



Food habits and range use of the mule deer in the Scudder Creek area, Beaverhead County, Montana
by Philip R South

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

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Abstract:

A study of range use, food habits, and effect on the range of mule deer (*Odocoileus h. hemionus*) was conducted at various times from 1953 to to 1957 in the Pioneer Mountains, Montana, A description of the area'S vegetational types is given. Observations of deer provided information on use of vegetational types at different seasons. Tracking deer through the fresh snow indicated browse preference by the presence of leaves on the snow beneath the plants used. Food habits, were determined by analysis of rumen samples. Range trend, as effected by deer, was indicated by measurements, in the spring and fall, of tagged browse plants, and also by ecological data. Population density was determined by a pellet group count, and some of the aspects of starvation in relation to deer population were discussed.

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Philip R. South

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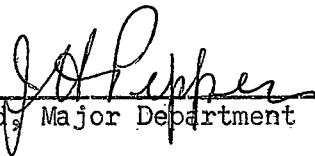
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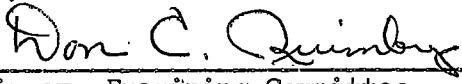
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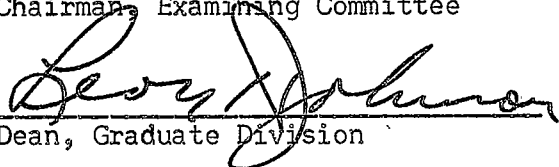
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Chairman, Examining Committee


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ABSTRACT

A study of range use, food habits, and effect on the range of mule deer (Odocoileus h. hemionus) was conducted at various times from 1953 to 1957 in the Pioneer Mountains, Montana. A description of the area's vegetational types is given. Observations of deer provided information on use of vegetational types at different seasons. Tracking deer through the fresh snow indicated browse preference by the presence of leaves on the snow beneath the plants used. Food habits were determined by analysis of rumen samples. Range trend, as effected by deer, was indicated by measurements, in the spring and fall, of tagged browse plants, and also by ecological data. Population density was determined by a pellet group count, and some of the aspects of starvation in relation to deer population were discussed.

INTRODUCTION

Reports indicate unusually large populations of mule deer (Odocoileus h. hemionus) in the vicinity of Scudder Creek, Beaverhead County, Montana, as early as 1949. According to Bob Harrison, sheepherders who crossed the range from the Harrison ranch in the spring months of 1949, 1950, 1951, reported seeing scores of deer carcasses. At least one rancher in the area complained that deer were causing heavy damage to his hay stacks in 1950. J. E. Gaab (1950) of the Montana Fish and Game Department ventured the opinion that deer had seriously depleted the mountain mahogany (Cercocarpus ledifolius) browse plants during the winters preceding 1949.

These fragmentary reports suggested a serious deer problem involving the usual conditions of winter mortality and range depletion common to such situations, but specific information was lacking. Data on the ecology of the deer were needed to aid in developing a sound management program. Studies were conducted at various times from the spring of 1953 to 1957. Mule deer food habits, range use, and effects on the range were emphasized but other ecological information was also recorded.

The writer is indebted to the following: the Montana Fish and Game Department for financial and other assistance under Federal Aid Project 35R; Dr. Don C. Quimby, Montana State College, for directing the study, and for valuable aid in preparing the manuscript; Joseph E. Townsend, Orville Lewis, and Wayne Fitzwater for aid in the field; Doctors W. E. Booth and John C. Wright, Montana State College, for aid in identification of plants; and Dr. Bernard Ostle for aid in statistical analysis of the data.

DESCRIPTION OF THE STUDY AREA

The range of the Scudder Creek Deer Herd encompasses the southern-most portion of the Pioneer Mountains. The highest peaks of this range are over 11,000 feet above sea level and the valley floors lie between 5,000 and 6,000 feet. Baldy Mountain, the southern-most peak, is 10,592 feet in elevation. The southern and western slopes of this mountain extend downward to dry foothills bordering the valley floor of the Grasshopper Creek drainage.

