Range use, food habits and agricultural relationships of the mule deer, Bridger Mountains, Montana
by Bruce T Wilkins

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 at Montana State College

Montana State University

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Abstract:

A study of the range use and food habits of the Rocky Mountain mule deer (*Odocoileus h. hemionus*) was carried out in 1955 and 1956 on a 6.5 square mile study area on the Bridger Mountains, Montana. A description of the area's general vegetative types is given. Observations of deer provided information on intraseasonal and interseasonal differences in use of the vegetative types. Food habits were determined by rumen analysis, direct observations of feeding deer, and examination of specific areas for evidence of plant use by deer. Deer damage to alfalfa haystacks and the occurrence of deer in alfalfa fields was noted. Characteristics of the haystacks and fields which seemingly affected the degree of use are discussed. Recent hunting seasons and their apparent results are presented and discussed. Recommendations for future seasons are included.

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ABSTRACT

A study of the range use and food habits of the Rocky Mountain mule deer (Odocoileus h. hemionus) was carried out in 1955 and 1956 on a 6.5 square mile study area on the Bridger Mountains, Montana. A description of the area's general vegetative types is given. Observations of deer provided information on intraseasonal and interseasonal differences in use of the vegetative types. Food habits were determined by rumen analysis, direct observations of feeding deer, and examination of specific areas for evidence of plant use by deer. Deer damage to alfalfa haystacks and the occurrence of deer in alfalfa fields was noted. Characteristics of the haystacks and fields which seemingly affected the degree of use are discussed. Recent hunting seasons and their apparent results are presented and discussed. Recommendations for future seasons are included.

INTRODUCTION

A pronounced increase in Rocky Mountain mule deer (Odocoileus h. hemionus) numbers has occurred in recent years in the Bridger Mountains, Gallatin County, Montana. Residents report that as late as 1948 deer were quite scarce and were not frequently seen. Today deer are commonly seen and a high population is evidenced by over-used browse plants as well as by damage to agricultural products. Predator control, buck only seasons (until 1952), and a scarcity of hunters, due to the precipitousness of the terrain, have undoubtedly been contributing factors to this increase.

Except for casual observations, no attempt had been made to secure basic ecological information necessary for proper management of this herd. Specific information on food habits and range use was lacking not only for this area but for much of the state. To help clarify the intricate problems associated with the management of this game animal, a study was carried out on a full time basis during the summer and winter months, and periodically in the fall and spring from June 16, 1955, to May 7, 1956. Food habits, range use and agricultural relationships were emphasized. Although the study was conducted primarily to aid in the future management of the mule deer in the Bridger Mountains, it was felt that the results would have definite application to the management of this animal in similar situations throughout the state.

Appreciation for aid during the study is extended to the following: Dr. Don C. Quimby for technical supervision and guidance in the writing of the manuscript; Joseph Townsend, District Game Biologist, for direction and assistance in the field; Drs. J. C. Wright and W. E. Booth for

aid in identifying plant materials. Further thanks are extended to the ranchers in the area, and particularly to Mr. and Mrs. Ralph Armstrong for their close cooperation. During the course of the study the author was employed by the Montana Fish and Game Department under Federal Aid Project W-73-R-1.

DESCRIPTION OF THE AREA

The Bridger Mountains are situated in southwest Montana, north and east of Bozeman. Their west slope is composed primarily of shale and limestone formations. The mountains are quite steep at the base (elevation 5,600 feet) and peaks (maximum elevation 9,669 feet). The numerous canyons in the range generally extend in an east-west direction. That part of the range involved in the food habits study was restricted to 6.5 square miles on the western slope (Fig. 1). This area was vegetatively typical of that slope with the foothills area devoted to agriculture.

Vegetative Types

Four distinct vegetative types were recognized on the study area.

Mountain Meadow

This type occurred at the base of the steep peaks (Fig. 2). The vegetation was characterized by grass and grasslike plants. Purple oniongrass (Melica spectabilis), Idaho fescue (Festuca idahoensis), and sedges (Carex spp.) were the principle species. The remainder of the vegetation was composed of various forbs with some intermittent patches of Douglas fir (Pseudotsuga taxifolia) and alpine fir (Abies lasiocarpa). This type occurs from 8,600 to 7,800 feet, extending further downward in the creek bottoms. The high altitude together with abundant springs kept the area moist and the vegetation succulent approximately a month

FIG. 1. MAP OF THE STUDY AREA

Fig. 2. Vegetative types at high elevations. Foreground, mountain meadow; right rear, upper montane forest; left rear shows steep mountain peaks.

Fig. 3. Vegetative types at lower elevations. Foreground, bunch grass prairie; mid-section, sagebrush-bitterbrush; rear, lower montane forest.

after the vegetation at the base of the mountain had dried up.

Montane Forest

This type is characterized by a Douglas fir forest (Figs. 2 and 3) which has not been logged commercially since approximately 1900. The understory is composed primarily of browse species and elk sedge (Carex geyeri). The principle browse species are common juniper (Juniperus communis) and common snowberry (Symphoricarpus albus). This type occurs from 8,600 to 6,000 feet. It extends downward in elevation another 200 feet on the northern exposures (Fig. 3).

