Antelope range use, food habits, and behavior in relation to sagebrush eradication
by David Alan Roberts

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 was conducted on a 130 square mile area, including four sagebrush control study plots, in central Montana during the summers of 1968 and 1969, to determine the influence of various sagebrush control treatments on the range use habits of antelope. Sagebrush control operations included treatment with 2,4-D as well as mechanical treatments to accomplish various degrees of sagebrush eradication. Antelope within an enclosure and free-ranging antelope were observed. This study followed a similar study in 1966 and 1967, prior to sagebrush control operations.

Vegetation measurements, which were restricted to one sagebrush control study plot, gave predictable results for vegetation changes following treatment as reported by various authors.

A total of 3,634 sightings of free-ranging antelope indicated female: male ratios of 129 and 135 females per 100 males for 1968 and 1969, respectively. The highest fawn:female ratios were 133 and 86 fawns per 100 females for these years and densities were 2.7 and 3.2 antelope per square mile.

A total of 188 sightings of 25 neck-banded antelope indicated that territorial males, bachelor herd males and females had relatively large, small, and intermediate sized home ranges, respectively.

A chi-square statistical analysis of use of vegetation types by free-ranging antelope indicated use of the grassland-abandoned meadow-timber, greasewood, and greasewood-sagebrush vegetation types was significantly less than expected, both summers, and use of shale-slope and cropland types was significantly greater. In 1968, use of sagebrush-grassland was as expected, but in 1969, it was significantly less. The sagebrush-grassland vegetation type averaged over 50 percent of the total antelope use both years. Over 75 percent of the antelope sighted on sagebrush-grassland were in common or dense sagebrush aspects.

On one sagebrush control study plot, there was an apparent increased use of the contour furrow, and a decreased use of the defer control, open control, and interseed treatment sites, when compared to pre-treatment data.

A chi-square statistical analysis of 966 observations of antelope within the enclosure indicated greater use than expected of the strip spray treatment site, and a lesser use of the partial kill and defer control treatment sites in 1968. In 1969, the strip spray site was used to a lesser extent than expected, and the defer control to a greater extent. The partial kill received approximately the expected use.

A total of 15,074 instances of plant use was recorded from the examination of 58 feeding sites on the sagebrush treatment study plots.

Big sagebrush was the most utilized plant in spring, followed by various forbs and grasses, respectively. By early summer, forbs were the most utilized, followed by browse and grasses. As the summer progressed, there was a declining use of forbs and an increasing use of browse. Within the

enclosure, the relative proportion of browse use was greater on the spray treatment sites in 1968 than in 1969.

Analysis of 13 antelope rumen samples indicated an increasing use of browse as the fall and winter progressed, until a peak was reached in early January. The major browse plant was big sagebrush. A comparison between the contents of rumen samples of free-ranging antelope and samples from antelope collected from the enclosure revealed a higher relative content of browse in the latter samples.

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Date May 23, 1970

ANTELOPE RANGE USE, FOOD HABITS, AND BEHAVIOR IN RELATION TO SAGEBRUSH ERADICATION

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 was conducted on a 130 square mile area, including four sagebrush control study plots, in central Montana during the summers of 1968 and 1969, to determine the influence of various sagebrush control treatments on the range use habits of antelope. Sagebrush control operations included treatment with 2,4-D as well as mechanical treatments to accomplish various degrees of sagebrush eradication. Antelope within an enclosure and free-ranging antelope were observed. This study followed a similar study in 1966 and 1967, prior to sagebrush control operations.

Vegetation measurements, which were restricted to one sagebrush control study plot, gave predictable results for vegetation changes following treatment as reported by various authors.

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A chi-square statistical analysis of 966 observations of antelope within the enclosure indicated greater use than expected of the strip spray treatment site, and a lesser use of the partial kill and defer control treatment sites in 1968. In 1969, the strip spray site was used to a lesser extent than expected, and the defer control to a

greater extent. The partial kill received approximately the expected use.

A total of 15,074 instances of plant use was recorded from the examination of 58 feeding sites on the sagebrush treatment study plots. Big sagebrush was the most utilized plant in spring, followed by various forbs and grasses, respectively. By early summer, forbs were the most utilized, followed by browse and grasses. As the summer progressed, there was a declining use of forbs and an increasing use of browse. Within the enclosure, the relative proportion of browse use was greater on the spray treatment sites in 1968 than in 1969.

Analysis of 13 antelope rumen samples indicated an increasing use of browse as the fall and winter progressed, until a peak was reached in early January. The major browse plant was big sagebrush. A comparison between the contents of rumen samples of free-ranging antelope and samples from antelope collected from the enclosure revealed a higher relative content of browse in the latter samples.

INTRODUCTION

Sagebrush (*Artemisia* spp.) removal or manipulation on range lands to affect better grass production for domestic use, has been a popular practice in many areas of western United States in recent years. This practice on public and private lands has often been undertaken with little or no consideration of the effects on wildlife, resulting from the changes in floral composition. To determine these effects, the Montana Fish and Game Department, in cooperation with the Bureau of Land Management initiated a 10-year project in 1965, in Petroleum County, central Montana. The ecology of pronghorn antelope (*Antilocapra americana*) was included in the overall objectives. The importance of sagebrush in the diet and range use habits of antelope in Montana, was reported by Cole (1956) and Cole and Wilkins (1958). Studies in other states and provinces showing similar relations include those of Einarsen (1948), Ferrel and Leach (1952), and Dirschl (1963). The effects of sagebrush eradication programs on sagebrush and associated vegetation was reported by several authors (Hurd 1955; Alley 1956; Blaisdell and Mueggler 1956; Hyder and Sneva 1956; Mueggler and Blaisdell 1958; and Hedrick *et al.* 1966). Results of the above studies tended to indicate that sagebrush eradication would be detrimental to the food and range use habits of pronghorn antelope. Quantitative data documenting these effects were lacking.

Results of the pre-treatment phase of the current study have been reported by Wentland (1968). The study reported herein is the initial

post-treatment phase. It was conducted on a full time basis from June 17, through September 13, 1968 and from June 11, through September 17, 1969 to quantitatively determine the influence of various sagebrush control treatments on antelope summer range use, food habits, and behavior. To facilitate comparison of data, the procedures of this study were quite similar to those of the pre-treatment phase.

DESCRIPTION OF THE STUDY AREA

The study area (Figure 1) is located roughly 50 miles east of Lewistown in central Montana. It is composed of nearly 83,597 acres (130.6 square miles) including sagebrush control study plots. Privately-owned lands comprise 57.9 percent and public lands administered by the State of Montana or the Bureau of Land Management, 42.1 percent (Wentland 1968).

The physiography of the study area has been described by Gieseker (1938) and Cole (1956). The soils have been described by Andrews *et al.* (1944) and personnel of the Soil Conservation Service (1968). Gieseker (1938), describes the climate of the area as semiarid, "... characterized by a comparatively low rainfall, great temperature extremes, a large number of sunny days, and a relatively low humidity." The mean average annual temperature at Flatwillow (U. S. Department of Commerce Weather Station), 1 mile east of the study area, is 45.4 degrees Fahrenheit. The highest temperature recorded during the field period of this study was 101 degrees in August, 1969 and the lowest was 30 degrees in September, 1969. The average annual precipitation is 12.57 inches. The summer (June-September) precipitation average is 6.74 inches. For the summers of 1968 and 1969, respectively, the precipitation was 47.6 percent and 1.8 percent above normal. The monthly climatological data for both summers are shown in Appendix, Table 15.

Cole (1956), Bayless (1969), and Wentland (1968) described the vegetation. For this study, the vegetation classification of the latter

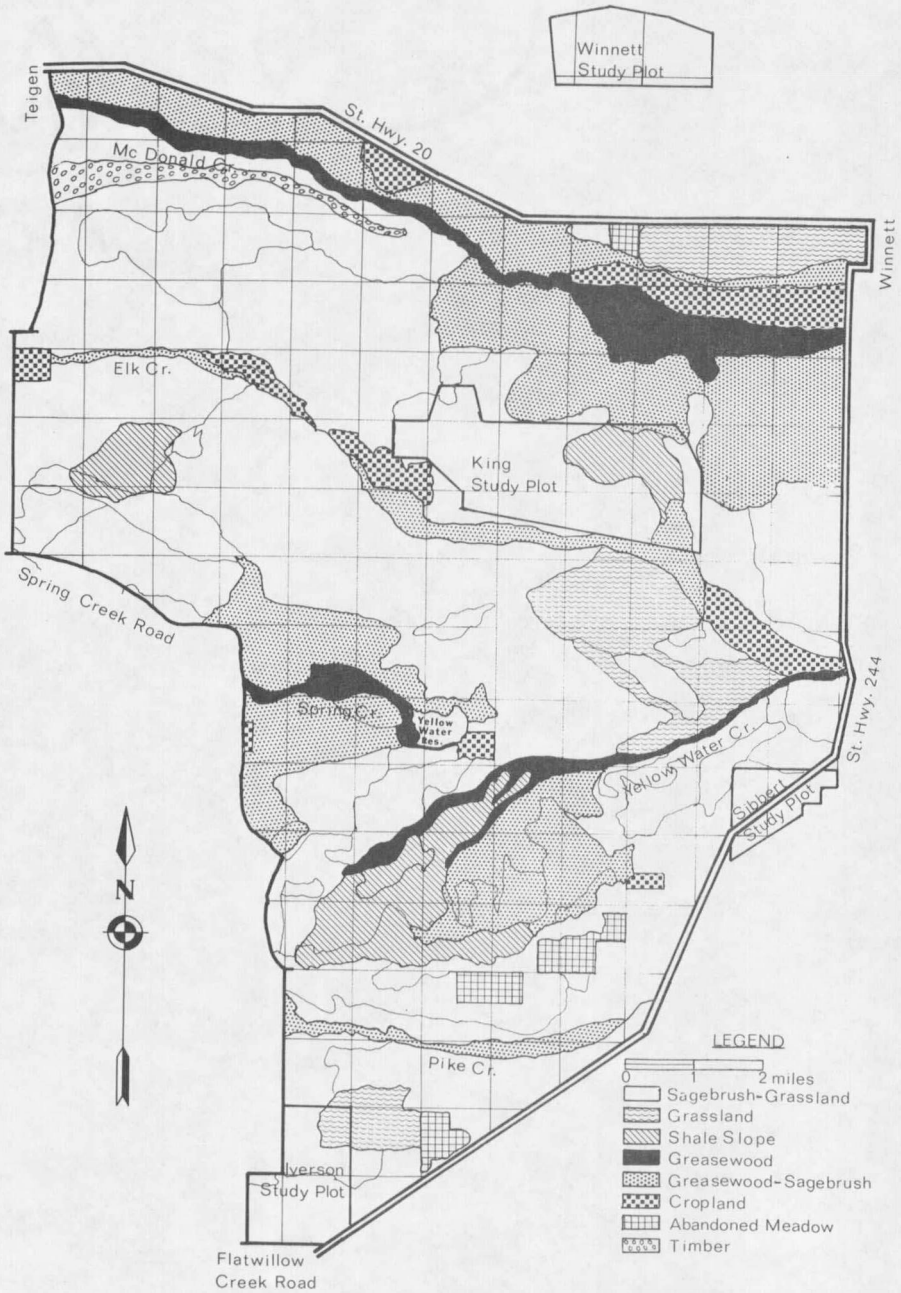

Figure 1. The study area, showing the sagebrush control study plots and the vegetation types (from Wentland).

was followed. Sagebrush-grassland comprised 59 percent of the area; greasewood-sagebrush, 22 percent; grassland, 7 percent; greasewood, 6 percent; shale-slope, 2 percent; cropland, 2 percent; abandoned meadow, 1 percent; and timber, 1 percent (Figure 1). Plant nomenclature follows that of Booth (1950), Booth and Wright (1966), and personnel of the Montana Fish and Game Department (1969).

The Winnett Study Plot is composed of approximately 1,220 acres of sagebrush-grassland including a site for total kill of sagebrush by chemical agents (Figure 2) and a site for kill of sagebrush on alternate strips. The King Study Plot is comprised of approximately 4,240 acres of sagebrush-grassland, shale-slopes, and greasewood bottoms including sites for mechanically manipulated sagebrush treatment (Figure 3) and for total kill of sagebrush by use of chemicals (Figure 4). The Sibbert Study Plot comprising nearly 910 acres of sagebrush-grassland, included a site for partial kill of sagebrush by chemicals. A portion of this study plot was burned in the 1950's. The Iverson Study Plot consisted of roughly 1,520 acres of sagebrush-grassland including a site for partial kill (Figure 5) and a site for kill of sagebrush on alternate strips by use of chemicals. Only 1,200 acres of this study plot were inclosed by a fence. The location of all study plots and treatment sites is shown in Appendix, Figure 9.