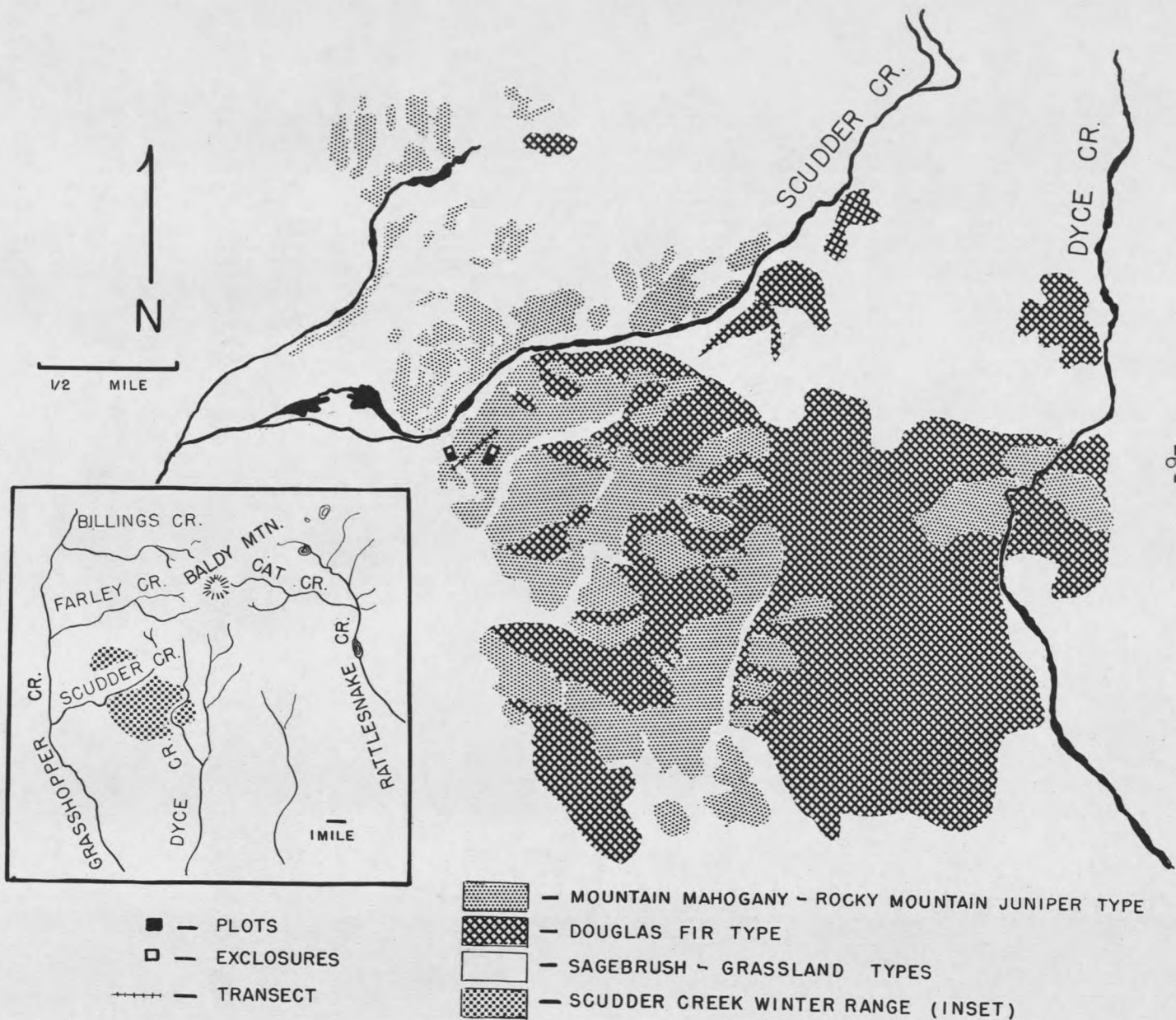
Five streams have their sources on the slopes of Baldy Mountain; Billings, Farley, Scudder, and Dyce Creeks, drain west and/or south into Grasshopper Creek (Fig. 1). Cat Creek drains eastward into the Rattlesnake drainage.

From the sliderock areas above 9,000 feet to sagebrush-grassland below 6,000 feet six vegetational types were recognized. The scientific and common names of the plants used in the following descriptions follow Booth (1950), and Wright and Booth (1954), or in cases where these authors did not cite common names, those given by the American Joint Committee on Horticultural Nomenclature are used.

Whitebark Pine - Alpine Fir Type

This type occurs at timber line and on the upper slopes. It is characterized by whitebark pine (Pinus albicaulis) and alpine fir (Abies lasiocarpa) interspersed with Englemann spruce (Picea englemanni) (Fig. 2). The vegetation of the forest floor is predominantly elk sedge (Carex geyeri) and/or low red huckleberry (Vaccinium scoparium).

FIG. 1 MAP OF STUDY AREA



Douglas Fir Type

This type is found on the intermediate slopes and on the northern exposures of the lower slopes (Fig. 3). It is characterized by Douglas fir (Pseudotsuga taxifolia) with an understory of buffaloberry (Shepherdia canadensis), snowberry (Symphoricarpus alba), and Kinnikinnick (Arctostaphylos uva-ursi).

Lodgepole Pine Type

This type appears in dense stands in various sites on the intermediate and upper slopes and is characterized by lodgepole pine (Pinus contorta) with an understory predominantly of low red huckleberry (Fig. 4).

Mountain Mahogany - Rocky Mountain Juniper Type

This type occurs on the southern exposures of the xeric lower slopes or foothills and is typical of a large part of the deer winter ranges in south-western Montana (Fig. 3). It is characterized by mountain mahogany interspersed with Rocky Mountain juniper (Juniperus scopulorum) and limber pine (Pinus flexilis). The under-story is mostly short vegetation represented by harbinger-of-spring (Haplopappus acaulis), square stem phlox (Phlox bryoides), and chimaya (Cymopterus bipinnata); with the important grasses being indian rice grass (Oryzopsis hymenoides) and bluebunch wheatgrass (Agropyron spicatum).

Sagebrush - Grassland Type

Three variations of this type were recognized which coincided with the upper, intermediate, and lower slopes.

The sagebrush - grassland type of the upper slopes is characterized by big sage (Artemisia tridentata), mountain brome (Bromus marginatus) and



Fig. 2. White bark pine - Alpine fir type.



Fig. 3. Mountain mahogany - Rocky Mountain juniper type with Douglas fir type on slopes right of center, and Baldy Mountain in the background.

