



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  
© Copyright by David Alan Roberts (1970)

**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.

Statement of Permission to Copy

In presenting this thesis in partial fulfillment of the requirements for an advanced degree at Montana State University, I agree that the Library shall make it freely available for inspection. I further agree that permission for extensive copying of this thesis for scholarly purposes may be granted by my major professor, or, in his absence, by the Director of Libraries. It is understood that any copying or publication of this thesis for financial gain shall not be allowed without my written permission.

Signature David Alan Roberts  
Date May 23, 1970

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

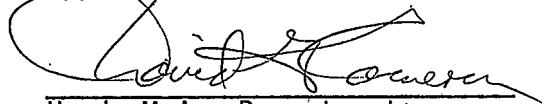
of

MASTER OF SCIENCE

in

Fish and Wildlife Management

Approved:



Head, Major Department



Chairman, Examining Committee



Graduate Dean

MONTANA STATE UNIVERSITY  
Bozeman, Montana

June, 1970

## ACKNOWLEDGMENT

To the following, I wish to extend my sincere appreciation for their contributions to this study: Dr. Don C. Quimby, Montana State University, who provided technical supervision and invaluable counsel and guidance in preparation of the manuscript; Dr. Edward F. Schlatterer and Mr. Duane B. Pyrah, Montana Fish and Game Department, for advice and field assistance; Mr. Harold J. Wentland, Montana Fish and Game Department, for the initial field orientation; Dr. Richard E. Lund, Montana State University, for advice and consultation on statistical analyses; Dr. Robert L. Eng and Dr. Richard J. Graham, Montana State University, for critical review of the manuscript; Mr. Thomas Mussehl and Mr. Kenneth Greer, Montana Fish and Game Department, for providing assistance and facilities during various phases of this study; and to my wife, Beverly, for patience, encouragement, and assistance. Thanks are also extended to several other individuals who have aided with various phases of the study. The writer was supported by the Montana Fish and Game Department under Federal Aid Project No. W-105-R-3, No. W-105-R-4, and No. W-105-R-5 and the U. S. Department of the Interior, Bureau of Land Management.

## TABLE OF CONTENTS

	Page
VITA .....	ii
ACKNOWLEDGMENT .....	iii
TABLE OF CONTENTS .....	iv
LIST OF TABLES .....	v
LIST OF FIGURES .....	vii
ABSTRACT .....	viii
INTRODUCTION .....	1
DESCRIPTION OF STUDY AREA .....	3
METHODS .....	8
Sagebrush Treatment and Animal Use of the Study Plots ...	8
Antelope Observations .....	10
Antelope Food Habits .....	10
Vegetational Analyses .....	11
RESULTS-DISCUSSION .....	13
Effects of Sagebrush Treatment on the Iverson Study Plot .....	13
Antelope Population Characteristics .....	21
Antelope Summer Home Ranges .....	24
Antelope Use of Vegetation Types .....	26
Antelope Food Habits .....	37
APPENDIX .....	47
LITERATURE CITED .....	54

## LIST OF TABLES

Table	Page
1. BIG SAGEBRUSH CHARACTERISTICS ON THE DIFFERENT TREATMENT SITES OF THE IVERSON STUDY PLOT AS DETERMINED BY MEASUREMENTS ALONG 100-FOOT LINE TRANSECTS .....	15
2. CONSTANCY, CANOPY COVERAGE, AND FREQUENCY OF OCCURRENCE OF TAXA ON THE DIFFERENT TREATMENT SITES OF THE IVERSON SAGEBRUSH TREATMENT STUDY PLOT IN 1969 .....	16
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 .....	22
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 .....	23
5. CHARACTERISTICS OF HOME RANGES OF 25 ANTELOPE AS DETERMINED BY SUCCESSIVE OBSERVATIONS OF INDIVIDUALLY RECOGNIZABLE ANIMALS .....	25
6. "EXPECTED" AND OBSERVED DISTRIBUTION OF INDIVIDUAL ANTELOPE SIGHTINGS BY VEGETATION TYPES IN THE SUMMERS OF 1968 AND 1969 .....	27
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 .....	29
8. PERCENTAGE DISTRIBUTION OF 3,634 INDIVIDUAL ANTELOPE SIGHTINGS BY SEX AND AGE ON EIGHT VEGETATION TYPES DURING THE SUMMERS OF 1968 AND 1969 .....	30
9. PERCENTAGE DISTRIBUTION OF SINGLE AND GROUP ANTELOPE OBSERVATIONS BY VEGETATION TYPE DURING THE SUMMERS OF 1968 AND 1969 .....	31
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 .....	34

## LIST OF TABLES (CONTINUED)

Table	Page
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 .....	35
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 .....	38
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 .....	39
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 1969 AND 1970 .....	45
15. MONTHLY CLIMATOLOGICAL DATA FROM THE UNITED STATES DEPARTMENT OF COMMERCE WEATHER STATION AT FLATWILLOW ON THE EAST EDGE OF THE STUDY AREA .....	48
16. SUMMARY OF MOVEMENT DATA FOR 25 INDIVIDUALLY RECOGNIZABLE ANTELOPE OBSERVED DURING THE SUMMERS OF 1968 AND 1969 .....	49
17. NUMBERS OF INDIVIDUAL ANTELOPE OBSERVED DURING 13 GROUND COUNTS FROM JUNE 17, 1968 to SEPTEMBER 17, 1969, LISTED BY SQUARE MILES .....	50



