Ecological relationships of mule deer in the Bridger Mountains, Montana with special reference to daily and seasonal movements
by Kenneth Lee Hamlin

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

Abstract:
A study was conducted in the Bridget mountains of southwestern Montana from April through December 1973 to provide current information on the ecological relationships of mule deer. Emphasis was placed on the relocation of deer which were individually marked on a west slope winter range. Vegetation was quantitatively sampled on the east slope to enable evaluation of deer range use. Vegetation on the west slope had been previously described. During spring, 87 percent of mule deer on the west slope were in the Bunchgrass Prairie Zone. Deer were more equally distributed in all vegetation zones during summer. Most mature bucks observed were in the Alpine Zone while the highest percentage of does with fawns were in the Douglas Fir Zone. During September and October on the east slope and throughout fall on the west slope, the Douglas Fir Zone received the most deer use. Mule deer food habits were determined by examination of 70 feeding sites and 28 rumen samples. Feeding sites examined on the west slope indicated that forbs constituted 81 percent of the summer diet and browse constituted 54 percent of the fall diet. Feeding sites examined on the east slope during September and October indicated an 82 percent of browse within the Douglas Fir Zone. Kidney fat indices from hunter-killed deer were 32, 67 and 132 percent for fawns, does and bucks respectively. A low fawn/ doe ratio of 46/100 during December 1973 and a 24 percent loss of fawns during the mild winter of 1973-74 were noted. The population on the; west slope winter range was estimated at slightly under 200 deer which is substantially less than the number indicated for 1955-56. Average activity radii for all deer were 769, 456, 476 and 418 yards in spring, summer, fall and winter respectively. During summer, marked deer were present within all vegetation zones on the west slope and 2 marked deer were located on the east slope. Summer relocations of marked deer ranged from 1/4 to 16 miles from the winter range. Most marked deer occupied areas near the winter range during spring and fall. Tracks and observations of deer indicated that some deer moved from the east to the west slope during fall. Twenty-eight deer were known to have been taken by 90 hunters within the area between Tom Reese and North Cottonwood Creeks during the fall of 1973.

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ECOLOGICAL RELATIONSHIPS OF MULE DEER IN THE BRIDGER MOUNTAINS, MONTANA WITH SPECIAL REFERENCE TO DAILY AND SEASONAL MOVEMENTS

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

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF TABLES
(Continued)

LIST OF FIGURES

ABSTRACT

A study was conducted in the Bridger mountains of southwestern Montana from April through December 1973 to provide current information on the ecological relationships of mule deer. Emphasis was placed on the relocation of deer which were individually marked on a west slope winter range. Vegetation was quantitatively sampled on the east slope to enable evaluation of deer range use. Vegetation on the west slope had been previously described. During spring, 87 percent of mule deer on the west slope were in the Bunchgrass Prairie Zone. Deer were more equally distributed in all vegetation zones during summer. Most mature bucks observed were in the Alpine Zone while the highest percentage of does with fawns were in the Douglas Fir Zone. During September and October on the east slope and throughout fall on the west slope, the Douglas Fir Zone received the most deer use. Mule deer food habits were determined by examination of 70 feeding sites and 28 rumen samples. Feeding sites examined on the west slope indicated that forbs constituted 81 percent of the summer diet and browse constituted 54 percent of the fall diet. Feeding sites examined on the east slope during September and October indicated an 82 percent of browse within the Douglas Fir Zone. Kidney fat indices from hunter-killed deer were 32, 67 and 132 percent for fawns, does and bucks respectively. A low fawn/doe ratio of 46/100 during December 1973 and a 24 percent loss of fawns during the mild winter of 1973-74 were noted. The population on the west slope winter range was estimated at slightly under 200 deer which is substantially less than the number indicated for 1955-56. Average activity radii for all deer were 769, 456, 476 and 418 yards in spring, summer, fall and winter respectively. During summer, marked deer were present within all vegetation zones on the west slope and 2 marked deer were located on the east slope. Summer relocations of marked deer ranged from ¼ to 16 miles from the winter range. Most marked deer occupied areas near the winter range during spring and fall. Tracks and observations of deer indicated that some deer moved from the east to the west slope during fall. Twenty-eight deer were known to have been taken by 90 hunters within the area between Tom Reese and North Cottonwood Creeks during the fall of 1973.

INTRODUCTION

The first comprehensive study of Rocky Mountain mule deer *(Odocoileus hemionus hemionus)* in the Bridger Mountains of southwestern Montana was conducted by Wilkins (1957) during 1955 and 1956 when deer had reached a peak in numbers and were damaging agricultural products. His study mainly concerned the range use and food habits of the population using the Armstrong winter range on the west slope of the mountains. Since Wilkins' study, deer numbers have declined on this area.

During 1972 and 1973, Schwarzkoph (1973) conducted a study on this same area to obtain current information for comparison with the results of the earlier study by Wilkins. To enable a more accurate study of deer movements, 21 deer were marked for individual identification.

My work, conducted from spring through fall of 1973, continued the study initiated by Schwarzkoph. I placed more emphasis on daily and seasonal movements, which was aided by the availability of marked deer from the earlier study. I also obtained information on food habits, population characteristics and range use. Information from the two previous studies and my study was compared to evaluate past and present ecological relationships.

METHODS

Vegetation

The vegetation on the west slope of the Bridger Mountains within the study area has been described by Wilkins (1957) and Schwarzkoph (1973). I used vegetation zones and types described by Schwarzkoph (1973) to evaluate the range use habits of deer on the west slope of the mountains.

Fourteen sites were examined on the east slope of the mountains to compare vegetation between slopes and to provide a basis for evaluating use of range. Plant species less than three feet in height were quantitatively sampled on each site with a method similar to that described by Daubenmire (1959). Canopy coverages and frequencies of species were recorded within each of twenty 2x5 decimeter plots placed at five foot intervals along a one hundred foot line at each site. General observations of vegetation were also made. Botanical nomenclature follows Booth (1950), Booth and Wright (1959) and Booth (1972).

Animal Range Use and Movements

In the winters of 1972 and 1973, Schwarzkoph individually marked twenty-one mule deer on the Armstrong winter range. All were tagged in each ear with standard ½ inch wide eartags. Sixteen of these were additionally marked with three inch wide neckbands of various colors and codes; three with 1½ inch wide permatags in their ears; one was equipped with a radio transmitter and one received no additional

markings. The localities of relocations of marked deer were plotted on aerial photographs of the area.

In spring, summer and fall, observations were made while traversing the west slope on foot, primarily in the area of and above the winter range. A camp was established in Tom Reese Basin (Fig. 1), a centrally located area above the winter range, for use in summer. In late summer and fall, observations were extended to the east slope of the mountains where a vehicle was also used. During the summer and fall, nine aerial flights were made to locate marked and unmarked deer. Deer were classified as to age, sex, markings and activity. The area occupied was classified as to vegetation zone and type, slope, exposure, elevation and location.

Food Habits

Food habits for deer and cattle were determined by examination of feeding sites. I specifically examined cattle food preferences in Tom Reese Basin, where approximately forty-five cows grazed for a month. Feeding sites were examined as soon as possible after being vacated by the animal. The use of one leaf or stem of a forb, an individual leader of browse or one rooted stem of grass was considered one instance of use as described by Cole and Wilkins (1958). When practical, the availability of plant taxa on feeding sites was determined by recording the canopy coverages and frequencies of species within ten to twenty 2x5 decimeter plots per site as previously described. Plants from the

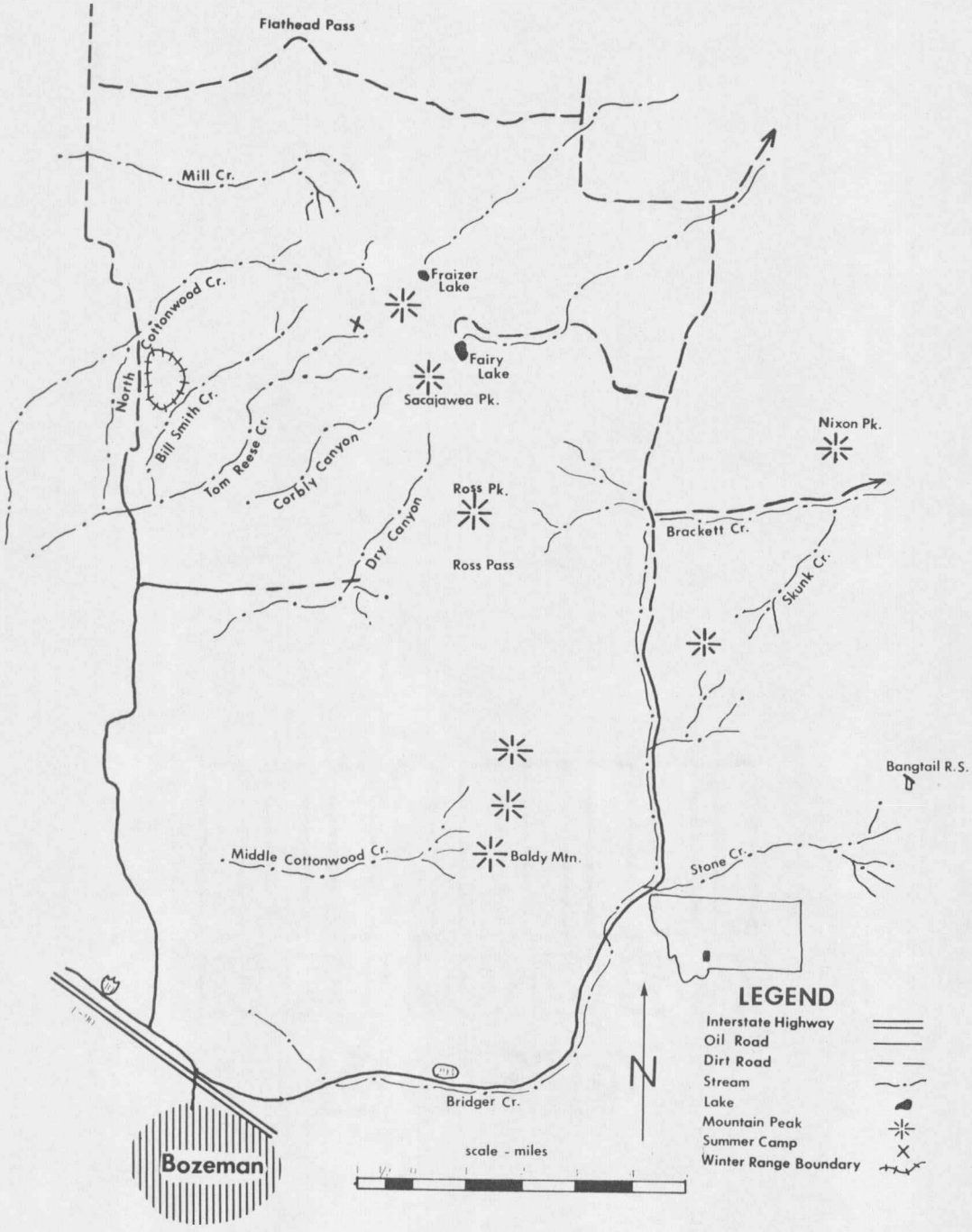

Figure 1. Map of the study area, showing major features.

study area were collected and identified to aid in determining plant species used by animals.

One quart rumen samples were collected from each of five winter-killed and twenty-three hunter-killed deer. The contents were analyzed according to the technique described by Wilkins (1957). Analysis of data from feeding sites and rumens followed the aggregate percentage method by Martin et al. (1946).

Population Characteristics and Condition

Population characteristics and productivity were determined from male/female, fawn/female and fawn/adult ratios. Reproductive tracts from two hunter-killed does were examined. Kidneys and the surrounding fat were collected from each of sixteen hunter-killed deer and were evaluated with the method described by Riney (1955) to indicate animal condition. The ages of hunter-killed deer were estimated by the eruption and wear of mandibular teeth (Robinette et al. 1957).

DESCRIPTION OF AREA

The main feature of the study area is the Bridger range which extends from Bridger Canyon, twenty-three miles northward, ending at Blacktail Mountain (Fig. 1). The highest point is Sacagawea Peak with an elevation of 9,665 feet.

