

Range use and relationships of mule deer on the west slope of the Bridger Mountains, Montana
by William Frederick Schwarzkoph

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 was conducted on the west slope of the Bridget mountains in southwestern Montana from January 1972 through April 1973. Objectives were to provide current information on range use, food habits, population characteristics and whether changes in ecological relationships have occurred since the study of Wilkins in 1956 on the same area. The vegetation of the area was classified into four major zones: Bunchgrass Prairie, Douglas Fir, Spruce-Fir and Alpine. Canopy coverages and frequencies of occurrence of the low-growing taxa were determined for most of the types within the Spruce-Fir and Alpine Zones. Distribution of mule deer was determined from 5,687 observations of individual deer. The Spruce-Fir Zone accounted for 63 percent of the summer observations. Eighty-four and 79 percent of all observations were recorded in the Douglas Fir Zone in fall and winter respectively. The Bunchgrass Prairie Zone was most important in the spring accounting for 78 percent of the observations. Mule deer food habits were determined from the examination of 76 feeding sites and the contents of 26 rumens. Forbs constituted 83 percent of the summer diet. Nuttall violet, yellow columbine and false dandelion were important forbs. Forbs remained the most important forage class in the fall constituting 49 percent of the diet as browse increased to 40 percent. During winter, grass and browse were equally important constituting 43 and 44 percent respectively. Green grass was utilized extensively on open, south-facing slopes as early as January. Douglas Fir, Rocky Mountain juniper and big sagebrush increased in usage as winter progressed and usage of bitterbrush decreased. Browse, forbs and grass constituted 44, 28, and 28 percent of the spring diet respectively. These food habits generally paralleled those reported for this area in the early 1950's. An average kidney fat index for 14 hunter-killed deer in the fall was .84 compared to .08 for four winter-killed deer. A fawn/doe ratio of 57/100 was calculated for the period August 15 to September 15 on the summer range. The fawn/doe ratio on the winter range in December was 68/100. A loss of 8-9 fawns/100 does was discovered during the months January through April, 1972 and 1973. A population estimate of 173 based on observations of marked deer came very close to estimates of 175 and 171 from air and ground counts respectively. An average activity radius and winter home range for mule deer was calculated to be 418 yards and 226 acres respectively. Mule deer appeared to extend their range in early spring.

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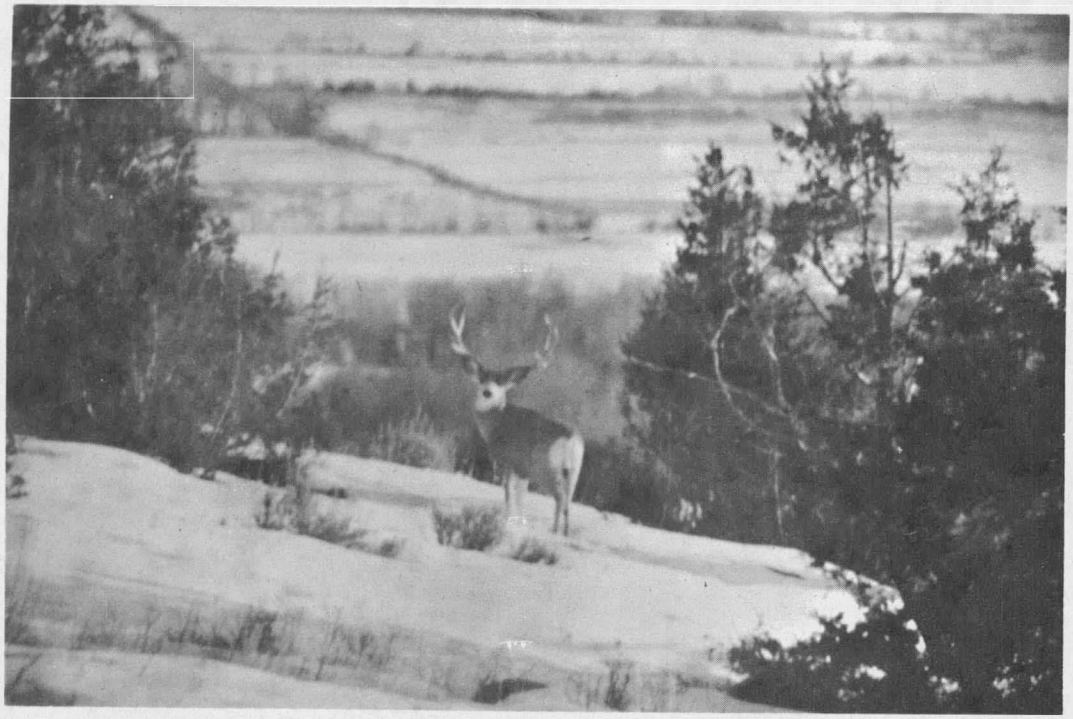
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Date July 3, 1973



FRONTISPIECE: THE ROCKY MOUNTAIN MULE DEER (*Odocoileus hemionus hemionus*).

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ABSTRACT

A study was conducted on the west slope of the Bridger mountains in southwestern Montana from January 1972 through April 1973. Objectives were to provide current information on range use, food habits, population characteristics and whether changes in ecological relationships have occurred since the study of Wilkins in 1956 on the same area. The vegetation of the area was classified into four major zones: Bunchgrass Prairie, Douglas Fir, Spruce-Fir and Alpine. Canopy coverages and frequencies of occurrence of the low-growing taxa were determined for most of the types within the Spruce-Fir and Alpine Zones. Distribution of mule deer was determined from 5,687 observations of individual deer. The Spruce-Fir Zone accounted for 63 percent of the summer observations. Eighty-four and 79 percent of all observations were recorded in the Douglas Fir Zone in fall and winter respectively. The Bunchgrass Prairie Zone was most important in the spring accounting for 78 percent of the observations. Mule deer food habits were determined from the examination of 76 feeding sites and the contents of 26 rumens. Forbs constituted 83 percent of the summer diet. Nuttall violet, yellow columbine and false dandelion were important forbs. Forbs remained the most important forage class in the fall constituting 49 percent of the diet as browse increased to 40 percent. During winter, grass and browse were equally important constituting 43 and 44 percent respectively. Green grass was utilized extensively on open, south-facing slopes as early as January. Douglas Fir, Rocky Mountain juniper and big sagebrush increased in usage as winter progressed and usage of bitterbrush decreased. Browse, forbs and grass constituted 44, 28, and 28 percent of the spring diet respectively. These food habits generally paralleled those reported for this area in the early 1950's. An average kidney fat index for 14 hunter-killed deer in the fall was .84 compared to .08 for four winter-killed deer. A fawn/doe ratio of 57/100 was calculated for the period August 15 to September 15 on the summer range. The fawn/doe ratio on the winter range in December was 68/100. A loss of 8-9 fawns/100 does was discovered during the months January through April, 1972 and 1973. A population estimate of 173 based on observations of marked deer came very close to estimates of 175 and 171 from air and ground counts respectively. An average activity radius and winter home range for mule deer was calculated to be 418 yards and 226 acres respectively. Mule deer appeared to extend their range in early spring.

INTRODUCTION

Mule deer (*Odocoileus hemionus*) using the Armstrong winter range on the west slope of the Bridger mountains were studied during 1955 and 1956 by Wilkins (1957). His study of range use and food habits was made at a time when the mule deer population had reached a peak in numbers. Since that time many intensive studies of mule deer in other areas of Montana have been completed. No further work has been done in the Bridger mountains.

Since Wilkins' study the mule deer population has declined. Hunting pressure has been light due to the steep and roadless terrain. Virtually no current information is available concerning the population characteristics, range use habits or movements of this herd. The objectives of this study were to provide current information on range use, food habits, seasonal distribution and population characteristics. The findings should aid in determining whether essential changes in ecological relationships have occurred since the studies of Wilkins and provide an information base for future management of mule deer in the Bridger mountains.

The study was conducted during the summer and fall of 1972 and winter of 1973. Part-time work was carried out during the winter and spring of 1972.

DESCRIPTION OF THE STUDY AREA

The study area (Fig. 1) of approximately 10 square miles, lies on the west slope of the Bridger Mountain Range of southwestern Montana, 20 miles northeast of Bozeman. The range extends from the Bridger Canyon northward in a gently curving arc for 23 miles to Blacktail Mountain. It's highest point is Sacagawea peak with an elevation of 9,665 feet. McMannis (1955) described the Bridger Range as exposed sedimentary rocks from Beltian time to Recent. On the study area these sedimentary rocks specifically range from Precambrian time through Mississippian and consist of shale, limestone, sandstone, and siltstone. Sediments at the base of the mountains consist of valley fill and alluvial gravels from Quaternary time. Isostatic arching in Oligcene time produced normal faults on the west side of the Bridger range.

Approximately 75 percent of the study area is publicly owned and administered by the U. S. Forest Service. The terrain is very steep with relief of 1,000 feet commonly occurring within a distance of 1/2 mile. Relief elevations range from 5,200 to 9,500 feet. North and south slopes predominate.