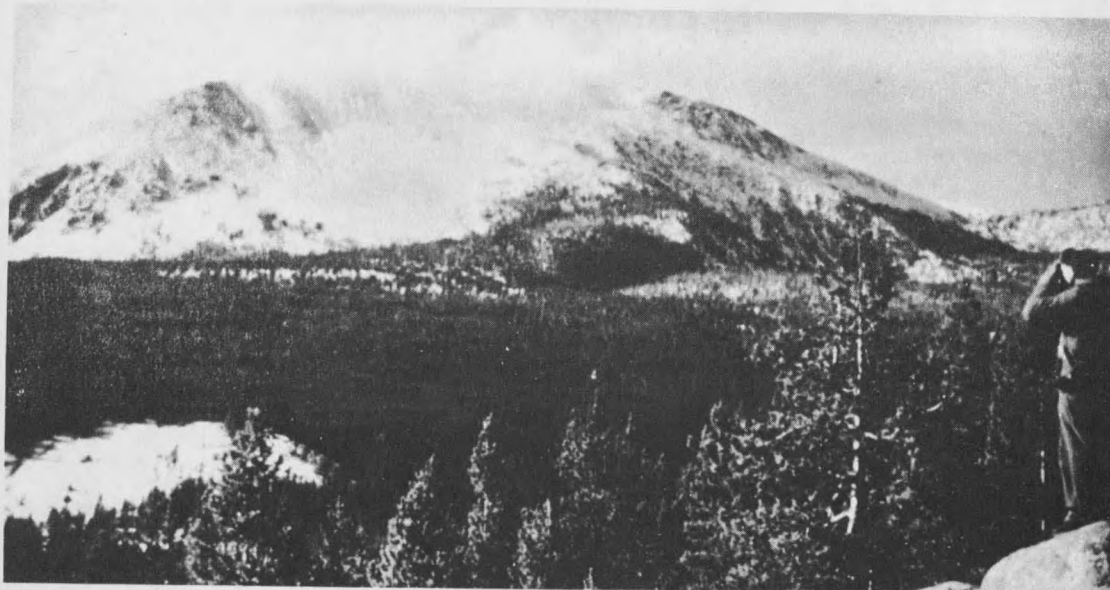


Fig. 4. Lodgepole pine type on Cat Creek left of center, with Baldy Mountain in the background.

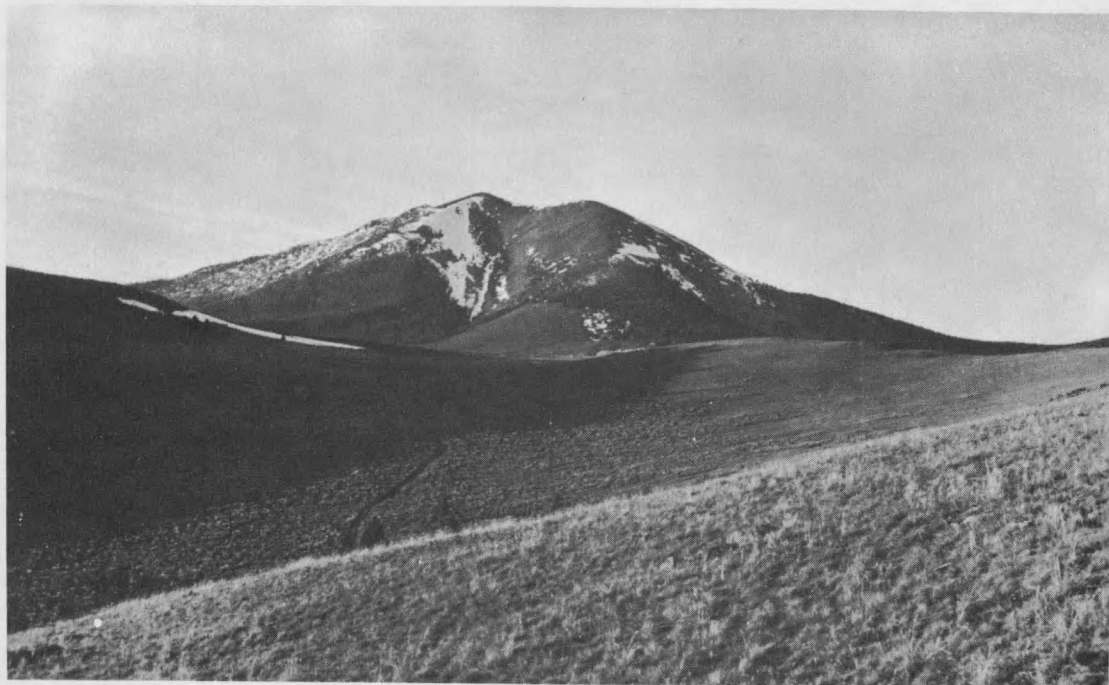


Fig. 5. Upper slopes sagebrush - grassland type appears below strip of timber on Baldy Mountain, foreground slope is intermediate sagebrush - grassland type.

purple onion grass (Melica spectabilis) (Fig. 5). Forbs are represented in the more open areas within the type by false dandelion (Agoseris spp.), dandelion (Taraxicum ceratophorum), Virginia strawberry (Fragaria virginiana), thickleaf groundsel (Senecio crassulus), and white stem frazera (Frazera albicaulis).

On the intermediate slopes, the sagebrush-grassland is characterized by big sage, bluebunch fescue (Festuca idahoensis), sheep fescue, (Festuca ovina), and lupine (Lupinus spp.) (Fig. 5). Characteristic plants appearing on rocky sites in this area are yellow stone crop (Sedum stenopalatum) and rose pussy toes (Antennaria rosea).

The sagebrush-grassland appearing on the lower slopes is characterized by big sage, two species of rabbit brush (Chrysothamnus nauseosus) and (C. vicidifloris), and gray horse brush (Tetradymia canescens) (Fig. 6). Characteristic grasses are bluebunch wheatgrass and june grass (Koeleria cristata).

Willow - Quaking Aspen Type

This type occurs along streams and is characterized by willow (Salix spp.), quaking aspen (Populus tremuloides), and at the lower elevations, an abundance of water birch (Betula occidentalis) (Fig. 7). Characteristic shrubs are rose (Rosa sp.), gooseberry (Ribes sp.), and chokecherry (Prunus virginiana).

Most of the data were collected from the Scudder Creek winter range and adjacent areas (Fig. 1). However, two other areas, Lost Creek drainage 20 miles to the northeast and Axes Canyon 28 miles southeast of Scudder Creek were included. Both areas are mountain mahogany - Rocky



Fig. 6. Lower slope sagebrush - grassland type in foreground, Douglas fir type top center.



Fig. 7. Willow - quaking aspen type on Dyce Creek.

Mountain juniper types but the degree of deer usage varies from that on Scudder Creek.

METHODS

Four principal methods were used: observations of deer and deer habitat; tracking of feeding deer, rumen analysis, and seasonal measurements of tagged browse plants. In addition, three aerial surveys and a pellet group count were made.