McMannis (1955) described the Bridger range as exposed sedimentary rock from Beltian time to Recent. Specific rock types are sandstone, limestone, shale, siltstone and conglomerates. Middle Cambrian Flathead sandstone is underlain by coarse Beltian arkoses in the northern part of the range and by metamorphics in the southern part. The range is characterized by folds and faults. Valley fill consists of Quaternary deposits of gravel fans, river gravels and muds, talus, morainal deposits and avalanche debris. The area to the north of Ross Peak shows some evidence of glaciation.

The west slope of the range is characterized by east-west ridges dropping off sharply into deep canyons and stream bottoms on the north and south. A change in elevation of one thousand feet within ½ mile is not uncommon. The east slope drops off sharply within ¼ mile of the divide but then slopes gently downward (Fig. 2). This slope does not have the abrupt contrasts of ridges and canyons as does the west slope.

Since a major objective of my study was to locate marked deer regardless of their location, definite boundaries were not established for the study area. Most observational trips on the west slope were

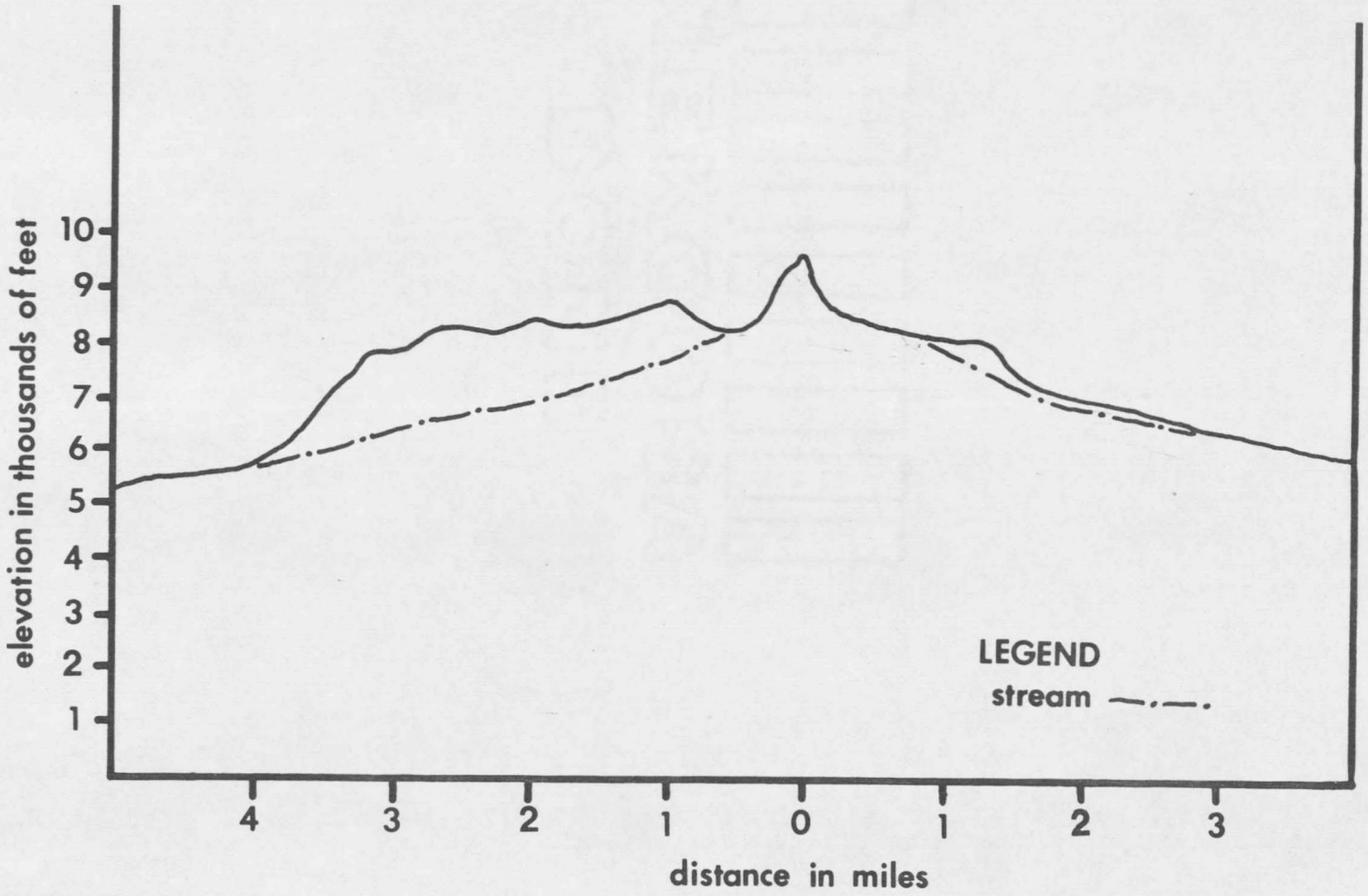

Figure 2. An east-west cross-section through the Bridger range in the area of the Armstrong winter range.

in the area bounded by Mill Creek Canyon on the north and by Dry Canyon on the south. This area included the Armstrong winter range and two major creeks, North Cottonwood and Tom Reese. Some field work was also conducted on the east slope within the triangular area bounded by lines connecting Flathead Pass, Ross Pass and the Bangtail Ranger Station. Major features within this area are Fairy Lake, Fairy Creek, Cache Creek and the north and middle forks of Brackett Creek (Fig. 1).

Schwarzkoph (1973) described four vegetation zones and several vegetation types within the west slope study area. Areas between elevations of 9,665 and 8,600 feet are within the Alpine Zone; important types are the Alpine Meadow and Spruce-Fir (Open Canopy) Types (Fig. 3). Occupying a belt from 8,600 to 8,000 feet and extending to lower elevations in creek bottoms and on north slopes is the Spruce-Fir Zone. Important types within this zone are the Spruce-Fir (Closed Canopy) Type, Spruce-Fir (Open Canopy) Type and Grass-Forb Meadow Type (Fig. 4). Extending from the Spruce-Fir Zone to the valley floor and making up the bulk of the forested area is the Douglas Fir Zone (Fig. 5). Important types are the Douglas Fir Type, the Lodgepole Pine Type and the Sagebrush-Bitterbrush Type. The valley floor was considered to be in the Bunchgrass Prairie Zone and included Sagebrush-Grassland, Agricultural, Fescue-Wheatgrass and Creekbottom Types (Fig. 5).

Weather conditions for the area may be found in Appendix Table 15. Climatological data (U. S. Department of Commerce) were included for a

Figure 3. Spruce-Fir (Open Canopy) Type and Alpine Meadow Type within the Alpine Zone.

Figure 4. Spruce-Fir (Open Canopy) Type interspersed with Grass-Forb Meadow Type in the foreground. The Douglas Fir Zone is in the background.

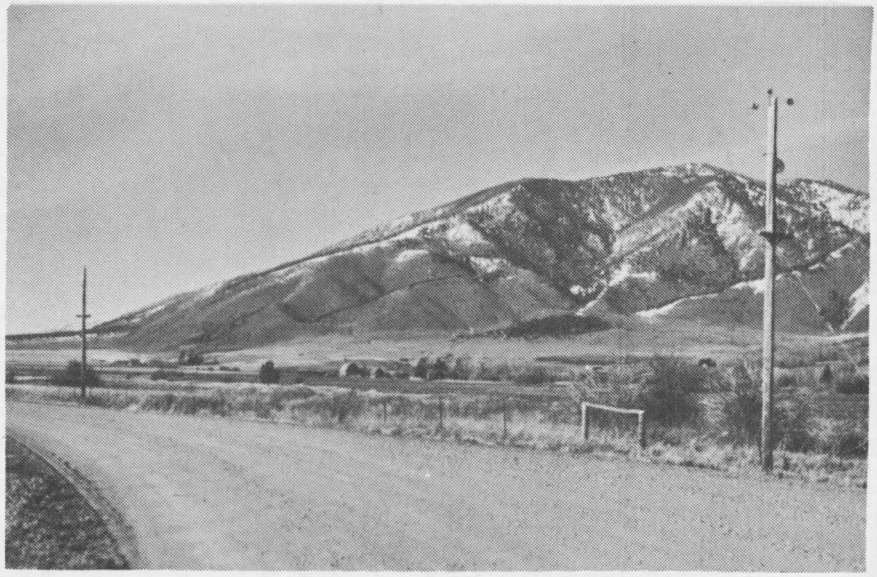

Figure 5. The Armstrong winter range, with the Bunchgrass Prairie Zone in the foreground and the Douglas Fir Zone on the slopes.

twenty-two year period (1952-1973) for two U. S. Weather Bureau Stations. The station at the Belgrade airport was located 10 airline miles southwest of the study area at an elevation of 4,451 feet and within the Bunchgrass Prairie Zone. The other station was located 12 airline miles northeast of Bozeman at an elevation of 5,950 feet and within the Douglas Fir Zone on the east side of the Bridger range. The mean annual temperature and precipitation at the Belgrade station are 41.83 degrees F and 13.43 inches respectively. The mean temperature and precipitation for 1973 were 42.03 degrees F and 15.66 inches respectively. January is the coldest month with a mean temperature of 17.1 degrees F while July is the warmest month with a mean temperature of 66.7 degrees F. June receives the most precipitation with a mean of 2.57 inches while February receives the least precipitation with a mean of .38 inches. Extreme temperatures for 1973 were 100 degrees F in July and -35 degrees F in January.

The mean annual temperature and precipitation at the Bozeman 12NE station are 37.9 degrees F and 34.72 inches respectively. The mean temperature and precipitation for 1973 were 34.1 degrees F and 33.55 inches respectively. January is the coldest month with a mean temperature of 20.1 degrees F and July is the warmest month with a mean temperature of 58.1 degrees F. June receives the most precipitation with a mean of 4.77 inches while July receives the least precipitation with a mean of 1.74 inches. Extreme temperatures in 1973 were 88 degrees F in July and -35 degrees F in January.

RESULTS

Vegetation

The vegetation within the area studied on the east slope of the Bridger range was classified into three zones; Douglas Fir, Spruce-Fir and Alpine. Species composition for those types quantitatively sampled within these zones is given in Table 1. Sampling was conducted in September and species composition reflects late summer conditions.

Douglas Fir Zone

This is the most extensive zone and occurs primarily between elevations of 5,500 and 7,200 feet. Five types are described.

Douglas Fir Type: Douglas Fir *(Pseudotsuga menziesii)* was the dominant tree within this type. Elk sedge *(Carex geyerii)* was an important plant (Table 1). Timothy *(Phleum pratense)*, bluebunch wheatgrass *(Agropyron spicatum)* and mountain brome *(Bromus carinatus)* occurred in small amounts. Lupine *(Lupinus* spp.), strawberry *(Fragaria virginiana)* and yarrow *(Achillea millefolium)* were the important forbs. Shrubs were the dominant class of low-growing vegetation and included snowberry *(Symphorocarpos* spp.), white spirea *(Spirea betulifolia)*, Oregon grape *(Berberis repens)* and common juniper *(Juniperus communis)*.

Sagebrush Park Type: Big sagebrush *(Artemisia tridentata)* was the dominant shrub species with serviceberry *(Amalanchier alnifolia)* and chokecherry *(Prunus virginiana)* present in lesser amounts (Table 1).

TABLE 1. PERCENT CANOPY CONVERAGES AND FREQUENCIES OF LOW-GROWING TAXA FOR VEGETATION TYPES AS DETERMINED BY EXAMINATION OF TWENTY 2 x 5 DECIMETER PLOTS ON EACH OF 14 SITES.