The study area is bordered by two creeks: North Cottonwood Creek on the north and Tom Reese Creek on the south. Both of these creeks originate in the high meadows near the divide of the range. North Cottonwood flows due west while Tom Reese flows southwesterly. The

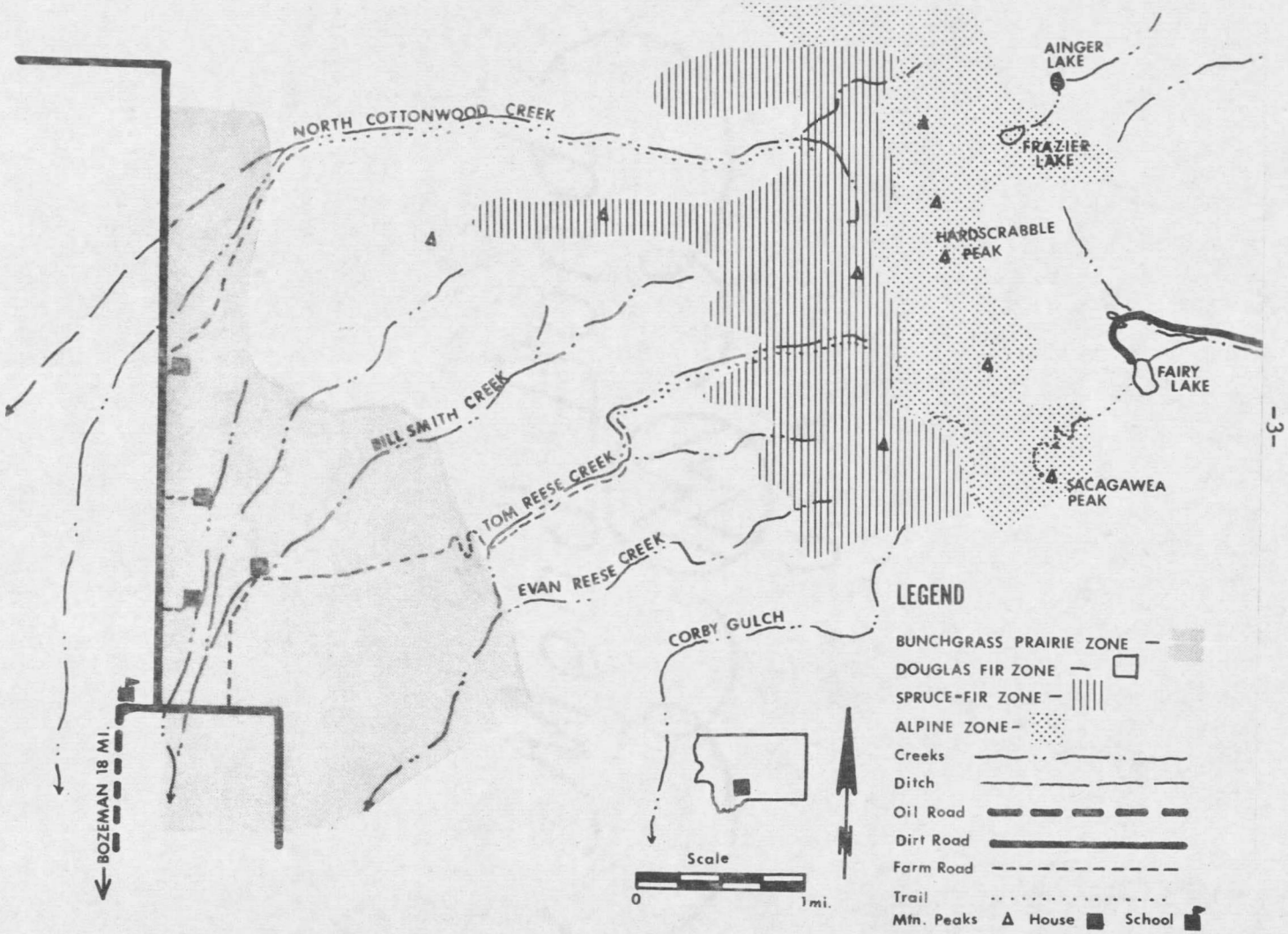


Figure 1. Map of Study Area showing vegetation zones.

only other creek in the area is Bill Smith Creek which originates in the montane forest and flows southwesterly.

An indication of weather conditions for the area was provided by data recorded at the U. S. Weather Bureau Station at the Belgrade airport located 10 airline miles southwest of the study area at an elevation of 4,451 feet. The climatological data (U. S. Department of Commerce Weather Bureau, 1952-1972) indicate the mean annual temperature and precipitation is 41.9 degrees F and 13.43 inches respectively. The mean temperature and precipitation for 1972 was 41.9 degrees F and 14.02 inches respectively. Monthly variations can be found in Appendix Table 15. January is the coldest month with a mean temperature of 17.2 degrees F while July is the warmest month with a mean of 66.6 degrees F. Extreme temperatures for the period of study were -39 degrees F in December 1972 and 95 degrees F in August 1972. The number of frost-free days in 1972 was 126 which was 23 days longer than the mean of 103 days. June received the greatest amount of precipitation with a mean of 2.51 inches and February received the least amount with a mean of 0.39 inches.

METHODS

Vegetation

Plants were collected from the summer range and identified to common and scientific names as listed by Booth (1950), Booth and Wright (1959), and Booth (1972). My description of the vegetation was similar to that of Wilkins (1957). Four zones were described based on major vegetation characteristics. Each zone was then subdivided into types based on minor vegetation characteristics. The low-growing species on the major types of the summer range were quantitatively sampled by a method similar to that described by Daubenmire (1959). When possible these vegetation measurements were recorded at feeding sites of mule deer. At each site the vegetation within each of twenty 2x5 decimeter frames was sampled. The frames were spaced at five foot intervals along each of two fifty foot lines which were either perpendicular to each other with the crossing at their centers or parallel to each other, depending on the terrain at the sample site. Canopy coverage and frequency were estimated for each low-growing taxon within each frame.

Mule Deer Distribution and Range Use

Deer were observed with the aid of a 7x50 binocular and a 15-60x spotting scope. During the summer deer were observed from an observation point overlooking North Cottonwood and Tom Reese Basins (Figs. 1 & 2) during the auroral and vesperal hours. During the fall,

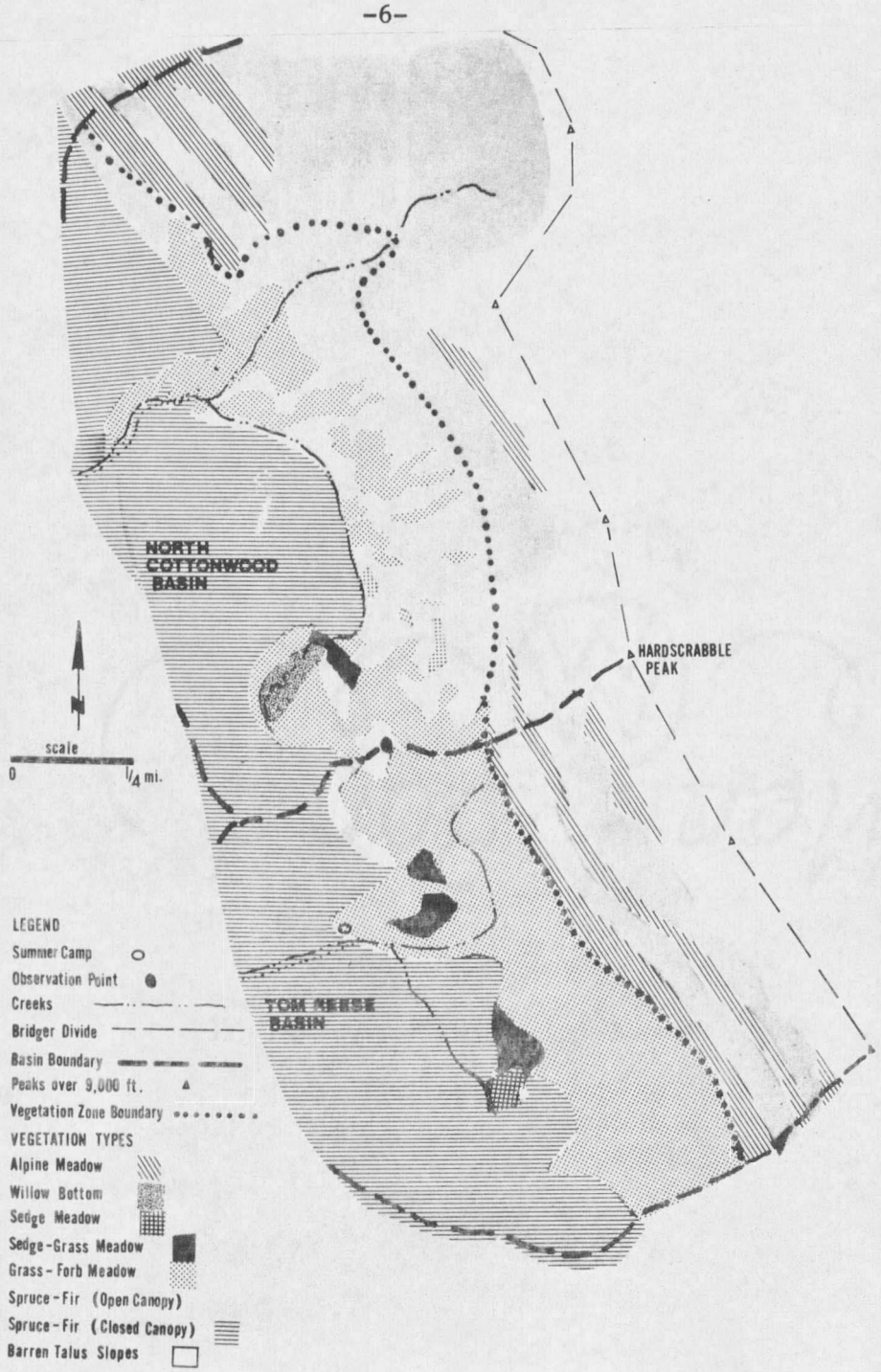


Figure 2. Map of summer range showing vegetation types within the Spruce-Fir (left) and Alpine Zones (right).

winter and spring periods deer were observed when I traversed the area on foot or by vehicle. Observations were also made during eight flights in a fixed-wing aircraft during fall and winter and two by helicopter during the winter. Deer were classified as to sex, age, marked or unmarked and activity. The area occupied was classified as to vegetation zone and type, slope and exposure. The approximate location of each observation was plotted on a map.