Some 968 direct deer observations were made with the aid of 7 x 35 binoculars. Occurrence by vegetative type was recorded.

Following snow storms (December through March) deer were tracked through the fresh snow to determine their browse preferences, Dean (1938). Use of plants was determined by the presence of freshly fallen leaves on the snow beneath. An examination of the plants confirmed usage. Observations were made on two separate areas with similar plants but differing in the intensity of deer usage (Scudder Creek and Axes Canyon).

Twenty-four deer, collected from April 15, 1953 to October 31, 1956, provided stomach samples of approximately one quart each for food habits analysis. Five were collected in December; three each in February and May; two each for March, April, August, and November; and one each for January, June, July, September, and October. The samples were preserved in 10 percent formalin at time of collection. The technique used in analysis of the samples was similar to that employed by Saunders (1955), Cole (1956), and Wilkins (1956). Each sample was washed consecutively on 3 mm. and 2 mm. mesh screens. The material remaining on the 3 mm. screen was then placed in water and the identifiable portions of plants removed.

Identification to genus and species was accomplished by comparison with plants in reference collection from the study area. The items identified were drained on paper toweling and measured volumetrically to the nearest 0.5 cc. by displacement of water. They were then air dried at room temperature and weighed to the nearest 0.01 grams. Similarly volumes and weights of the unidentifiable materials were taken. Material with a volume less than 0.5 cc. was recorded as "trace". A total of 2,989 cc. of material from the 24 rumen samples remained on the screens after being washed; only 25.34 percent of this was identifiable. Percentages of individual items making up the identifiable stomach contents of each sample were determined. Mean percentages for all samples in any one period were computed.

Information on the range use and the range trend of the winter range was obtained by taking measurements of the same plants (tagged) at different seasons. Tagged plants within exclosures and plants on unprotected adjacent plots, and established 1,000 foot transects were included. In the fall, plants were measured to determine the annual growth. Spring measurements were made to determine the percentage removed by browsing deer. A total of 9,086 measurements were recorded from May of 1953 to May of 1956. The measurements taken varied according to species. One lateral branch within reach of the deer was tagged for each mountain mahogany and mountain juniper plant. All twigs above the tag were measured to the nearest one half inch, and the inches totaled for each branch. For big sage, average height plus the size of the crown (measured on the longest and shortest axis) was used. The average height of rabbit brush

and threetip sage (Artemisia tripartita) was recorded.

Two of the exclosures and their adjacent plots were located near Scudder Creek. One in a mountain mahogany & mountain juniper type and the other in a lower elevation sagebrush - grassland type. Also in the vicinity of Scudder Creek one 1,000 foot transect was established. As a check on the information gained from the Scudder Creek exclosures and transects; one exclosure, one adjacent plot and one transect were established on Lost Creek, a similar area.

In August of 1954, October of 1954, and December of 1955 aerial surveys of the Scudder Creek range were made to determine the distribution and density of the deer. To obtain additional information on the number of deer using the winter range, a pellet-group count was made on sample strips in March of 1957. Counts were made on a total of 8.38 acres (3.93 acres in sagebrush - grassland type and 4.45 acres in mountain mahogany - mountain juniper type). To measure the number of acres covered, a pole was cut to a length of 4.35 feet (the area represented by the pole being moved one foot in a direction 90 degrees from its long axis is about 1/10,000 of an acre). When traversing the area on compass lines, selected at random, the pole was carried to measure width of strip. The distance covered was paced and recorded on a mechanical counter held in one hand. The number of pellet groups were recorded by a counter held in the other. If 50 percent or more of a pellet-group fell within the strip it was counted. Pellet group numbers were converted to deer usage by the method of Robinett et al (1952).

RESULTS

Use of Vegetative Types

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

During the winter months 90.5 per cent of all deer observed were in the mountain mahogany - Rocky Mountain juniper type (Table I). Eighty deer seen while making an aerial survey in December were all within this type. The deer were active, when observed, throughout the day and were usually feeding when seen. The slopes would become interlaced with trails a day or two after fresh snow had covered the range. Lower elevation sagebrush - grassland and Douglas fir were second and third respectively in degree of usage but appeared to be of secondary importance to the former type.

Spring - mid-March, April and May

Deer remained on the mountain mahogany - Rocky Mountain juniper type throughout most of the early spring (30.5 per cent of the number observed for the season) but this type was secondary to lower elevation sagebrush - grassland in total usage. When green grass began to appear in the lower sagebrush - grassland type, deer were seen there at a distance of a mile or more from the foothills. At one time in mid-April 103 deer were seen within a radius of about one mile, 30 were in a mountain mahogany - Rocky Mountain juniper type and 73 were in a lower elevation sagebrush - grassland type. Movement toward higher range began during the last month of this season. Seventeen of 23 deer in a Douglas fir type were seen in the latter part of May. Feeding activity was noted through the day during the entire period.

TABLE I. Use of vegetative types at different seasons as determined by ground observations of 968 deer and observations of 241 deer during three aerial surveys.

Vegetational Type	Observations of deer							
	Winter		Spring		Summer		Fall	
	%	No.	%	No.	%	No.	%	No.
Mountain mahogany - Rocky Mountain juniper	90.5	257	30.5	201	-	-	32.4	55
Willow - quaking aspen	0.3	1	3.3	22	36.5	35	17.6	30
Douglas fir	2.1	6	3.5	23	14.6	14	1.2	2
Lodgepole pine	-	-	-	-	11.4	11	6.5	11
Whitebark pine - alpine fir	-	-	-	-	5.2	5	0.6	1
Lower elevation sagebrush - grassland	5.3	15	46.1	304	3.1	3	5.3	9
Intermediate elevation sagebrush - grassland	1.8	5	16.6	109	10.4	10	9.4	16
Upper elevation sagebrush - grassland	-	-	-	-	18.8	18	27.0	46

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

Most summer observations of deer were at higher elevations. Willow - quaking aspen types were concerned in 36.5 per cent of these observations. Other timber types also appeared to be more important at this season than any other. More than 31 per cent of the deer seen were in Douglas fir, lodgepole pine, or whitebark pine - alpine fir types as compared to 2.1 per cent for winter, 3.5 per cent for spring, and 8.3 per cent for fall. Nearly all deer were sighted early in the morning or late in the evening. Deer seen in open areas were usually only a short distance from timber, seldom more than a hundred yards. Sixty-five per cent of those seen in timber types were in fringe areas adjacent to open meadows.