	DOUGLAS FIR ZONE				SPRUCE-FIR ZONE		ALPINE ZONE
Taxa[1]	Douglas Fir Type 2 Sites	Sagebrush Park Type 2 Sites	Grass-Forb Park Type 3 Sites	Logged Type 3 Sites	Spruce-Fir Forest Type 1 Site	Grass-Forb Meadow Type 2 Sites	Alpine Meadow Type 1 Site
GRASSES AND SEDGES:							
Agropyron spicatum	tr./ 2	5/58[2]		tr.[3]/3			
Agropyron trachycaulum				tr. /2		2/25	
Agropyron spp.			2/33				1/20
Elymus glacus				2/18			
Bromus carinatus	tr./2	tr./5	4/52	tr./13		1/30	
Calamogrostis rubescens				7/22	16/70		
Carex geyeri	19/65	13/45		17/45	8/25		
Carex spp.		1/8	5/52			tr./2	2/20
Festuca idahoensis		3/25				tr./2	
Koeleria cristata		1/8					2/35
Phleum pratense	1/8	1/10	5/40	2/20		tr./8	
Poa alpinum							1/30
Poa compressa			28/67				
Unknown grasses	1/23	tr./5				1/15	
Total Grasses and Sedges	23/75	23/100	45/100	31/100	25/85	5/70	6/80
FORBS:							
Achillea millefolium	2/30	tr./20	3/55	2/23		tr./15	7/100
Agroseris glauca						1/8	
Aquilegia flavescens						1/5	
Arenaria spp.		tr./12					

TABLE 1 (CONTINUED)

Taxa	DOUGLAS FIR ZONE				SPRUCE-FIR ZONE		ALPINE ZONE
	Douglas Fir Type 2 Sites	Sagebrush Park Type 2 Sites	Grass-Forb Park Type 3 Sites	Logged Type 3 Sites	Spruce-Fir Forest Type 1 Site	Grass-Forb Meadow Type 2 Sites	Alpine Meadow Type 1 Site
FORBS (continued)							
Artemisia michauxiana							3/20
Aster conspicuus				11/58			
Aster engelmanni						2/8	
Aster integrifolius			2/5			11/50	
Balsamorrhiza sagittata	tr./ 2	1/5					
Bupleurum americanum							1/15
Cerastium arvensis	tr./ 2	1/20	tr./8	tr./2		tr./2	1/45
Cirsium arvense	1/ 8		7/46	1/35			
Cirsium foliosum							2/10
Cymopterus bipinnatus							1/20
Delphinium occidentalis						1/15	
Eriogonum umbellatum		2/10					
Erythronium grandiflorum						tr./8	2/35
Fragaria virginiana	4/23		1/7	1/7	3/50		
Fraseria speciosa							1/10
Galium boreale	tr./8	tr./5	1/13	1/16	1/35	3/48	2/35
Geranium viscosissimum			2/30			4/28	
Hackelia floribunda			2/20			tr./2	
Helianthella uniflorus						10/35	
Leguminosae			tr./2			tr./13	2/15
Linum perenne	tr./2						2/45
Lomatium cous							1/10
Lupinus spp.	2/13	1/10	1/3			2/5	
Mertensia oblongifolia						1/8	
Potentilla gracilus	tr./5	tr./5	5/53				

TABLE 1 (CONTINUED)

Taxa	DOUGLAS FIR ZONE				SPRUCE-FIR ZONE		ALPINE ZONE
	Douglas Fir Type 2 Sites	Sagebrush Park Type 2 Sites	Grass-Forb Park Type 3 Sites	Logged Type 3 Sites	Spruce-Fir Forest Type 1 Site	Grass-Forb Meadow Type 2 Sites	Alpine Meadow Type 1 Site
FORBS (continued)							
Phlox hoodii		1/10					
Rudbeckia occidentalis			1/5			3/8	
Ranunculus escholtzii						1/8	
Sedum lanceolatum							1/25
Senecio serra						1/13	
Senecio spp.							5/50
Taraxicum officinale	tr./5		tr./5		tr./10	1/15	
Thalactium venulosum					4/30	tr./5	
Trifolium haydenii							8/85
Trifolium spp.			tr./2		2/10		
Valariana sitchensis						1/15	
Unidentified forbs	2/20		2/35			3/33	
Total Forbs	14/65	10/53	28/100	18/88	12/80	48/100	33/90
BROWSE:							
Abies lasiocarpa					15/30		
Acer glabrum	1/2						
Amelanchier alnifolia	tr./ 2	4/23		tr./ 2			
Artemisia tridentata		10/45					
Berberis repens	4/35	1/5		5/48	1/5		
Juniperus communis	4/5						
Potentilla fruiticosa							1/5
Prunus virginiana		3/23					
Pseudotsuga menziessi					1/10		

TABLE 1. (CONTINUED)

Taxa	DOUGLAS FIR ZONE				SPRUCE-FIR ZONE		ALPINE ZONE
	Douglas Fir Type 2 Sites	Sagebrush Park Type 2 Sites	Grass-Forb Park Type 3 Sites	Logged Type 3 Sites	Spruce-Fir Forest Type 1 Site	Grass-Forb Meadow Type 2 Sites	Alpine Meadow Type 1 Site
BROWSE (continued)							
Rosa spp.	tr./5	2/23	tr./ 2	1/7	2/5		
Spirea betulifolia	9/38	1/10		3/38	tr./ 5	2/20	
Symphoricarpos spp.	13/63	1/18	tr./ 2	12/47	2/10		
Total Browse	30/88	23/75	tr./ 3	23/77	21/60	2/20	1/5
BARE GROUND	tr./2	23/68	10/78	9/28		35/93	23/100
ROCK	2/40	6/53		2/8		6/40	21/90
LITTER	59/40	74/78	41/95	39/82	55/95	25/100	9/95
Selaginella densa							3/15

[1]Includes taxa with at least 0.5% canopy coverage or 5% frequency on at least one type.
[2]Canopy coverage (% area covered)/Frequency (% occurrence among plots).
[3]tr. = trace; a value less than 0.5% canopy coverage.

Bluebunch wheatgrass and Idaho fescue *(Festuca idahoensis)* were the major grasses present. Forbs occurred in minor amounts with sulfer eriognum *(Eriognum umbellatum)* most common. Canada bluegrass *(Poa compressa)* and sticky geranium *(Geranium visicossimum)* did not occur on the sample sites but were present on distrubed sites within this type.

Grass-Forb Park Type: Site features and species composition indicate that this type occurs mainly on disturbed sites. Grass and grass-like plants were the dominant vegetation. Canada bluegrass was the predominant grass (Table 1). Other important grasses were timothy and mountain brome. Common forbs were Canada thistle *(Cirsium arvense)*, northwest cinquefoil *(Potentilla gracilus)* and yarrow. Shrubs were rare with rose (*Rosa* spp.) and snowberry occurring in trace amounts.

Logged Type: The gently rolling topography of the east slope is much more suited to logging than is the west slope. Much of the logging activity on the National Forest in the Brackett Creek area was conducted in the years 1961 to 1964 (John Heckman, personal communications). Dates of logging activities on privately owned lands are unknown. Logged areas varied from those completely clearcut to those with scattered trees remaining (Fig. 6).

Elk sedge was the predominant plant within this type (Table 1). Grasses present included pinegrass *(Calamogrostis rubescens)*, timothy and wheatgrasses *(Agropyron* spp.). Showy aster *(Aster conspicuus)* was the dominant forb and yarrow, strawberry, Canada thistle and bedstraw

Figure 6. Logged Type within the Douglas Fir Zone.

(Galium boreale) were present in lesser amounts. Important shrub species were snowberry, Oregon grape and white spirea.

Lodgepole Pine Type: Lodgepole pine (*Pinus contorta)* was the dominant species in this type. No quantitative data were obtained, but general observations suggested that thinleaved huckleberry *(Vaccinium membranaceum)*, low red huckleberry *(Vaccinium scoparium)*, white spirea and Oregon grape were important shrub species. Heartleaf arnica *(Arnica cordifolia)* and meadow rue *(Thalictrum venulosum)* were common forbs. Elk sedge and pinegrass were other important understory species.

Spruce-Fir Zone

This was a narrow zone primarily occupying the area between elevations of 7,200 and 8,400 feet but extending somewhat lower on moist north slopes. There were two important types.

Spruce-Fir Forest Type: The dominant trees were alpine fir *(Abies lasiocarpa)* and limber pine *(Pinus flexilus)*. Engelman spruce *(Picea engelmanni)* was less common and Douglas Fir occurred at lower elevations within this type. Pinegrass and elk sedge were important understory species (Table 1). Meadow rue and strawberry were the predominant forbs. Bedstraw, dandelion *(Taraxicum officinale)* and clover *(Trifolium* spp.) were present in lesser amounts. Oregon grape, rose, snowberry and white spirea were present in minor quantity. Present, but not occurring in the plots were yellow columbine *(Aquilegia flavescens)*

and redshoot gooseberry *(Ribes setosum)*.

Grass-Forb Meadow Type: This type occurred as openings in the spruce-fir forest. Forbs were the dominant vegetation class in the sites sampled. Thickstem aster *(Aster integrifolius)*, oneflower helianthella *(Helianthella uniflorus)*, sticky geranium and bedstraw were the most important forbs (Table 1). Grasses were of minor importance. Slender wheatgrass *(Agropyron caninum)* and mountain brome *(Bromus carinatus)* were present in plots. Shrubs were uncommon and only white spirea was found in plots. Bare ground made up a major portion of sample plots.

Alpine Zone

The alpine zone is limited in vegetational cover because much of the area consists of perpendicular rock faces and talus slopes. This zone occupies the area between elevations of 8,400 and 9,665 feet. Two types were recognized.

Alpine Meadow Type: Forbs were the dominant class of vegetation with Hayden clover *(Trifolium haydenii)* and yarrow predominant (Table 1). Michaux sagebrush *(Artemisia michauxiana)* and groundsel *(Senecio* spp.) were other important forbs. Junegrass *(Koeleria cristata)*, alpine bluegrass *(Poa alpina)* and wheatgrass were common grass species. Sedges were also important. Shrubs were uncommon with only shrubby cinquefoil *(Potentilla fruticosa)* present in the sample plots. Bare ground and

rock were important components of sample plots while litter made up a lower percentage cover in this type than any other type.

Spruce-Fir (Open Canopy) Type: Tree species present were alpine fir, limber pine and Engelmann spruce. These species occurred as clones or islands. Grasses present were alpine bluegrass and slender wheat grass. Hayden clover, yellow columbine and green gentian *(Frasera speciosa)* were common forbs. Redshoot gooseberry was the only shrub noted.

Range Use

During the study, 2,920 and 512 observations of mule deer were recorded from the ground and air respectively, according to vegetation zones and types. All vegetation zones could not be covered during one trip, except by air. The percentage of deer in each zone was determined from aerial observations; the use of vegetation types was determined from ground and aerial observations combined (Tables 2 and 3).

West Slope

Spring (April-May): Comparison of the numbers of deer observed per trip in the Bunchgrass Prairie Zone with the population estimates of this herd by Schwarzkoph (1973) indicated that a majority of the population was using the Bunchgrass Prairie Zone. No aerial observations were made during this period to determine the relative distribution of deer within vegetation zones.

TABLE 2. PERCENT OF GROUND OBSERVATIONS OF MULE DEER ON THE WEST SLOPE BY VEGETATION ZONE AND TYPE; APRIL 1973 THROUGH DECEMBER 1973.

Vegetation Zone and Type	SPRING			SUMMER				FALL			
	Apr.	May	Season	July	Aug.	Sept.	Season	Oct.	Nov.	Dec.	Season
BUNCHGRASS PRAIRIE ZONE											
Sagebrush-Grassland Type	2	1	1								
Agricultural	73	30	53								
Fescue-Wheatgrass	9	61	33								
Creek Bottom						4	1	5	1	tr.[1]	1
Total	84	92	87	—	—	4	1	5	1	tr.	1
DOUGLAS FIR ZONE											
Douglas Fir Type		3	2	3		4	2	33	66	32	38
Sagebrush-Bitterbrush	15	5	10	5			1	2	14	20	17
Juniper	2		1						1	7	5
Fescue-Wheatgrass				1			tr.		5	3	3
Bitterbrush										3	2
Sagebrush-Grassland											
Douglas Fir-Sagebrush Park				1			tr.	4	11	35	26
Lodgepole Pine									2		tr.
Total	17	8	13	10	—	4	4	39	99	100	91
SPRUCE-FIR ZONE											
Spruce-fir (Closed Canopy) Type				1	tr.		tr.				
Spruce-fir (Open Canopy)				6	5	17	7	12			2
Willow Bottom				14	9	7	10				
Sedge Meadow											
Sedge-Grass Meadow											
Grass-Forb Meadow				19	58	42	43	20	—	—	3
Total				39	72	66	60	32			5
ALPINE ZONE											
Spruce-fir (Open Canopy) Type				20	6	11	12	11			2
Alpine Meadow				31	22	15	24	13	—	—	2
Total				51	28	26	36	24			4
Number of Deer Observations	924	813	1,737	117	216	81	414	93	100	451	644
Percent of Deer Observations	32	30	62	4	8	3	15	3	4	16	23

[1]tr. = trace, less than 0.5% of the total deer occurring in a zone or type during a month or season.