In October two weather stations were established to record daily temperature, humidity, precipitation, wind and solar radiation on the winter range. The upper station was located on a south-facing slope in an ecotone between a juniper and bitterbrush type in the Douglas Fir Zone at an elevation of 5,850 feet. It contained a hygrothermograph, a solar radiation unit and an anemometer. The lower station was located in the Armstrong ranch yard in the Bunchgrass Prairie Zone at an elevation of 5,250 feet. It contained a hygrothermograph and a standard rain gauge.

Food Habits

Year-long trends in mule deer food habits were determined from examination of 74 feeding sites and the contents of 26 rumen samples. A one-quart sample was collected from the rumen of each of 16 hunter-killed deer during the fall and from 10 winter-killed deer during the winter and spring for analysis following the technique of Wilkins (1957)

and others. Feeding sites were examined shortly after being vacated by feeding deer. One nip on a forb or browse plant or one bite of grass constituted one instance of use as described by Knowlton (1960) and others. The number of instances of use for each species was computed as a percentage of the total for each feeding site. The aggregate percentage method (Martin *et al.*, 1946) was used to tabulate the data by month and vegetation zone for feeding sites and by month for rumen samples.

In most cases availability of various taxa on feeding sites was determined by the use of twenty 2x5 decimeter frames as previously described. The results when compared with the food habits data provided a basis for determining food preference.

Condition, Productivity and Population Estimates

An index of productivity and population characteristics was determined for mule deer from male/female, fawn/female and fawn/adult ratios. The reproductive tracts from each of two hunter-killed females and three winter-killed females were examined to determine ovulation incidence and pregnancy. Kidneys and kidney fat collected from each of 14 hunter-killed deer and four winter-killed deer were weighed to evaluate physical condition. The age of each of 13 hunter-killed deer and 12 winter-killed deer was estimated by the eruption and wear of the mandibular teeth (Robinette *et al.*, 1957).

The size of the population using the winter range was estimated from aerial and ground counts and by observations of marked deer in a manner similar to that of Geiss (1956).

Average Activity Radii and Home Ranges in Winter and Early Spring

During the winter of 1972 and 1973, twenty-two deer were trapped by the use of Oregon style traps and individually marked (Fig. 3) using neckbands similar to those described by Knight (1966). Second-cutting alfalfa was used as bait. Each deer was classified as to sex, condition and age. Fawns trapped during the winter of 1972 were marked with large visible permatags in the lower portion of the left ear. Subsequent observations of these marked deer provided data on movements and size of winter home range.

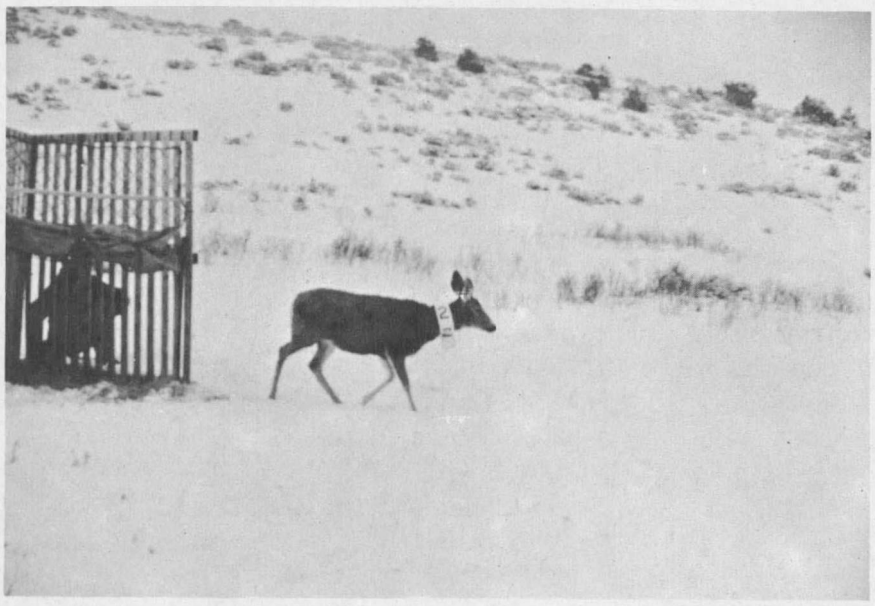


Figure 3. Oregon style deer trap and individually marked deer number 2.

RESULTS

Vegetation

The vegetation within the study area was classified into four major zones. These were the Bunchgrass Prairie, Douglas Fir, Spruce-Fir and Alpine Zones (Fig. 1). Only the low-growing vegetation of the Spruce-Fir and Alpine Zones were described quantitatively (Fig. 2). The species composition of zones and types for which quantitative measurements were taken are given in Table 1. Some ground cover characteristics are given in Table 2. The Bunchgrass Prairie Zone described by Wilkins (1957) and types not quantitatively sampled in other zones were described from general observations.

Bunchgrass Prairie Zone

This zone occurred on the alluvial fan at the base of the mountain below 5,600 feet (Fig. 4). Included are four types.

Sagebrush-Grassland Type: Big sagebrush (*Artemisia tridentata*) and bluebunch wheatgrass (*Agropyron spicatum*) were the dominant shrub and grass respectively. Other grasses included Idaho fescue (*Festuca idahoensis*), needle and thread (*Stipa comata*) and onespike oatgrass (*Danthonia unispicata*). Arrowleaf balsamroot (*Balsamorhiza sagittata*), yarrow (*Achillea millefolium*), Sagebrush buttercup (*Ranunculus glabberimus*), and helianthella (*Helianthella* spp.) were common forbs.

TABLE 1 CONSTANCY, PERCENT CANOPY COVERAGE AND FREQUENCY OF LOW-GROWING TAXA FOR VEGETATION TYPES AS DETERMINED BY EXAMINATION OF TWENTY 2X5 DECIMETER PLOTS ON EACH OF 20 SITES.

	DOUGLAS FIR ZONE	SPRUCE-FIR ZONE					ALPINE ZONE
Taxa[1]	Lodgepole Pine Type 1 site	Spruce-Fir (Closed Canopy) 3 sites	Spruce-Fir (Open Canopy) 3 sites	Sedge Meadow 1 site	Sedge-Grass Meadow 3 sites	Grass-Forb Meadow 5 sites	Alpine Meadow 4 sites
GRASS AND GRASS-LIKE PLANTS							
Agrostis spp.					67/3/22[2]		
Agropyron trachycaulum			100/4/43		67/1/12		50/3/21
Bromus marginatus			67/1/12		67/1/8		25/3/19
Calamagrostis montanensis			67/1/12		67/7/47	100/2/31	75/1/19
Carex geyeri	100/1/5	100/10/40	67/8/32		100/33/77		
Carex festivella					33/7/13	20/tr[3]/1	
Carex spp.				100/22/50		60/1/16	25/tr/8
Equisetum spp.				100/1/20			
Festuca idahoensis					67/4/27		
Helica spectabilis					100/3/22	100/3/49	
Phleum alpinum	100/2/5		33/tr/2	100/2/10	67/tr/3	20/tr/3	
Poa alpina			33/tr/5	100/3/15			25/3/13
Unidentified Grass			67/1/18	100/3/40	67/8/43	100/8/51	50/7/41
Total Grass and Grass-Like Plants	100/3/10	100/11/42	100/17/82	100/29/50	100/71/97	100/16/87	100/17/94
FORBS							
Achillea millefolium		33/tr/2	100/7/37	100/3/10	100/16/88	100/7/39	100/18/74
Agoseris glauca			67/5/30		100/4/30	80/3/23	100/5/43
Allium schoenoprasm				100/5/40			
Antennaria lanata						20/2/7	
Aquilegia flavescens			33/1/7		33/1/3	40/1/5	25/1/5
Arabis nuttallii			33/1/5			40/1/14	75/2/19
Arabis spp.					33/1/13		25/tr/1
Arnica cordifolia	100/2/10	100/10/60	33/6/27		67/1/5	20/1/8	
Arnica sororia		67/tr/3			33/1/10		25/tr/1
Artemisia campestris							50/3/11
Aster foliaceus					33/tr/3		25/2/16
Astragalus miser					67/1/15	20/tr/6	50/2/8
Balsamorrhiza sagittata					33/2/5		
Besseya wyomingensis					67/2/22		25/tr/5
Cardaria draba			33/tr/5		33/tr/2	60/1/7	100/1/8
Cerastium arvense					33/1/20		
Circium foliosum						20/1/3	100/5/24
Claytonia lanceolata				100/tr/5		60/2/24	
Collomia linearis			33/3/17		67/3/18	60/4/36	25/3/16
Compositae					33/4/15		
Cruciferae						20/tr/1	25/tr/3
Delphinium bicolor						60/tr/5	25/tr/1
Delphinium occidentale			33/tr/2		67/4/12	80/10/26	
Dryas octopetala							50/1/9
Erigeron glabellus			67/6/47		100/5/25	20/tr/1	50/8/33
Erigeron spp.			33/8/30				
Erythronium grandiflorum	100/tr/5		33/tr/2			60/3/24	25/3/18
Geranium viscosissimum					100/6/28	40/3/10	
Hackelia floribunda					33/tr/2	20/1/5	
Helianthella uniflora			33/1/15		100/6/25	100/13/47	
Heracleum lanatum			67/1/15				
Hydrophyllum capitatum						40/1/5	
Linum watatsnamum					33/1/10		50/1/23
Lomatium cous			33/tr/2				100/4/41
Lupinus argenteus			67/5/38		100/2/17	80/2/16	
Mertensia longiflora			33/1/7		67/3/12	60/4/14	25/1/4
Osmorhiza occidentalis			100/3/20			40/4/19	25/6/19
Plantago spp.				100/17/50			
Polemonium pulcherrimum						20/1/7	50/2/8
Potentilla gracilis					100/21/67		25/3/23
Ranunculus eschscholtzii			33/1/17			80/2/13	100/3/25
Selinum rosea							50/1/16
Senecio serra	100/2/20		33/5/27				25/5/19
Senecio triangularis			33/tr/5		67/1/7	100/19/79	25/6/23
Senecio spp.			33/5/28				
Silene acaulis							25/2/11
Taraxacum officinale			67/5/27	100/2/15	33/tr/2	60/2/11	25/tr/3
Trifolium haydenii			33/1/13				100/23/79
Umbelliferae				33/1/12			
Valeriana occidentalis			33/1/5		33/1/2	80/12/27	
Viola nuttallii			100/3/25		100/1/12	100/10/64	25/1/10
Unidentified Forbs	100/tr/5	67/2/20	100/8/48	100/tr/5	100/5/27	80/6/47	75/7/41
Total Forbs	100/5/35	100/12/68	100/56/100	100/23/50	100/61/97	100/64/99	100/62/99
BROWSE							
Abies lasiocarpa		67/7/20	33/tr/3				25/1/1
Juniperus communis	100/2/5						
Pinus flexilis &/or *P. albicaulis*		33/2/7					
Spiraea betulifolia	100/6/70				33/2/13		
Symphoricarpos spp.	100/3/5						
Vaccinium membranaceum	100/34/90	33/1/3					
Vaccinium scoparium	100/40/75	100/57/97	33/12/28				
Total Browse	100/73/95	100/55/93	33/12/30		33/2/13		25/1/1
BARE GROUND			100/12/75	100/3/40	100/4/62	100/25/93	100/13/94
ROCK	100/6/60	100/19/75	100/21/92		100/6/45	100/7/82	100/20/99