Fall - mid-September, through October, and November

Deer were widely distributed during the fall with all types represented in the deer observations. A majority of early fall observations were associated with an upper slope sagebrush - grassland type. Willow - quaking aspen types were also much frequented by deer prior to November. Downward movements began during this period and by late fall most deer were observed on the winter range (mountain mahogany - Rocky Mountain juniper type). Heavily used migration trails between Baldy and Black Mountain indicated that substantial numbers of deer moved from Cat Creek to upper Dyce Creek during this season (Fig. 1).

Variation in the dates that deer arrived on the winter range during different years suggested that migration was influenced by weather and/or snow cover. In mild fall weather deer would remain at higher elevations much later. In 1954 deer were seen near timber-line as late as November 15;

few deer arrived on the winter range before December. However, in 1956, following snow storms, substantial numbers of deer completed their fall migration by October 31.

Deer were seen only in morning and evening periods early in the fall, but throughout the day late in the season.

Browse Preference.

Tracking results demonstrated that the deer had a marked preference for mountain mahogany (Cercocarpus ledifolius) as winter browse. Use of this plant constituted 48.1 per cent of all the observations (Table 2). A species of rabbit brush (Chrysothamnus nauseosus) was second in importance with a use of 15.7 per cent. Gray horse brush (Tetradymia canescens) and threetip sage (Artemisia tripartita) were third and fourth respectively in the number of observations recorded. Use on 12 browse species comprised 98.4 per cent of all the observations. Rocky Mountain juniper shrubs (Juniperus scopulorum) on the Scudder Creek deer range show a high degree of "high-lining" (Fig. 8) and observations indicated that these plants furnished only a small part of the food eaten. Lack of any appreciable use of Rocky Mountain juniper on the Axes Canyon deer range (an area similar to Scudder Creek but supporting abundant mountain mahogany browse) suggested that juniper may be heavily utilized on this range type only when there is a shortage of mountain mahogany. To support this theory three unbrowsed Rocky Mountain juniper shrubs were transferred from Axes Canyon to Scudder Creek in February. One month later all three shrubs had been completely defoliated by browsing deer.

TABLE II. Browse preference and food habits as computed from 913 instances of plant use and 24 rumen samples.

(T=trace - less than 0.5 per cent)

Plants	Winter		Spring		Summer		Fall			
	Obs.		Ten		Six		Five		Three	
	Instances		Rumen		Rumen		Rumen		Rumen	
	%	No.	%	%	%	%	%	%	%	%
			Vol.	Wt.	Vol.	Wt.	Vol.	Wt.	Vol.	Wt.
<u>Cercocarpus ledifolius</u>	48.1	439	40.0	42.3	21.5	24.0	T	T	54.5	55.0
<u>Pseudotsuga taxifolia</u>	0.1	1	4.5	5.1	7.5	9.5			12.5	12.5
<u>Chrysothamnus nauseosus</u>	15.7	143	10.2	9.3	2.0	2.5			0.5	0.5
<u>Artemisia tripartita</u>	9.0	82	10.0	8.3	5.5	5.0				
<u>Artemisia tridentata</u>	3.9	35	2.3	2.0	4.0	3.5	0.5	1.0	5.5	4.0
<u>Juniperus scopulorum</u>	3.9	35	6.5	7.0	4.0	4.0			T	T
<u>Tetradymia canescens</u>	12.8	117	1.1	1.0	4.5	3.5			0.5	1.5
<u>Rosa</u> spp.	0.3	3	0.5	0.8			9.3	10.0		
<u>Arctostaphylos uva-ursi</u>	0.1	1	2.7	2.8	4.5	4.5	T	T		
<u>Juniperus communis</u>			0.3	0.3	6.0	6.5				
<u>Salix</u> spp.			1.5	1.7			4.0	4.5		
<u>Betula occidentalis</u>			4.0	4.3			T	T		
<u>Populus tremuloides</u>			1.0	1.3			2.5	2.5		
<u>Chrysothamnus vicidiflorus</u>	4.0	37	1.4	1.5	T	T				
<u>Prunus virginiana</u>							2.5	4.3		
<u>Shepherdia canadensis</u>			T	T	1.0	1.0	1.3	1.3	T	T
<u>Pinus flexilis</u>	0.3	3	1.4	1.5	0.5	0.5	T	T		
<u>Vaccinium scoparium</u>							1.5	2.0		
<u>Potentilla fruticosa</u>			1.4	1.1						
<u>Ribes</u> spp.	0.2	2	1.0	1.3			T	T		
<u>Symphoricarpus alba</u>			T	T						
Browse totals	98.4	898	89.8	91.6	61.0	64.5	21.6	25.6	73.0	73.0

TABLE II. Browse preference and food habits as computed from 913 instances of plant use and 24 rumen samples.