TABLE 3. PERCENT OF AERIAL OBSERVATIONS OF MULE DEER ON THE WEST SLOPE BY VEGETATION ZONE AND TYPE; JULY 1973 THROUGH DECEMBER 1973.

Vegetation Zone & Type	July	Aug.	Sept.	Season	Oct.	Dec.	Season
BUNCHGRASS PRAIRIE ZONE							
Sagebrush-Grassland Type							
Agricultural							
Fescue-Wheatgrass	15	17	6	12	2		1
Creek Bottom							
Total	15	17	6	12	2		1
DOUGLAS FIR ZONE							
Douglas Fir Type	34		62	42	77	55	69
Sagebrush-Bitterbrush	12	25		8		5	2
Juniper							
Fescue-Wheatgrass						12	4
Bitterbrush							
Sagebrush-Grassland							
Douglas Fir-Sagebrush							
Parks						26	9
Lodgepole Pine			12	5	5	3	4
Total	46	25	72	55	82	101	88
SPRUCE-FIR ZONE							
Spruce-Fir (Closed							
Canopy) Type	6	58		8			
Spruce-Fir (Open Canopy)			4	2	7		5
Willow Bottom							
Sedge Meadow							
Sedge-Grass Meadow							
Grass-Forb Meadow	1		16	8	7		5
Total	7	58	20	18	14		10
ALPINE ZONE							
Spruce-Fir (Open							
Canopy) Type	1			1	2		1
Alpine Meadow	31			15			
Total	32			16	2		1
Number of Deer Observations	59	12	49	120	320	172	492
Percent of Deer Observations	10	2	8	20	52	28	80

Deer were active throughout the day in April and May. Most of my time was spent in the Bunchgrass Prairie Zone where the deer were easily observable. Eighty-seven percent of all deer observations were in the Bunchgrass Prairie Zone and thirteen percent were in the Douglas Fir Zone (Table 2). The Agricultural Type within the Bunchgrass Prairie Zone was the most used type during April. Plant taxa in the Agricultural Type, including alfalfa *(Medicago sativa)*, winter wheat *(Triticum aestivum)*, smooth brome *(Bromus inermis)* and orchard grass *(Dactylis glomerata)*, were among the first species to "green-up". Deer used the agricultural fields in groups numbering up to 100 during April and early May. By May, forbs were "greening-up" on the Fescue-Wheatgrass Type and deer use shifted toward this type, which was the most used type for this month. The Sagebrush-Bitterbrush Type within the Douglas Fir Zone received moderate use, mostly in April.

After May 13th, the numbers of deer observed decreased dramatically. Almost all deer observed throughout the rest of May were males.

Summer (July-Sept.): Aerial observations indicated that deer were well dispersed during the summer and showed greater use of the Douglas Fir and Bunchgrass Prairie Zones than was shown by ground surveys (Tables 2 and 3). They indicated that some deer used the Bunchgrass Prairie Zone all summer since deer were observed there on four of five flights. A range of zero to eighteen percent and an average of twelve percent of the deer observed per flight were in this zone. Deer were

observed within the Douglas Fir Zone on all five flights. A range of 25 to 100 percent and an average of 55 percent of the deer observed per flight were in this zone. Deer were observed in the Spruce-Fir Zone on three of five flights. A range of zero to fifty-eight percent and an average of eighteen percent of the deer observed per flight were in this zone. Deer were observed in the Alpine Zone on one of the five flights, when 61 percent of the deer observed were in this zone. Observations of fresh deer tracks and droppings during ground surveys also indicated that deer were present in all zones throughout the summer.

Combined data from aerial and ground surveys indicated that deer were differentially distributed by age and sex within the vegetation zones. I observed 56 fawns per 100 females (27 females and 15 fawns) within the Douglas Fir Zone, but only 5.4 fawns per 100 females (187 females and 10 fawns) within the Spruce-Fir Zone. Observations within the Alpine Zone included 26 females and no fawns, while only one female and two fawns were observed in the Bunchgrass Prairie Zone. This, plus the fact that 46 fawns per 100 females were observed on the winter range during December indicates that females with fawns predominantly used the Douglas Fir Zone during the summer.

Most deer seen during the summer were observed in the hours near dawn and dusk. Deer were most active at this time with feeding and moving the predominant activities.

On July 2nd, four newborn fawns were found; one in the Sagebrush-Bitterbrush Type, one in the Douglas Fir-Sagebrush Park Type and two at the lower edge of the Douglas Fir Type.

The deer using the Bunchgrass Prairie Zone were found in the Fescue-Wheatgrass and Creek Bottom Types. Eighty-one percent of all deer observed in this zone were males (Appendix Table 17).

Most of the deer observed in the Douglas Fir Zone were in the Douglas Fir Type. The Sagebrush-Bitterbrush Type received moderate use. Sixty-nine percent of all deer observed within this zone were females and fawns (Appendix Table 17).

Within the Spruce-Fir Zone, most observations were recorded on the Grass-Forb Meadow Type. Deer would commonly emerge from the spruce-fir forest types to feed in the Grass-Forb Meadow Type and then return to the spruce-fir forest after feeding. The presence of thinleaved huckleberry in the rumens of deer collected on the "mountain meadows" by Wilkins (1957) indicated deer also fed in the forested types during this season. This plant was found only in the Spruce-Fir (Closed Canopy) and Lodgepole Pine Types. The Willow Bottom and Spruce-Fir (Open Canopy) Types were occasionally used by feeding deer. Seventy-three percent of the deer observed in the Spruce-Fir Zone were females and fawns (Table 4).

The Alpine Meadow Type was the most heavily used type within the Alpine Zone and was predominantly used by feeding deer. The Spruce-Fir

TABLE 4. PERCENTAGE DISTRIBUTION OF MALE AND FEMALE MULE DEER BY MONTH AND VEGETATION ZONE AS DETERMINED FROM GROUND SURVEYS OF THE WEST SLOPE.

	July		Aug.		Sept.		Summer Season	
	Males	Females & fawns	Males	Females & fawns	Males	Females & fawns	Males	Females & fawns
BUNCHGRASS PRAIRIE ZONE	-	-	-	-	4	3	1	1
DOUGLAS FIR ZONE	3	21	-	-	-	5	1	6
SPRUCE-FIR ZONE	31	51	40	97	41	77	37	82
ALPINE ZONE	66	28	60	3	55	15	62	11
Number of Males and Number of Females and Fawns	70	43	91	116	22	60	183	219
Percent of all Deer For a Month or Season	62	38	44	56	27	73	46	54

	Oct.		Nov.		Dec.		Fall Season	
	Males	Females & fawns	Males	Females & fawns	Males	Females & fawns	Males	Females & fawns
BUNCHGRASS PRAIRIE ZONE	33	1	4	-	1	-	4	tr.[1]
DOUGLAS FIR ZONE	17	43	96	100	99	100	93	89
SPRUCE-FIR ZONE	17	36	-	-	-	-	1	6
ALPINE ZONE	33	20	-	-	-	-	2	4
Number of Males and Number of Females and Fawns	12	79	28	76	131	285	171	440
Percent of all Deer for a Month or Season	13	87	27	73	31	69	28	72

[1]tr. = trace, a value of less than 0.5%.

(Open Canopy) Type within the Alpine Zone was commonly used as a bedding area for deer during the diurnal period. The high deer usage of the Alpine Zone during July was mainly attributable to usage by mature males. Most of the deer observed during July were males and 66 percent of all males observed during July were in the Alpine Zone (Table 4). The alpine areas could be called "buck habitat" since 82 percent of all deer observed there during the summer were males.

Numbers of deer recorded per observation period within Tom Reese and North Cottonwood basins (Fig. 7) increased throughout July and early August. Much of this increase was due to an increase in the percentage of females in the observations as summer progressed (Table 4). This suggested that males moved to high elevation types before females.

Thirty-six observations of Rocky Mountain goats were made during the summer. Twenty of these were in North Cottonwood basin, six in Mill Creek basin, one in Tom Reese basin and nine on the east slope above Fairy and Fraizer Lakes (Fig. 1). Most goats observed were using the Alpine Meadow Type and talus slopes, but a few were seen in the upper reaches of the Spruce-Fir Zone. Goats fed in the same areas as mule deer males and on one occasion were observed to feed within about 50 feet of one another.

Mill Creek Canyon, North Cottonwood basin, Tom Reese basin, Corbly Canyon and Dry Canyon all received cattle use at some time during the summer. The cattle in Tom Reese basin used the Sedge and Sedge-Grass

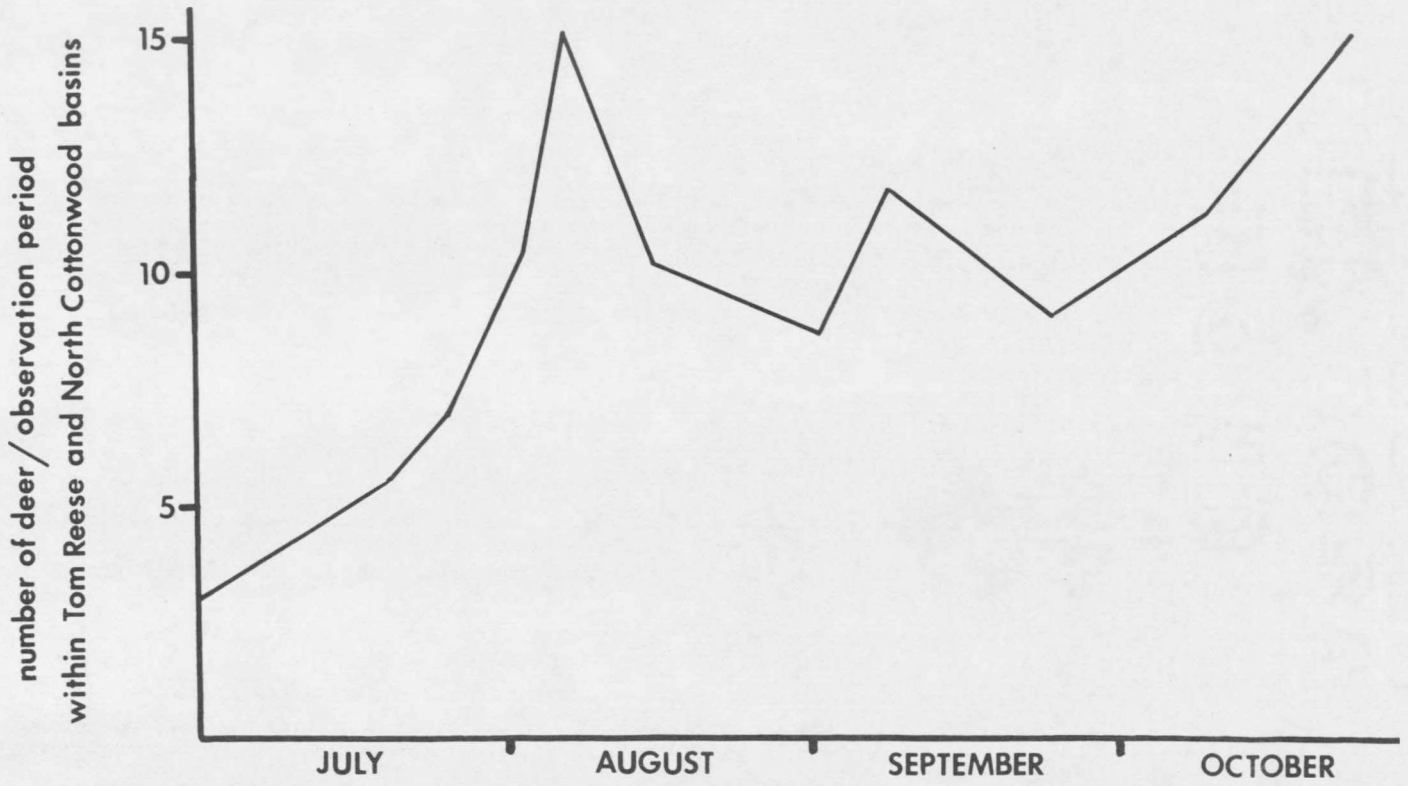

Figure 7. Number of deer/observation period in Tom Reese and North Cottonwood basins by monthly period.