[1]Includes those taxa with a canopy coverage of .5% or greater or a frequency of 5% or greater in at least one type. Plants occurring at a level less than 0.5% canopy coverage or a frequency less than 5% in any type include: *Stipa columbiana*, *Cymopterus bipinnatus*, *Gaillardia aristata*, Liliaceae, *Perideridia gairdneri*, *Fragaria dedymocarpa*, *Polygonum bistortoides*, *Zygadenus elegans*, and *Ribes montigenum*.

[2]Constancy (% occurrence among sites)/canopy coverage (% of area covered)/ average frequency (% occurrence among plots).

[3]tr=trace; a value less than .5%.

TABLE 2. GROUND COVER CHARACTERISTICS OF SIX TYPES WITHIN THREE ZONES. DATA ARE FREQUENCIES OF OCCURRENCE OF BARE GROUND, ROCK, LITTER AND LIVING VEGETATION AMONG 920 POINTS.

Vegetation Zone	Vegetation Type	Number Points	Bare Ground	Rock	Litter	Living Vegetation
Douglas Fir	Lodgepole Pine	80	-[1]	20[1]	50[1]	30[1]
Spruce-Fir	Spruce-Fir (Closed Canopy)	240	-	16	47	37
	Spruce-Fir (Open Canopy)	240	21	18	24	37
	Grass-Sedge Meadow	160	21	12	9	58
	Sedge Meadow	40	32	-	15	53
Alpine	Alpine Meadow	160	30	17	6	47

[1]Percent of the total points in each type.

Agriculture Type: This type occurred below 5,400 feet and was used extensively for agricultural purposes. Crops grown in this type consisted of winter wheat (*Triticum aestivum*), alfalfa (*Medicago sativa*) and mixed growths of smooth brome (*Bromus inermis*) and orchard grass (*Dactylis glomerata*).



Figure 4. Bunchgrass Prairie Zone in foreground with the Douglas Fir Zone at center.

Fescue-Wheatgrass Type: This type was characterized by bluebunch wheatgrass, Idaho fescue and needle and thread. Common forbs were arrowleaf balsamroot, yarrow, and cudweed sagewort (*Artemisia ludoviciana*).

Creek Bottom Type: This type occurred in narrow bands along the major creeks and intermittent drainages. The dominant overstory consisted of black cottonwood (*Populus trichocarpa*) and black hawthorn (*Crataegus douglasii*) along North Cottonwood Creek and quaking aspen (*Populus tremuloides*) along Bill Smith Creek. Shrubs included snowberry (*Symphoricarpos* spp.), mountain maple (*Acer glabrum*) and chokecherry (*Prunus virginianus*). Willow (*Salix* spp.), hawthorn, and rose (*Rosa* spp.) occurred along minor intermittent drainages. Important forbs and grasses were yarrow and helianthella and bluebunch wheatgrass and Idaho fescue respectively.

Douglas Fir Zone

This zone occurred from 5,800 to 8,000 feet. The northern exposures were covered with timber consisting of Douglas fir (*Pseudotsuga menziesii*). The southern exposures at elevations as high as 6,800 feet were barren of timber and dominated by shrubs (Fig. 4). Included are eight types.

Douglas Fir Type: This type occured on northern exposures from 5,800 to 8,000 feet. Douglas fir was the dominant tree. According to

Wilkins (1957) this area had not been logged since the early 1900's. Major shrubs in the understory included snowberry, Oregon grape (*Berberis repens*) and white spiraea (*Spiraea betulifolia*). Present in lesser amounts were common juniper (*Juniperus communis*), mountain maple, and thinleaved huckle-berry (*Vaccinium membranaceum*). Elk sedge (*Carex geyeri*) was an abundant plant. Bluebunch wheatgrass and Idaho fescue were the only grasses of any importance. Common forbs were aster (*Aster* spp.), western spring beauties (*Claytonia lanceolata*), and shrubby penstemon (*Penstemon fruiticosa*).

Sagebrush-Bitterbrush Type: This type occurred on south-facing exposures from 5,800 to 6,800 feet. Major shrubs were big sagebrush and bitterbrush (*Purshia tridentata*). Rocky Mountain Juniper (*Juniperus scopulorum*) occurred in lesser amounts. The dominant forb was arrowleaf balsamroot. Other forbs were common salsify (*Tragapogon dubius*), cudweed sagewort, sagebrush buttercup, helianthella and common dandelion (*Taraxicum officinale*). Major grasses were bluebunch wheatgrass, Idaho fescue, cheatgrass (*Bromus tectorum*), Junegrass (*Koleria cristata*) and Sandberg bluegrass (*Poa secunda*).

Juniper Type: This was a minor type occurring at lower elevations. The dominant plant was Rocky Mountain juniper. Other important shrubs were big sagebrush and bitterbrush. Arrowleaf balsamroot was the dominant forb. Cheatgrass was an important grass.

Fescue-Wheatgrass Type: This minor type occurred on west-facing slopes and was similar to that in the Bunchgrass-Prairie Zone. The dominant species were bluebunch wheatgrass and Idaho fescue.

Bitterbrush Type: This was an important type on south-facing slopes. The dominant shrub was bitterbrush. Rocky Mountain juniper occurred in lesser amounts. Arrowleaf balsamroot and cheatgrass were the dominant forb and grass respectively.

Sagebrush-Grassland Type: This type was similar to that of the same type in the Bunchgrass Prairie Zone except that it occurred at slightly higher elevations.

Douglas Fir-Sagebrush Park Type: This type occurred as small parks in scattered locations at higher elevations (6,000 to 6,200 feet). Douglas fir was the dominant tree and big sagebrush was the dominant shrub. Bluebunch wheatgrass and Idaho fescue were important grasses.

Lodgepole Pine Type: This type occurred on old burns along Tom Reese Creek. Lodgepole pine (*Pinus contorta*) was the dominant tree species. Important shrubs were white spiraea, thinleaved huckleberry and low-red huckleberry (*Vaccinium scoparium*). Arnica (*Arnica cordifolia*) was an important forb. Other important shrubs and forbs not in the sample site but commonly occurring were sticky currant (*Ribes viscosissimum*), redshoot gooseberry (*Ribes setosum*), yellow columbine (*Aquilegia flavescens*) and cow parship (*Heracleum lanatum*).

Spruce-Fir Zone

This zone occurred from 8,000 to 8,600 feet and consisted of the upper montane forest and the mountain meadows described by Wilkins (1957). The six types which comprised this zone were quantitatively sampled (Table 1).