Figure 2. Total kill chemical sagebrush treatment site. Winnett Study Plot.

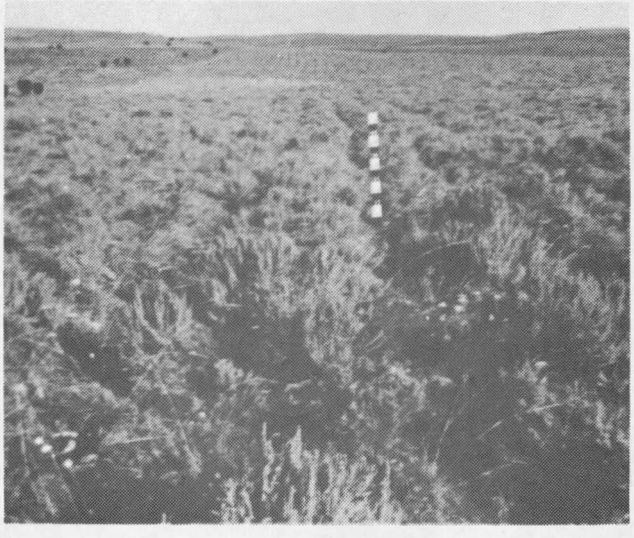

Figure 3. Contour furrow mechanical sagebrush treatment site. King Study Plot.

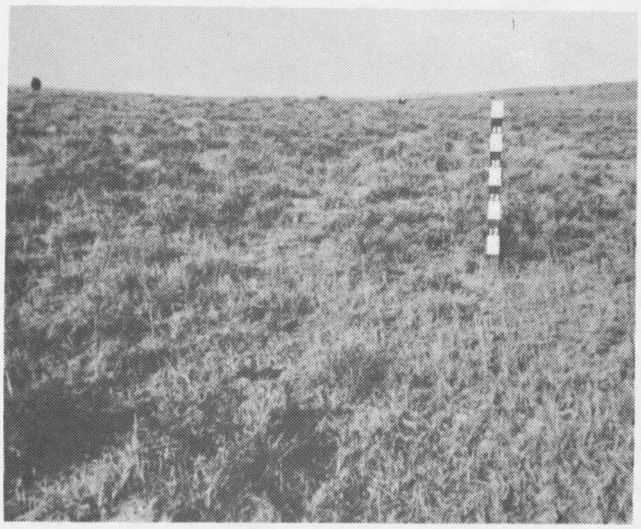

Figure 4. Total kill chemical sagebrush treatment site. King Study Plot.

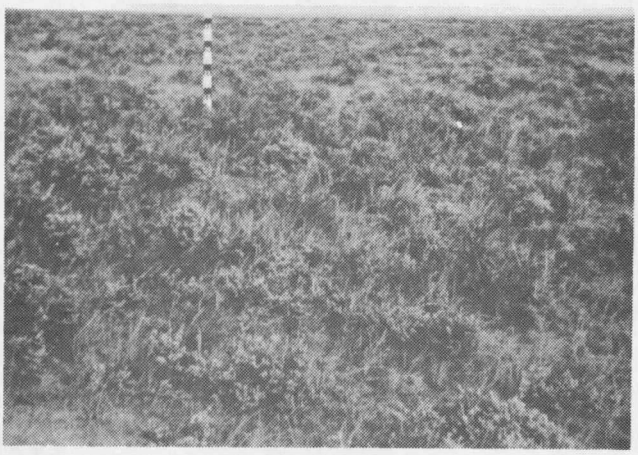

Figure 5. Partial kill chemical sagebrush treatment site. Iverson Study Plot.

METHODS

Sagebrush Treatment and Animal Use of the Study Plots

In the fall of 1967, 511 acres of the King Study Plot were contour-furrowed (Schlatterer and Pyrah 1969). Of these 511 acres, 251 acres received no further treatment. Seventy acres were seeded at the rate of 4, 1, and 1 pounds of *Agropyron smithii, Stipa viridula,* and *Melilotus officinalis* seeds per acre, respectively. The remaining 190 acres were surface-scalped and furrow-interseeded at the rate of 4 pounds of *Agropyron smithii* and 2 pounds of *Stipa viridula* seeds per acre.

In June of 1968, 1,650 acres on the four study plots were sprayed aerially with 2,4-D (Schlatterer and Pyrah 1969). Two hundred forty acres of the King Study Plot and 480 acres of the Winnett Study Plot were sprayed with a mixture of 2 pounds of low volatile isoctyl ester of 2,4-dichlorophenoxyacetic acid per 6 gallons of water to accomplish a total kill of big sagebrush. Alternate 100 foot wide strips were sprayed with the same mixture on 400 acres of the Winnett Study Plot. Two hundred fifty-three acres of the Sibbert Study Plot and 317 acres of the Iverson Study Plot were sprayed to accomplish a partial kill of big sagebrush. The mixture consisted of 1 pound of dimethylamine salt of 2,4-dichlorophenoxyacetic acid per 6 gallons of water. Alternate 100 foot wide strips were sprayed on 320 acres of the Iverson Study Plot to obtain a total kill of big sagebrush. The mixture consisted of 2 pounds of dimethylamine salt of 2,4-dichlorophenoxyacetic acid per 6 gallons of water.

Fences were completed in the fall of 1967, around all study plots except the open control treatment sites on the King and Sibbert Study Plots which were already fenced. A 3-foot, woven wire fence with three strands of barbed wire on top was constructed for the Iverson Study Plot. Various types of barbed wire fences encompassed the other study plots. Only the fence of the Iverson Study Plot was "antelope-proof" except for occasional individuals that jumped fences.

The open control treatment sites of the King and Sibbert Study Plots received cattle use during the mid and late summers of 1968 and 1969. The open control treatment site of the Iverson Study Plot was grazed from May through November during both years. The other treatment sites and study plots were not grazed by livestock during the field period of this study.

In the spring of 1968, eight female and four male antelope were enclosed in the Iverson Study Plot. One fawn was born in June. Considering escapes, births, and deaths, the antelope population within the enclosure numbered seven does, two bucks, and ten fawns in the summer of 1969. One adult male intermittently used the plot by jumping in and out. These antelope were observed in the summers of 1968 and 1969. All adults were marked with neck bands.

From December 1966, through February 1969, 126 individual antelope were trapped, marked with color-coded neckbands, and released back onto the study area.

Antelope Observations

To determine the distribution of antelope, a 120-mile vehicle route, which included the 50-mile route of Wentland (1968), and covering most of the study area including the Winnett, King, and Sibbert sagebrush control study plots, was established (Appendix, Figure 9). Antelope were located with the aid of a 7 x 35 binocular and a variable power 15-60X spotting scope while traveling along the vehicle route at slow speeds once every 2 weeks during early morning and evening hours. During the summers of 1968 and 1969, the vehicle route was traveled in its entirety, a total of 13 times. For each antelope observed the following were recorded: location to the nearest tenth mile; vegetation type including treatment site and sagebrush aspect occupied; sex; age class; herd composition for those in groups; and whether the animal was neckbanded. All animals in the Iverson Study Plot enclosure were observed at 2-hour intervals from dawn until dusk for 2 days of each week. These observations were recorded in like manner to those of the vehicle route.

Home ranges for marked animals observed four or more times per summer were calculated using a method similar to that of Hayne (1949), which was also used by Wentland (1968).

Antelope Food Habits

Fifty-eight antelope feeding sites were examined on the four sagebrush treatment study plots. Data were evaluated following the proced-

ure of Wentland (1968). A 1-quart rumen sample from each of eight fawns collected at the rate of two per month from the Iverson Study Plot enclosure from November, 1969 through February, 1970, and from each of five adults killed during the hunting season of 1968 and 1969, was analyzed according to the methods of Norris (1943) and Cole (1956). For each feeding site and rumen sample the utilization of each plant species was computed as a percent of the diet. These percentages were totaled and averaged by study plot, treatment site, vegetation type, or time period using the aggregate percentage method (Martin *et al.* 1946).

Vegetational Analysis

A vegetation analysis was made at each of 35 antelope feeding sites in 1968 and 1969. Twenty-three sites where analyses had been made within 2 weeks were not included. The number of big sagebrush plants, their heights (6-inch intervals), and canopy intercept (Canfield 1941) were determined along a 100-foot line. The floral composition was also determined by a modification of the technique described by Daubenmire (1959). Vegetation within 20, 2 x 5 decimeter frames placed at 10-foot intervals along a 50-foot line leading in each of the four cardinal directions from a center of origin was analyzed. Canopy coverage and frequency of occurrence of each taxon, grasses composite, forbs composite, shrubs composite, rock, lichens and mosses, and bare ground found within the 2 x 5 decimeter frames were visually estimated. The midpoints of the coverage classes were used in data analysis. The

canopy coverage classes were: Class 1 = 0-1 percent; Class 2 = 1-5 percent; Class 3 = 5-25 percent; Class 4 = 25-50 percent; Class 5 = 50-75 percent; Class 6 = 75-95 percent; Class 7 = 95-100 percent.

RESULTS-DISCUSSION

Effects of Sagebrush Treatment on the Iverson Study Plot

In this paper, the effects of the sagebrush treatment on the vegetation are presented for only the Iverson Study Plot. Prior to the treatment of sagebrush, Wentland (1968) measured the floral composition only on the partial kill, defer control, and open control treatment sites on the Iverson Study Plot. Data for 1969, 1 year after sagebrush treatment, included all treatment categories (Tables 1 and 2). The delineation of the treatment sites and the different categories of sagebrush densities of this study plot are shown in Figure 6.

The percentage of dead plants among sagebrush plants counted per 100 feet of line intercept increased from 1 percent to 22 percent from pre- to post-treatment measurements on the partial kill treatment site. On the same treatment site, there was an increase from 1 percent to 31 percent in relative proportion of dead sagebrush measured per total sagebrush intercept in 100 feet of line. A relative decrease of 30 percent occurred in the proportion of live sagebrush intercept per 100-foot line, 44 percent in the average intercept per live plant, and 37 percent in the average height per live plant. The sagebrush characteristics of the defer control treatment site remained generally the same in pre- and post-treatment measurements. The open control treatment site showed an increase from 3 percent to 26 percent in the proportion of dead plants per 100-foot line, and from 3 percent to 14 percent in the relative proportion of dead sagebrush intercept per 100-foot line.

The reason for this increase is unexplained. A relative decrease of 11 percent was observed in the average live sagebrush intercept, and 22 percent in the average height per live plant.

Total canopy coverage of grasses indicated a relative increase of 24 percent, 19 percent, and 7 percent, respectively, on the partial kill, defer control, and open control treatment sites in 1969, when compared to pre-treatment data. A relative decrease of 36 percent and 14 percent in total shrub canopy coverage was observed on the partial kill and open control treatment sites, respectively, and a relative increase of 17 percent was noted on the defer control. A relative decrease of 18 percent in total forb canopy coverage was observed on the open control. Relative forb coverage increased (50 percent) and remained roughly the same on the defer control and partial kill, respectively. The 68 plant species observed on the study plot in 1969, was greater by ten than in the pre-treatment measurements. Growing conditions and precipitation may make a significant difference in the number of species between years (Hurd 1955). Aside from sagebrush, the response of any particular plant species following treatment appears to have varied; some increased while others decreased. Similar findings were reported by Hurd (1955), Blaisdell and Mueggler (1956), and Martin (1965). Again, factors other than sagebrush spraying may have affected this response.

TABLE 1. BIG SAGEBRUSH CHARACTERISTICS ON THE DIFFERENT TREATMENT SITES OF THE IVERSON STUDY PLOT AS DETERMINED BY MEASUREMENTS ALONG 100-FOOT LINE TRANSECTS.

Treatment Site	Average Number 100-Ft. Line Intercepts	Average No. Plants/100-Ft. Line Intercept LIVE/DEAD	Average Intercept/ 100-Ft. Line LIVE/DEAD[1]	Average Intercept/ Live Plant	Average Height of Live Plants[1]	Average Max. Height of Live Plants[2]
Partial Kill Spray	4	31.0/8.7	19.4/8.9	0.5	5.0	13.5
Spray Strip	4	10.5/14.5	5.9/10.4	0.5	5.1	10.0
Leave Strip	4	29.8/10.0	21.7/5.7	0.7	5.4	13.6
Defer Control	10	33.9/1.6	28.4/1.4	0.9	7.0	14.4
Open Control	4	27.3/9.8	20.3/3.3	0.8	7.5	16.8

[1] Intercept in feet and tenths of feet. Height in inches and tenths of inches.
[2] Represents the average of the heights of the highest plants measured along the 100-foot line transects.