Meadow Types heavily until those areas were depleted. At that time they moved onto the Grass-Forb Meadow Type. Cattle used the meadows of Tom Reese basin for slightly less than a month and then moved down the creek bottom. This movement was probably due to a lack of suitable forage at that time in the meadows. A major effect of the cattle in these basins was the trampling of vegetation.

Fall (Oct.-Dec.): Aerial flights during October indicated deer use of all vegetation zones. Although eighty-two percent of the deer observed on these flights were in the Douglas Fir Zone, ground surveys of the Alpine and Spruce-Fir Zones during October indicated that usage of the latter zones was as high as at any time during the summer (Fig. 7). All deer observed during a flight in December were in the Douglas Fir Zone.

Within the Douglas Fir Zone, the Douglas Fir Type received the most usage during the fall. Open types, such as the Sagebrush-Bitterbrush and Douglas Fir-Sagebrush Park Types, became important areas of deer activity after the end of hunting season. Deer use of other zones and types during the fall was minor.

Although the first groups of deer seen on the winter range were females and fawns, deer were not differentially distributed by sex during the fall. At this time the breeding season and common movement to the winter range were in progress. The peak of breeding activity seemed to be during the latter half of November.

Elk were first observed on the area during a flight on October 11th. Thirty-seven elk, including 5 males (2 mature), 20 females and 12 calves were spotted during a flight on December 5th and were concentrated high above Corbly Canyon, on the Armstrong winter range and just north and above the mouth of North Cottonwood Creek.

East Slope

The observation of a female marked at a west slope locality, on the east slope of the Bridger Mountains during August, resulted in initiation of limited range use investigations in that area.

During the latter part of August, observations were carried out only within the Douglas Fir Zone. A majority of the deer observed were within the Douglas Fir Type (Table 5). All zones were surveyed during September and most of the deer observed during that month were within the Douglas Fir Zone. Many of those deer were using small logged areas (Fig. 6). Work during October indicated that some deer were using the Spruce-Fir and Alpine Zones. Most of the deer observed during ground surveys in October were within the Douglas Fir Zone. An aerial flight on October 11th revealed that deer were congregating at high elevations on Grass-Forb Meadows within the Spruce-Fir Zone.

Food Habits

Mule deer food habits were determined by the examination of 70 feeding sites at which 8,587 instances of use were recorded and the

TABLE 5. PERCENT OF GROUND OBSERVATIONS OF MULE DEER ON THE EAST SLOPE BY VEGETATION ZONE AND TYPE.

	Aug. 22-31	Sept. 1-30	Oct. 1-20
DOUGLAS FIR ZONE			
Douglas Fir Type	78	41	73
Logged Type		40	12
Grass-Forb Park Type	11	3	
Lodgepole Pine Type		6	
Sagebrush Park Type	11	5	
Total	100	95	85
SPRUCE-FIR ZONE			
Spruce-Fir Forest Type		5	
Grass-Forb Meadow Type		1	9
Total		6	9
ALPINE ZONE			
Alpine Meadow Type			6
Spruce-Fir (Open Canopy) Type			
Total			6
Number of Deer Observations	28	64	33

examination of the contents of 28 rumen samples from hunter and winter-killed deer (Tables 6, 7, 8 and 9). Cattle food habits were determined by examination of 4 feeding sites at which 2,440 instances of use were recorded (Table 10).

West Slope

Spring: Five rumen samples were collected from deer that died during the latter part of April, 1973. Contents included Douglas fir,

TABLE 6. FOOD HABITS OF MULE DEER BY SEASON AND MONTH AS DETERMINED BY EXAMINATION OF 27 RUMEN SAMPLES.

	Spring	Fall		
	April	Oct.	Nov.	Season
	5[1]	7	15	22
GRASS AND GRASS-LIKE PLANTS				
Carex geyeri			9/33	5/23
green grass		2/57	7/40	5/45
dry grass	28/80[2]	2/14	5/27	4/23
Total Grass and Grass-like Plants	28/80	4/57	21/80	14/73
FORBS				
Antennaria racemosa		3/57	tr./6	2/23
Aster conspicuus		4/29	1/27	2/18
Balsamorrhiza sagittata	tr./60		1/6	1/5
Cirsium spp.		1/14	1/20	1/18
Chrysopsis villosa			2/6	1/5
Helianthella uniflorus			2/6	1/5
Heuchera parviflora		3/29	1/6	2/14
Medicago sativa		18/29	tr./6	9/14
Penstemon fruiticosa		3/43	2/33	2/36
Pyrola secunda		4/29	7/13	5/18
unid. green forbs		2/43	3/13	3/23
unid. dry forbs	1/40	26/71	27/93	27/86
Total Forbs	2/80	64/100	47/100	57/100
BROWSE				
Abies lasiocarpa			1/13	1/9
Artemisia tridentata	29/80		2/47	1/32
Berberis repens	tr./60	13/71	8/53	10/59
Juniperus communis			1/20	tr./13
Juniperus scopulorum	4/100		tr./6	tr./5
Pseudotsuga menziesii	35/100	tr./71	4/40	2/50
Purshia tridentata	tr./40	1/14	7/33	4/28
Symphorocarpos spp.		16/43	tr./13	8/27
unid. browse	1/80	tr./14	1/27	tr./23
Total Browse	70/100	31/100	24/93	26/95
LICHEN		1/14	8/47	4/36

[1]Number of rumen samples per time period.

[2]Percent of rumen contents/frequency of occurrence among rumens. Plants occurring at levels of less than 0.5% are the following: *Achillea millefolium*, Compositae, *Geum triflorum Lomatium* spp., *Lupinus* spp., *Monardia fistulosa*, *Pinus contorta*, *Pinus flexilus*, *Prunus virginiana*, *Ribes* spp., *Salix* spp., *Sedum* spp., *Selagenella densa*, *Rosa* spp., and *Fungi*.

TABLE 7. SUMMER AND FALL FOOD HABITS OF MULE DEER BY VEGETATION ZONE AS DETERMINED BY EXAMINATION OF 58 FEEDING SITES ON THE WEST SLOPE.

	SUMMER			FALL	
	(1033)[2]	(2268)	(51)	(111)	(3842)
	8 Sites	18 Sites	1 Site	2 Sites	29 Sites
Taxa[1]	Alpine	Spruce-Fir	Douglas Fir	Spruce-Fir	Douglas Fir
GRASS AND GRASS-LIKE PLANTS					
Agropyron spicatum					3/17
Carex geyerii					5/21
Poa alpina	1/25[3]				
Poa reflexa				21/50	
Poa secunda					1/ 7
Unidentified grasses	tr.[4]/25	tr./11			
Total Grasses and Grass-Like Plants	1/25	tr./11		21/50	10/41
FORBS					
Achillea millefolium		1/11			tr./7
Agroseris glauca	2/38	12/28			
Aquilegia flavescens	19/38	3/ 6			
Arnica cordifolia	5/25	tr./11			
Arnica rydbergii	1/25	tr./11			
Aster engelmanni		6/ 6			
Aster conspicuus					6/21
Balsamorrhiza saggittata					13/48
Cerastium arvensis					tr./3
Cirsium spp.					1/10
Claytonia lanceolata		1/ 6			
Delphinium occidentale		tr./ 6		1/50	
Erigeron simplex	5/25	1/17			
Erythrorium grandiflorum		5/22			
Fraseria speciosa	tr./13	1/ 6			
Geranium viscosissimum		5/22			
Helianthella uniflorus		1/ 6			1/ 7
Heraculum lanatum		1/11			

TABLE 7. (CONTINUED)

Taxa	SUMMER (1033) 8 Sites Alpine	SUMMER (2268) 18 Sites Spruce-Fir	SUMMER (51) 1 Site Douglas Fir	FALL (111) 2 Sites Spruce-Fir	FALL (3842) 29 Sites Douglas Fir
FORBS (continued)					
Lomatium cous	8/50				
Lupinus argenteus		1/ 6		4/50	
Osmorhiza occidentalis		1/11		6/50	
Pedicularis groenlandica		3/ 6			
Penstemon fruiticosa					12/17
Polemonium viscosum	10/50				
Potentilla diversifolia	10/38	tr./ 6			
Ranunculus escholtzii		4/18		11/50	
Senecio serra		6/22		4/50	
Senecio triangularis				29/50	
Sisymbrium altissimum			10/100		
Synthyris pinnatifida	30/38				
Taraxicum officionale		1/17			
Thalictrum venulosum		9/22			
Trifolium haydenii	5/38	tr./ 6			
Valariana sitchensis		6/22			
Viola nutalli	2/13	6/11			
Unidentified forbs		2/22			
Total Forbs	99/100	75/84	10/100	54/100	35/79
BROWSE					
Abies lasiocarpa				25/50	tr./ 3
Artemisia tridentata					22/38
Berberis repens					1/ 7
Juniperus communis					3/ 7
Philadelphius lewesii					1/ 3
Pseudotsuga menziesii					1/ 3
Purshia tridentata			90/100		20/28

TABLE 7. (CONTINUED

Taxa	SUMMER (1033) 8 Sites Alpine	SUMMER (2268) 18 Sites Spruce-Fir	SUMMER (51) 1 Site Douglas Fir	FALL (111) 2 Sites Spruce-Fir	FALL (3842) 29 Sites Douglas Fir
BROWSE (continued)					
Ribes setosum		6/11			1/ 7
Salix glauca		19/28			
Sambucus melanocarpa					1/ 3
Spirea betulifolia		1/ 6			2/14
Symphorocarpos spp.					2/ 7
Total Browse		25/50	90/100	25/50	55/79

[1]Includes taxa occurring at a level of at least 0.5% in at least one season in one zone. Plants occurring at less than this level include the following: *Bromus tectorum*, *Festuca idahoensis*, *Koeleria cristata*, *Delphinium bicolor*, *Epilobium angustifolium*, *Galium boreale*, *Heuchurea parviflora*, Leguminosae, *Lupinus* spp., *Mertensia oblongifolia*, *Pedicularis paysoniana*, *Polygonum bistortoides*, *Townsendia parayi*, *Tragopogon dubius*, *Prunus virginiana* and *Rosa* spp.

[2]Number of instances of use per zone by season.

[3]Percent of seasonal diet in a vegetation zone/frequency of occurrence among sites.

[4]tr. = trace, precent of diet is less than 0.5%.

TABLE 8. SUMMER AND FALL FOOD HABITS OF MULE DEER BY MONTH AND SEASON AS DETERMINED BY EXAMINATION OF 58 FEEDING SITES ON THE WEST SLOPE.