Spruce-Fir (Closed Canopy) Type: This type consisted of the upper montane forest (Fig. 5). The dominant trees were Alpine Fir (*Abies lasiocarpa*), limber pine (*Pinus flexilis*) and/or whitebark pine (*Pinus albicaulis*). Englemann spruce (*Picea englemanni*) occurred in lesser amounts and Douglas fir occurred at lower elevations of the type. The understory consisted mainly of elk sedge and/or low-red huckleberry (Table 1). Scattered forbs were arnica, yarrow, and various lilies (Liliaceae).

Spruce-Fir (Open Canopy) Type: This type occurred mainly in North Cottonwood basin at higher elevations, (Fig. 6). It consisted of stands or "islands" of alpine fir and limber pine and/or whitebark pine with some Englemann spruce intermixed. Important shrubs were redshoot gooseberry and low-red huckleberry (Table 1). Important forbs were yarrow, false dandelion (*Agoseris glauca*), cow parsnip, fleabane (*Erigeron* spp.), silvery lupine (*Lupinus argenteus*), western sweetroot, (*Osmorhiza occidentale*) and common dandelion. Grasses were few with slender wheatgrass (*Agropyron trachycaulum*) predominating. Grass-forb meadows were interspersed as parks between these islands.

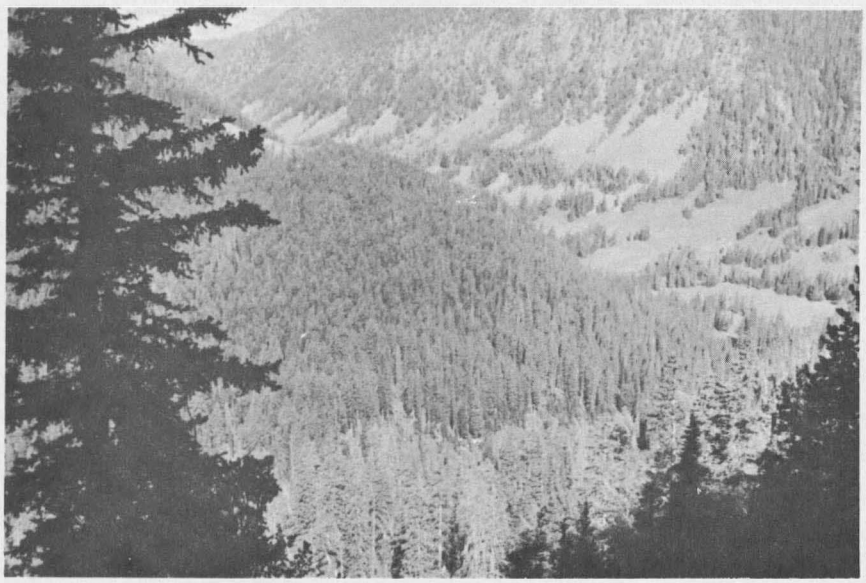


Figure 5. Spruce-Fir (Closed Canopy) Type within the Spruce-Fir Zone.



Figure 6. Spruce-Fir (Open Canopy) Type within the Spruce-Fir Zone. Parks are Grass-Forb Meadow Type.

Willow Bottom Type: This type occurred at one site in North Cottonwood basin at an elevation of 7,900 feet. The site appeared to have been an ancient cirque lake where succession had progressed to a willow type (Fig. 7). Bebb willow (*Salix bebbiana*) was the dominant shrub. Important forbs were arrowleaf groundsel (*Senecio triangularis*) and tall larkspur (*Delphinium occidentale*). Grasses were minor. Horsetail (*Equisetum* spp.) was a common low-growing plant.

Sedge Meadow Type: This type, like the Willow Bottom Type occurred at only one site, this being in Tom Reese basin at an elevation of 8,200 feet. This site too, appears to have been a cirque lake in origin where succession had progressed to the sedge type (Fig. 8). Carex species and horsetail were common plants (Table 1). Important grasses were alpine timothy (*Phleum alpinum*) and alpine bluegrass (*Poa alpina*).

Sedge-Grass Meadow Type: This type consisted mainly of grasses and sedges (Fig. 9). Elk sedge was the dominant sedge with ovalhead sedge (*Carex festivella*) next in importance (Table 1). Purple onion grass (*Melica spectabilis*), Idaho fescue, plains reedgrass (*Calomagrostis montanensis*), slender wheatgrass, mountain brome (*Bromus marginatus*) and alpine timothy were important grasses. Forbs were fewer in number but consisted of yarrow, false dandelion, fleabane, sticky geranium (*Geranium viscosissimum*), silvery lupine and northwest cinquefoil (*Potentilla gracilis*).



Figure 7. Willow Bottom Type at center within the Spruce-Fir Zone.



Figure 8. Sedge Meadow Type within the Spruce-Fir Zone.

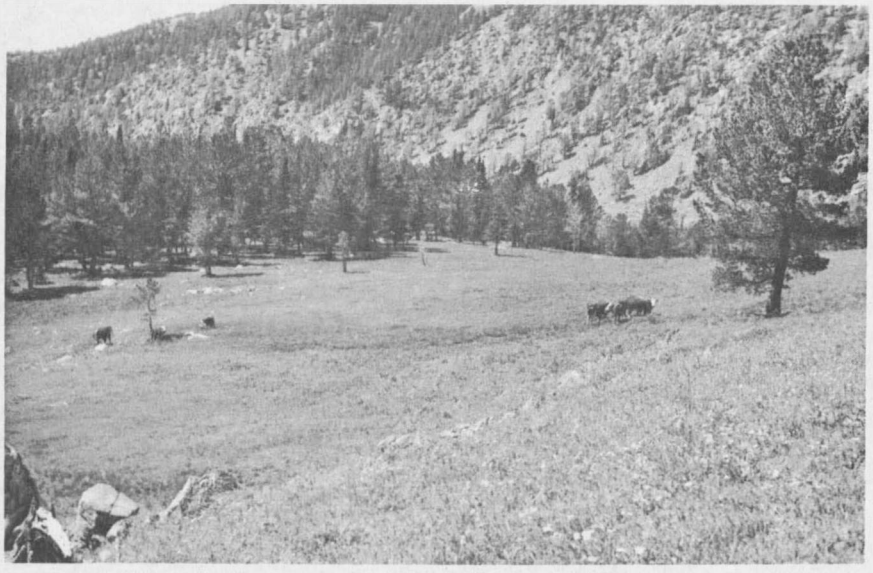


Figure 9. Sedge-Grass Meadow Type within the Spruce-Fir Zone.



Figure 10. Grass-Forb Meadow Type within the Spruce-Fir Zone.

Grass-Forb Meadow Type: This was a major type and occurred in more places than any other non-timber type in this zone (Fig. 10). Species composition was diverse with the more important forbs being yarrow, arrowleaf groundsel, Nuttal violet (*Viola nuttalli*), marsh valeriana (*Valariana dioca*), largeflower buttercup (*Ranunculus eschscholtzii*), silvery lupine, tall larkspur, and false dandelion (Table 1). Important grasses were plains reedgrass, purple onion grass and alpine timothy. Ovalhead sedge was present in lesser amounts.

Alpine Zone

This zone occurred at the highest elevations (8,600 to 9,500 feet) on the study area (Figs. 2 & 11). Steep talus slopes from 45 to 60 degrees predominated. The highest portion of this zone was barren and consisted of slide rock and shale. The east slope drops abruptly with 90 degree slopes in most places. Two types were included.

Alpine Meadow Type: This type occurred as parks among the spruce-fir stands and as strips along old faults described by McMannis (1955). Forbs were the dominant class of vegetation with Hayden clover (*Trifolium haydenii*) the predominant species. Other important forbs were yarrow, false dandelion, mountain biscuitroot (*Lomatium cous*), largeflower buttercup, elk thistle (*Cirsium foliosum*), whitetop (*Cadaris draba*) and Nuttall rockcress (*Arabis nuttallii*). Alpine bluegrass was an important grass.



Figure 11. Spruce-Fir (Open Canopy) Type and Alpine Meadows (strips) within the Alpine Zone.

Spruce-Fir (Open Canopy) Type: This type was similar to the Spruce-Fir (Open Canopy) Type within the Spruce-Fir Zone only occurring at higher elevations. The tree composition was the same and it too occurred in stands. The important shrub was redshoot gooseberry with some common juniper in limited amounts. Yellow columbine was an important forb and grasses were minor in importance.

Mule Deer Distribution and Range Use

During the study 5,043 observations of mule deer from the ground and 644 from the air were classified as to occurrence on vegetation zone and/or type, (Table 3 & Appendix Table 13). Average group size of mule deer for summer, fall and winter was 2.0, 4.0 and 14.7 respectively. Distribution of mule deer throughout the year is shown in Figure 12.

Summer (mid-June to September). Sixty-three percent of 410 observations of mule deer from the ground was in the Spruce-Fir Zone (Table 3). The Spruce-Fir (Open Canopy) and Grass-Forb Meadow Types within this zone together accounted for 55 percent of the observations. Mule deer were attracted to these types by the abundance and great variety of succulent forbs characteristic of the grass-forb meadows (Table 1), and the cover afforded by timber in the spruce-fir stands. North Cottonwood basin (Fig. 2) where 53 percent of the observations

TABLE 3. PERCENT OF GROUND OBSERVATIONS OF MULE DEER ON VEGETATION ZONES AND TYPES BY MONTH AND SEASON FOR THE PERIOD JUNE 1972 TO APRIL 1973.