Sagebrush-bitterbrush

This type occurs on the steep mountain base from approximately 6,400 to 5,600 feet (Fig. 3). Big sagebrush (Artemisia tridentata), bitterbrush (Purshia tridentata) and Rocky Mountain juniper (Juniperus scopulorum) are the characteristic plants. Grasses are next in abundance with cheatgrass (Bromus tectorum) and bluebunch wheatgrass (Agropyron spicatum) predominant. Balsam-Root (Balsamorhiza sagittata) and field chickweed (Cerastium arvense) appear to be the most common forbs.

Bunch Grass Prairie

This type is located on the alluvial fan at the base of the mountain (below 5,600 feet) and is used extensively for agricultural purposes (Fig. 3). The untilled portion is grazed. Here the principle grasses are Idaho fescue, bluebunch wheatgrass and needle-and-thread (Stipa comata). Balsam-Root, yarrow (Achillea lanulosa) and arnica (Arnica spp.) are abundant forbs. Some big sagebrush also occurs on this type. In the more moist situations other woody plants occur, the most common

species being black poplar (Populus trichocarpa) and black hawthorn (Crataegus douglasii). That portion which is tilled is devoted primarily to growing wheat, or alfalfa and smooth brome (Bromus inermis) hay.

USE OF VEGETATIVE TYPES

Deer use of vegetative types was determined by morning and evening observations with a 7 x 35 binocular and a 20 power spotting scope. Approximately 3,500 observations of deer were recorded during the study. Observations were made on the bunch grass prairie and sagebrush-bitterbrush types throughout the study and from July 15 to September 12 on the mountain meadow type. One aerial flight over the entire study area was made on November 25.

Sagebrush-bitterbrush was the most heavily utilized type. From June 16 to August 14, an average of 4.9 deer per observation (41 observations) were seen here. The number of young fawns observed (including four that were caught and tagged) suggest that parturition occurs on this type. From August 15 to October 31, the number of deer dropped to an average of 1.7 per observation (25 observations). This was probably related to the arid conditions present at this lower elevation during that time. On November 7 when 45 deer were observed, and continuing throughout the remainder of the study, large numbers of deer were present here. From November 7 to March 19 this concentration averaged 24.6 deer per observation (71 observations). Over 90 percent of these deer were observed on southern exposures. These slopes seldom remained snow covered for periods exceeding one or two days, and provided the principle wintering areas for the herd (Fig. 4). The slopes not receiving the direct rays of the sun remained snow covered throughout the winter. Use

Fig. 4. Lower study area showing difference in snow on northern and southern exposures of sagebrush-bitterbrush type.

of the sagebrush-bitterbrush type continued through the remainder of the study, averaging 46.0 deer per observation (11 observations). This increase over the average number of deer seen in the November to March 19 observations is believed to be due to the earlier and later time of day at which observations could be carried out.

The bunch grass prairie was moderately used from June 16 to October 31 (an average of 3.9 deer per observation for 90 observations). From August to October most of these deer were in close proximity to Cottonwood Creek or Bill Smith Creek, the two main creeks in the area. From December through March 19 this type was continually covered by one to two feet of snow, and few deer were seen (0.6 deer per observation for 75 observations). Deer at haystacks were not considered in these counts. By March 20 much of this area was clear of snow and on that date 18 deer were seen feeding on this type. From that date until the conclusion of the study (May 7) there was an increase in use, indicated by an average

of 13.0 deer per observation for 13 observations.

In the montane forest, trees restricted vision so few observations were carried out here. The absence of deer from other areas during most days makes it apparent this area was used for shelter and rest. The lower portion was used as escape cover for the deer on the sagebrush-bitterbrush type and the upper portion was visited by the deer using the mountain meadows. No tracks or deer were seen in the upper half of this type on the November 25 flight, but deer and tracks were present on the lower half.

Deer used the mountain meadows extensively in the summer. This is indicated by an average of 11.1 deer seen per observation in the 23 observations made here. The only other observation on this type was the November 25 flight, when no deer or tracks were seen on this area.

FOOD HABITS

The techniques used to determine food habits were similar to those used by Saunders (1955) and Cole (1956). This consists of rumen analysis together with the recording of feeding observations. Feeding observations were made by examination of areas where deer were seen to feed for signs of recent plant use. Direct observation of use was recorded when possible. During the winter it was possible to follow deer tracks and determine use of certain plants.

Twenty-seven deer were collected from June 22, 1955 to May 6, 1956, and a one-quart rumen sample was obtained from each. A minimum of two deer per month was obtained with the exception of May and June. Only one deer was taken in each of these months. Three were collected in both October and January. Five were obtained in December. Collections

were generally made at approximately 15-day intervals. The rumen samples were preserved in a 10 percent formalin solution. In the laboratory, the sample was washed with water on consecutive 3 mm. and 2 mm. screens. The material retained on the 3 mm. screen was then placed in a pan of water and the identifiable portions removed. Identification to species, genus, family or general group was then made by comparison with a reference plant collection. After drying on paper toweling to remove excess moisture, the volumes (to the nearest 0.5 cc.) of the segregated portions were determined by water displacement. The same material was then air dried and weighed to 0.01 grams. Material with a volume less than 0.5 cc. was recorded as "trace". The unidentifiable material on the 3 mm. screen was included with that on the 2 mm. screen. Volume and weight were taken. A total of 4,403 cc. of material from the 27 rumen samples was obtained, of which 31.8 percent was identified. The percent of the stomach contents that any one item constituted for a season or other period was computed by the aggregate percent method (Martin, et al., 1946). This involves a determination of the percent of the total identifiable material in each rumen sample that the item in question constituted. The percentages for all stomachs for any period are then averaged (Table 1).