(T = trace -- less than 0.5 per cent)

Plants	Winter		Spring		Summer		Fall	
	Obs. Instances of Use	No.	Ten		Six		Five	
			Rumen		Rumen		Rumen	
			Sampls	Sampls	Sampls	Sampls	Sampls	Sampls
	%		%	%	%	%	%	%
			Vol.	Wt.	Vol.	Wt.	Vol.	Wt.
<u>Lupinus</u> spp.	0.1	1					2.3	2.0
<u>Taraxacum ceratophorum</u>					1.5	1.0	22.5	19.8
<u>Haplopappus acaulis</u>	0.4	4	2.3	1.5	8.5	8.5		
<u>Phlox bryoides</u>			2.5	2.0	8.0	7.0		
<u>Helianthella uniflora</u>	0.1	1					8.5	8.8
<u>Geranium viscosissimum</u>							7.5	6.0
<u>Senecio crassulus</u>							5.5	5.3
<u>Cymopterus bipinnata</u>			T	T	5.0	4.0		
<u>Frazeria albicaulis</u>					6.5	0.5	4.3	3.5
<u>Aster</u> spp.							4.3	4.5
<u>Potentilla</u> spp.							4.0	4.3
<u>Cordylanthus ramosus</u>			3.8	3.3	T	T		
<u>Penstamen procerus</u>								
<u>Epilobium</u> sp.							3.3	3.3
<u>Fragaria virginiana</u>							2.5	2.6
<u>Astragalus vexilliflexis</u>							1.8	2.3
<u>Erigeron</u> sp.							2.0	2.0
<u>Agoseris</u> spp.							1.5	2.0
<u>Trifolium longipes</u>					0.5	0.5	1.3	0.8
<u>Trifolium</u> sp.							1.0	1.3
<u>Arnica cordifolia</u>							0.8	1.0
<u>Achillea lanulosa</u>							1.0	0.5
<u>Balsamorhiza sagittata</u>							0.5	0.8
<u>Artemisia frigida</u>							0.5	0.5
<u>Cirsium arvense</u>			0.3	0.3	T	T		
			0.3	0.3	T	T		

TABLE II (Continued). Browse preference and food habits as computed from 913 instances of plant use and 24 rumen samples.

(T = trace - less than 0.5 per cent)

Plants	Winter		Spring		Summer		Fall			
	Obs. Instances of Use % No.	Ten Rumen Samples		Six Rumen Samples		Five Rumen Samples		Three Rumen Samples		
		% Vol.	% Wt.	% Vol.	% Wt.	% Vol.	% Wt.	% Vol.	% Wt.	
<u>Potentilla diversifolia</u>						0.3	0.3			
<u>Lesquerella alpina</u>			T	T	T	T				
<u>Zygadenus venosus</u>			T	T	T	T				
<u>Arenaria nuttallii</u>					T	T				
<u>Douglasia montana</u>					T	T				
<u>Draba ologosperma</u>					T	T				
<u>Eriogonum ovalifolium</u>					T	T				
<u>Eriogonum umbellatum</u>							T	T		
<u>Ligisticum</u> sp.					T	T				
<u>Pedicularis contorta</u>							T	T		
<u>Sedum stenopetalum</u>					T	T				
<u>Urtica dioica</u>							T	T		
Unidentified forbs	1.0	9			1.0	0.5	T	T		
Forb totals	1.6	15	9.2	7.4	27.0	24.0	75.4	71.6	21.0	20.5
Gramineae			T	T	11.0	10.5	2.0	1.8	5.5	4.0
Lichen			T	T					T	T

Food Habits

Winter

Ten rumen samples, all of which were from a mountain mahogany - Rocky Mountain juniper type, were included in the winter season. Mountain mahogany constituted 40 per cent by volume of all the identifiable plant material (Table 2). No other species furnished more than one-fourth as much of the winter diet. Rubber rabbit brush (Chrysothamnus nauseosus) and threetip sage (A. tripartita), the two browse species most nearly approaching mahogany in quantity utilized, furnished only 10.2 and 10 per cent respectively of the total volume of food. On the basis of rumen analyses, browse comprised 89.9 per cent by volume of all plants eaten by deer during the winter season. Only five species of forbs appeared in appreciable quantities in the rumen samples.

Spring

Six rumen samples from the mountain mahogany-Rocky Mountain juniper type were included in this period. Browse was the most important class for the season as a whole but a transition from browse to green grass to forbs occurred late in the season. There was evidence that the smaller amount of mountain mahogany (21.5 per cent volume) consumed during the early part of this period as compared to the winter season was the result of an exhausted supply. A yearling doe collected in April was too weak to stand. Examination of the bone marrow in the femur confirmed malnutrition, Cheatum (1949). The paunch was full, but it contained mostly square stem phlox, dry grass, sage, and various dry forbs. A rumen sample from a deer collected on the second of May contained 62.4 per cent of

mountain mahogany by volume. This deer was collected after a week of warm weather when the receding snow had uncovered young mahogany plants that had been protected by drifts during the winter. The greatest amount of green grass for any one period was 20 per cent of the volume of a rumen sample obtained on May 5. A rumen sample from a deer collected on May 30 was composed of 90 per cent forbs. The two most important forbs for this season were harbinger-of-spring (Haplopappus acaulis) and chimaya (Cymoptera bipinnata). Forbs and grasses constituted 27 and 11 per cent respectively of the volume of all spring rumen samples.

Summer

Five rumen samples were obtained from deer for this season; two from willow - quaking aspen types, and three from upper slope sagebrush - grassland types. Mountain mahogany appeared only as a trace in one sample during this period. Browse was less important during this season than any other (21.6 per cent by volume). Wild rose (Rosa sp.) exceeded all other browse species constituting 9.3 per cent by volume for all summer rumen samples. Willow (Salix spp.), chokecherry (Prunus virginiana), and quaking aspen (Populus tremuloides) were the other more important browse plants. Twenty-four different species of forbs were identified in this group of samples. Dandelion (Taraxacum ceratophorum) was the most important, comprising 22.5 per cent by volume of the total. Little sunflower (Helianthella uniflora) (8.5 per cent) and sticky geranium (Geranium viscosissimum) (7.5 per cent) followed dandelion in importance. Forbs (75.4 by volume) was the most important forage class for the summer period. Grass use was minor.