TABLE 2. CONSTANCY, CANOPY COVERAGE, AND FREQUENCY OF OCCURRENCE OF TAXA ON THE DIFFERENT TREATMENT SITES OF THE IVERSON SAGEBRUSH TREATMENT STUDY PLOT IN 1969.[1]

Taxa	TREATMENT SITE				
	Partial Kill (4 Stands) (80 Frames)	Spray Strip (4 Stands) (80 Frames)	Leave Strip (4 Stands) (80 Frames)	Defer Control (10 Stands) (200 Frames)	Open Control (4 Stands) (80 Frames)
SHRUBS:					
Artemisia tridentata	100/16/63[2]	100/ 9/49	100/20/73	90/27/69	100/19/66
Gutierrezia sarothrae	50/ 1/8	25/tr/1	75/tr/5	40/tr/6	
Total Shrubs	100/16/63	100/ 9/49	100/20/73	90/27/69	100/19/66
FORBS:					
Achillea millefolium	50/tr/7	25/tr/1	25/1/9	50/tr/5	25/tr/1
Androsace septentrionalis	25/tr/4				
Antennaria rosea		25/tr/1	X		
Arenaria hookeri		25/tr/4	25/tr/8		
Artemisia frigida	100/ 2/28	100/ 4/39	100/ 3/44	70/ 1/13	75/ 2/25
Aster pansus				10/tr/1	
Astragalus bisulcatus				10/tr/1	
Astragalus drummondii			X		
Astragalus gracilis	25/tr/1	25/tr/1			
Astragalus missouriensis		25/tr/1	25/tr/1		25/tr/3
Astragalus purshii			X		25/tr/4
Bahia oppositifolia		25/tr/1			
Camelina microcarpa				30/tr/5	
Chenopodium album				30/tr/2	25/tr/1
Cersium flodmanii				10/tr/1	
Draba brachycarpa			75/tr/4	10/tr/4	
Erigeron pumilus	25/tr/3	25/tr/1	X	10/tr/1	50/tr/3
Gaura coccinea		25/tr/1	75/tr/10	10/tr/1	50/tr/5
Grindelia squarrosa				40/tr/9	
Haplopappus spinulosus				10/tr/1	
Hymenoxys acaulis			25/tr/3		

TABLE 2. (CONTINUED)

Taxa	TREATMENT SITE				
	Partial Kill (4 Stands) (80 Frames)	Spray Strip (4 Stands) (80 Frames)	Leave Strip (4 Stands) (80 Frames)	Defer Control (10 Stands) (200 Frames)	Open Control (4 Stands) (80 Frames)
Kochia scoparia				10/tr/1	
Lactuca serriola	25/tr/1				
Lepidium densiflorum					50/tr/7
Lesquerella alpina			25/tr/3	10/tr/1	
Linum rigidum	50/tr/7	50/tr/4	25/tr/8		
Medicago lupulina				20/ 2/6	
Medicago sativa				10/tr/1	
Melilotus officinalis				60/ 2/16	
Opuntia polycantha	50/ 1/8	25/ 1/9	X	40/tr/4	75/tr/8
Orbanche fasiculata		25/tr/1			
Oxytropis sericea		25/tr/1	25/tr/1		
Penstemon nitidus	25/tr/1				
Petalostemon purpureum	25/tr/1				
Phlox hoodii	75/tr/23	75/ 1/38	75/ 3/59	40/ 1/15	100/ 1/49
Plantago elongata					25/tr/3
Plantago purshii	100/tr/9	75/tr/9	100/tr/29	60/tr/8	75/tr/17
Potentilla hippiana			25/tr/1		
Potentilla pennsylvanica					25/tr/1
Psoralea tenuiflora	25/tr/6				
Rorippa islandica	25/tr/3				
Sphaeralcea coccinea	75/tr/9	50/tr/3	75/tr/15	60/tr/7	75/tr/8
Taraxacum officinale	25/ 1/3	75/tr/5	25/tr/4	50/ 2/18	75/tr/6
Thelasperma marginatum	25/tr/1	25/tr/1	25/tr/3		50/tr/17
Tragopogon dubius	75/tr/4	25/tr/1	50/tr/4	60/ 1/10	100/tr/8
Vicia americana	75/tr/10	50/tr/4	75/tr/20	80/ 1/23	100/ 4/55
Total Forbs	100/ 6/75	100/ 6/76	100/ 8/99	100/ 9/78	100/ 9/94

TABLE 2. (CONTINUED).

Taxa	TREATMENT SITE				
	Partial Kill (4 Stands) (80 Frames)	Spray Strip (4 Stands) (80 Frames)	Leave Strip (10 Stands) (80 Frames)	Defer Control (10 Stands) (200 Frames)	Open Control (4 Stands) (80 Frames)
GRASSES AND GRASS-LIKE:					
Agropyron desertorum	25/ 5/23	50/tr/5	25/ 3/15	30/ 6/29	
Agropyron smithii	100/11/79	100/15/90	100/ 7/81	80/16/68	100/ 7/83
Agropyron spicatum		25/ 2/11	25/ 1/6		25/ 2/15
Bouteloua gracilis	75/14/41	75/15/49	75/16/49	40/ 6/26	100/18/78
Bromus inermis				10/tr/1	
Bromus japonicus		25/tr/1			
Bromus tectorum	50/tr/3		25/tr/4	10/tr/1	
Carex eleocharis	75/ 3/53	75/tr/17	75/tr/40	50/ 1/14	100/ 4/51
Carex filifolia		25/tr/1	50/ 1/9	20/tr/1	
Distichlis stricta				10/tr/4	
Koeleria cristata	100/ 4/56	75/ 5/55	100/ 3/59	80/ 2/31	100/ 6/69
Poa spp.		25/ 1/1	100/tr/56		
Poa pratensis				10/ 1/4	
Poa secunda	75/ 4/45	100/tr/26		100/ 2/48	100/tr/19
Schedonnardus paniculatus	50/tr/7	50/ 1/19	75/ 1/21	80/ 1/23	
Stipa comata	75/ 5/36	100/ 7/71	75/ 6/62	70/1/13	100/ 7/70
Stipa viridula	50/ 6/33	75/ 5/23	75/ 9/25	70/ 7/27	75/ 1/8
Total Grasses	100/47/100	100/49/100	100/46/100	100/43/100	100/45/100

TABLE 2. (CONTINUED).

Taxa	TREATMENT SITE Partial Kill (4 Stands) (80 Frames)	Spray Strip (4 Stands) (80 Frames)	Leave Strip (10 Stands) (80 Frames)	Defer Control (10 Stands) (200 Frames)	Open Control (4 Stands) (80 Frames)
OTHERS:					
Nostoc	25/tr/5	75/tr/5		50/tr/5	
Lichens	100/ 4/90	100/ 5/74	100/ 3/61	60/ 3/38	100/10/96
Selaginella densa			25/tr/3	20/tr/4	25/tr/3
Bare Ground	100/33/99	100/29/98	100/19/98	100/36/98	100/27/94
Rock	100/ 3/51	100/ 8/76	100/ 5/78	90/ 3/47	100/ 2/40
Litter I[3]	100/44/100	100/42/100	100/54/100	100/41/100	100/43/100
Litter II[4]	100/21/96	100/18/88	100/22/94	100/25/93	100/ 6/66

[1] Location and extent of treatment sites are shown in Appendix, Figure 9..

[2] Constancy (percent occurrence among stands)/Canopy Coverage (average percent of area covered by foliage in all frames)/Frequency (average percent occurrence among all frames). Values of less than 1 percent for canopy coverage are recorded as trace (tr). X indicates taxon present, but less than 5 percent frequency of occurrence.

[3] Litter I includes dead organic material lying on the ground.

[4] Litter II includes dead organic material still standing.

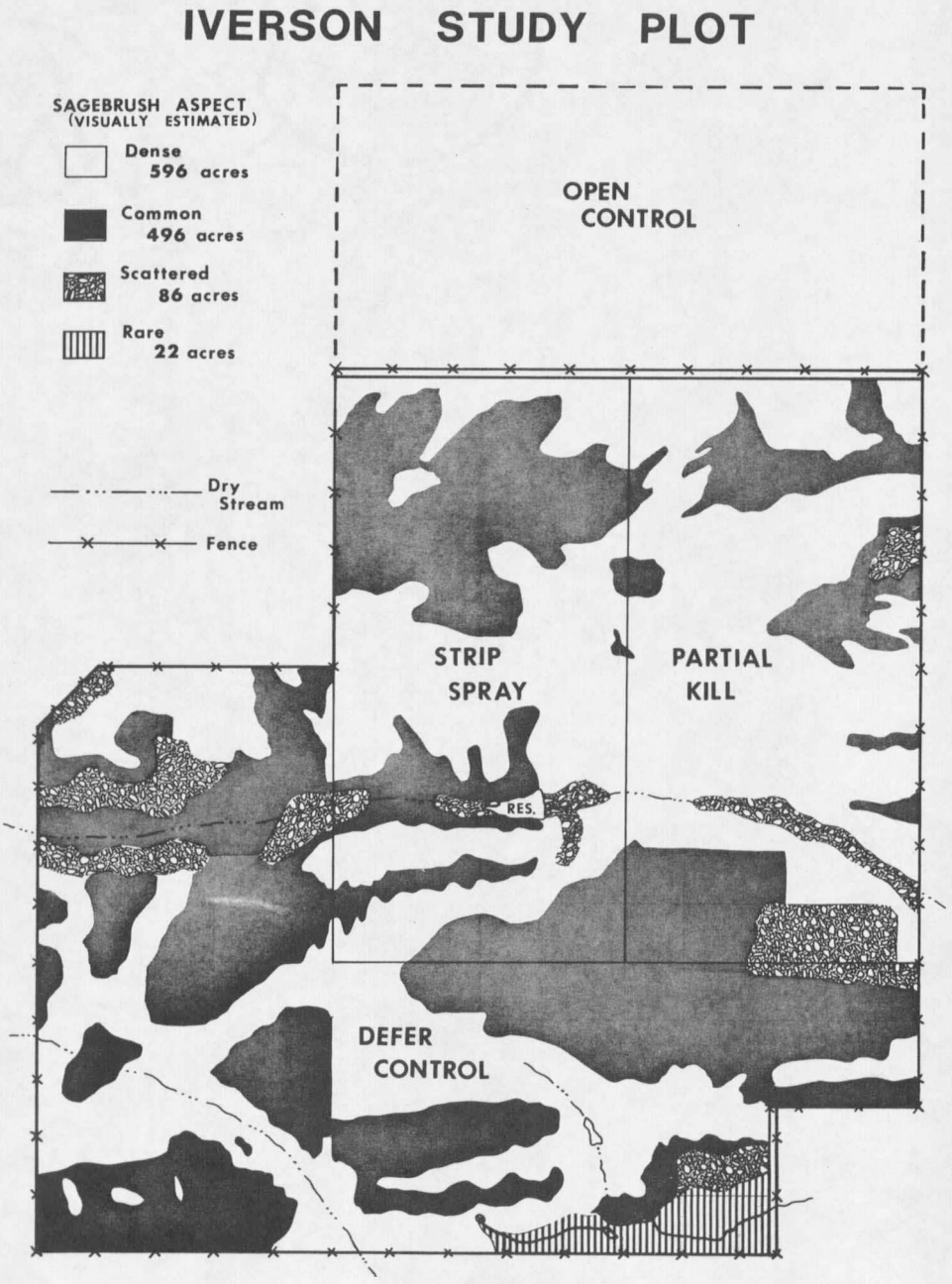

Figure 6. Delineation of the treatment sites and the different categories of sagebrush density of the Iverson Study Plot.

Antelope Population Characteristics

A total of 3,634 individual antelope sightings were recorded while traveling the vehicle route during the summers of 1968 and 1969 (Table 3). The female:male ratios observed in 1968 and 1969, respectively, were 129 and 135 females per 100 males. The highest fawn:female ratios observed were 133 and 86 fawns per 100 females in 1968 and 1969, respectively. During both years, there was a steady increase in the observed fawn:female ratio as the summer progressed, until a peak was reached in August. One explanation might be that the does kept fawns secluded for a period of time after birth. As the fawns grew older and more capable of caring for themselves, the does became less secretive and tended to join bands of other does and fawns. These groups were more readily observed. This trend was also noted by Buechner (1950). By late summer, the fawns were often of such stature that they were difficult to distinguish from adults at a distance. This explanation for observed changing fawn:doe ratios is supported by the data in Table 4 showing a proportionate increase in the number of group observations when compared to single animal observations, as the summer progressed, during both years. The lower fawn:doe ratio for 1969 was possibly related to the high fawn:doe ratio of 1968, which followed a low fawn:doe ratio in 1967 (Wentland 1968). Assuming good overwinter survival, there were proportionately more yearling females in the population in the summer of 1969 than in 1968 which possibly accounts for the lower

fawn:doe ratio in 1969. Females generally don't breed until one and one-half years of age (Wright and Dow 1962, Mitchell 1967). The unusually low fawn:doe ratio (one fawn:eight does) in 1968 for the antelope in the Iverson enclosure was possibly due to inadequate adjustment to captive conditions. The fawn:doe ratio in 1969 was ten fawns:seven does.