Summer (June, July, August, to mid-September)

Six rumen samples were included in this season (1 June, 2 July, 2 August and 1 early September). Three were from deer collected on the mountain meadow, one was from a deer on an alfalfa field and two were from deer on the sagebrush-bitterbrush type. One of the latter was seen to feed earlier on the bunch grass prairie. Forbs (19 items) constituted

Table I. -- Mule deer food habits as determined by analysis of 27 rumen samples and 505 instances of plant use.
(T = trace -- less than 0.5 cc.)

Plants	Summer				Fall		Winter				Spring	
	Observed instances of use		Six rumen samples		Six rumen samples		Observed instances of use		Eleven rumen samples		Four rumen samples	
	%	No.	% Vol.	% Wt.	% Vol.	% Wt.	%	No.	% Vol.	% Wt.	% Vol.	% Wt.
<u>Purshia tridentata</u> - Bitterbrush	9.3	29	15.4	16.1	40.7	44.0	11.4	22	13.6	18.2	1.6	1.6
<u>Artemisia tridentata</u> - Big sagebrush	0.6	2			6.1	5.4	17.1	33	25.1	24.4	16.1	18.0
<u>Juniperus scopulorum</u> - Rocky Mountain juniper	0.6	2			T	T	16.1	31	13.2	16.9	5.1	7.6
<u>Rosa engelmannii</u> - Zigzag rose	1.6	5	0.8	1.0	2.2	2.2			3.0	3.0	T	T
<u>Prunus virginiana</u> - Chokecherry	1.6	5	0.4	0.5	3.7	3.2	9.3	18	1.2	1.5	0.5	0.6
<u>Populus trichocarpa</u> - Black cottonwood	0.6	2	0.6	0.1	3.1	3.3	1.6	3	0.3	0.2		
<u>Mahonia repens</u> - Oregon grape					0.3	0.1			0.8	0.4	T	T
<u>Artemisia frigida</u> - Fringed sagewort					0.3	0.1			T	T	T	T
<u>Symphoricarpus occidentalis</u> - Western snowberry					11.4	11.4			0.6	0.5		
<u>Pyrus</u> spp. - Apple					0.9	0.5			5.3	3.1		
<u>Ribes setosum</u> - Redshoot gooseberry	1.3	4			2.6	2.9						
<u>Crataegus douglasii</u> - Black hawthorn	0.3	1			2.1	2.5						
<u>Philadelphus lewesii</u> - Lewis mockorange			T	T			2.1	4	1.7	1.6		
<u>Pseudotsuga taxifolia</u> - Douglas fir					T	T	0.5	1	1.6	2.0		
<u>Rhamnus alnifolia</u> - Alder buckthorn					0.1	0.1			0.3	0.2		
<u>Alnus sinuata</u> - Sitka alder	1.6	5							T	T		
<u>Vaccinium membranaceum</u> - Thinleaved huckleberry			3.4	3.5								
<u>Rubus</u> spp. - Raspberry	0.6	2										
<u>Salix bebbiana</u> - Bebb Willow					T	T						
<u>Acer glabrum</u> - Rocky Mountain maple									T	T		
Unidentified browse									0.2	0.1		
Browse Totals	18.1	57	20.6	21.2	73.5	75.7	58.1	112	66.9	72.1	23.3	27.8
<u>Balsamorhiza sagittata</u> - Balsam-Root	10.9	34	8.7	8.4	9.4	8.1	17.6	34	11.7	11.3	10.2	9.6
<u>Medicago sativa</u> - Alfalfa	16.7	52	12.1	13.3	10.9	11.9			T	T	11.8	12.3
<u>Lupinus argentea</u> - Silvery lupine	2.2	7	3.5	3.6	T	T			1.4	1.4	1.3	1.2
<u>Cerastium arvense</u> - Field chickweed			T	T	T	T	2.6	5	3.7	2.8	2.2	1.1
<u>Achillea lanulosa</u> - Western yarrow			0.3	0.3	0.3	0.1	1.6	3	1.0	0.9	2.2	1.8
<u>Gaillardia aristata</u> - Gaillardia	1.0	3	T	T	T	T			0.3	0.3		

Table I (Continued). — Mule deer food habits as determined by analysis of 27 rumen samples and 505 instances of plant use.
(T = trace — less than 0.5 cc.)