	SUMMER				FALL			
Taxa[1]	12 Sites (1274)[2] July	10 Sites (1590) Aug.	5 Sites (488) Sept.	27 Sites (3352) Season	6 Sites (531) Oct.	12 Sites (1426) Nov.	13 Sites (1996) Dec.	31 Sites (3953) Season
GRASS AND GRASS-LIKE PLANTS								
Agropyron spicatum						5/17[3]	3/23	3/16
Bromus tectorum						1/ 8	tr.[4]/8	tr./ 6
Carex geyerii						13/42	1/ 8	5/19
Poa alpina	1/17			tr./ 7				
Poa reflexa					5/17			1/ 3
Poa secunda						1/ 8	1/ 8	1/ 6
Unidentified grasses	1/25	tr./10		tr./15				
Total Grasses and Grass-Like Plants	1/25	tr./10		1/15	5/17	20/67	6/31	11/42
FORBS								
Achillea millefolium	tr./ 8		2/20	tr./ 7		tr./ 8	tr./ 8	tr./ 6
Agroseris glauca	2/25	16/50		8/30				
Aquilegia flavescens	16/25	5/10		8/15				
Arnica cordifolia	4/17		1/40	2/15				
Arnica rydbergii	2/25			1/11				
Aster engelmanni		8/20		4/ 7				
Aster conspicuus					tr./17	17/42		6/19
Balsamorrhiza sagittata					28/50	7/25	14/62	13/45
Cerastium arvensis						1/8		tr./ 3
Cirsium spp.					5/17	1/8	tr./ 8	1/10
Claytonia lanceolata	2/ 8			1/ 4				
Delphinium occidentale	1/ 8			tr./ 4	tr./17			tr./ 3
Erigeron simplex	4/25	1/20		2/19				
Erythronium grandiflorum	3/ 8	4/30		3/15				
Fraseria speciosa	tr./ 8		3/20	1/ 7				
Geranium viscosissimum	6/ 8	1/20	3/20	3/15				
Helianthella uniflorus		1/10		tr./ 4	2/17		1/ 8	1/ 6
Heracleum lanatum		1/10	2/20	1/ 7				
Heuchurea parviflora						1/8		tr./ 3
Lomatium cous	6/25	tr./10		3/15				
Lupinus argenteus			7/20	1/ 4	2/33			tr./ 6

TABLE 8. (CONTINUED)

Taxa	SUMMER 12 Sites (1274) July	10 Sites (1590) Aug.	5 Sites (488) Sept.	27 Sites (3352) Season	FALL 6 Sites (531) Oct.	12 Sites (1426) Nov.	13 Sites (1996) Dec.	31 Sites (3953) Season
FORBS (continued)								
Lupinus spp.							tr./ 8	tr./ 3
Osmorhiza occidentalis	1/8	tr./10		1/ 7	2/17			tr./ 3
Pedicularis groenlandica		4/10		2/ 4				
Penstemon fruiticosa					4/17	10/17	15/15	12/16
Polemonium viscosum	4/17	1/10	6/20	3/15				
Potentilla diversifolia	8/25	1/10	1/20	3/19				
Ranunculus escholtzii			15/20	2/ 4	2/17			tr./ 3
Senecio serra	tr./17	8/20		6/15	1/17			tr./ 3
Senecio triangularis					6/17			1/ 3
Synthyris pinnatifida	3/8	12/10	18/20	9/11				
Taraxicum officionale	tr./ 8	1/20		1/11				
Thalictrum venulosum		6/20	17/40	5/15				
Tragopogon dubius					2/33	tr./ 8	tr./ 8	tr./13
Trifolium haydenii	4/25		1/20	2/15				
Valariana sitchensis	3/17	6/20		4/15				
Viola nutalli	11/17	tr./10		4/11				
Unidentified forbs	1/17	2/20		1/15				
Total Forbs	84/83	81/70	74/100	81/82	52/100	37/75	30/77	36/81
BROWSE								
Abies lasiocarpa					5/17			1/ 3
Artemisia tridentata					24/33	3/ 8	34/62	22/36
Berberis repens						4/17		1/ 6
Juniperus communis						10/17		3/ 6
Philadelphius lewesii						2/ 8		1/ 3
Prunus virginiana					2/17	tr./ 8		tr./ 6
Pseudotsuga menziesii					5/17			1/ 3
Purshia tridentata	4/ 8			1/ 4		13/25	30/38	20/26
Ribes setosum		2/10	19/20	4/ 7	3/17	tr./ 8		1/ 6
Rosa spp.						1/ 8		tr./ 3
Salix glauca	12/17	16/30	7/20	13/22				
Sambucus melanocarpa						2/ 8		1/ 3

TABLE 8. (CONTINUED)

Taxa	SUMMER 12 Sites (1274) July	10 Sites (1590) Aug.	5 Sites (488) Sept.	27 Sites (3352) Season	FALL 6 Sites (531) Oct.	12 Sites (1426) Nov.	13 Sites (1996) Dec.	31 Sites (3953) Season
BROWSE (continued)								
Spirea betulifolia		1/10		tr./ 4	3/33	4/17		2/13
Symphorocarpos spp.						3/17		1/ 6
Total Browse	15/25	19/50	26/40	19/37	43/83	43/83	64/69	54/77

[1]Includes taxa occurring at a level of at least 0.5% in at least one month or season. Plants occurring at less than this level include the following: *Festuca idahoensis, Koeleria cristata, Delphinium bicolor, Epilobium angustifolium, Galium borale,* Leguminosae, *Mertensia oblongifolia, Pedicularis paysoniana, Polygonum bistortoides, Sisymbrium altissimum* and *Townsendia parayi.*

[2]Number of instances of use per month or season.

[3]Percent of monthly or seasonal diet/frequency of occurrence among sites.

[4]tr. = trace, percent of diet is less than 0.5%.

TABLE 9. MULE DEER FOOD HABITS BY MONTH AND SEASON AS DETERMINED BY EXAMINATION OF 12 FEEDING SITES ON THE EAST SLOPE.

Taxa	(998)[1] 9 Sites Sept.	(284) 3 Sites Oct.	(1282) 12 Sites Season
GRASS AND GRASS-LIKE PLANTS			
Phleum pratense	____	tr.[3]/33	tr./8
Total Grass and Grass-Like Plants		tr. /33	tr./8
FORBS			
Aquilejia flavescens	tr./11[2]		tr./8
Balsamorrhiza sagitata		4/33	1/8
Cerastium arvensis	tr./11		tr./8
Ephilobium angustifolium	3/22		2/17
Fragaria virginiana	1/11		tr./8
Geranium viscosissimum	2/44		2/33
Hacklea floribunda		20/33	4/8
Helianthella uniflorus		11/33	2/8
Iliamna rivularis	4/11		3/8
Lupinus spp.	2/11		2/8
Potentilla gracilus	1/22	tr. /33	1/25
Unidentified forbs		3/33	1/8
Total Forbs	14/67	38/67	18/67
BROWSE			
Acer glabrum	16/22		12/17
Amalanchier alnifolia	3/33		2/25
Berberis repens		2/33	tr./8
Clematis columbiana	12/11		9/8
Populus tremuloides	tr./11		tr./8
Prunus virginiana	35/33	tr./33	27/33
Rosa spp.	14/56		11/42
Spirea betufolia	4/44	20/67	7/50
Symphorocarpos spp.	4/33	41/33	12/33
Total Browse	86/89	62/67	82/75

[1]Number of instances of use per month or season.
[2]Percent of monthly or seasonal diet/frequency of occurrence among sites.
[3]tr. = trace, percent of diet is less than 0.5%.

big sagebrush, dry grass, Rocky Mountain Juniper *(Juniperus scopulorum)* and dry forbs. These species were reported to be used during this season by Wilkins (1957) and Schwarzkoph (1973), however, my data indicated a higher use of Douglas fir.

These rumen contents should not be considered to represent the food habits of the deer herd during the spring. At the time these rumens were obtained, large numbers of deer were using the agricultural fields containing green grasses and alfalfa. None of the rumen samples contained either of these items. These deer may have been too weak to range into the fields.

Summer: Results of feeding site examinations indicated that forbs constituted 81 percent of the summer diet of mule deer using the Spruce-Fir and Alpine Zones. Ninety-six percent of the feeding sites examined during the summer were in these zones, which are characterized by extensive growths of forbs. Cutleaf kittentail *(Synthyris pinnatifida)*, yellow columbine, skunk polomonium *(Polomonium viscosum)*, varileaf cinquefoil *(Potentilla diversifolia)* and mountain lomatium *(Lomatium cous)* were important items in the diet of deer feeding within the Alpine Zone. False dandelion *(Agroseris glauca)*, meadow rue, groundsel *(Senecio serra)* and Sitka valariana *(Valariana sitchensis)* were important in the diet of deer feeding within the Spruce-Fir Zone. Nuttal violet *(Viola nuttali)* received considerable use during July but was not important later due to desiccation. Largeflower buttercup

(Ranunculus escholtzii) and meadow rue were important forbs during September when they were among the few plant species which were green and succulent.

Browse was scarce in the Spruce-Fir and Alpine Zones, but constituted 19 percent of the items taken at feeding sites. Gray willow *(Salix glauca)* was the most important browse plant but redshoot gooseberry became important during late summer.

Deer usage of grass was minor during the summer.

Four cattle feeding sites were examined on the Grass-Forb Meadow Type in Tom Reese basin during August. Grasses and sedges constituted 67 percent of the cattle diet on this type. Slender wheatgrass and sedges were the most important species in this forage class. Forbs constituted 33 percent of the cattle diet. Groundsel, Nuttal violet, oblong bluebell *(Mertensia oblongifolia)* and common dandelion were important forbs used by cattle. Grasses and sedges appeared to be preferred since the cattle used the Sedge and Sedge-Grass Meadow Types heavily before moving onto the Grass-Forb Meadows.

Fall: Forbs, browse and grasses and sedges constituted 36, 54 and 11 percent of the instances of use at 31 feeding sites and 57, 26 and 14 percent of the rumen contents of 22 hunter-killed deer respectively. Lichens constituted 4 percent of rumen contents.

Nine-four percent of feeding sites examined during the fall were within the Douglas Fir Zone. Browse increased from 43 percent of the

TABLE 10. CATTLE FOOD HABITS ON THE GRASS-FORB MEADOW TYPE DURING AUGUST AS DETERMINED BY 4 FEEDING SITES WITH 2440 INSTANCES OF USE.

Taxa[1]	
GRASS AND GRASS-LIKE PLANTS	
Agropyron canium	32/75[2]
Bromus carinatus	6/75
Carex spp.	15/25
Poa spp.	1/50
Trisetum spicatum	7/50
Unidentified grasses	5/50
Total Grasses and Grass-like Plants	67/100
FORBS	
Achillea millefolium	1/50
Aquilegia flavescens	1/25
Erigeron simplex	1/25
Mertensia oblongifolia	6/75
Osmorhiza occidentalis	2/50
Secenio serra	8/50
Taraxicum officionale	4/75
Valariana sitchensis	1/25
Viola nuttali	5/75
Unidentified forbs	4/50
Total Forbs	33/100

[1]Includes taxa occurring at a level of at least 0.5%. Plants occurring at less than this level include the following: *Agroseris glauca*, *Allium* spp., *Polygonum bistortoides* and *Rannunculus escholtzii*.
[2]Percent in diet/frequency of occurrence among sites.

diet during October to 64 percent during December. The most important browse species were big sagebrush and bitterbrush *(Purshia tridentata)*, with much of their usage occurring during late November and December. Common juniper, white spirea and Oregon grape were important browse species for those deer using the Douglas Fir Type.

Shrubby penstemon *(Penstemon fruiticosa)*, dry arrowleaf balsamroot *(Balsamorrhiza sagittata)* and dry showy aster were the forbs most commonly utilized by deer during the fall. Shrubby penstemon, found in the understory of the Douglas Fir Type, was utilized throughout the fall and by December most plants showed prior usage. Deer were occasionally observed to paw through snow in order to feed on arrowleaf balsamroot when other plants including big sagebrush and bitterbrush were readily available at the same site. Wilkins (1957) and Schwarzkoph (1973) also noted considerable usage of arrowleaf balsamroot on this area during the fall and winter. Showy aster is found in the understory of the Douglas Fir Type and was most heavily used during November. With the exception of largeflower buttercup, all forbs used during October within the Spruce-Fir Zone were desiccated.

Grasses and sedges constituted 11 percent of the deers' diet as determined by feeding site examination. Use of this forage class was highest during November when elk sedge was prominent in the diet. One feeding site in the Spruce-Fir Zone during October revealed heavy usage of nodding bluegrass *(Poa reflexa)* which was "greening up" at that time.

The plant species found in the rumen samples reflect the high usage by deer of the Douglas Fir Type during the hunting season. Important identifiable forbs in rumen samples were side-bells wintergreen *(Pyrola secunda)*, shrubby penstemon, showy aster, raceme pussytoes *(Antennaria racemosa)*, littleleaf alumroot *(Heuchera parviflora)* and alfalfa. Alfalfa was a major item in two rumens obtained early in the hunting season. The other species are characteristic of the Douglas Fir and Lodgepole Pine Types. The unidentified dry forbs category was important and consisted mainly of pieces of stems which may have included stems of showy aster.

Oregon grape, snowberry and bitterbrush were important browse species present in rumen samples.

Grasses and sedges were most important during November when they made up 21 percent of rumen volumes. Elk sedge was an important item in the rumens obtained during November.

Lichens *(Letharia vulpina)* were an important item in the rumens obtained during November.

East Slope

All feeding sites on the east slope were located in the Douglas Fir Zone and were examined during September and October. Browse constituted 82 percent of the recorded use at these sites. Important browse species included chokecherry, mountain maple *(Acer glabrum)*, snowberry,

rose and white spirea.

Forbs comprised 18 percent of the use at feeding sites, while grass was only used in trace amounts.