TABLE 3. SEX AND AGE CLASSES OF ANTELOPE OBSERVED ON THE STUDY AREA WHILE TRAVELING THE VEHICLE OBSERVATION ROUTE DURING THE SUMMERS OF 1968 AND 1969.

Time Interval	Adults		Fawns	Total Classified	Females: 100 Males	Fawns: 100 Females
	Females	Males				
June 1-15						
1968	36	15	16	68	225	44
1969	118	97	33	248	122	28
June 16-30						
1968	159	101	89	349	157	56
1969	133	104	82	319	128	62
July 1-15						
1968	74	72	50	196	103	68
1969	154	109	117	380	141	76
July 16-31						
1968	61	93	72	226	66	118
1969	113	114	91	318	99	81
Aug. 1-15						
1968	89	70	109	268	127	122
1969	172	103	148	423	167	86
Aug. 16-31						
1968	101	54	134	289	187	133
1969	136	83	89	308	164	65
Sept. 1-15						
1968	79	58	105	242	136	133
1969	--	--	--	--	--	--
COMBINED:						
1968	599	464	575	1,638	129	96
1969	826	610	560	1,996	135	68

TABLE 4. PERCENTAGE DISTRIBUTION OF 3,634 INDIVIDUAL ANTELOPE SIGHTINGS BY ONE-HALF MONTH INTERVALS ON EIGHT VEGETATION TYPES DURING THE SUMMERS OF 1968 AND 1969.

Time Interval	Sagebrush-Grassland	Grassland-Abandoned Meadow-Timber[1]	Greasewood-Sagebrush	Greasewood	Shale Slope	Cropland	Comb.[2]	Number Observations[3] S.	Grp.	Total Antl.
June 1-15										
1968	71.4	3.6	14.3	10.7	--	--	28.6	16	12	68
1969	53.8	8.7	16.3	4.8	11.5	4.9	46.2	56	48	248
June 16-30										
1968	66.1	0.8	16.1	3.6	13.4	--	33.9	52	66	349
1969	53.3	--	6.7	13.3	20.0	6.7	46.7	40	35	319
July 1-15										
1968	60.7	1.8	21.4	--	16.1	--	39.3	18	38	196
1969	55.9	4.4	22.1	2.8	7.4	7.4	44.1	34	34	380
July 16-31										
1968	47.1	--	15.7	3.9	31.4	1.9	52.9	19	32	226
1969	53.4	1.1	20.8	3.9	18.0	2.8	46.3	80	98	318
Aug. 1-15										
1968	48.7	--	25.6	--	25.7	--	51.3	11	28	268
1969	55.2	6.3	17.7	1.0	16.7	3.1	44.8	34	62	423
Aug. 16-31										
1968	71.1	2.2	11.1	2.3	8.9	4.4	28.9	11	34	289
1969	54.5	--	15.2	9.1	19.7	1.5	45.5	24	42	308
Sept. 1-15										
1968	48.8	8.9	17.8	4.4	13.3	6.8	51.2	17	28	242
1969	--	--	--	--	--	--	--	--	--	--
AVERAGE:										
1968	59.1	2.5	17.4	3.6	15.5	1.9	40.9			234.0
1969	54.4	3.4	16.5	5.7	15.6	4.4	45.6			332.6
								Total 1968 = 1,638		
								Total 1969 = 1,996		
								Overall Total 3,634		

[1]No individual antelope sightings were recorded on the timber vegetation type, and few on the abandoned meadow type, so these types were combined with grassland type for tabulation.
[2]All but sagebrush-grassland. [3]S = Singles; Grp. = Groups; Antl. = Antelope.

Based on the highest count for one complete circuit of the vehicle route, each summer the antelope density on the entire study area was 2.7 and 3.2 animals per square mile for the summers of 1968 and 1969, respectively. Cole (1956) observed antelope densities of about 4 and 4.5 per square mile on part of this same general area in 1953 and 1954, respectively.

Summer Home Ranges of Antelope

To determine summer home range characteristics, 188 individual sightings of 25 neck-banded antelope observed four or more times each during the summers of 1968 or 1969, were evaluated (Table 5 and Appendix Table 16). Territorial males sighted alone, or with females and fawns, were observed to move the shortest distance between successive locations, and to have the lowest average distance between the geometric center of the home range and successive locations. "Bachelor" herd males were observed to move the greatest distances between successive sightings and to have the highest average distance between the geometric center of the home range and successive locations. All female-fawn associations were intermediate with regard to the forementioned measurements.

Assuming the three group categories are realistic, and acknowledging that factors other than sex and age affect home range size, these group home range sizes were tested with a standard analysis of variance, one-way classification, at the $P(I) = 0.05$. The hypothesis tested was: there was no significant difference between the mean home range size of territorial males, bachelor herd males, and females alone or associated

with other females and fawns. The resulting F value of 3.96 with 2 and 27 degrees of freedom dictated rejection of the hypothesis. Territorial males had the smallest home ranges while bachelor herd males had the largest. Females were intermediate in regard to this measurement.

TABLE 5. CHARACTERISTICS OF HOME RANGES OF 25 ANTELOPE AS DETERMINED BY SUCCESSIVE OBSERVATIONS OF INDIVIDUALLY RECOGNIZABLE ANIMALS.

	Territorial Males Observed Alone Or With Females and Fawns[1] (15)	Males Associated With Male Herds[1] (11)	Females Associated With Other Females and Fawns or With Females, Fawns and A Single Male[1] (14)
Average Number Observations/Animal	8 [5-12][2]	6 [4-9]	6 [4-9]
Average Number Days Between Successive Observations	11 [7-18]	16 [11-26]	14 [8-19]
Distance Between Successive Locations:			
Maximum	1.2[3]	2.8	1.6
Mean	.7	1.8	.9
Distance Between Geometric Center of Home Range and Successive Locations: Maximum	.9	2.0	1.2
Mean	.5	1.2	.7
Average Size Home Range (Square Miles)	.70 [.24-1.21][4]	2.72 [.36-7.58]	1.05 [.12-3.76]

[1]An individual animal may fall in one category one year and in another the next. Numbers in parenthesis indicate sample size.
[2]Numbers in brackets represent the range.
[3]All distances in miles.
[4]Size of home range in square miles.

Antelope Use of Vegetation Types

Use of vegetation types during both summers was determined from 3,634 individual antelope sightings recorded while traveling the vehicle route. To test whether distribution was random, a χ^2 goodness of fit statistical analysis was performed. It was assumed that antelope, if distributed randomly on the study area, would occur on the vegetation types in direct proportion to the area occupied by each vegetation type. The hypothesis tested was: distribution was independent of vegetation type. Each year was tested separately at the P(I) = 0.05 with 5 degrees of freedom. Chi-square values of 1,386.79 and 1,481.99 dictated rejection of the hypothesis. During both summers, the antelope occurrence on the grassland-abandoned meadow-timber, greasewood, and greasewood-sagebrush vegetation types was significantly less than expected, and the occurrence on the shale-slope, and cropland types was significantly greater. In 1968, occurrence on sagebrush-grassland was as expected, but in 1969 it was significantly less than expected (Table 6). Table 4 shows generally, a progressive decline in the use of sagebrush-grassland, accompanied by a progressive increase in the use of all other vegetation types combined throughout the summer of 1968. This trend may be explained by a progressive desiccation of the sagebrush-grassland vegetation and a resulting shift by antelope to the more mesic sites with remaining succulent vegetation (Wentland 1968). Cole (1956) and Bayless (1969) noted similar trends. In 1969, the antelope

utilization of sagebrush-grassland was consistently low and use of all other vegetation types combined was consistently high throughout the summer as compared to 1968. This might be the result of the abnormally dry spring and early summer of 1969, causing a premature shift to the more mesic sites. A similar cause-effect relation was expounded by Wentland (1968) for his 1966 data.

TABLE 6. "EXPECTED" AND OBSERVED DISTRIBUTION OF INDIVIDUAL ANTELOPE SIGHTINGS BY VEGETATION TYPES IN THE SUMMERS OF 1968 AND 1969.

Vegetation Type	Percentage Composition of Study Area	DISTRIBUTION			
		1968		1969	
		Expected[1]	Observed	Expected	Observed
Sagebrush-Grassland	59	966	956	1,178	1,091
Grassland-Abandoned Meadow-Timber[2]	9	147	21	179	67
Greasewood	6	99	36	120	86
Greasewood-Sagebrush	22	360	310	439	397
Shale-Slope	2	33	227	40	272
Cropland	2	33	88	40	83
TOTAL	100	1,638	1,638	1,996	1,996

[1]Expected occurrence was obtained by multiplying the percentage of the entire study area comprised by each vegetation type times the total individual antelope sightings for that year.

[2]No individual antelope sightings were recorded on the timber vegetation type, and few on the abandoned meadow type, so these types were combined with grassland type for tabulation.

Despite the differences in the intensity of use during each summer during both years, the sagebrush-grassland vegetation type averaged over 50 percent of the total use. The density of big sagebrush was visually estimated at 956 and 1,091 individual antelope sightings on the sagebrush-grassland vegetation type in 1968 and 1969, respectively. For each year, over 75 percent of these sightings were made in areas where sagebrush densities were estimated to be common or dense (Table 7). Wentland (1968) observed the majority of the antelope found on sagebrush-grassland during summer in scattered or common sagebrush.

During both summers, the majority of female, and fawn, pronghorn sightings occurred on the sagebrush-grassland and greasewood-sagebrush vegetation types (Table 8). The majority of male antelope sightings were on the sagebrush-grassland and shale-slope types. To determine whether a differential occurred in the antelope group type distribution on the various vegetation types, the raw data of Table 9 were entered in an R x C contingency table and tested with the χ^2. The hypothesis tested was: the distribution of antelope groups, by group type, is independent of vegetation type. Due to its small size, the fawn group category was omitted from the test. Each summer was tested separately at the $P(I) = 0.05$ with 20 degrees of freedom. For the year 1968, the hypothesis was accepted, although the shale-slope type appeared to receive greater than expected use by all antelope group types, especially bachelor male groups. In 1969 the χ^2 value of 44.69 dictated rejection of the hypothesis. A

notable increase was observed in the use of greasewood by female-male groups and the use of shale-slopes by bachelor male herds. Apparently bachelor male herds are forced to use the shale slopes, probably as the result of social or hierarchical pressure from territorial males. The female-fawn group size was significantly larger than average on the cropland type, especially in 1969. The female-fawn-male groups were notably smaller than average on the grassland-abandoned meadow and greasewood types in 1968.

TABLE 7. PERCENTAGE DISTRIBUTION OF 2,047 INDIVIDUAL ANTELOPE SIGHTINGS BY FOUR SAGEBRUSH DENSITY CATEGORIES ON THE SAGEBRUSH-GRASSLAND VEGETATION TYPE DURING THE SUMMERS OF 1968 AND 1969.

Year	SAGEBRUSH DENSITY[1]				Total Number Antelope
	Rare	Scattered	Common	Dense	
1968	1.3	12.7	57.6	28.4	956
1969	2.8	17.5	40.2	39.5	1,091
Average	2.1	15.1	48.9	33.9	
				Total =	2,047

[1]Sagebrush densities (in percent) were visually estimated for each individual antelope sighting based on the following criteria:

Shrub Intercept

Rare - Less than 2 percent
Scattered - 2 - 5 percent
Common - 6 - 25 percent
Dense - More than 25 percent.

TABLE 8. PERCENTAGE DISTRIBUTION OF 3,634 INDIVIDUAL ANTELOPE SIGHTINGS BY SEX AND AGE ON EIGHT VEGETATION TYPES DURING THE SUMMERS OF 1968 AND 1969.

Vegetation Type	ADULTS Females	ADULTS Males	Fawns	Total Number Antelope
Sagebrush-Grassland:				
1968	60.1(360)[1]	50.2(233)	63.1(363)	956
1969	58.8(486)	44.1(269)	60.0(336)	1,091
Grassland-Abandoned Meadow-Timber:				
1968	0.6(4)	2.8(13)	0.7(4)	21
1969	3.6(30)	3.1(19)	3.2(18)	67
Greasewood-Sagebrush:				
1968	20.4(122)	13.8(64)	21.6(124)	310
1969	19.1(158)	19.3(118)	21.6(121)	397
Greasewood:				
1968	3.2(19)	1.1(5)	2.1(12)	36
1969	6.2(51)	2.5(15)	3.6(20)	86
Shale-Slope:				
1968	8.0(48)	31.2(145)	5.9(34)	227
1969	7.1(59)	28.5(174)	7.0(39)	272
Cropland:				
1968	7.7(46)	0.9(4)	6.6(38)	88
1969	5.2(42)	2.5(15)	4.6(26)	83
TOTAL NUMBER ANTELOPE				
1968	599	464	575	1,638
1969	826	610	560	1,996
			TOTAL =	3,634

[1]Individual antelope sightings in parenthesis.