Plants	Summer				Fall		Winter				Spring	
	Observed instances of use		Six rumen samples		Six rumen samples		Observed instances of use		Eleven rumen samples		Four rumen samples	
	%	No.	% Vol.	% Wt.	% Vol.	% Wt.	%	No.	% Vol.	% Wt.	% Vol.	% Wt.
<u>Phacelia leucophylla</u> - Silverleaf phacelia			T	T			0.5	1	0.2	0.3		
<u>Descurainia pinnata</u> - Pinnate tansymustard	0.3	1			T	T			T	T		
<u>Artemisia ludoviciana</u> - Louisiana sagebrush					0.3	0.2	3.1	6	0.4	0.4		
<u>Lactuca scariola</u> - Prickly lettuce	2.6	8	2.6	2.0					T	T		
<u>Geranium viscosissimum</u> - Sticky geranium			1.3	1.9							0.6	0.5
<u>Antennaria microphylla</u> - Littleleaf pussytoes					0.6	0.5					1.0	0.9
<u>Penstemon albertinus</u> - Alberta penstemon			0.2	0.2	T	T						
<u>Hieracium albertinum</u> - Woollyweed									T	T	0.2	0.2
<u>Aster</u> spp. - Aster			T	T	T	T						
<u>Tragopogon dubius</u> - Salsify	0.3	1	12.3	10.3								
<u>Aster modestus</u> - Fewflower aster			4.6	5.1								
<u>Taraxacum officinale</u> - Common dandelion	1.0	3	3.7	3.0								
<u>Delphinium occidentale</u> - Duncecap larkspur			2.9	2.7								
<u>Heracleum lanatum</u> - Cowparsnip	0.3	1	1.2	0.9								
<u>Thalictrum sparsiflorum</u> - Few-flowered meadow rue			0.6	0.8								
<u>Leguminosae</u> - Legumes			0.3	0.2								
<u>Rudbeckia laciniata</u> - Cutleaf coneflower			0.2	0.3								
<u>Liliaceae</u> - Lilies			0.2	0.2								
<u>Smilacina stellata</u> - Starry solomonplume			0.2	0.2								
<u>Valeriana occidentalis</u> - Western valeriana	0.3	1	T	T								
<u>Galium boreale</u> - Northern bedstraw			T	T								
<u>Capsella bursapastoris</u> - Shepherd purse			T	T								
<u>Haplopappus acaulis</u> - Stemless goldenweed	6.7	21										
<u>Crepis</u> spp. - Hawksbeard	4.8	15										
<u>Agoseris glauca</u> - Pale agoseris	3.8	12										
<u>Townsendia parryi</u> - Parry townsendia	3.8	12										
<u>Erigeron glabellus</u> - Smooth fleabane	3.2	10										
<u>Castilleja miniata</u> - Scarlet painted cup	2.6	8										
<u>Iris missouriensis</u> - Rocky Mountain iris	1.9	6										
<u>Parnassia fimbriata</u> - Fringed parnassia	1.6	5										
<u>Astragalus drummondii</u> - Drummond milkvetch	0.6	2										

Table I (Continued). — Mule deer food habits as determined by analysis of 27 rumen samples and 505 instances of plant use.
(T = trace — less than 0.5 cc.)

Plants	Summer				Fall		Winter				Spring	
	Observed instances of use		Six rumen samples		Six rumen samples		Observed instances of use		Eleven rumen samples		Four rumen samples	
	%	No.	% Vol.	% Wt.	% Vol.	% Wt.	%	No.	% Vol.	% Wt.	% Vol.	% Wt.
<u>Angelica arguta</u> - Common Angelica	0.3	1	0.2	0.1								
<u>Chenopodium album</u> - Lamb's quarter					0.3	0.2						
<u>Cirsium undulatum</u> - Wayleaf thistle					T	T						
<u>Chrysopsis villosa</u> - Hairy goldaster					T	T						
<u>Heuchera ovalifolia</u> - Ovalleaf alumroot									0.4	0.3		
<u>Artemisia canadensis</u> - Canada sagewort							3.6	7				
<u>Arabis nuttallii</u> - Nuttall rockcress									T	T		
<u>Claytonia lanceolata</u> - Western springbeauty											4.1	2.6
<u>Ranunculus glaberrimus</u> - Sagebrush buttercup											2.9	1.8
<u>Fritillaria pudica</u> - Yellow bell											1.2	0.6
<u>Delphinium bicolor</u> - Low larkspur											1.0	0.9
<u>Veronica americana</u> - American speedwell											0.9	0.8
<u>Erigeron pumilus</u> - Low fleabane											0.6	0.7
<u>Potentilla gracilis</u> - Northwest cinquefoil											T	T
Unidentified forbs	8.3	26	21.9	22.2	2.6	0.7	1.0	2	0.2	0.2	T	T
Forb Totals	73.2	229	77.0	75.7	24.4	21.7	30.0	58	19.3	17.9	40.2	35.0
<u>Gramineae</u> - Grass	1.6	5	2.9	3.5	2.7	2.7	11.9	23	13.9	10.1	37.1	37.6
<u>Juncus regelii</u>	6.4	20										
<u>Carex geveri</u> - Elk sedge			T	T								
<u>Equisetum laevigatum</u> - Smooth horsetail	0.3	1										

77.0% by volume and 75.7% by weight of the samples. Salsify composed 12.3% by volume and 10.3% by weight. Alfalfa made up 12.1% and 13.3% by volume and weight respectively. Other important identifiable forbs included Balsam-Root, fewflower aster, dandelion and silvery lupine. Unidentified forbs made up 21.9% by volume and 22.9% by weight. Browse (5 species) formed 20.6% of the samples by volume and 21.2% by weight, with bitterbrush comprising 15.4% by volume and 16.1% by weight. Thinleaved huckleberry was the only other important browse species, being 3.4% by volume and 3.5% by weight. Grass composed 2.9% of the volume and 3.5% of the weight.

Undue importance was probably given to alfalfa and bitterbrush by the limited sampling. The one sample from the deer taken on an alfalfa field contained 70.8% alfalfa by volume and 77.6% by weight. The only other occurrence of alfalfa in this season's samples was June 22 (1.7% by volume and 2.0% by weight). In the one sample from a deer seen only on the sagebrush-bitterbrush type, bitterbrush composed 87.4% by volume and 88.8% by weight. The most important browse species from the samples taken from deer on the mountain meadow was thinleaved huckleberry. This species was present in all the samples from deer on the mountain meadow and only in these samples. Most of the unidentified forbs came from deer collected on the mountain meadow.