One rumen obtained from this area during hunting season contained 60 percent green grass, 22 percent Oregon grape, 16 percent Douglas fir and 2 percent dry forbs.

The high availability of browse species on the Douglas Fir and Logged Types (Table 1) probably accounts for the greater use of browse on the east slope than on the west slope during September and October. Browse use was lower on the west slope during these months, but all feeding sites during September and 33 percent of those during October were in the Spruce-Fir or Alpine Zones.

Condition, Productivity and Population Estimates

Condition

Average kidney fat indices obtained for each of 16 hunter-killed deer taken on the west slope during the fall of 1973 (Table 11) were 0.32, 0.67, and 1.32 for fawns, females and males respectively. These values are very close to those obtained by Schwarzkoph during 1972 for hunter-killed deer. Ransom (1965) determined that a kidney fat index of 30 percent was the critical value for noticable utilization of bone marrow fat. My data and that of Schwarzkoph (1973) indicate that fawns and some females enter the winter with omental fat reserves close to this critical level. The low fat reserves together with indadequate quality and/or quantity forage during the winter probably explains the

TABLE 11. SEX, AGE AND KIDNEY FAT INDICES FOR 16 MULE DEER.

Date of Collection	Sex	Assigned Age	Kidney Fat Index[1]
10/22/73	M	5½	1.72
10/26/73	F	4½	.80
10/28/73	F	7½	.45
10/28/73	F	3½	.45
11/3/73	M	½	.49
11/4/73	M	2½	.09*
11/4/73	M	1½	1.17
11/9/73	F	2½	1.48
11/10/73	F	3½	.56
11/11/73	M	4½	.70
11/18/73	M	½	.27
11/20/73	F	1½	.50
11/21/73	F	2½	.53
11/21/73	M	4½	1.68
11/24/73	M	½	.19
11/24/73	M	3½	1.32

[1]Determined by dividing the weight of the kidney fat and capsule by the weight of the kidney.

*This deer had part of its jaw shot away and was in extremely poor condition. Its kidney fat index was not used in computing averages.

predominance of fawns among winter-killed deer. Schwarzkoph (1973) found 37 winter-killed deer during 1972 and 1973 on the Armstrong winter range, 21 of which were fawns.

Productivity

Differences in the summer distribution of productive and unproductive females was discussed in the "Range Use" section. Data from aerial and ground surveys during December (Table 12), indicated a fawn/female ratio of 46/100. During a flight over the Armstrong winter range on December 27th, Mackie (personal communication) noted a similar fawn/female ratio of 43/100. These figures indicate low productivity and are much below potential productivity noted for many mule deer ranges (Robinette 1956). Data obtained for the Armstrong winter range by Mackie (personal communication) during a flight on April 1st as compared to my December data, indicated a minimal loss of about 24 percent of the fawns during the mild winter of 1973-1974.

During the late summer and fall of 1973, 125 deer including 62 females, were classified on the east slope. The indicated fawn/female ratio was 50/100.

Ovaries from a 4½ year old female killed on October 26th and a 2½ year old female killed on November 21st were examined. One corpus albicans was present in the ovaries of each deer, indicating sexual activity during the previous breeding season. A primary corpus luteum

TABLE 12. SEX AND AGE CLASSES OF MULE DEER AS DETERMINED BY GROUND AND AERIAL COUNTS FROM JULY 1973 THROUGH DECEMBER 1973.

Time Period	Total No. Observed	Male	Female	Fawns	Uncl.	Males: 100 Females	Fawns: 100 Females	Fawns: 100 Adults	Method of Survey
July 1973	168	109	44	9	16	154	20	6	Ground & Air
August 1973	228	96	119	4	9	81	3	2	Ground & Air
September 1973	129	31	78	13	7	40	17	12	Ground & Air
October 1973	415	57	174	88	96	33	50	38	Ground & Air
November 1973	112	28	52	24	8	54	46	30	Ground
December 1973	630	160	272	126	72	59	46	29	Ground & Air

was present in the ovaries of the female killed on November 21st. A coming 3-year-old female, killed during a trapping accident on the Armstrong winter range during April 1974 was not pregnant (Mackie, personal communication).

Many researchers have shown that the nutritional level of deer during all seasons may affect productivity of the herd (Verme 1963 and 1969; Julander et al. 1961; Robinette et al. 1973). Factors which may be affected include the ovulation rate, pregnancy rate and litter size of females and the pre- and post-natal weight, growth and survival of fawns. Some workers have found the productivity of fawns and yearlings to be the most affected by nutritional level. The nutritional quality of rumen contents was linked to differing weights, skeletal measurements and sex and age composition of deer populations from areas of different range quality by Klein (1962) and (1965).

The nutritional level of the deer during any season or combination of seasons could be a factor affecting the productivity of the deer herd in this area. A study similar to that conducted by Klein (1962), comparing nutritional quality of rumen contents with range conditions, might be helpful in explaining the low productivity of deer in this area.

A situation similar to that described by Verme (1969) for white-tail deer in Michigan may apply to mule deer in this area. Deer in his "reproductive class III" suffer chronic malnutrition in the face of long, rigorous winters. If the does are in poor physical condition in

the final stage of pregnancy, development and vitality of the fetus is seriously impaired and mortality may occur before or shortly after birth. Does relieved from the demands of lactation quickly recuperate and are very productive at the coming rut. On the other hand, mothers that manage to rear young cannot fully recover from the strain of nursing in time to be fully productive during the rut.

Population Trends

During early spring, deer used the agricultural fields extensively and counts could be made without including the same deer more than once. On May 4th, 196 deer were counted within the area between Bill Smith Creek and North Cottonwood Creek, which are the general boundaries of the Armstrong winter range. In addition, 99 deer were counted within the area between Bill Smith Creek and Tom Reese Creek. Schwarzkoph (1973) utilized several censusing techniques and estimated that 171-175 deer utilized the Armstrong winter range. Qauntitative estimates of the population were not made at the time of Wilkins' study in 1955-56, however, deer were reported to occur at high densities and to cause considerable damage to agricultural products. Some comparisons of relative population levels are possible using data reported by Wilkins. Although the time periods compared are not exactly the same for both studies, the data (Table 13) indicate that considerably more deer were present on the study area during 1955 and 1956 than at the present time.

TABLE 13. THE ARMSTRONG DEER HERD'S POPULATION LEVEL OF 1955-56 COMPARED WITH THE LEVEL OF 1973.

	Sagebrush-Bitterbrush Type	Bunchgrass Prairie Zone	Mountain Meadows
Wilkins (1957)	June 16-Aug. 14 41 observations 5 deer/observation	June 16-Oct. 31 90 obs. 4 deer/obs.	July 15-Sept.12 23 obs. 11 deer/obs.
The present study	July 2-Aug. 14 10 observations 1.6 deer/observation	July 2-Oct. 31 22 obs. 0.8 deer/obs.	July 15-Sept.12 35 obs. 8.5 deer/obs.

Movements

Ten of twenty-one deer marked on the winter range in 1972 and 1973 were observed on the winter range by spring of 1974. Two marked deer were known to have died during the spring of 1973 and two were known to have been killed by hunters, one in 1972 and one in 1973. Four deer were known to have lost all markings other than small eartags. Some and possibly all of the remaining deer may also have lost their neckbands.

A geographical center of activity (Hayne, 1949) was determined for each marked deer observed three or more times by either Schwarzkoph (1973) or myself. Distances of all observations from this center of

activity were then measured and averaged for each deer to determine its seasonal average activity radius (Table 14). All observations of marked deer during the spring and most of those during the fall were on or near the winter range (Fig. 8). When calculating average activity radii, I included no observations which were considered to be on "transitional range". Spring and fall movements which I included are considered to be extensions of the winter range.

Spring

The average activity radius for females during spring was determined to be 739 yards with a range of 525 to 990 yards (Table 14). Males showed an average activity radius of 859 yards with a range of 583 to 1,213 yards for the period. The maximum distances between observations were 2½ and 2¼ miles for females and males respectively. The maximum distance a deer was observed from the winter range was approximately 2 miles (Fig. 8).

Summer

Six different marked deer were relocated during the summer (Fig. 8). The maximum observed locations of these deer from the wintering area ranged from ¼ mile to 16 miles. A 2½ year old male was located on the east slope of the Bridger range about 16 miles southeast of the winter range. This male was observed on the winter range both as a fawn and

TABLE 14. AVERAGE ACTIVITY RADIUS, IN YARDS, FOR 21 INDIVIDUALLY MARKED MULE DEER.

			Winter[1]		Spring		Summer		Fall	
Deer No.	Capture Date	Sex	No. of Observations	AAR[2]	No. of Observations	AAR	No. of Observations	AAR	No. of Observations	AAR
1	3/ 6/72	F	16	462						
2	1/ 5/73	F	8	440	9	918			5	327
3	1/ 5/73	F	17	374	8	860			9	597
4	1/ 5/73	F	12	418	3	692				
5	1/ 8/73	F	13	264	7	861			5	541
6	1/ 8/73	F	14	506	5	603				
7	1/12/73	F	18	484					4	446
8	1/13/73	F	24	308	10	622	6	344		
9	1/29/73	F	6	440	10	525				
10	2/ 7/73	F	8	440						
11	2/ 9/73	F	15	308	4	990				
12	2/10/73	F	3	264						
13	2/20/73	F	10	352	6	582			11	308
Average for Females				389		739				444
14	2/20/72	M	3	264						
15	2/27/72	M	13	462	3	1,213				
16	3/27/72	M	4	528						
17	3/27/72	M	20	528	7	583				
18	1/11/73	M	3	572						
19	2/ 7/73	M	13	396						
20	2/11/73	M	7	396						
21	1/31/73	M	7	572	9	780	6	594	7	629
Average for Males				465		859				
Average for all Deer				418		769		456		476

[1]From Schwarzkoph (1973).
[2]AAR = Average Activity Radius.

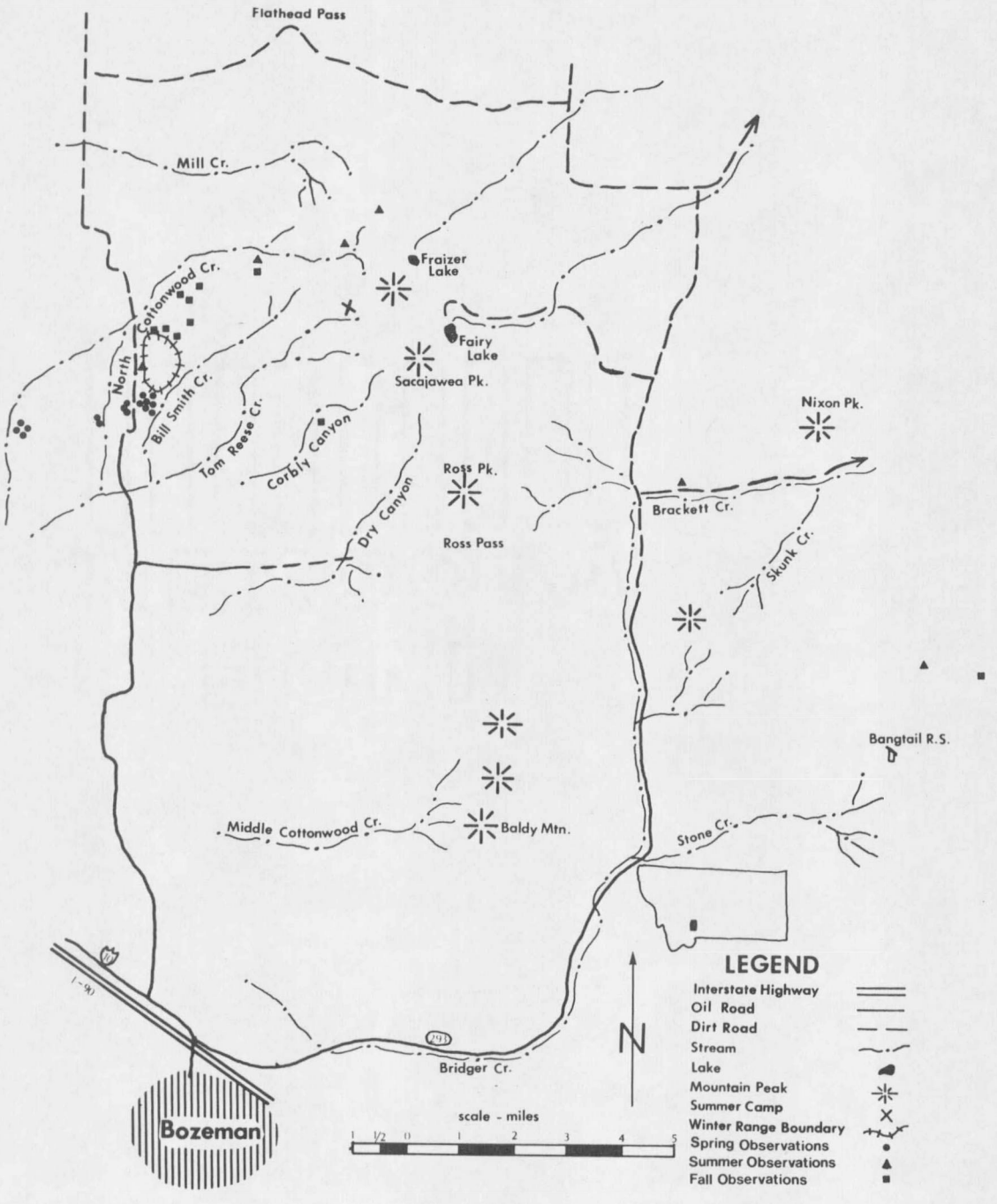

Figure 8. Location by season for the observation that was the greatest distance from the winter range for each marked deer observed.