TABLE 9. PERCENTAGE DISTRIBUTION OF SINGLE AND GROUP ANTELOPE OBSERVATIONS BY VEGETATION TYPE DURING THE SUMMERS OF 1968 and 1969.

Vegetation Type	GROUP TYPE[1]						Single	Single	Single
	Female-Fawn[2]	Female-Fawn-Male[2]	Female-Male[2]	Fawn[2]	Female[2]	Male[2]	Female[3]	Male[3]	Fawn[3]
Sagebrush-Grassland:									
1968	70(5.1)	57(11.4)	64(3.3)	100(2)	63(2.8)	53(3.5)	62(38)	57(47)	50(1)
1969	60(6.8)	57(10.2)	50(3.9)	60(2)	67(3.0)	42(3.4)	51(37)	56(91)	100(1)
Grassland-Abandoned Meadow-Timber:									
1968	2(3)	1(4)	----	----	----	6(3)	3(2)	----	----
1969	5(5.3)	3(9.5)	----	----	3(6)	5(3)	5(4)	3(5)	----
Greasewood:									
1968	3(7)	3(7)	----	----	----	2(3)	12(7)	----	----
1969	4(2.3)	6(13)	18(3)	----	9(2)	1(2)	4(3)	3(5)	----
Greasewood-Sagebrush:									
1968	19(6.3)	23(10.6)	21(2.3)	----	26(3.3)	10(3.7)	20(12)	14(12)	----
1969	22(6.4)	24(9.6)	18(2.8)	20(2)	9(2.3)	15(5.4)	23(17)	16(27)	----
Shale Slope:									
1968	3(3.5)	10(9.4)	15(3)	----	11(4)	29(5.5)	3(2)	29(24)	50(1)
1969	7(4.0)	7(10.8)	14(4.7)	20(2)	9(4)	35(4.6)	3(2)	20(32)	----
Cropland:									
1968	3(10)	6(17)	----	----	----	----	----	----	----
1969	2(14)	3(15)	----	----	3(2)	2(5)	14(10)	2(3)	----
TOTAL ANTELOPE:									
1968	322	765	43	2	82	278	61	83	2
1969	506	727	80	10	98	338	73	163	1
TOTAL GROUPS:									
1968	59(5.5)	69(11.1)	14(3.1)	1(2)	27(3.0)	68(4.1)			
1969	79(6.4)	70(10.4)	22(3.6)	5(2)	33(3.0)	82(4.1)			

[1] Includes group types most commonly seen. A group was composed of two or more animals.
[2] Numbers in parenthesis indicate average group size.
[3] Numbers in parenthesis are an actual count, *not* an average.

Antelope occurrence on the various treatment sites of the sagebrush control study plots was recorded (Table 10). Trends in preference for most treatment sites were not apparent, either between the years 1968 and 1969 or when compared to pre-treatment data of 1967 (Wentland 1968). On the King Study Plot however, there was an apparent increase in the use of the contour furrow. Seven, 21, and 23 antelope were observed here in 1967, 1968, and 1969, respectively. There was an apparent decrease on this same plot, when compared to the 1967 pre-treatment data in the use of the interseed, defer control, and open control treatment sites for both 1968 and 1969. Total antelope observed for respective treatment sites and years were: 35, 13, 16; 23, 6, 5; 426, 200, 80. Due to the comparatively small size of the treatment sites in relation to the entire study area, some real preferences may have been masked.

Locations of all individual antelope sightings in 1968 and 1969 were tabulated by coordinates (Appendix, Table 8 and Figure 9).

A total of 966 observations of antelope utilization of the various treatment sites of the Iverson Study Plot were recorded during the summers of 1968 and 1969 (Table 11). The percent of total antelope utilization received by each treatment site during both summers is plotted in Figure 7. To determine whether a preference for particular treatment sites existed, a χ^2 goodness of fit test was made. The assumption was made, that if antelope were distributed randomly on the study plot, their occurrence on the treatment sites would be proportionate to the percent-

age of the study plot made up by each treatment site. The hypothesis tested was: distribution on the Iverson Study Plot was independent of treatment site. Each year was tested separately at the P(I) = 0.05 with 2 degrees of freedom. The χ^2 values of 64.11 and 14.19 for 1968 and 1969, respectively, dictated rejection of the hypothesis. In 1968 the strip spray treatment site was used to a greater extent, and the partial kill and defer control sites to a lesser extent, than expected. The inadequate adjustment of the antelope to captive conditions was reflected in their distribution in the enclosure for 1968. During that summer, the antelope were observed to occupy the northwest corner of the enclosure consistently. This was apparently related to a desire to escape. This portion of the enclosure was part of the strip spray treatment site. In 1969, the antelope adjustment was considered more nearly "normal." For this year, the strip spray treatment site was used to a lesser extent than expected and the defer control, to a greater extent. The partial kill received approximately the expected use. The differential distribution in 1969, may reflect in part; the effects of the sagebrush treatment. The small size of the enclosure may have introduced a bias in the distribution data and concealed the full effects of the sagebrush treatment. The intolerant and aggressive nature of the dominant male in the enclosure often forced the subordinate males to occupy distant portions of the enclosure. Thus, an observation of the dominant male on one treatment site was often countered by an observation of the subordinate males on another treatment site. Only the former indicated preference.

TABLE 10. INDIVIDUAL ANTELOPE SIGHTINGS ON THE DIFFERENT TREATMENT SITES OF EACH OF THE SAGEBRUSH CONTROL STUDY PLOTS DURING 13 COMPLETE CIRCUITS OF THE VEHICLE ROUTE IN THE SUMMERS OF 1968 AND 1969.

Treatment Sites	King 5 Treatment Sites F/M/Fawns	Sibbert 2 Treatment Sites F/M/Fawns	Winnett 3 Treatment Sites F/M/Fawns	Total F/M/Fawns
Complete Spray (1)[1]				
1968	3/0/0		0/0/0	3/0/0
1969	4/0/0		0/0/0	4/0/0
Partial Spray (2)				
1968		0/0/0		0/0/0
1969		6/0/0		6/0/0
Strip Spray (3)				
1968			0/2/0	0/2/0
1969			0/0/0	0/0/0
Contour Furrow (5)				
1968	11/2/8			11/2/8
1969	8/10/5			8/10/5
Interseed (6)				
1968	4/5/4			4/5/4
1969	8/1/7			8/1/7
Defer Control (7)				
1968	3/1/2		2/0/2	5/1/4
1969	0/5/0		0/0/0	0/5/0
Open Control (8)				
1968	27/65/8	0/0/0		27/65/8
1969	32/42/6	9/3/5		41/45/11
TOTAL	100/131/40	15/3/5	2/2/2	117/136/47

[1]Numbers in parenthesis identify the treatment sites and locations on each study plot (Figure 9).

TABLE 11. PERCENTAGE ANTELOPE DISTRIBUTION ON THE VARIOUS TREATMENT SITES OF THE IVERSON STUDY PLOT BY 2-WEEK INTERVALS DURING THE SUMMERS OF 1968 AND 1969.

Year	Strip Spray	Partial Spray	Defer Control	Total Observations
June 1-15				
1968	-	100.0(2)	-	2
1969	45.5(5)[1]	36.3(4)	18.2(2)	11
June 16-30				
1968	44.4(28)	15.9(10)	39.7(25)	63
1969	22.8(31)	22.8(31)	54.4(74)	136
July 1-15				
1968	54.0(54)	16.0(16)	30.0(30)	100
1969	22.2(20)	31.1(28)	46.7(42)	90
July 16-31				
1968	41.6(32)	28.5(22)	29.9(23)	77
1969	22.1(19)	10.5(9)	67.4(58)	86
Aug. 1-15				
1968	21.7(13)	28.3(17)	50.0(30)	60
1969	23.2(16)	27.5(19)	49.3(34)	69
Aug. 16-31				
1968	60.0(39)	16.9(11)	23.1(15)	65
1969	10.4(7)	23.9(16)	65.7(44)	67
Sept. 1-15				
1968	34.7(26)	26.6(20)	38.7(29)	75
1969	21.5(14)	26.2(17)	52.3(34)	65
TOTAL				
1968	43.4(192)	22.2(98)	34.4(152)	442
1969	21.3(112)	23.7(124)	55.0(288)	524
			Overall Total =	966

[1]Number of observations in parenthesis. An observation refers to one animal or a group of animals on a definite location at a certain time as contrasted to an individual antelope sighting.

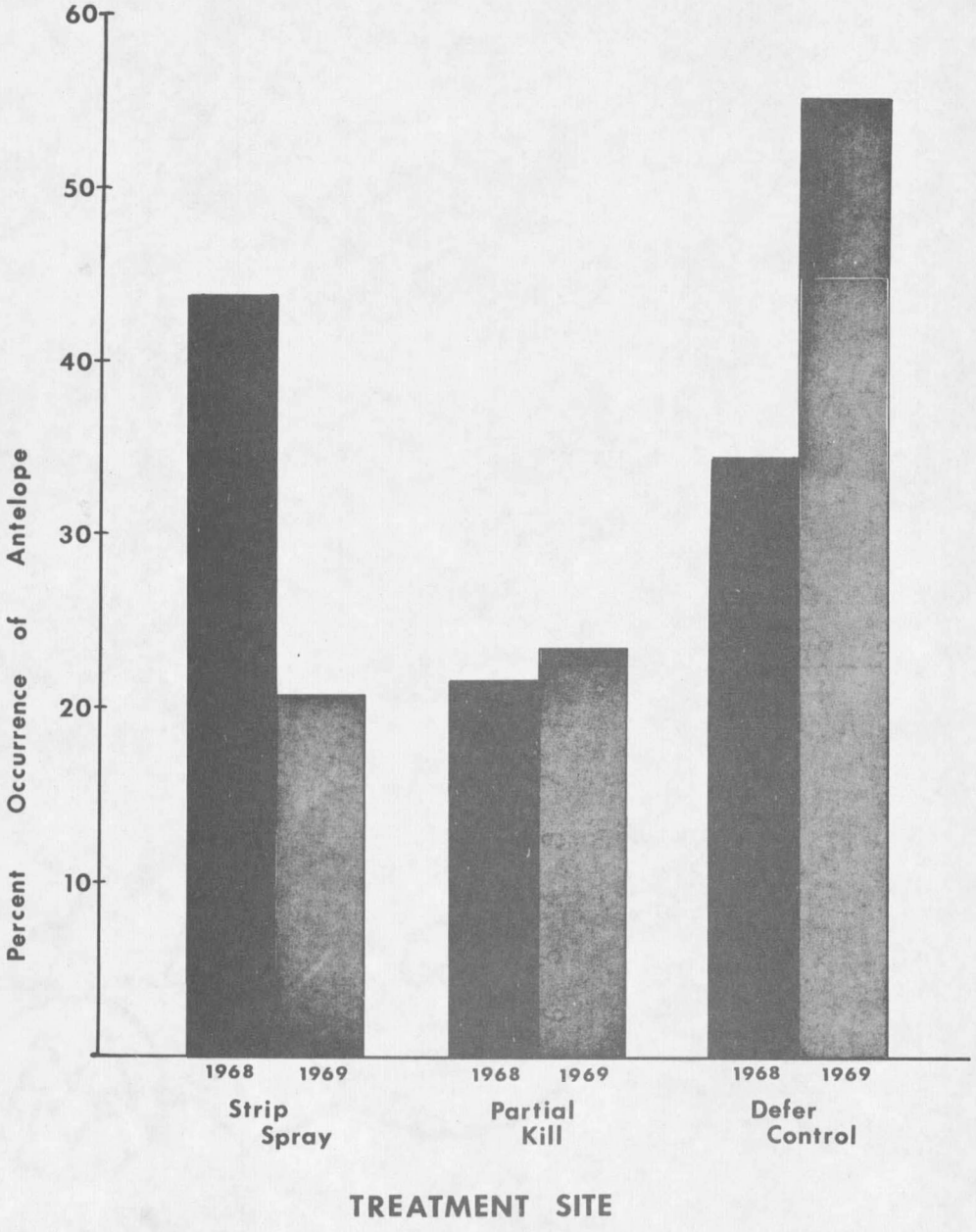

Figure 7. Percentage antelope distribution on the various treatment sites of the Iverson Study Plot during the summers of 1968 and 1969.