Three hundred twelve feeding observations were made during this season. The breakdown by types was: mountain meadow 162; sagebrush-bitterbrush 26; bunch grass prairie 124 (including 70 from alfalfa fields). Forbs constituted 73.2% of the observed plant use. Alfalfa (16.7%) and Balsam-Root (10.9%) were the most important species.

Browse (18.1%) was second in importance, with bitterbrush forming 9.3% of the observations. Grass formed 1.6% of the observed plant use.

Fall (Mid-September, October, November)

Six rumen samples were analyzed (1 late September, 3 October, and 2 November). The September and October 8 samples were from deer collected on the bunch grass prairie near Cottonwood Creek. The remaining four samples were collected from deer on the sagebrush-bitterbrush type. Browse was most important in this season (73.5% by volume, 75.7% by weight). Bitterbrush (40.7% volume, 44.0% weight) and western snowberry (11.4% by volume and 11.4% by weight) were the more important of the 12 browse species. Forbs (7 items) constituted 24.4% by volume and 21.7% by weight. Alfalfa (10.9% volume, 11.9% weight) and Balsam-Root (9.4% by volume, 8.1% by weight) were the more important members of this group. Grass composed 2.7% by volume and 2.7% by weight.

For the four samples from deer on the sagebrush-bitterbrush type, bitterbrush constituted over 53.3% by volume and 58.4% by weight for each sample. Big sagebrush was first present in the October 16 sample as a trace. In the October 23 sample it was 1.3% by volume and 1.2% by weight. In the November 7 and 21 samples it was respectively: 2.9% by volume and 3.4% by weight; 32.1% by volume and 27.8% by weight. Of the two samples from deer on the bunch grass prairie, western snowberry averaged 32.7% by volume and 32.6% by weight, making it the most important species in these samples. Alfalfa was the most common forb in these two samples, constituting 15.9% by volume and 21.7% by weight. Alfalfa was present in all samples for this season except the one from November 21. Alfalfa seeds found in the October 8 and 16 samples were

well developed. As this forb is usually cut before seeds mature, much of this was probably taken directly from alfalfa fields rather than from haystacks.

Winter (December, January, February, to mid-March)

Eleven rumen samples (5 December, 3 January, 2 February, and 1 early March) were analyzed. All were collected from deer on the sagebrush-bitterbrush type. Eight browse species constituted 66.9% by volume and 72.1% by weight of the samples. Big sagebrush, bitterbrush and Rocky Mountain juniper were important browse species, constituting 51.9% by volume and 59.5% by weight. Nine forbs made up 19.3% by volume and 17.9% by weight. The major forb was Balsam-Root (11.7% by volume and 11.3% by weight). Grass represented 13.9% by volume and 10.1% by weight.

Big sagebrush ranked first in December, January, and February, and was third in the March sample (volumes and weights for respective months: 23.9%, 24.1%; 26.6%, 27.7%; 26.6%, 20.6%; 25.1%, 23.6%). In no month did bitterbrush form over 18.1% by volume and 21.4% by weight of the samples. In the March sample it was 5.9% by volume and 5.4% by weight. An increase in the percent of juniper and Douglas fir in the samples from December to February was noted. Juniper volumes and weights for the respective months were: 9.8%, 12.0%; 13.3%, 19.1%; 13.3%, and 16.1%. Douglas fir was 0.2% by volume and 0.4% by weight in December. In January and February it was respectively: 1.0% by volume, 1.0% by weight; 6.9% by volume and 9.4% by weight. In the March sample Juniper was the most important species (29.4% by volume, 36.6% by weight. No Douglas fir was present in the March sample. Grass was present in all but one sample

(January 20). It constituted 43.5% by volume and 26.6% by weight in the January 2 sample. In the March sample it was 27.5% by volume and 24.7% by weight.

Deer use of 193 plants was noted, 158 on sagebrush-bitterbrush type and 35 on the bunch grass prairie. Browse constituted 58.1% of the use noted. Big sagebrush, bitterbrush and Rocky Mountain juniper were important, totaling 44.6%. Forbs composed 30.0% of the observations with Balsam-Root being the most important species (17.6%). Grass use was 11.9% of the observations.

Spring (Mid-March, April, May)

Four rumen samples were included in this season (1 late March, 2 April, 1 May). Three samples were from deer feeding on the sagebrush-bitterbrush type, the other from a deer on the bunch grass prairie.

Forbs (14 species) constituted 40.2% by volume and 35.0% by weight. Balsam-Root (10.2% by volume and 9.6% by weight) and alfalfa (11.8% by volume and 12.3% by weight) were again the major forbs. Western spring-beauty and sagebrush buttercup were other important forbs. Grass was equal to forbs in importance, constituting 37.1% by volume and 37.6% by weight. Browse was of lesser importance, composing 23.3% by volume and 27.8% by weight. Sagebrush and juniper were important browse species and formed respectively 16.1% by volume, 18.0% by weight and 5.1% by volume, 7.6% by weight. Bitterbrush was 1.6% by volume and 1.6% by weight. In the May 6 sample sagebrush dropped to 1.2% by volume and 1.3% by weight, the lowest since the October 16 sample. In the two samples obtained after April 4, juniper and bitterbrush were absent, or present only as a trace. Alfalfa was present in only one sample (May 6)

and composed 47.1% by volume and 49.1% by weight in this sample. The deer from which this sample was obtained was feeding on the sagebrush-bitterbrush type within 500 yards of an alfalfa field. The alfalfa appeared to be new growth.