Fall

Three rumen samples were obtained from deer collected during the fall season: one in an upper slope sagebrush - grassland type, one in a Douglas fir type, and one in a mountain mahogany - Rocky Mountain juniper type. Mountain mahogany exceeded other plant species in amounts consumed. This plant comprised 54.5 per cent by volume of all the fall samples. On the basis of the three samples, different browse species constituted 73 per cent of the volume of all food materials. The species of plants utilized during the fall appeared to be largely determined by availability associated with migration. A rumen sample obtained from a deer collected on a high summer range was composed mostly of lupine (Lupinus spp.), Douglas fir (Pseudotsuga taxifolia) and grass. A sample from a deer collected on an intermediate Douglas fir range was largely Douglas fir and mountain mahogany. A deer collected on a lower elevation winter range yielded a rumen sample that was 98 per cent mountain mahogany.

Year-Long Food Habits

In the period immediately following their arrival on the winter range, the deer fed mainly on mountain mahogany. As the season progressed the percentage of this plant found in rumen samples decreased and plants such as rabbit brush, sages, and junipers increased. By early spring deer were utilizing plants that had not been used to any great extent earlier such as square stem phlox (Phlox bryoides), Kinnikinnick (Arctostaphalus uva-ursi), and dry grass. After grass began to grow in late April or early May, there was a change in diet from browse to grass and forbs. By May 30, forbs constituted about 90 per cent of the plants

utilized. Forbs were the most important item in the summer. Dandelion was the most important forb. Browse constituted somewhat more than 20 per cent of the summer diet but the species varied from those utilized in the winter and were mainly composed of shrubs associated with the willow - quaking aspen vegetational type. Lupine was an important item in the early fall. Grass also appeared to be more important at this time than in the summer. Morris et al (1957) stated that the November and December consumption of grass was high. As deer migrated from the higher to the lower portion of the Scudder Creek range there appeared to be a shift in browse use from big sage - to Douglas fir - to mountain mahogany.

Smith (1952) in a study of mule deer in Utah, stated that big sage was utilized by deer in the late summer, and that along with cliffrose (Cowania stansburiana) and bitterbrush (Purshia tridentata) provided more than four-fifths of the winter diet, with bitterbrush receiving the most use. Wilkins (1956) in the Bridger Mountains, Montana, found big sagebrush, bitterbrush, and Rocky Mountain juniper to be the most important food items in the winter (more than two-thirds of the diet for this season) with big sage providing the largest volume. Cowan (1947) Jasper Park, Canada, listed trees and shrubs as contributing 79 per cent of the December diet of mule deer. "Bearberry" (Arctostaphalus uva-ursa) alone furnished 58 per cent of the total foods in this study. Harris (1945) in South Dakota, also found that "bearberry" was the most utilized winter browse item for whitetail deer (Odocoileus virginianus macrourus). Smith (1952) rated grass as the most important food in the spring (90 per cent) and forbs more important than browse in the early summer, but

with browse exceeding forbs after mid-summer. Wilkins (1956) found forbs and grass to be of equal importance in the spring; forbs (more than 75 per cent of the total) to be the most important food item in the summer, and browse, especially bitterbrush, the most important in the fall.

Range Trend

Measurements indicate that mountain mahogany was utilized to a much greater degree than any other browse species. Aldous (1945), in a study of mule deer in Nevada, stated that deer used 100 per cent of the annual growth of this plant. On the Scudder Creek plot and transect, measurements of tagged mountain mahogany plants during the fall and spring seasons indicated that 100 per cent of the annual growth was removed in each of the three years measured, and in addition ^{there was} a mean decrease of 19 per cent (from spring of 1953 to spring 1956) in total inches of twigs on these plants. The mean annual increase (spring to fall) was 66 per cent for plants within the enclosure and 108 per cent for plants on the adjacent plot and along the transect. Statistical analysis of these data show a rather large sample standard deviation, probably due to personal error in measuring and variability of the growing seasons. However, a t-test helped confirm the existence of excessive use of mountain mahogany. A null hypothesis that the decrease in browse (amount utilized from fall to spring) was less than or equal to 70 per cent of the increase (annual growth from spring to fall) could be rejected at the one per cent level. Usage in excess of 70 per cent of annual growth over a three year period was assumed to be excessive.

A decline in the amount of this browse available was suggested to

some degree by the physical appearance of the deer. Each year by early spring, the hair was worn away from the faces and from behind the ears of deer observed at close range (Fig. 9). This loss of hair from the facial regions was attributed to browsing in the partially dead shrubs after the outer more easily accessible shoots had been removed.

Usage of other plants based on measurement data was as follows: gray horse brush 99, rubber rabbit brush 88, threetip sage 83, Rocky Mountain juniper 65, and big sage three per cent of the annual growth. Measurement data from the Lost Creek range coincided with that obtained from Scudder Creek with respect to plant usage and range trend.

There is evidence that an excessive population of deer is producing a definite change in the Scudder Creek winter range. Networks of trails throughout the slopes are apparently causing some erosion in the loose rocky soil. On steeper slopes, amid dead or partially dead mountain mahogany shrubs, small gullies and pediceled clumps of grass attest to the loss of soil (Fig. 10). This condition was first noticed after heavy spring rains in 1956. On some of the more level areas grass appears to be replacing dead browse plants (Fig. 11).

Deterioration of the range seems also to be reflected in a higher degree of disease and parasitism, a condition considered to be associated with poor diet. All deer collected between December and May were parasitized by larvae of the head bot fly (Cephenemyia jellisoni). There was a large number of ticks on a starving yearling collected in April. Cysticerci of tapeworms (Taenia sp.) were found in the back muscles of one deer, and three instances of deer infected with (Corynebacterium ovis)



Fig. 8. High-lined Rocky Mountain juniper in a mountain mahogany - Rocky Mountain juniper type in the vicinity of Scudder Creek.