Antelope Food Habits

A total of 15,074 instances of plant use was recorded from the examination of 58 feeding sites on the sagebrush treatment study plots during the summers of 1968 and 1969 (Tables 12 and 13). Spring feeding sites in 1968 indicated a heavy use of a browse plant, big sagebrush, followed by utilization of forbs and grasses, respectively (Figure 8). The highest observed use of grass was during the spring. During late spring and early summer there was a notable shift to forbs, accompanied by a decline in the use of browse and grasses. This was probably due to the increased palatability of the new year's growth of forbs. As the summer progressed, there was a declining use of forbs and an increasing use of browse. This increasing use of browse in late summer might be expected, since antelope were generally observed to shift to shale slopes where the deciduous browse species made up a relatively greater share of the diet. The data for September, 1968 may not be representative since only one feeding site was taken. Forage class utilization in 1969 (Figure 9) indicates a generally similar trend. Similar findings have been reported by Cole (1956), Cole and Wilkins (1958), Dirschl (1963), and Wentland (1968).

In the spring of 1968, big sagebrush (*Artemisia tridentata*) and bluegrass (*Poa* spp.) were prominent. The three most prominent plants in the summer diet in 1968 were: yellow sweetclover (*Melilotus officinalis*), fringed sagewort (*Artemisia frigida*), and longleaf sagebrush (*Artemisia longifolia*). In 1969 the five most prominent plants in the summer diet

TABLE 12. SUMMER FOOD HABITS OF ANTELOPE BY MONTH AND YEAR AS DETERMINED FROM 15,074 INSTANCES OF PLANT USE ON 58 FEEDING SITES LOCATED ON SAGEBRUSH STUDY PLOTS IN THE SUMMERS OF 1968 AND 1969.

	TIME PERIOD										
	March-May[1]	June		July		August		September		SUMMER	
	1968	1968	1969	1968	1969	1968	1969	1968	1969	1968	1969
	(8)[2]	(2)	(8)	(9)	(10)	(8)	(9)	(1)	(3)	(28)	(30)
Taxa	(2505)	(20)	(2166)	(2460)	(1502)	(3108)	(2416)	(187)	(710)	(8280)	(6794)
	Fr/%[3]	Fr/%	Fr/%	Fr/%	Fr/%	Fr/%	Fr/%	Fr/%	Fr/%	Fr/%	Fr/%
SHRUBS:											
Artemisia cana				11/tr						4/tr	
Artemisia tridentata	88/55			11/tr	20/tr	100/9	44/4	100/4	33/1	61/19	23/1
Chrysothamnus nauseosus				11/2		13/2	11/3		33/24	7/1	7/3
Gutierrezia sarothrae			25/2	22/1	30/1	88/13	56/5	100/8	67/1	36/4	40/2
Rosa arkansana				22/1		13/tr	11/2			11/tr	3/1
Sarcobatus vermiculatus						13/2				4/1	
Total Shrubs	88/55		25/2	56/4	30/1	100/27	89/13	100/12	100/25	71/25	53/7
FORBS:											
Achillea millefolium	13/2		13/tr	56/11	60/4	25/1	22/tr			29/4	30/2
Amaranthus retroflexus							11/3				3/1
Artemisia frigida	50/3		13/6	11/tr	90/45	63/16	78/11	100/72	67/13	39/8	63/22
Artemisia longifolia				22/11		13/1	11/5			11/4	3/1
Astragalus bisulcatus			25/4	11/tr						4/tr	7/1
Astragalus drummondii							11/1		33/tr		7/tr
Astragalus gilviflorus		50/50	38/16	22/8		13/1	22/14		33/20	14/6	20/11
Astragalus gracilis				22/tr	10/1	13/tr	11/1			11/tr	7/1
Astragalus missouriensis			25/2	22/1	30/5	38/2				18/1	17/2
Astragalus spatulatus			13/tr						33/26		7/3
Atriplex dioica			13/1		10/tr		11/tr		33/6		13/1
Bahia oppositifolia				11/1		25/3	11/1		33/1	11/1	7/1
Cersium vulgare						13/tr				4/tr	
Chenopodium album							11/tr				3/tr
Erigeron pumilis				11/5	10/tr	13/tr	22/1			7/2	10/tr
Eriogonum multiceps				11/tr			11/tr		33/3	4/tr	7/tr
Gaura coccinea			13/tr	11/tr	10/tr	25/1				11/tr	7/tr
Grindelia squarrosa			25/1	11/tr	10/1		11/1			4/tr	13/1
Haplopappus nuttalii				11/1		13/2				7/1	
Hyoscyamus niger					10/tr						3/tr
Iva xanthifolia			13/1		10/tr						7/tr
Lepidium densiflorum				11/tr						4/tr	
Liatris punctata			13/1		10/tr	38/4				11/1	7/tr
Linum rigidum					30/1	38/2				11/tr	10/tr
Lygodesmia juncea					10/2	25/2				7/1	3/1
Medicago lupulina				11/1		13/2	44/10			7/1	13/3
Medicago sativa			38/7	11/2	10/1		22/8			4/1	20/4
Melilotus alba				11/tr						4/tr	
Melilotus officinalis	13/1		38/29	44/33	10/7	38/24	56/12	100/17		32/18	30/13
Petalostemon candidum			13/5								3/1
Petalostemon purpureum			25/11				11/tr				10/3
Phlox hoodii	50/16			11/tr	10/1		11/5			18/4	7/2
Plantago spinulosa						13/tr	11/1			4/tr	3/tr
Psoralea tenuiflora		50/50	13/1		50/10	13/3				7/4	20/3
Polygonum achoreum					10/1						3/tr
Potentilla gracilis					10/1						3/tr
Sisymbrium loeselii					10/tr						3/tr
Solidago missouriensis				11/6			11/tr			4/2	3/tr
Sphaeralcea coccinea				11/1	10/3	63/4	22/tr			21/2	10/1
Taraxacum officinale	25/12			11/tr	30/5	13/tr	33/tr			14/4	20/2
Thelaesperma marginatum						13/1				4/tr	
Thermopsis rhombifolia				22/1		13/2	11/tr			11/1	3/tr
Tragopogon dubius			25/tr	22/1	20/1		78/5			7/tr	37/2
Verbena bracteata			13/11								3/3
Vicia americana	13/tr		13/1	67/7	80/12	75/5	78/8		33/5	46/4	57/7
Total Forbs	75/33	100/100	100/98	100/95	100/98	100/73	100/87	100/88	100/75	93/71	100/93
GRASSES:											
Agropyron desertorum				11/1			11/tr			4/tr	3/tr
Agropyron smithii	50/1			22/tr	10/tr		11/tr			21/tr	7/1
Bouteloua gracilis				11/tr	10/tr	13/tr				7/tr	3/tr
Koeleria cristata	25/1			11/tr						11/tr	
Poa spp.	63/10									18/3	
Stipa viridula					10/tr						3/tr
Total Grasses	63/12			44/1	20/1	13/tr	22/tr			36/4	13/tr

[1] March-May, 1968, feeding sites were supplied by Harold Wentland.
[2] Numbers in parenthesis indicate number of feeding sites (top figure) and total instances of use (bottom figure).
[3] Frequency of use among feeding sites/aggregate percent of the diet. Tr indicates less than 0.5 percent of the diet.

TABLE 13. SUMMER FOOD HABITS OF ANTELOPE BY VEGETATION TYPE, YEAR, AND TREATMENT SITE AS DETERMINED FROM 15,074 INSTANCES OF USE ON 58 FEEDING SITES IN THE SUMMERS OF 1968 AND 1969.[1]

	IVERSON STUDY PLOT[2]						KING STUDY PLOT				SIBBERT STUDY PLOT
	DEFER		PARTIAL		STRIP		OPEN				OPEN
	Sagebrush-Grassland		Sagebrush-Grassland				Sagebrush-Grassland		Shale-Slope		Sagebrush-Grassland
Taxa	1968 (11)[3] (3428)	1969 (13) (3912)	1968 (4) (922)	1969 (5) (866)	1968 (8) (2415)	1969 (6) (790)	1968 (1) (1)	1969 (3) (469)	1968 (4) (1514)	1969 (2) (521)	1969 (1) (236)
SHRUBS:	Fr/%[4]	Fr/%	Fr/%	Fr/%	Fr/%	Fr/%	Fr/%	Fr/%	Fr/%	Fr/%	Fr/%
Artemisia cana	9/tr										
Artemisia tridentata	55/14	15/tr	100/29	60/4	63/29	17/2			50/4	50/1	
Chrysothamnus nauseosus									50/10	100/48	
Gutierrezia sarothrae	36/1	54/3	50/10	60/6	38/8	17/1		33/1	25/1		
Rosa arkansana									75/2	50/8	
Sarcobatus vermiculatus									25/5		
Total Shrubs	73/15	54/3	100/39	80/10	75/38	33/2		33/1	75/21	100/56	
FORBS:											
Achillea millefolium	18/1	31/1	50/5	20/tr	50/11	50/5		33/2	25/1		
Amaranthus retroflexus				20/5							
Artemisia frigida	36/6	54/19	100/29	100/26	38/5	67/39		67/7			100/6
Artemisia longifolia									75/26	50/22	
Astragalus bisulcatus		8/2		20/1	13/tr						
Astragalus drummondii		8/tr						33/2			
Astragalus gilviflorus	18/10	31/16			13/1			67/36	25/18		
Astragalus gracilis		8/tr	25/1		13/tr			33/4	25/tr		
Astragalus missouriensis	9/1	15/1		40/7	25/4			33/3	25/3		
Astragalus spatulatus		15/6									
Atriplex dioica						33/2				100/11	
Bahia oppositifolia	9/1	15/1			25/3						
Cersium vulgare					13/tr						
Chenopodium album				20/1							
Erigeron pumilis	18/5	23/tr									
Eriogonum multiceps									25/1	100/6	
Gaura coccinea	18/tr			40/1	13/1						
Grindelia squarrosa	9/tr	23/1				17/1					
Haplopappus nuttalii									50/7		
Hyoscyamus niger						17/tr					
Iva xanthifolia		8/tr				17/1					
Lepidium densiflorum	9/tr										
Liatris punctata	9/1		25/2	20/2	13/2	17/tr					
Linum rigidum	18/1	15/tr			13/tr			33/1			
Lygodesmia juncea		8/1	25/tr		13/2						
Medicato lupulina	9/1	15/3		20/9	13/2						100/6
Medicago sativa		38/5			13/2						100/61
Melilotus alba	9/tr										100/8
Melilotus officinalis	36/31	46/25	50/8	40/14	25/5		100/100				
Petalostemon candidum		8/3									
Petalostemon purpureum		8/tr						33/28			100/3
Phlox hoodii	9/4	8/tr	25/13	20/8	25/4				25/1		
Plantago spinulosa				20/1	13/tr						
Psoralea tenuiflora	18/11	8/3		40/4		33/6		33/2			
Polygonum achoreum						17/1					
Potentilla gracilis								33/2			
Sisymbrium loeselii						17/1					
Solidago missouriensis									25/13		100/2
Sphaeralcea coccinea	18/2	8/tr	25/1	20/tr	25/2	17/5			25/1		
Taraxacum officinale	9/tr	8/tr	25/1	20/tr	25/12	33/2		33/11			100/2
Thelasperma marginatum			25/2								
Thermopsis rhombifolia									75/8	50/2	
Tragopogon dubius	9/tr	38/1		60/2	13/1	17/4		33/2			100/12
Verbena bracteata						17/15					
Vicia americana	64/6	54/5	25/1	80/8	38/4	50/10		33/1	50/2	50/4	
Total Forbs	91/80	100/97	100/60	100/90	88/56	100/97	100/100	100/98	100/79	100/44	100/99
GRASSES:											
Agropyron desertorum	9/1	8/tr									
Agropyron smithii	27/tr		25/tr		25/1	17/tr					100/1
Bouteloua gracilis	9/tr							33/1	25/tr		
Koeleria cristata	9/tr				13/1				25/tr		
Poa spp.	9/4		25/tr		38/5						
Stipa viridula						17/1					
Total Grasses	45/5	8/tr	25/1		38/6	17/1		33/1	25/tr		100/1

[1] Feeding sites were taken only on study plots.
[2] Eight March-May 1968, feeding sites were supplied by Wentland.
[3] Numbers in parenthesis indicate number of feeding sites (top figure) and total instances of use (bottom figure).
[4] Frequency of use among feeding sites/aggregate percent of the diet. Tr indicates less than 0.5 percent of the diet.