Yearlong Trends and Discussion

The food habits data indicate certain trends in the diet of the deer on the study area. During the summer forbs were most important. Browse was of less importance and grass was little utilized. In the fall, browse became the important group and the percentage of forbs was reduced. Grass remained a minor food. Bitterbrush was the most important browse species in the fall, composing the majority of all samples from deer on the sagebrush-bitterbrush type. In the winter there was a decided decline in the use of this species, although browse remained the important group. Concurrent with the decrease in bitterbrush was an increase in the utilization of big sagebrush. Rocky Mountain juniper and Douglas fir tended to increase in percentage as the winter progressed. Forbs were of limited importance during this period with Balsam-Root the most abundant forb in the samples. More grass was present in winter samples than either the fall or summer, but this group was still least utilized. Going into spring the samples indicate a shift toward grass. During the spring forbs and grass were of equal importance. Browse was of lesser importance in this season, with big sagebrush being moderately utilized until May. Bitterbrush use steadily declined.

These seasonal trends are similar to those found by Smith (1952) in Utah. Studies by the Interstate Deer Herd Committee (1951) and

Lassen et al. (1952) have also indicated a decided decline in bitterbrush consumption from fall to winter, accompanied by increased use of big sagebrush. These authors suggest that this subrogation may be in part due to a decrease in palatability or nutritional value of bitterbrush. Bissell et al. (1955) tested digestibility of bitterbrush and big sagebrush. They concluded that in periods of greatest use (November and December in their study) bitterbrush digestibility appeared to be slightly lower than in March. They further found bitterbrush would maintain deer for several weeks with only a slight loss of weight and that it appeared to be an extremely palatable food. Big sagebrush proved to be extremely unpalatable. Smith and Hubbard (1954), testing palatability of species in December and March, rated bitterbrush as preferred over big sagebrush. It would seem from these works that the decline in bitterbrush consumption might be best attributed to decreased availability of this browse. In the California studies where this decreased consumption of bitterbrush was noted the use of this plant appears to have been excessive. Such was the case on this study area, where hedging and death of plants is apparent (Fig. 5). On May 7, 43 bitterbrush twigs, which had been marked at the base of the new growth on November 25, were re-measured. The late date for initial marking was chosen to preclude any livestock use. These marked twigs indicated consumption of 61% of the new growth. It is estimated that about 40% of the twig growth should remain on bitterbrush plants each season to maintain plant vigor and to insure adequate seed production (Hormay 1943). Twenty-four marked twigs were not re-located, and it is felt most of these received 80-90% use, resulting in the loss of markers. The area

Fig. 5. Stunted bitterbrush plant on January 27 showing hedging and use of new growth. Note length of new growth previously covered by snow.

on which the tagged plants were located did not receive the heaviest use by deer during the winter. As the amount of bitterbrush present in rumen samples decreased in all samples analyzed after the date on which the plants were tagged, probably the period of greatest bitterbrush use was not included in the results. All these factors would tend to give an under-estimate of percentage consumed.

Norris (1943) has indicated the possibility of undue weight being given to browse species by stomach analysis. There seems little question, however, that stomach analysis can be used as an indication of use, especially as related to major items in the diet. The similarity between the observed feeding percentages and the rumen analysis percentages strengthens this contention.

AGRICULTURAL DEPREDAATION

Deer damage to agricultural products has been reported frequently

in various sections of the country (Doman and Rasmussen 1944, Leopold et al. 1947, Thomas and Pasto 1955). Since 1949 numerous complaints have been made of deer damaging alfalfa haystacks and growing alfalfa in the study area vicinity. Two alfalfa fields were kept under observation throughout the study. Another was under observation from September 11 to February 18. From June 15 to October 31 an average of 1.5 deer per observation (81 observations) was noted on alfalfa fields. One of the fields observed throughout the study was adjacent to Bill Smith Creek. The one field under observation after September 11 was adjacent to Cottonwood Creek. These two areas averaged 1.1 deer per observation (69 observations), and 2.4 per observation (12 observations) respectively. The northeast edge of the remaining field was approximately 400 yards from the sagebrush-bitterbrush type, and averaged 0.3 deer per observation (61 observations). It would appear that fields in close proximity to moist areas received heavier deer use than others.

Damage to haystacks was studied by observations of deer usage, examination of stacks used, and rancher interviews. Eight stacks of unbaled alfalfa hay were kept under surveillance on the study area through the fall and winter, or until they were removed. The haystacks were 400 to 1,300 yards from the foot of the mountain (Fig 1).

The first usage of haystacks was evidenced by tracks in the snow at stack 1 on November 7. Damage to the stack was moderate. The exact date at which this damage began was not determined. The owner moved this stack soon afterward. On December 3 extensive damage to stacks 2,

3 and 4 was noted. According to the owner, damage had been severe for the past two weeks. Deer damage to stack 4 on the night of December 3-4 can be seen in Figure 6. This stack was removed December 5. Stack 2 and 3 were moved to a location near a ranch (stack 5) soon after this date. Here damage was moderate but virtually ceased after December 20 (discussed later).

The other three stacks on the study area (6, 7 and 8) were all "paneled". These panels are rectangular wooden structures eight feet high and eight feet wide with six-inch horizontal boards placed six inches apart (Fig. 7). The panels were placed against the haystack, surrounding it, and were wired together. Deer were able to pull small amounts of hay through openings between the horizontal boards but only minor damage was noted.