Vegetation Zone and Type	SUMMER					FALL				WINTER				SPRING
	Mid June	July	Aug.	Sept.	Season	Oct.	Nov.	Dec.	Season	Jan.	Feb.	Mar.	Season	Apr.
BUNCHGRASS PRAIRIE ZONE														
Sagebrush-Grassland Type								3	2	18	5		8	15
Agriculture		2			1			2	1		4	18	7	41
Fescue-Wheatgrass										4		17	6	18
Creek Bottom	3		2				2		tr[1]	1		1	1	3
Total	3	2	2	—	1	—	2	5	3	23	8	36	21	78
DOUGLAS FIR ZONE														
Douglas Fir Type	16		tr	8	3	33	77	6	23	1	5		2	
Sagebrush-Bitterbrush	16	1			2	6	10	76	49	32	29	38	33	11
Juniper	3	1	1		1			1	tr	6	10	8	8	4
Fescue-Wheatgrass								12	7	3	1	3	2	6
Bitterbrush							2	1	1	32	32	8	25	1
Sagebrush-Grassland							8		1	3	4	6	4	
Douglas Fir-Sagebrush Parks						4			1	1	11	2	5	
Lodgepole Pine	13	1	tr		2	4			1					
Total	47	4	2	8	7	47	98	95	84	77	92	64	79	22
SPRUCE-FIR ZONE														
Spruce Fir Type (Closed Canopy)	19	1	2	10	4	13			3					
Spruce Fir (Open Canopy)		24	24	4	19	8			2					
Willow Bottom		2	3		2									
Sedge Meadow			tr		tr									
Sedge-Grass Meadow			4		2	8			2					
Grass-Forb Meadow	28	31	34	52	36	24			6					
Total	47	59	66	66	63	53	—	—	13	—	—	—	—	—
ALPINE ZONE														
Spruce-Fir Type (Open Canopy)		13	12	11	11									
Alpine Meadow	3	22	18	15	17									
Total	3	35	30	26	28	—	—	—	—	—	—	—	—	—
Total Number of Deer Observed	32	82	223	73	410	78	48	194	320	771	915	711	2397	756
Percent of Total Deer Observed	8	20	54	18	100	24	15	61	100	24	29	23	100	100

[1]tr=trace, less than .5% of the total deer occurring in a zone or type during a month or season.

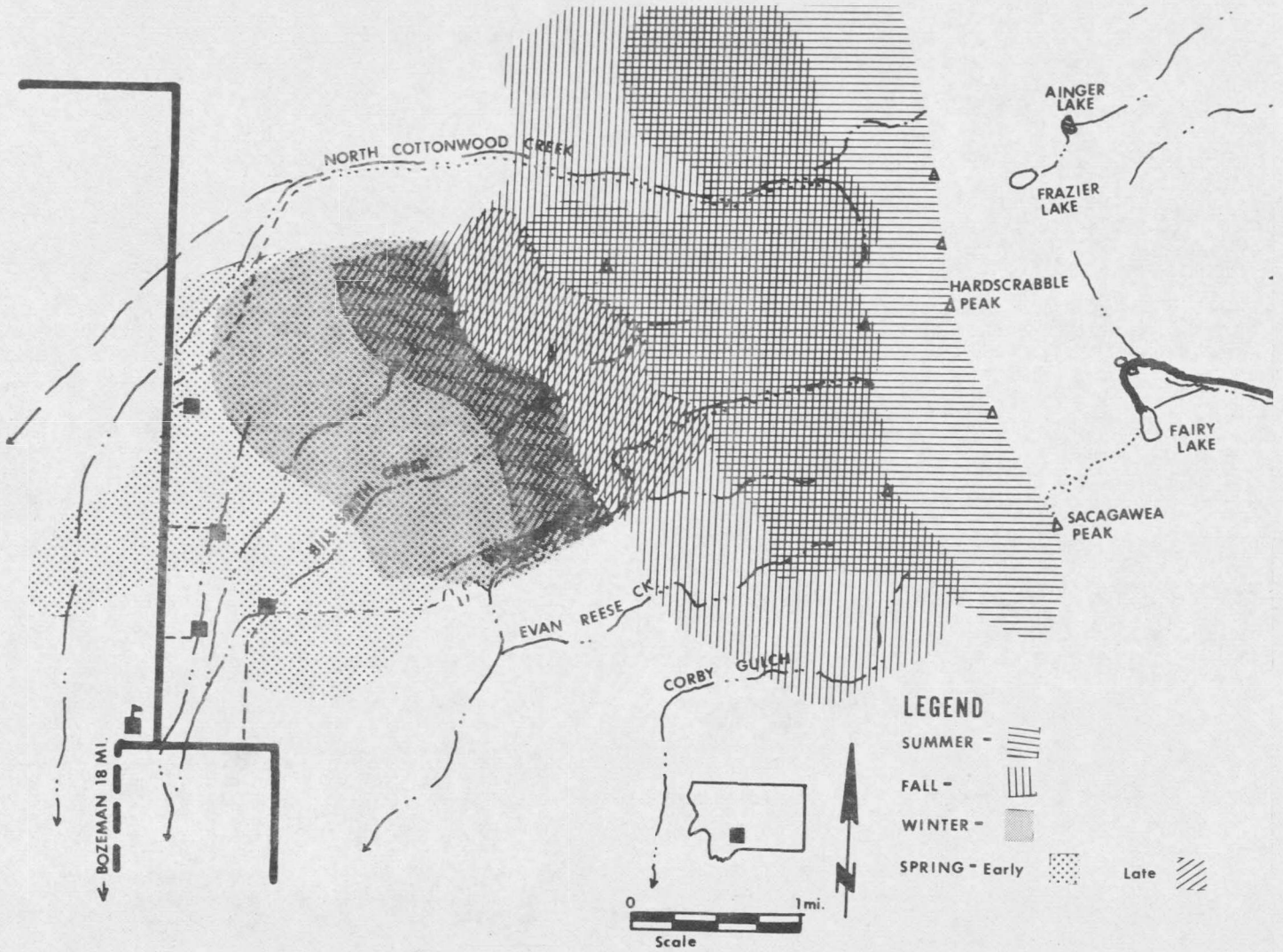


Figure 12. Map of study area showing distribution of mule deer throughout the four seasons.

were made during this period was characterized by spruce-fir stands with the grass-forb meadows interspersed as parks among the stands. Mule deer were observed to feed in the parks and bed in the spruce-fir stands. Tom Reese basin (Fig. 2) which accounted for 40 percent of the summer observations was characterized by large open grass-forb meadows.

The Alpine Zone accounted for 28 percent of the observations. The Alpine Meadow and Spruce-Fir (Open Canopy) Types were characterized by an abundance of succulent forbs and protective cover respectively.

As in the Spruce-Fir Zone, deer were observed feeding in the meadows until approximately 3 1/2 hours after sunrise. They then bedded down in the spruce-fir stands until approximately 3 1/2 hours before sunset when they would resume feeding in the meadows. At sunset they would often move down from the Alpine Zone and into the Spruce-Fir Zone and back again in the early morning hours. Of all deer observed above 8,600 feet or in the Alpine Zone, 80 percent were mature males. Only 19 percent of all yearling males observed were in this zone. Both Mackie (1970) and Knapp (1972) found "buck habitat" areas. Knapp related this to exposure and stated that does with fawns avoided these areas. I believe this was related to slope and that does with fawns avoided the steep slopes. Forty percent of all observations were on slopes of 45 degrees or greater. Thirteen observations of mountain goats (*Oreamnos americana*) were made in the

Alpine Zone with some observations in the same areas used by mule deer males. The mule deer were never observed at higher elevations lacking vegetation whereas the goats utilized the barren talus slopes regularly in their daily activity.

Forty-two percent of all morning observations and 34 percent of all evening observations occurred between the hours of seven and eight A.M. and P.M. respectively (Fig. 13). This was due to the increased activity of the deer when 80 percent of all deer observed were feeding or moving.

Of all mule deer observed in North Cottonwood basin, 21, 45, and 24 percent were males, females and fawns respectively. This compares to 54, 30, and 11 percent for males, females and fawns respectively in Tom Reese basin. Factors responsible for this differential distribution may have included the cover of the spruce-fir stands in North Cottonwood basin which may have been preferred by females with fawns (Fig. 2). Most males in both basins were in the Alpine Zone.

Deer use of the meadows increased from 2.5 deer/observation period in late June to 11.7 deer/observation period in late August and then declined (Fig. 14). Deer numbers increased in the Spruce-Fir Zone from 47 percent of all deer observed in all zones in June to 66 percent in August with a corresponding decrease from 47 to two percent in the Douglas Fir Zone. All these data point to an upward movement as the summer progressed. This was probably related to the phenology

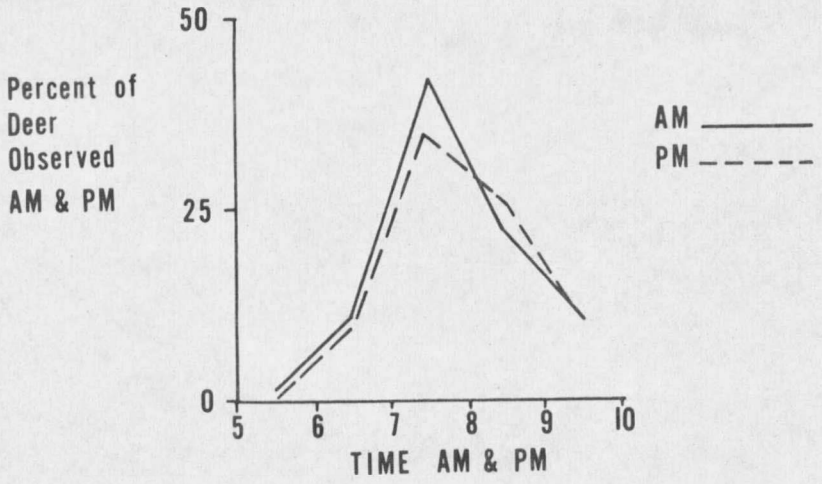


Figure 13. Percent of mule deer observed/hour A.M. and P.M.