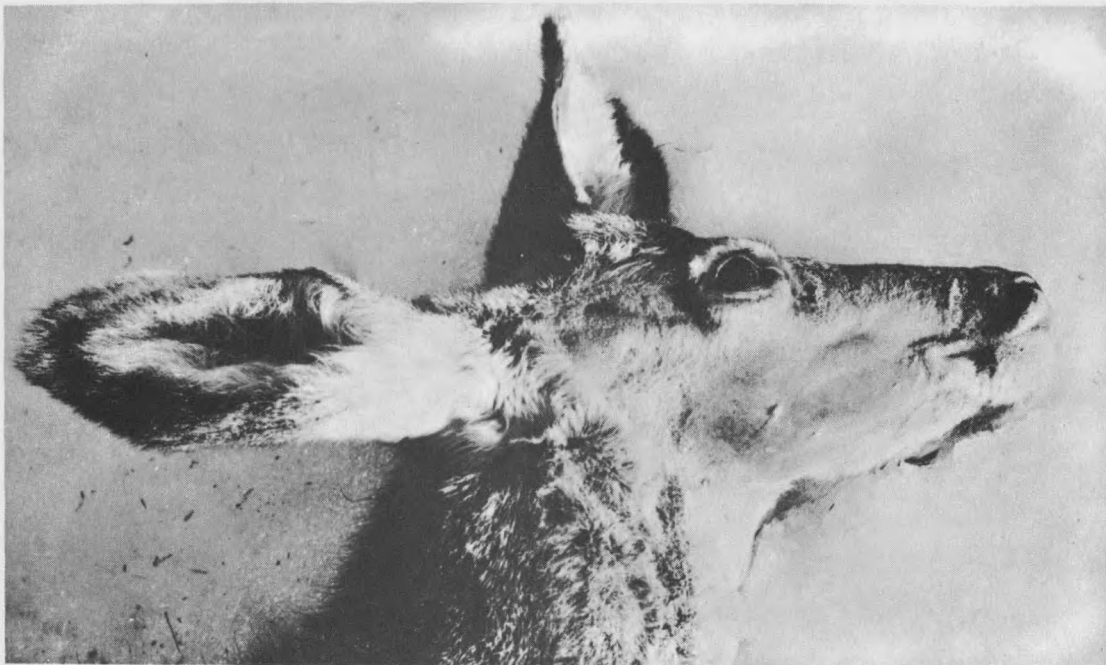


Fig. 9. A yearling deer collected in April with the hair worn away from the face.



Fig. 10. Partially dead mountain mahogany with an under-story of pediceled grass showing evidence of soil erosion.



Fig. 11. Dead mountain mahogany shrubs in the foreground, apparently, are being succeeded by grass.

were brought to the writer's attention by local hunters. Infections by C. ovis cause large amounts of pus to collect along the ribs and on the spinal column in the thoracic cavity, similar to infection by C. pyogenes as described by Longhurst et al (1952). One other case of infection, C. ovis, was the only instance of disease or parasitism from other ranges in the vicinity observed during the study.

Information from local residents suggests that the highest rate of starvation occurred just prior to the study. However, malnutrition, as confirmed by bone marrow samples, was the attributed cause of death of seven deer within one half mile of the Scudder Creek enclosure. Three of the carcasses were found in the spring of 1953 and four in the spring of 1956. This continued starvation would indicate that the deterioration of the range is still in process, also that the deer population density of 0.23 per acre in the mountain mahogany - Rocky Mountain juniper type and 0.08 per acre in the lower elevation grassland type (as determined by pellet-group count) is probably still too large for the present carrying capacity of the range. Robinette et al (1952) found that despite heavy losses of deer on one of the study sites prior to the time of that study, the range was still overstocked. Such seems to be the case on Scudder Creek. Starvation losses before and during the study coupled with greatly expanded hunting seasons which began with 100 special permits (either sex) in addition to the regular 31 day buck season in 1952 and culminated in a two deer either-sex season of 12 weeks duration in 1956, had apparently failed, at the termination of this study, to reduce the herd to numbers compatible with the available forage.

SUMMARY

1. A study of mule deer food habits, range use, and effects on the range was conducted at various times from the spring of 1953 to 1957. The main study area encompassed the southern portion of the Pioneer Mountains in Beaverhead County, Montana.

2. Six vegetational types were recognized and described: alpine fir - whitebark pine, Douglas fir, lodgepole pine, mountain mahogany - Rocky Mountain juniper, three variations of sagebrush - grassland, and willow - quaking aspen type.

3. Use of vegetational types at different seasons was determined by direct observations of deer from the ground and three aerial surveys.

4. Browse preference was determined by tracking deer through fresh snow. Incidence of use was indicated by leaves on the snow beneath the plants.

5. Food habits were determined by analysis of 24 rumen samples. Mountain mahogany was the key winter food. There was evidence that an overpopulated and depleted winter range led to the exhaustion of mountain mahogany browse before spring. Early spring rumen samples contained plants that had not been used to any great extent earlier such as square stem phlox and kinnikinnick. Grass and forbs were important in the spring. Forbs constituted most of the summer diet. Summer browse types differed from those utilized in the winter. Lupine and grass were important in the early fall. Mountain mahogany and Douglas fir comprised the bulk of the late fall diet.

6. Range trend was determined by measurements at different seasons

of tagged browse plants, and also by other recorded ecological data. The indicated trend was downward as evidenced by excessive use of mountain mahogany, soil erosion, changes in vegetation, parasitism, disease and starvation.

Population density for the winter of 1956-57 (0.23 deer on the mountain mahogany type and 0.08 deer per acre on the lower elevation sagebrush - grassland type) was determined by a pellet group count. Some of the aspects of starvation and the deer population are discussed briefly.

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