Three unpaneled stacks of baled alfalfa hay 6.5 miles north of the study area were visited by the author on December 18, and periodically thereafter. Stack 9 was 300 yards from the mountain and 75 yards west of a farm house, while 10 was 200 yards west of the mountain and 80 yards south of 9. Stack 11 was 700 yards west of the mountain.

On December 18, twelve deer were seen on stack 9; on January 27, fifty; and on February 22, a minimum of 36. All observations were made at night (Fig. 8). Twenty-nine deer were observed at stack 11 on January 27. This number remained quite constant through the winter according to the rancher. On February 22 no deer were seen at this haystack. On March 23, no deer were observed at any of the haystacks. The rancher reported the deer had stopped coming to the stacks about March

Fig. 6. Haystack 4. Side in foreground had been perpendicular the night before. Note present concavity and deer tracks in foreground.

Fig. 7. Panels which proved useful in controlling deer damage to haystacks.

Fig. 8. Deer on haystack 9 night of February 22.

20. Beyond this date very few deer were reported at the stacks and little or no damage was noted.

The distance the haystack was from the mountain apparently had some effect on the time depredation began. As the fall progressed the deer utilized stacks further from the mountain. This may have been due to the removal of stacks closer to the mountain base. The deer traveled to the furthest stack in early December, but this stack was not in place until that time.

The degree of damage to any one stack over the winter was difficult to determine as the stacks varied widely in amounts of hay contained and length of time available for depredation. The three paneled stacks suffered the least damage. The stack that was located the greatest distance from the mountain received slightly more damage. The short time the remainder of the stacks on the study area were available made it virtually impossible to rate their year-long damage. Certain unpaneled stacks available all winter suffered the greatest damage.

Deer ate mainly the leaves and small stems of alfalfa. By defecating and urinating on the hay, making it unpalatable to livestock, the deer spoiled much more hay than was eaten. Four tons of spoiled hay were removed from haystack 11 in mid-February. Perpendicular sides, which prevent deer from climbing to the top of a haystack, curtail spoilage. Such sides are more easily constructed with baled hay than with unbaled hay. Baled haystacks did not escape deer damage, however.

It is known that alfalfa hay will be eaten by deer when their natural diet is not adequate. Deer depredation on haystacks is be-

lieved to have been caused primarily by a lack of adequate amounts of palatable browse species following the restriction of the winter range by snow. Moderate damage was initiated in November when deer first arrived en masse on the winter range. There was some snow on the hills, but the snow cover was sporadic until early December. From early December to late March all of the slopes with northern exposures were continually snow covered. Severe damage to the most heavily depredized stacks commenced in early December. March 20 followed three days of generally clear, mild (45° F.) weather. March 20 is the date the last extensive damage to stacks occurred. After this date the range remained free of deep snow. A few deer were reported at the haystacks after this date but apparently caused little damage.

The overbrowsing can only be eliminated by a herd reduction, either through winter starvation, such as the six deer found in 1956 with marrow indicative of starvation (Cheatum, 1949), or through greater hunter harvests. The attainment of the latter presents a problem discussed under "HUNTING SEASONS". Hunting activity alone will not prevent haystack damage in all cases. From October 15 to November 15, 1955, an either sex deer season was held on the Bridger Mountains. Despite this season the first damage to haystacks was noticed when the first large groups of deer came on to the winter range. From December 20, 1955, to January 15, 1956, another either sex season was held on a portion of the Bridger range including all areas under this study. After the opening of this season damage to stack 5 virtually ceased. The damage to the baled stacks continued, totaling an estimated 20 tons of hay by the end

of the winter. Although it may have prevented continued damage by the estimated 200 deer killed (including several shot on haystacks) it would seem that this season which was initiated to prevent severe haystack damage did not achieve its goal.

HUNTING SEASONS

Since the mid-1930's deer seasons for the general locality including the study area have been held from October 15 to November 15. From 1931 until 1952 hunting was on a "buck only" basis. For the years 1952-1954 buck only seasons were held with periods when does could be killed (November 8-15, 1952; November 1-3, 1953; October 31-November 15, 1954). The 1955 season was either sex. Two either sex post-season hunts have been held, January 9-31, 1954, and December 20, 1955 to January 15, 1956. During the latter season, 200 second deer permits were issued and deer tags on regular licenses could also be used.

Reliable estimates of kills on the study area for seasons prior to 1955 are not available. Kills during the study period were estimated by checking station data, personal contact with hunters, questionnaires and rancher interviews. A checking station on the main road leading from the study area was operated December 20 and December 31, 1955. Forty-two hunters were questioned as to the general area hunted, number of deer seen and whether they were hunting on a regular license or a second deer permit. Sex and age of kills was recorded. Hunters were also asked if they had had an opportunity to kill a deer. The latter was asked to eliminate the effect of poor shooting and of hunting only bucks.

A questionnaire was sent to 150 of the 200 second deer permit holders requesting information as to their success. Fifty-four percent of the 106 hunters replying had been successful. From a ratio of 58 permit hunters to 42 regular license hunters (checking station data and hunter contacts) an estimated 200 deer were taken throughout the area open during the special season. Of the hunters contacted at the checking station, 45% were successful while 52% had an opportunity to kill a deer. Of those that hunted off of the road, 66% were successful and 93% had an opportunity to kill a deer. Thirteen (almost one-third) of the hunters never left the road; none of these had an opportunity to kill a deer. The reluctance of hunters to leave the road poses a definite problem in attempting to manage the deer in this area.