## LIST OF FIGURES

Figure	Page
1. The study area showing the sagebrush control study plots and the vegetation types .....	4
2. Total kill chemical sagebrush treatment site. Winnett Study Plot .....	6
3. Contour furrow mechanical sagebrush treatment site. King Study Plot .....	6
4. Total kill chemical sagebrush treatment site. King Study Plot .....	7
5. Partial kill chemical sagebrush treatment site. Iverson Study Plot .....	7
6. The delineation of the treatment sites and the different categories of sagebrush density of the Iverson Study Plot .....	20
7. Percentage antelope distribution on the various treatment sites of the Iverson Study Plot during the summers of 1968 and 1969 .....	36
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 .....	40
9. Grid map of the study area showing locations of sagebrush control study plots and treatment sites .....	53

## 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.

## 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 Gieseke (1938) and Cole (1956). The soils have been described by Andrews *et al.* (1944) and personnel of the Soil Conservation Service (1968). Gieseke (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

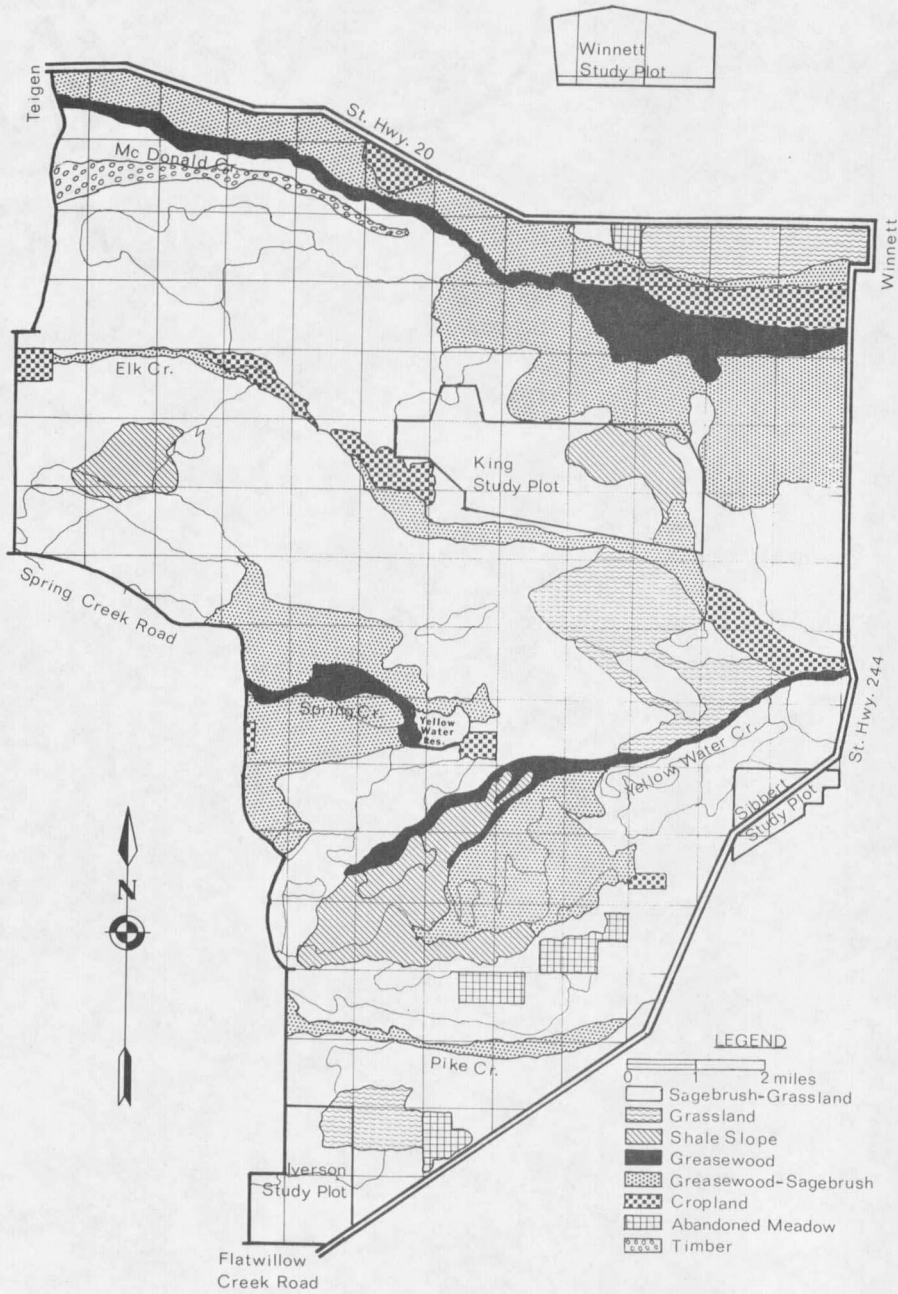


Figure 1. The study area, showing the sagebrush control study plots and the vegetation types (from Wentland).

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.





















































































