a yearling. A mature female was located on the east slope approximately 10 miles southeast of the winter range. A male was located in the Alpine Zone about 4½ miles northeast of the winter range. Two females were located on a north slope in the Douglas Fir Zone about 2 miles northeast of the winter range. One of these females was observed a month and a half later 4 miles northeast of the winter range in the Spruce-Fir Zone. One female remained on the winter and spring ranges during the summer.

Only one marked female and one marked male were observed a sufficient number of times to determine an average activity radius for the summer. The average activity radii determined were 344 and 594 yards for the female and male respectively. The maximum distances between observations were 0.7 and 0.8 miles for the female and male respectively. The movements of a group of 5 unmarked females and one unmarked yearling male were followed for a three day period during the summer. An average activity radius of 431 yards was determined with a maximum distance between observations of 0.6 miles.

Fall

During October and November, most locations of marked deer were on the northern and eastern edges of the winter range in timbered types. By mid-December, most observations of marked deer were on the open slopes of the winter range. The 2½ year old male which was observed

about 16 miles southeast of the winter range in summer was killed by a hunter about one mile southeast of the summer location on October 28th (Fig. 8). The fall location, which was one mile further from the winter range than the summer location, suggested that this deer was not destined to return to the area he used in winter as a fawn and yearling. The female which was observed about 10 miles southeast of the winter range, in summer, was last seen on October 6th and was still on the east slope. All other marked deer observed during the summer of 1973 were observed on or near the winter range during the fall of 1973. Schwarzkoph (1973) reported that a marked yearling male was killed about 3¼ miles southeast of the winter range during the fall of 1972 (Fig. 8).

The average activity radius for females during fall was 444 yards with a range of 308 to 597 yards. One male showed an average activity radius of 629 yards.

New snow enabled observation of many tracks crossing the Bridger range at Ross Pass, Bridger Divide and at the head end of North Cottonwood Creek during an aerial flight on October 11th. During this same flight, groups of deer were observed congregated at high elevations on the east slope just north of Ross Pass and south of Flathead Pass. During this flight and one on October 26th, many more deer were observed than on flights during the summer (Table 3). In addition the number of deer observed in Tom Reese and North Cottonwood basins increased

from September through October (Fig. 7). On October 19th, during a ground survey, I noted a set of deer tracks originating near Fairy Lake and crossing Bridger Divide onto the west slope.

Discussion of Movements

Information collected during this study indicates that deer are well scattered during the summer. Marked deer were observed within all four vegetation zones on the west slope during the summer. In addition, two marked deer were observed on the east slope during the summer. Evidence from tracks and observations of deer indicated that some deer cross from the east slope to the west slope of the range during the fall. Although the data indicated use of both the east and west slopes in summer by deer using the Armstrong range in winter, no quantitative expression of this relationship is currently available.

During April and May as well as much of the fall, deer used areas near the winter range. Data indicated a larger activity radius during these times, especially during spring, than during the winter (Table 14). The data also indicate that during summer, deer used an area only slightly larger in size than that they used during the winter. In general, males used a larger area than females during all seasons, however, the overlap in average activity radii sizes is evidence of individual variation in animals.

Hunting Season

The hunting season was from October 21st through November 25th during 1973. A minimum of 90 people hunted within the area between Tom Reese and North Cottonwood Creeks. There were two areas of access to hunters. It was necessary to obtain a permission slip at one. All who hunted from this access point were available for survey. I was able to obtain information from 76 of the 90 hunters. Forty-two hunted for one day only, 18 hunted for 2-3 days, 8 hunted for 4-5 days and 8 hunted for more than 5 days. The majority of those hunters who were successful hunted for more than one day. The known kill in the area between Tom Reese and North Cottonwood Creeks was 28 mule deer; 15 males, 8 females and 5 fawns.

APPENDIX

TABLE 15. CLIMATOLOGICAL DATA GATHERED BY THE U. S. DEPARTMENT OF COMMERCE FROM THE BELGRADE FAA AND BOZEMAN 12 NE, MONTANA WEATHER STATIONS.

Stations	J	F	M	A	M	J	J	A	S	O	N	D	Yearly Ave.
	TEMPERATURE (DEGREES F)												
Belgrade FAA (22 year ave.)	17.1	23.5	28.8	40.1	50.7	58.7	66.7	65.6	54.4	44.2	30.7	21.5	41.8
Belgrade (1973)	14.0	16.8	33.8	38.9	51.0	60.0	69.1	68.6	55.2	45.1	26.1	26.4	42.0
Bozeman 12 NE (22 year ave.)	20.1	23.6	26.1	34.6	44.2	51.7	58.1	57.6	48.6	40.6	29.2	22.7	37.9
Bozeman 12 NE (1973)	16.4	21.2	27.5	31.7	43.3	51.9	57.2	57.5	46.8	40.8	27.4	24.8	34.1
	PRECIPITATION (INCHES)												
Belgrade FAA (22 year ave.)	.65	.38	.84	1.18	2.15	2.57	.99	1.17	1.20	1.07	.70	.53	13.43
Belgrade FAA (1973)	.55	.29	.95	2.03	.73	4.01	.18	2.06	1.86	1.47	.99	.54	15.66
Bozeman 12 NE (22 year ave.)	2.81	2.31	2.60	3.12	4.06	4.77	1.74	2.28	3.05	2.70	2.60	2.53	34.72
Bozeman 12 NE	1.40	.56	1.38	5.92	2.53	4.86	.48	3.15	3.75	2.32	3.41	3.79	33.55

TABLE 16. TAXA WITH CANOPY COVERAGES OF LESS THAN 0.5% AND/OR FREQUENCIES OF LESS THAN 5% ON ALL SITES.

	DOUGLAS FIR ZONE				SPRUCE-FIR ZONE		ALPINE ZONE
	Douglas Fir Type 2 Sites	Sagebrush Park Type 2 Sites	Grass-Forb Park Type 3 Sites	Logged Type 3 Sites	Spruce-Fir Forest Type 1 Site	Grass-Forb Meadow Type 2 Sites	Alpine Meadow Type 1 Site
GRASSES							
Calamogrostis montanensis						X	
Poa reflexa						X	
Poa spp.		X					
Stipa columbiana			X				
FORBS							
Artemisia ludoviciana	X						
Companula rotundifolia							X
Chimaphila umbellata					X		
Erigeron simplex						X	
Iliamna rivularis				X			
Microseris nutans		X	X				
Monardia fistulosa	X						
Tragopogon dubius		X					
Viola nuttali						X	
BROWSE							
Picea engelmanni					X		
Pinus contorta				X			

TABLE 17. PERCENTAGE DISTRIBUTION OF MALE AND FEMALE MULE DEER BY MONTH AND VEGETATION ZONE AS DETERMINED FROM GROUND AND AERIAL SURVEYS OF THE WEST SLOPE.

	July		Aug.		Sept.		Summer Season	
	Males	Females & fawns	Males	Females & fawns	Males	Females & fawns	Males	Females & fawns
BUNCHGRASS PRAIRIE ZONE	8	-	2	-	10	2	6	1
DOUGLAS FIR ZONE	13	28	3	-	19	29	10	16
SPRUCE-FIR ZONE	20	47	38	97	32	59	29	74
ALPINE ZONE	59	25	57	3	39	10	56	10
Number of Males and Number of Females and Fawns	108	53	96	123	31	94	235	270
Percent of all Deer in a Month or Season	67	33	44	56	25	75	46	54

	Oct.		Nov.		Dec.		Fall Season	
	Males	Females & fawns	Males	Females & fawns	Males	Females & fawns	Males	Females & fawns
BUNCHGRASS PRAIRIE ZONE	7	3	4	-	1	-	3	1
DOUGLAS FIR ZONE	54	67	96	100	99	100	88	88
SPRUCE-FIR ZONE	22	24	-	-	-	-	5	9
ALPINE ZONE	17	6	-	-	-	-	4	2
Number of Males and Number of Females and Fawns	59	279	28	76	160	398	247	753
Percent of all Deer in a Month or Season	18	82	27	73	29	71	25	75

LITERATURE CITED

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

_____ and J. C. Wright. 1959. Flora of Montana, Part II, Dicotyledons. Montana State College, Bozeman. 305pp.

_____. 1972. Grasses of Montana. Montana State University, Bozeman. 64pp.

Cole, G. F. and B. T. Wilkins. 1958. The Pronghorn Antelope, Its range use and food habits in Central Montana with special reference to wheat. Montana Fish and Game Dept. Tech. Bull. No. 2. 39pp.

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

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

Heckman, John. 1974. Personal communication. U. S. Forest Service, Bozeman, Montana.

Julander, Odell; W. L. Robinette and D. A. Jones. 1961. Relation of summer range condition to mule deer herd productivity. J. Wildl. Manage. 25(1):54-60.

Klein, D. R. 1962. Rumen contents analysis as an index to range quality. Trans. 27 N. A. Wildl. Conf.: 150-162.

_____. 1965. Ecology of deer range in Alaska. Ecol. Mono. 35(3):259-284.

Mackie, R. J. 1974. Personal communication. Assoc. Professor, Montana State University, Bozeman.

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

McMannis, W. J. 1955. Geology of the Bridger range, Montana. N. Y. Geological Society of America, Bull. Vol. 66: 1385-1430.

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

Riney, T. 1955. Evaluating condition of free-ranging red deer *(Cervus elaphus)*, with special reference to New Zealand. New Zealand J. Sci. Technol. 36(5):429-463.

Robinette, W. L. 1956. Productivity - the annual crop of mule deer. Pages 415-429 in W. P. Taylor, ed. The deer of North America. The Stackpole Co., Harrisburg, Pa.

_____, D. A. Jones, C. Rodgers and J. S. Gashwiler. 1957. Notes on tooth development and wear for Rocky Mountain mule deer. J. Wildl. Manage. 21(2):134-153.

_____, C. Harold Baer, Richard Pillmore and C. Edward Knittle. 1973. Effects of nutritional change on captive mule deer. J. Wildl. Manage. 37(3):312-326.

Schwarzkoph, W. F. 1973. Range use and relationships of mule deer on the west slope of the Bridger Mountains, Montana. Unpubl. Thesis (M.S.), Montana State University, Bozeman. 65pp.

U. S. Dept. of Commerce. 1952-1973. Climatological data for Montana. National Oceanic and Atmospheric Administration, Environmental Data Service. Asheville, N. C. Vols. 55-76.

Verme, L. J. 1963. Effects of nutrition on growth of white-tailed deer fawns. Trans. 27 N. A. Wildl. Conf.:431-443.

_____. 1969. Reproductive patterns of white-tailed deer related to nutritional plane. J. Wildl. Manage. 33(4):881-887.

Wilkins, B. T. 1957. Range use, food habits, and agricultural relationships of the mule deer, Bridger Mountains, Montana. J. Wildl. Manage. 21(2):159-169.