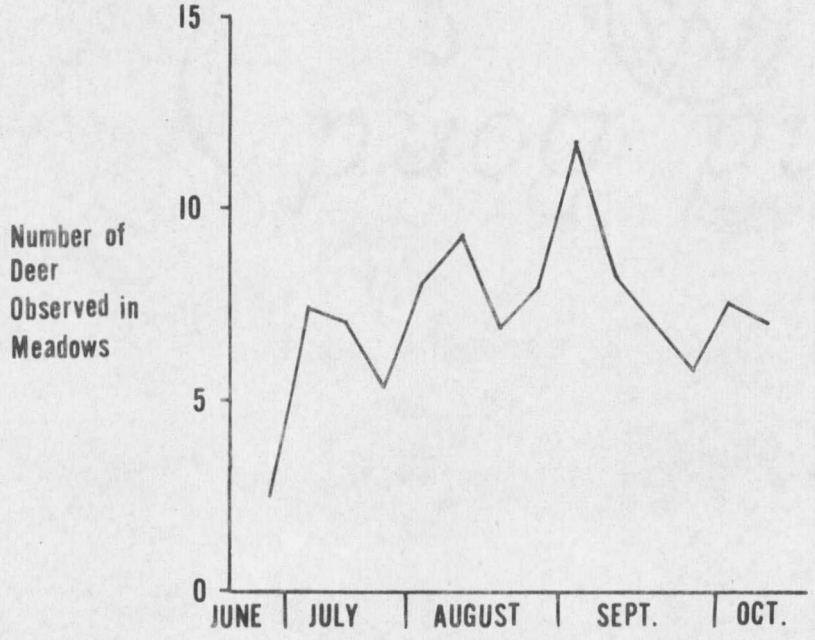


Figure 14. Number of deer/observation period in meadows.

of forbs throughout the different zones.

Several observations were made where mule deer could have moved onto the east slope of the mountain range. The east slope at high elevations was very steep with only a few areas existing where deer could travel from the west slope to the east slope. According to Gruel and Papez (1963), deer in the mountains of northeast Nevada did travel over mountain ranges as high as 10,000 feet in travels from winter range to summer range. One observation was made of several deer leaving Tom Reese basin at an elevation of 9,000 feet and moving into Corby Canyon. These deer could have entered the Fairy Lake drainage. Eight deer, including seven males were observed on the east slope on a small area in September when deer observations in the meadows on the west slope had dropped to 5.8 deer/observation period.

The Spruce-Fir (Closed Canopy) Type within the Spruce-Fir Zone and the Lodgepole Pine Type within the Douglas Fir Zone were probably used more than my data show. Most observations in these types were of deer alarmed from their beds in the diurnal period. Past use of forbs and browse such as low-red huckleberry and thinleaved huckleberry indicated these types are used in early summer by deer migrating to the meadows, again in late summer when they begin to move down and possibly all summer by some deer.

By the first of September, observations of deer in the meadows became increasingly less frequent. The dessication and actual depletion of forbs in the meadows seemed to be a factor for the decreased use. Cattle were allowed to enter the meadows on August 11. In Tom Reese they remained on and heavily utilized the Sedge Meadow and Sedge-Grass Meadow Types. They did not use the Grass-Forb Meadow Type until the vegetation on the former types was virtually depleted. In contrast to the isolation of the cattle on the sedge and sedge-grass meadows in mid summer, by late summer, cattle were ranging over the entire basin to obtain sufficient forage. The Alpine Zone was unused by cattle due to the steep terrain. Mule deer avoided areas used by cattle. Six observations of deer utilizing willow in the Willow Bottom Type were made prior to the cattle entry. After cattle entered North Cottonwood basin and the willow bottom, no observations of deer were made in this type. Observations of deer on the sedge and sedge-grass meadows in Tom Reese basin were few. On the seventh of September, cattle in Tom Reese basin were observed moving out of the meadows to forage on the mesic sites along Tom Reese creek in the montane forest. The cattle were not herded out of the meadows but left by themselves when forced to find forage elsewhere. I believe this also applies to mule deer use of the meadows. According to a Forest Service publication (1973), the Bridger allotments are generally in high fair-to-good condition, but there may be some competition between

cattle and big game on the north and west side of the Bridgers.

Fall (October-December). The Douglas Fir Zone was of major importance accounting for 84 percent of the 320 mule deer observations. The Douglas Fir and Sagebrush-Bitterbrush Types within this zone accounted for 72 percent of all observations, with the former being used most in November and the latter in December. Observations of mule deer in the Spruce-Fir Zone totaled 53 percent of all mule deer observations in October but dropped to zero thereafter. Deer became increasingly difficult to observe with the use of the Douglas Fir Type. By November, 77 percent of the observations were in this type. All of these data point to a downward movement.

Snowfall was light throughout the fall of 1972 and as a consequence deer remained above 7,000 feet and in the Douglas Fir Type throughout most of the period. Seventy-four percent of the hunter-killed deer in known locations were at or above 7,000 feet and in the Douglas Fir Type. Rumen contents of these hunter-killed deer represented plant species characteristic of this type. Due to the difficulty in approaching deer in the forest, 39 percent of all deer observed were alarmed. As the season progressed activity periods lengthened from auroral-vesperal periods in October to all-day activity in December. Use of southwest and south-facing slopes predominated in the observations with 65 and 23 percent respectively. Many mule deer observed by aircraft in October and November were using grassland types on

west-facing slopes just north of North Cottonwood creek. Flights in December revealed no mule deer using these same areas. It is possible that these deer moved south onto the study area to utilize the south-facing sagebrush-bitterbrush slopes.

Eighty-one observations of elk (*Cervis canadensis*) were recorded during four flights over the study area during this period, Appendix Table 14. Elk apparently moved onto the study area sometime in early November as no elk were observed in a late October flight but were observed in both late November and December flights. Only three males were observed. One yearling male was taken on the study area in the Spruce-Fir Zone during hunting season. All observations of elk were in the Douglas Fir Zone. During two flights, 106 whitetail deer (*Odocoileus virginianus*) were observed in agricultural fields in close association with Tom Reese creek, Appendix Table 14.

Winter (January-March). During this period deer began to concentrate in large groups and were easily observed. Seventy-nine percent of the 2,397 observations of mule deer were in the Douglas Fir Zone. The Sagebrush-Bitterbrush and Bitterbrush Types within the zone accounted for 58 percent of the observations. There was a slight decrease from 77 to 64 percent in the Douglas Fir Zone from January to March and a corresponding increase of 23 to 36 percent in the Bunchgrass Prairie Zone. Extreme limits of mule deer use in relation to elevation ranged from 5,200 to 7,000 feet with the majority of the herd utilizing

areas within 5,400 to 6,500 feet. Forty-six, 28 and 21 percent of the observations were on south, southwest and southeast-facing slopes respectively. Mule deer were active throughout the day and 67 percent of the observations were recorded for feeding animals. Snowfall was light and the winter was considered mild. South-facing slopes were free of snow most of the winter (Fig. 15). Temperatures recorded from the two hygrothermographs revealed a difference of 5.8 degrees F warmer than the 21 year seasonal average. It was also found that the location of the upper station on the south-facing slope was 3.5 degrees F warmer than the lower station during this season (Appendix Table 15). This was probably one of the factors responsible for the early green-up of grass and the concentration of mule deer on these slopes.

Many males were consistently observed near a large patch of Douglas fir and juniper at an elevation of 5,500 feet. In February it was possible to determine that males were still using this area in greater numbers than females by the observation of banded males. This area was determined to be a winter "buck habitat". No explanation could be given for this differential distribution and it became less distinct in March.

Of 222 observations of elk (169 from the ground and 53 from the air), only 18 were males, and of these only two were mature males, Appendix Table 14. All observations were made in the Douglas Fir



Figure 15. South-facing slopes, free of snow were key concentration areas during winter.

Zone except one which occurred in the Bunchgrass Prairie Zone at an elevation of 5,100 feet. In three flights, 251 observations of whitetail were noted in agricultural fields in close association with Reese creek, Appendix Table 14. There appeared to be approximately 100 whitetails along a three mile stretch of Reese creek immediately south of the study area.

Spring (April to mid-June). There was a pronounced increase in mule deer use in the Bunchgrass Prairie Zone in early spring as compared with winter. In April, 78 percent of the total mule deer observations were in this zone. The Agriculture Type accounted for 41 percent with the Fescue-Wheatgrass and Sagebrush-Grassland Types accounting for 18 and 15 percent respectively. Mule deer began to range over a much more extensive area at lower elevations (as low as 4,800 feet). This was primarily due to the greenup of grass and alfalfa in the agricultural fields. Mule deer would remain in the alfalfa fields in groups numbering up to 100 throughout the diurnal period. When disturbed they would move onto the Fescue-Wheatgrass Type at a slightly higher elevation and bed down. Within a few hours they would return to the fields by way of small coulees used as travel routes between the types. Group size in April was 18.1 but by late May these large groups broke up and left the Bunchgrass Prairie Zone and moved to the Douglas Fir Zone. This was probably due to the greenup of forbs on the slopes and solitude apparently preferred by

does nearing parturition. Use of the Douglas Fir-Sagebrush Park Type seemed to increase by late May in 1972.

