope (*Antilocapra americana* Ord). Ph.D. thesis, University of Montana, Missoula. 161 pp.

Ransom, A. B. 1965. Kidney and marrow fat as indicators of white-tailed deer conditions. J. Wildl. Mgmt. 29(2):397-398.

Roberts, D. A. 1970. Antelope range use, food habits, and behavior in relation to sagebrush eradication. M. S. thesis, Montana State University, Bozeman. 53 pp.

Severson, K., M. May, and W. Hepworth. 1968. Food preferences, carrying capacities, and forage competition between antelope and domestic sheep in Wyoming's Red Desert. Agri. Expt. Sta., University of Wyoming, Laramie. 51 pp.

Spillett, J. J., J. B. Low, and D. Sill. 1967. Livestock fences -- how they influence pronghorn antelope movements. Agri. Expt. Sta. Bull. No. 470, Utah State University, Logan. 79 pp.

U. S. Department of Commerce. 1969. Climatological Data -- Montana. Monthly Summaries. Vol. 72, No. 10-12. U. S. Gov't. Print. Office, Washington, D. C.

_____. 1970. Climatological Data -- Montana. Monthly Summaries. Vol. 73, No. 1-3. U. S. Gov't. Print. Office, Washington, D. C.

Wright, P. L., and S. A. Dow, Jr. 1962. Minimum breeding age in pronghorn antelope. J. Wildl. Mgmt. 26(1):100-101.

Wentland, H. J. 1968. Summer range habits of the pronghorn antelope in central Montana with special reference to proposed sagebrush control study plots. M. S. thesis, Montana State University, Bozeman. 65 pp.