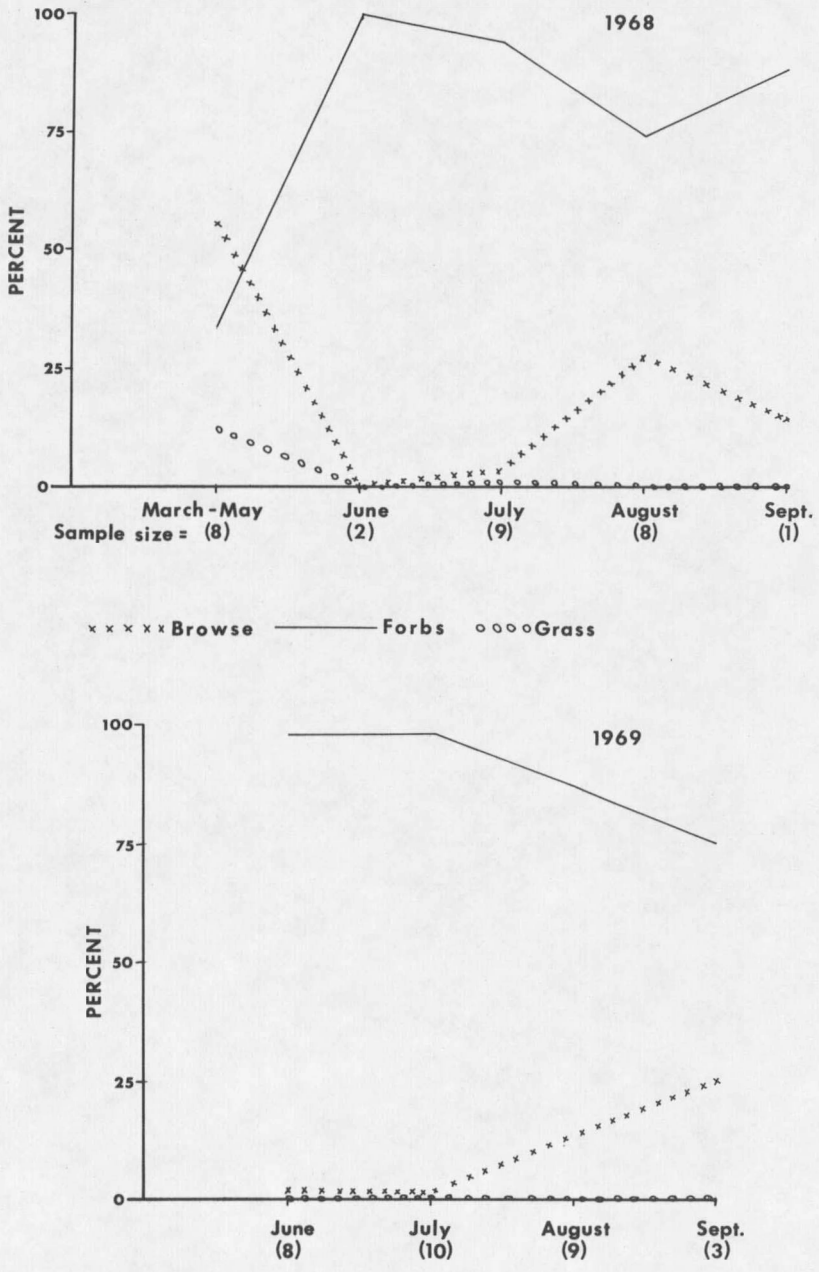

Figure 8. Percent forage class composition in the diet at 58 antelope feeding sites on the sagebrush control study plots during the summers of 1968 and 1969.

were: yellow sweetclover, fringed sagewort, threeleaved milkvetch (*Astragalus gilviflorus*), alfalfa (*Medicago sativa*), and black medic (*Medicago lupulina*), respectively. Although the intensity of use on any particular plant species varied from month to month, and year to year, there appeared to be an increasing occurrence in the antelope diet of those plant species characteristic of the shale-slope, greasewood-sagebrush, and greasewood vegetation types as the summer progressed. This trend is supported by the antelope distribution findings, and is apparently due to the desiccation of the succulent vegetation on the sagebrush-grassland, and the resulting shift by antelope to the other vegetation types (Wentland 1968). Dirschl (1963) reported that seasonal distribution of pronghorns on the range was correlated with the distribution of the food supply.

Feeding sites were tabulated by treatment site and year for the King and Iverson sagebrush treatment study plots (Table 13). Enough data were available to facilitate comparisons between years for all treatment sites of the Iverson Study Plot, and for the open control treatment site on the shale-slope vegetation type of the King Study Plot. The proportion of browse in the antelope diet was lower, and forbs greater, in 1969, than in 1968, on all treatment sites of the Iverson Study Plot. The reverse was true on the open control shale-slopes of the King Study Plot. This probably reflected the climatic conditions and their effect on the available forage. On the Iverson Study Plot, there was a greater use of

browse in 1968 on the partial kill and strip spray treatment sites than on the defer control. A relatively greater proportion of browse use on the two former sites was on broom snakeweed (*Gutierrezia sarothrae*), which may not have been affected as severely as sagebrush by the spray treatment. This relatively heavy browse use on the spray teatment sites in 1968 may be a reflection of the unpalatability of forbs due to their "wilted" condition following chemical treatment. In 1969, the relative proportion of browse and forbs in the antelope diet was nearly the same on all treatment sites of this study plot suggesting the plausibility of the former explanation. That this difference was not due to differences in floral composition is revealed by vegetation measurements for 1968 and 1969. From eight vegetation analyses made on the defer control treatment site in each of the summers of 1968 and 1969, no apparent difference in forb canopy coverage was observed. In three analyses made during each summer on the strip spray treatment site, however a decrease from 16 to 3 percent in the average forb coverage was observed from 1968 to 1969. Average forb canopy coverage decreased from 5 to 3 percent on the partial kill treatment site, as ascertained from one and four vegetation analyses in 1968 and 1969, respectively.

A rumen sample from each of five adult antelope collected from the general study area during the hunting seasons of 1968 and 1969, and from each of eight fawns collected in the Iverson enclosure during the fall and winter of 1969-70, were analyzed (Table 14). The diet of fawns at

this age is probably similar to adults (Buechner 1950). October samples indicated a progressively greater use of browse, with accompanying decreased use of forbs noted for late summer. As the fall progressed, browse use increased until a peak was reached in early January. The major browse plant used at this time, and throughout the winter, was big sagebrush. Similar findings have been reported by Cole (1956), Dirschl (1963), Severson, May and Hepworth (1968), and Bayless (1969). In the late January and February samples, the forb content increased, but still remained much less than the browse content. Similar findings of forage class composition in the fall and winter antelope diet are reported by several authors (Couey 1946; Ferrell and Leach 1952; Mason 1952; and Baker 1953).

In this study, the data from rumen content analyses of animals collected on sagebrush treatment sites are inadequate for comparison with data from animals collected on non-treatment sites due to the timing of collections. Bayless (1969) reported on the rumen contents of two antelope collected in January and three in February from the general study area during the winter of 1966-67. His January samples contained 92 percent browse and 7 percent forbs as compared to 98 percent browse and 1 percent forbs for the two specimens taken in early January on the Iverson Study Plot during my study. Bayless observed an average browse content of 71 percent and an average forb content of 28 percent in his February samples. In this study an average browse content of 82 and 81 percent and an average forb content of 9 and 13 percent, respectively, was observed in the two late January and two mid-February samples. Bayless

observed only a trace of grass in his February samples whereas there was a 9 percent and 6 percent grass content, respectively, in the late January and February samples of this study. Whether the greater volume of forbs and the lesser volumes of browse and grasses in the rumens examined by Bayless, as compared to rumen contents for antelope from the Iverson Study Plot, were related to sagebrush treatment on the Iverson Study Plot was not apparent.

TABLE 14. FREQUENCY OF OCCURRENCE AND VOLUME PERCENTAGES OF PLANT TAXA AND FORAGE CLASSES AMONG 13 RUMEN SAMPLES FROM ANTELOPE COLLECTED DURING THE FALL AND WINTER OF 1968 AND 1969.

	General Study Area			Iverson Study Plot			
	Sagebrush-Grassland	Sagebrush-Grassland	Shale Slope	Sagebrush-Grassland			
	Oct. 28 1968	Oct. 19 1969	Oct. 19 1969	Nov. 11 1969	Jan. 3 1970	Jan. 31 1970	Feb. 21 1970
Taxa	(1)[1]	(2)	(2)	(2)	(2)	(2)	(2)
	Fr/%[2]	Fr/%	Fr/%	Fr/%	Fr/%	Fr/%	Fr/%
Shrubs:							
Artemisia cana		50/9					
Artemisia tridentata	100/27	100/43	100/10	100/71	100/98	100/82	100/81
Chrysothamnus nauseosus		50/1	100/37				
Gutierrezia sarothrae	100/tr	50/2					
Rosa arkansana		50/tr	50/tr				
Unidentified Browse	100/9						
Total Shrubs	100/36	100/54	100/47	100/71	100/98	100/82	100/81
Forbs:							
Achillea millefolium		100/6					
Antennaria rosea	100/40	100/7		50/tr		50/1	50/1
Artemisia frigida	100/13	100/11		100/21	100/1	100/5	100/6
Artemisia longifolia			100/43				
Astragalus agrestis		50/tr					
Astragalus gilviflorus		50/tr					
Astragalus missouriensis						50/tr	
Erigeron pumilus		50/tr					
Haplopappus nuttalii		100/3	50/3				
Lappula echinata		50/2					50/tr

TABLE 14. (CONTINUED).

Taxa	General Study Area			Iverson Study Plot			
	Sagebrush-Grassland	Sagebrush-Grassland	Shale Slope	Sagebrush-Grassland			
	Oct. 28 1968 (1)	Oct. 19 1969 (2)	Oct. 19 1969 (2)	Nov. 11 1969 (2)	Jan. 3 1970 (2)	Jan. 31 1970 (2)	Feb. 21 1970 (2)
	Fr/%	Fr/%	Fr/%	Fr/%	Fr/%	Fr/%	Fr/%
Medicago lupulina		50/tr			50/tr		
Medicago sativa				50/1			
Medicago spp.	100/1						
Melilotus officinalis		50/1					
Phlox hoodii					50/tr	100/3	100/6
Spharaelcea coccinea		50/1					
Verbena bracteata		50/1					
Vicia americana		50/1		50/1			
Unidentified Forbs	100/4	100/6	50/tr	50/tr	50/tr	100/tr	100/tr
Total Forbs	100/59	100/38	100/45	100/22	100/1	100/9	100/13
Grass	100/5	100/8	100/8	100/7	100/1	100/9	100/6
Lichens						100/tr	50/tr

[1] Number of rumen samples in parenthesis.

[2] Frequency of occurrence/Aggregate percent of total volume of identifiable material. Tr indicates less than 0.5 percent.

APPENDIX

TABLE 15. MONTHLY CLIMATOLOGICAL DATA FROM THE UNITED STATES DEPARTMENT OF COMMERCE WEATHER STATION AT FLATWILLOW ON THE EAST EDGE OF THE STUDY AREA.

		TEMPERATURE IN DEGREES FAHRENHEIT					PRECIPITATION IN INCHES		
Year	Month	Average Maximum	Average Minimum	Average	High	Low	Total	Departure From Normal	Normal
1968	June	73.9	48.1	61.0	92	40	5.61	2.44	3.17
	July	85.2	52.0	68.6	96	37	1.54	.14	1.40
	August	81.3	50.5	65.9	91	41	1.65	.46	1.19
	September	73.9	44.2	59.1	92	31	1.15	.17	.98
	Total						9.95	3.21	6.74
1969	June	74.5	45.0	59.8	93	28	4.02	.85	3.17
	July	82.6	52.9	67.8	96	43	2.36	.96	1.40
	August	89.7	50.0	69.9	101	35	.31	- .88	1.19
	September	78.0	41.9	60.0	94	30	.17	- .81	.98
	Total						6.86	.12	6.74

TABLE 16. SUMMARY OF MOVEMENT DATA FOR 25 INDIVIDUALLY RECOGNIZABLE ANTELOPE OBSERVED DURING THE SUMMERS OF 1968 AND 1969.