On the study area itself an estimated 50 deer were killed during the 1955 regular season and 50 more during the special season. Fourteen other deer were collected specifically for rumen analysis to February 17, (when the first starvation loss was noted) making a total kill of 114 to that time. After February 17, six additional deer were collected for rumen analysis and ten dead deer were found (five of which had apparently starved). The starvation losses (all fawns); excessive use of a key plant (bitterbrush); large amounts of an emergency food, juniper (Leopold, 1935) in late winter rumen samples; and extensive haystack damage all point to an overbrowsed winter range. That overbrowsing has not been restricted to this one year is attested by highlined juniper, dead and hedged bitterbrush plants, and rancher reports of excessive winter deer losses (apparently starvation) and

haystack damage in recent years. A need for an increased harvest is apparent. If this is not achieved further lowering of the carrying capacity of the range will undoubtedly occur. If this harvest is not made by hunters, starvation (accompanied by further damage to the range) will probably accomplish the reduction.

Not until approximately November 7 (the fourth week of the season) were large numbers of deer relatively accessible to hunters on this area. Most hunters in this area were observed to be reluctant to climb high into the mountains early in the season, or to wait until late in the season to get a deer. Thus there is little opportunity for a substantial harvest of this herd. Rogers (1953) has indicated that most deer are killed in the first week of a season.

Harvests on this area must be increased until at least some signs of bitterbrush recovery appear. Several possible means of achieving this herd reduction are apparent. Either sex seasons should be continued. Two deer of either sex should probably be allowed all license holders. If this does not achieve the desired harvest it would possibly be useful to require one of the deer taken be a female. Special non-resident deer license holders should be encouraged to hunt this area. Extending the season or providing permits for deer, in addition to those permitted on the regular license, would result in increased harvest. However, prior attempts at these solutions on this area have not resulted in adequate harvests. This corresponds with Hunter and Yeager's (1949) findings that post seasons have generally not been successful in Colorado.

SUMMARY

1. The range use, food habits and agricultural depredations of the Rocky Mountain mule deer (Odocoileus h. hemionus) were investigated from June 16, 1955, to May 7, 1956, on a 6.5 square mile section of the Bridger Mountains, Montana.

2. Four vegetative types; mountain meadow, montane forest, sagebrush-bitterbrush and bunch grass prairie were recognized and described.

3. Use of the vegetative types throughout the study period was determined by observations. Intraseasonal and interseasonal differences in use of vegetative types were indicated. In early summer moderate use of the bunch grass prairie and sagebrush-bitterbrush type was noted. In late summer and early fall there was a decrease in use of these two types and extensive use of mountain meadows. In late fall and continuing throughout the winter large numbers of deer were observed on the sagebrush-bitterbrush type and minimal usage of the bunch grass prairie was suggested. In the spring the sagebrush-bitterbrush type continued to receive considerable use and maximum use of the bunch grass prairie occurred. Few observations were carried out on the montane forest, but it was apparent it was extensively used by deer for shelter.

4. Food habits were determined by rumen analysis, direct observations of feeding deer, and examination of specific areas for evidence of plant use by deer. During the summer forbs made up 77.0% by volume, browse 20.6% and grass 2.9% of the six rumen samples. Observations substantiated the relative importance of these groups. The data from

the fall indicate a reversal in importance of browse (75.7%) and forbs (24.4%). Grass remained a minor group (2.7%). Bitterbrush was the most abundant item in the fall, forming 40.7% of the six rumen samples. During the winter the relative positions of the groups were retained, with browse forming 66.9% and forbs 19.3% of the eleven rumen samples. Grass remained the least utilized group but increased to 13.9% of the samples. Big sagebrush (25.1%) replaced bitterbrush (13.6%) as the most abundant species. The subrogation of bitterbrush by big sagebrush from fall to winter was apparently due to decreased availability of the former. In late winter the percentage of Rocky Mountain juniper and Douglas fir noticeably increased. In the spring forbs (40.2% by volume, 35.0% by weight) were again an important group. Grass was equally important, forming 37.1% by volume and 37.6% by weight of the four rumen samples. Browse (23.3% by volume and 27.8% by weight) was the least abundant group in the samples.

5. Deer depredation on agricultural products was determined by observations and rancher interviews. The number of deer seen utilizing alfalfa fields was presented. Deer damage to alfalfa haystacks was analyzed and an examination of the influence of certain factors was made. Paneling the haystacks virtually eliminated deer damage. Stacks of baled hay did not escape damage by deer. The distance the haystacks were from the wintering range apparently influenced the time damage was initiated. Hunting pressure alone did not keep deer away from haystacks in all cases. The primary reason for the deer use of the haystacks probably was an overbrowsed winter range. Three haystacks suffered an

estimated loss of 20 tons of hay during the winter.

6. Deer seasons which have been held on the study area in recent years were presented. Personal contact with hunters, checking station data, rancher interviews and post-season questionnaires were used to analyze the results of the 1955-6 seasons. Data on hunter success indicated a high degree of opportunity to kill a deer for only those that left the road. Arrival of the deer on wintering areas late in the season is one of the probable reasons for an insufficient harvest of this herd. Numerous signs of overuse of the winter range were present.

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