Antelope	Number Observations	Average Number Days Between Observations	Year	Social Status[1]	DISTANCE IN MILES: Shift Between Home Ranges[2]	Maximum Distance Between Observations	Distance From First to Last Observation	From Center of Range[3]: Mean	From Center of Range[3]: Maximum	Between Successive Locations: Mean	Between Successive Locations: Maximum	Estimated Home Range Size (Sq. Miles)
Adult Male No. 43	9	11	1968	BM	---	4.8	2.8	1.9	2.8	1.6	4.0	7.58
	8	12	1969	BM	1.5	3.3	1.1	1.0	1.7	1.5	2.7	.85
Adult Male No. 54	5	18	1968	TM	---	2.3	1.1	.8	1.5	1.3	2.1	1.21
Adult Male No. 47	4	26	1968	BM	---	2.8	1.8	1.0	1.5	1.7	1.9	1.70
	7	13	1969	TM	1.3	1.2	.7	.5	.8	.7	1.2	.61
Adult Male No. 46	10	8	1968	TM	---	.7	.3	.2	.4	.3	.6	.24
	12	7	1969	TM	.4	1.4	.2	.4	.9	.5	1.1	.48
Adult Male No. 42	5	18	1968	BM	---	2.2	.7	.9	1.3	1.1	1.9	.73
Adult Male No. 37	6	17	1968	BM	---	3.3	2.5	.9	1.7	1.5	1.9	2.67
Adult Male No. 29	9	11	1968	BM	---	2.3	2.1	.9	1.2	1.0	2.3	1.21
Adult Male No. 44	4	26	1968	BM	---	2.9	1.8	1.2	1.7	2.1	2.9	2.55
Adult Male No. 40	6	16	1968	BM	---	6.0	1.8	1.8	4.2	2.7	5.0	6.67
Adult Male No. 45	5	13	1968	BM	---	4.9	4.5	2.1	2.8	3.5	4.3	4.73
Adult Male No. 104	5	11	1969	TM	---	1.6	1.6	.7	1.0	.7	1.2	.97
Adult Male No. 70	4	15	1969	BM	---	2.1	1.4	.9	1.3	1.9	2.1	.85
Adult Male No. 80	4	15	1969	BM	---	1.7	1.4	.9	1.3	.7	1.7	.36
Adult Female No. 30	5	11	1968	FF	---	.7	.7	.2	.5	.2	.5	.12
	9	8	1969	FF	.1	1.7	.6	.5	1.0	.7	1.3	.73
Adult Female No. 55	6	12	1969	FF	---	2.5	2.5	.8	1.4	.6	1.1	1.58
Adult Female No. 28	6	17	1968	FF	---	1.5	1.1	.6	.8	.8	1.0	.97
	7	10	1969	FF	.8	1.9	.8	.5	1.1	.8	1.3	.97
Adult Female No. 64	6	17	1968	FF	---	2.3	1.0	.7	1.4	1.3	2.3	1.21
Adult Female No. 52	9	10	1969	FF	---	2.3	1.5	.7	1.4	1.0	2.2	1.45
Adult Female No. 35	6	15	1969	FF	---	2.1	.9	.6	1.3	1.0	1.6	.85
Adult Female No. 24	5	19	1969	FF	---	.9	.3	.4	.5	.6	.9	.36
Adult Female No. 88	6	12	1969	FF	---	4.3	1.4	1.4	2.6	1.8	3.2	3.76
Adult Female No. 22	7	13	1969	FF	---	3.4	1.6	.9	1.8	1.1	3.4	1.70
Adult Female No. 25	4	19	1969	FF	---	1.4	.8	.5	.8	1.1	1.4	.24
Adult Female No. 3	4	14	1969	FF	---	2.0	2.0	.7	1.3	.7	1.2	.24
Adult Female No. 87	5	15	1969	FF	---	1.5	1.1	.6	.8	.9	1.3	.48

[1] BM = Bachelor Herd Male; TM = Territorial Male; FF = Female.
[2] Geometric center to geometric center between years.
[3] Geometric center of the area within which the animal was observed, calculated by averaging deviations in each plane, from a reference point (Hayne 1949).

TABLE 17. NUMBERS OF INDIVIDUAL ANTELOPE OBSERVED DURING 13 GROUND COUNTS FROM JUNE 17, 1968 TO SEPTEMBER 17, 1969 LISTED BY SQUARE MILES.

Location[1]	Adults[2] F	Adults[2] M	Fawns	Total[3]	Location	Adults F	Adults M	Fawns	Total
19-K[4]	-	-	-	-	18-0	14	4	13	31
	7	9	2	18		5	25	1	31
20-K	-	-	-	-	19-0	9	5	2	16
	5	18	-	23		11	1	7	19
					20-0	21	3	16	40
20-L	-	15	-	15		1	4	-	5
	1	62	-	63	21-0	12	5	14	31
21-L	-	-	-	-		3	-	-	3
	-	5	-	5	22-0	4	21	-	25
						2	2	4	8
17-M	2	-	3	5	23-0	5	2	1	8
	22	9	8	39		4	2	3	9
18-M	-	-	-	-	24-0	2	1	-	3
	6	1	6	13		18	3	12	33
19-M	1	2	3	6	25-0	8	2	11	21
	9	2	4	15		8	4	2	14
20-M	3	16	6	25	26-0	11	3	14	28
	10	22	3	35		1	-	-	1
21-M	-	1	-	1	29-0	3	1	6	10
	2	-	-	2		3	-	-	3
17-N	-	4	-	4	17-P	3	1	-	4
	-	9	-	9		-	-	-	-
18-N	5	2	10	17	18-P	3	13	-	16
	38	4	23	65		7	7	5	19
19-N	-	-	-	-	19-P	-	6	-	6
	7	1	3	11		12	1	7	20
20-N	33	3	24	60	20-P	20	1	10	31
	14	2	11	27		14	2	2	18
21-N	5	6	3	14	21-P	8	1	11	20
	1	2	-	3		-	-	-	-
22-N	5	1	6	12	22-P	5	2	2	9
	10	1	6	17		2	2	3	7
23-N	1	1	-	2	23-P	1	3	-	4
	1	-	-	1		2	5	-	7
27-N	-	-	-	-	24-P	2	1	-	3
	-	1	-	1		10	4	10	24
30-N	-	-	-	-	25-P	12	2	10	24
	-	1	-	1		5	3	-	8

TABLE 17. (CONTINUED).

Location	Adults F	Adults M	Fawns	Total	Location	Adults F	Adults M	Fawns	Total
31-N	-	-	-	-	26-P	3	-	3	6
	-	2	-	2		3	1	3	7
					28-P	3	1	3	7
16-0	-	-	-	-		3	1	3	7
	-	1	-	1	29-P	9	2	14	25
17-0	1	-	-	1		3	1	3	7
	21	5	11	37	30-P	3	-	-	3
						3	1	-	4
18-Q	5	2	1	8	30-R	2	1	4	7
	1	-	-	1		8	1	5	14
19-Q	-	-	-	-					
	2	13	-	15	18-S	2	1	4	7
20-Q	16	2	12	30		7	-	9	16
	9	6	5	20	19-S	4	5	4	13
21-Q	14	2	13	29		3	33	1	37
	10	2	9	21	20-S	8	29	4	41
22-Q	7	20	-	27		13	11	-	24
	2	14	-	16	21-S	-	7	-	7
23-Q	7	12	2	21		5	8	4	17
	-	2	-	2	22-S	6	22	5	33
24-Q	4	1	-	5		17	34	15	66
	-	-	-	-	23-S	-	3	-	3
25-Q	5	2	8	15		1	2	-	3
	2	-	1	3	25-S	5	4	6	15
26-Q	-	1	-	1		12	2	13	27
	-	8	-	8	26-S	7	14	6	27
27-Q	-	23	-	23		6	20	9	35
	-	33	-	33	27-S	10	17	12	39
28-Q	2	1	-	3		6	18	-	24
	-	-	-	-	28-S	13	8	24	45
29-Q	5	3	9	17		36	12	34	82
	5	1	-	6	29-S	-	-	-	-
30-Q	-	-	-	-		6	4	4	14
	3	-	-	3					
31-Q	-	-	-	-	14-T	1	-	1	2
	-	1	-	1		-	-	-	-
					15-T	1	-	1	2
14-R	-	2	-	2		-	-	-	-
	-	-	-	-	18-T	1	-	-	1
18-R	1	-	-	1		3	-	-	3
	1	-	-	1	19-T	5	7	7	19

TABLE 17. (CONTINUED).

Location	Adults F	Adults M	Fawns	Total	Location	Adults F	Adults M	Fawns	Total
19-R	10	1	1	12		12	20	17	49
	2	3	2	7	20-T	2	27	-	29
20-R	18	11	4	33		3	15	-	18
	7	5	4	16	21-T	-	1	-	1
21-R	3	1	2	6		12	5	2	19
	17	2	11	30	22-T	25	3	24	52
22-R	15	2	20	37		32	4	40	76
	3	3	1	7	23-T	4	2	5	11
23-R	3	5	2	10		14	3	24	41
	1	3	1	5	24-T	-	-	-	-
26-R	-	3	-	3		-	1	-	1
	4	2	-	6	25-T	-	1	-	1
27-R	4	6	6	16		11	6	3	20
	28	3	17	48	26-T	5	4	5	14
20-R	3	7	-	10		11	7	10	28
	5	5	1	11	27-T	15	12	40	67
29-R	2	5	7	14		37	10	32	79
	23	4	12	39					
28-T	26	4	40	70	25-U	4	-	5	9
	18	2	13	33		6	2	-	8
18-U	-	-	-	-	18-V	25	7	13	45
	2	-	-	2		34	5	25	64
19-U	4	1	-	5	19-V	12	2	10	24
	3	6	1	10		19	3	9	31
20-U	5	28	7	40	20-V	27	3	19	49
	4	18	-	22		20	6	12	38
21-U	-	-	-	-	21-V	10	2	18	30
	8	2	14	24		6	2	12	20
22-U	-	-	-	-	22-V	20	4	28	52
	5	2	8	15		9	2	18	29
23-U	-	-	-	-	24-V	8	2	11	21
	13	1	8	22		8	3	2	13
24-U	1	-	-	1	25-V	-	-	-	-
	-	2	-	2		17	2	10	29
					1968	599	464	575	1,638
					1969	826	610	560	1,996
						OVERALL TOTAL =			3,634

[1] See Figure 9 for locations.
[2] M = Male; F = Female.
[3] This includes multiple observations of individual antelope.
[4] First row of numbers indicates the year 1968, and second row, 1969.

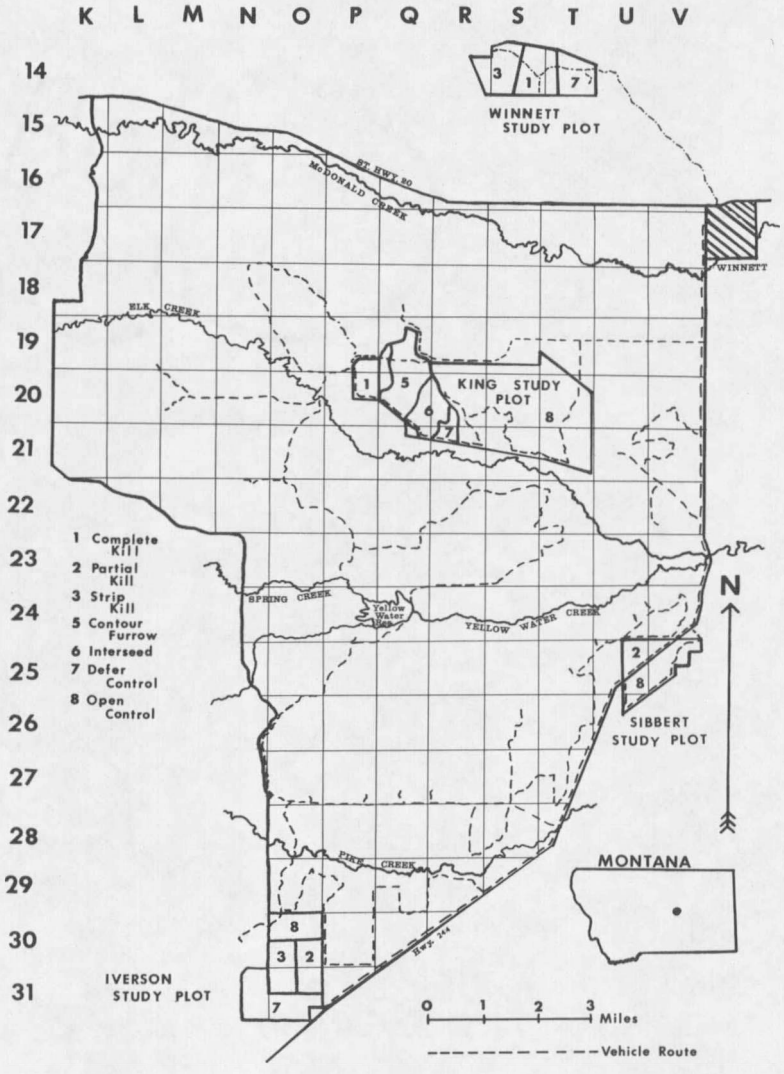

Figure 9. Grid map of the study area showing locations of sagebrush control study plots and treatment sites.

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