Food Habits

Year-long trends of mule deer food habits were determined by the examination of the contents of 26 rumen samples from hunter and winter-killed deer and the examination of 76 feeding sites involving 9,173 instances of use (Tables 4, 5, and 6).

Summer: Forbs were the most important forage class constituting 83 percent of the summer diet as indicated by examination of feeding sites (Fig. 16). Nuttall violet, yellow columbine and false dandelion were important forbs. By comparing the use of these species with their availabilities in the vegetation types (Table 1) it appeared that yellow columbine was the most preferred forb. Because of dessication in late summer, Nuttall violet was not used in August. Dogtooth lily (*Erythronium grandiflorum*), yellow bell (*Fritillaria pudica*) and western spring beauties (*Claytonia lanceolata*), all typically early forbs, were important in June but were little used later in the season except at some mesic sites. Hayden clover, abundant in the Alpine Meadow Type, was used extensively in August by male mule deer. Evidence of prior usage indicate this clover was utilized much more than was shown by my data which included current usage only.

TABLE 4. SUMMER, FALL, AND WINTER FOOD HABITS OF MULE DEER BY SEASON AND MONTH AS DETERMINED BY 76 FEEDING SITES.

	SUMMER					FALL				WINTER			
	(1)[2]	(9)	(15)	(2)	(27)	(7)	(3)	(2)	(12)	(11)	(14)	(12)	(37)
	(50)[3]	(1557)	(1845)	(158)	(3610)	(660)	(250)	(266)	(1176)	(1336)	(1850)	(1171)	(4357)
Taxa[1]	June	July	Aug.	Sept.	Season	Oct.	Nov.	Dec.	Season	Jan.	Feb.	Mar.	Season
GRASS AND GRASS-LIKE PLANTS:	2/100[4]	2/78	3/33		3/48	1/29	10/33	3/50	3/33	31/73	22/93	60/83	35/84
FORBS:													
Achillea millefolium		tr/22[5]	2/33		1/26					tr/9	tr/7		tr/5
Agoseris glauca		6/56	13/67	5/50	9/59								
Aquilegia flavescens		22/44	8/40	65/50	16/41								
Arabis nuttallii		1/22	tr/7		1/11								
Arnica cordifolia		4/11	2/20	7/50	3/19								
Artemisia frigida										1/9			tr/3
Artemisia ludoviciana						3/14			2/8	7/9	1/21		3/11
Aster spp.			5/7	1/50	2/7								
Astragulus miser			4/20		2/11								
Balsamorrhiza sagittata							3/33		1/8	15/82	15/93	11/42	14/73
Cirsium arvense										1/27			tr/8
Cirsium spp.							19/67		4/17	tr/9			tr/3
Claytonia lanceolata	10/100	1/44	tr/7		1/22								
Cymopteris bipinnatus			1/7		1/4								
Delphinium occidentale						3/14			2/8				
Erythronium grandiflora	66/100	4/33	4/7		5/19								
Erigeron glabellus		5/22	2/20	3/50	3/22								
Fritillaria pudica	10/100				tr/4								
Helianthella uniflora		1/11	tr/7		1/7					1/9			tr/3
Heracleum lanatum			3/7		1/4	40/43			23/25				
Linum usitatissimum			1/13		1/7								
Lomatium cous		2/33			1/11								
Lupinus argenteus			4/17		2/4	7/14			4/8	tr/9			tr/3
Medicago sativa												13/17	3/5
Osmorhiza occidentale						12/43			7/25				
Penstemon fruticosa							26/67		6/17				
Polemonium pucherrimum		1/11	tr/7		1/7								
Potentilla gracillis													
Ranunculus eschscholtzii		3/34	3/13	3/100	3/30								
Senecio serra		5/11			2/4								
Senecio triangularis		4/44	tr/7		2/19	10/57			6/33				
Taraxicum officinale		2/33	tr/7		1/15							tr/8	tr/3
Tragapogon dubius										3/82	1/43	tr/8	1/43
Trifolium haydenni		1/22	10/20		5/19								
Valeriana dioca			1/13		tr/7								
Viola nuttallii		22/56	13/27		16/33								
Unidentified Forbs	2/100	6/44	1/33	6/50	4/41	4/14			2/8	tr/18	1/36	tr/8	tr/22
Total Forbs	88/100	90/89	77/93	100/100	83/93	79/71	48/100		55/67	28/100	18/93	24/67	21/87
BROWSE:													
Artemisia tridentata								52/50	12/8	21/91	42/71	7/42	26/68
Juniperus scopulorum										6/18	6/36	3/17	5/24
Prunus virginiana							30/67		6/17	tr/9	2/21		1/11
Purshia tridentata								45/50	10/8	14/45	10/64	4/42	10/51
Ribes setosum		6/11	15/20		10/15	20/29			11/17				
Salix bebbiana			6/7		3/4								
Sambucus spp.							12/33		3/8				
Symphoricarpus spp.												1/8	tr/3
Vaccinium scoparium		3/11			1/4								
Total Browse		9/22	21/27		14/22	20/29	42/67	97/100	42/50	41/91	60/100	15/58	42/84
LICHENS:	10/100				tr/4								

[1]Includes taxa occurring at a level of at least .5% in at least one month or season. Plants occurring at a level of less than .5% include the following: *Antennaria* spp., *Collomia linearis*, *Delphinium bicolor*, *Mertensia longiflora*, *Sedum alpinum*, *Abies lasiocarpa*, and *Rosa* spp.

[2]Number of sites.

[3]Number of instances of use.

[4]Percent of monthly or seasonal diet/frequency (percent occurrence among sites).

[5]tr=trace, percent of monthly or seasonal diet less than .5%.

TABLE 5. FOOD HABITS OF MULE DEER BY SEASON AND MONTH AS DETERMINED FROM THE EXAMINATION OF 26 RUMEN SAMPLES.

	WINTER			SPRING			FALL			
Taxa[1]	(1)[2] Feb.	(1) Mar.	(2) Season	(2) Apr.	(6) May	(8) Season	(4) Oct.	(11) Nov.	(1) Dec.	(16) Season
GRASS AND GRASS-LIKE PLANTS:	73/100[3]	15/100	50/100	29/100	28/100	28/100	4/100	22/100	2/100	16/100
FORBS:										
Achillea millefolium				1/100		tr/13[4]		1/64		tr/44
Aster conspicuus								9/27		5/19
Aster spp.								18/27	4/100	12/25
Balsamorrhiza sagittata					3/17	2/13				
Helianthella uniflora								tr/9	1/100	tr/13
Heracleum lanatum				2/50	2/17	2/25		1/9	87/100	5/13
Lupinus argenteus					1/17		tr/25	1/27		
Medicago sativa	6/100	tr/100	3/100	5/100		2/13	43/50			14/13
Penstemon fruiticosa							1/50	5/55		3/50
Unidentified Forbs	1/100	tr/100	1/100	28/100	17/67	21/50	7/75	4/64		5/63
Total Forbs	7/100	tr/100	4/100	36/100	23/83	27/88	51/100	39/100	92/100	44/100
BROWSE:										
Artemisia tridentata	8/100	2/100	5/100	5/100	18/100	13/100		tr/36	3/100	3/31
Berberis repens	1/100	tr/100	1/100	tr/100	tr/17	tr/38	tr/50	5/73	2/100	9/69
Juniperus communis							3/25	7/55		5/44
Juniperus scopulorum	3/100	6/100	4/100	tr/100	6/67	4/75			1/100	tr/6
Pinus flexilis		3/100	1/50					tr/9		tr/6
Populus trichocarpa							3/25	tr/9		1/13
Pseudotsuga menziesii	2/100	67/100	27/100	4/50	2/83	3/75	tr/25	1/36	tr/100	tr/38
Purshia tridentata		tr/100	tr/50	tr/50	tr/67	tr/63		4/36		3/25
Ribes setosum							7/25	tr/9		2/13
Rosa spp.					2/17	1/13	1/50	tr/18		tr/25
Spiraea betulifolia	1/100		1/50				tr/25			tr/6
Symphoricarpus spp.							27/75	1/9		10/25
Vaccinium membranaceum								1/9		1/6
Unidentified Browse	7/100	7/100	7/100	26/100	21/100	23/100	1/50	2/36		2/38
Total Browse	22/100	85/100	46/100	35/100	49/100	44/100	42/100	21/100	6/100	36/100
LICHENS:							3/25	5/45	tr/100	4/44

[1]Includes taxa occurring at a level of at least .5% in at least one month or season. Plants occurring at a level of less than .5% include the following: *Allium* spp., *Artemisia ludoviciana*, *Biden* spp., *Cirsium* spp., Compositae, *Erigeron* spp., *Potentilla* spp., *Townsendia parryii*, Umbelliferae, *Viola* spp., *Abies lasiocarpa*, *Alnus sinuata*, *Chrysothamus nauseousus*, *Prunus virginiana*, *Ribes viscosissimum*, *Rubus* spp., *Salix* spp., and *Vaccinnium scoparium*.

[2]Sample size.

[3]Percent of monthly or seasonal diet/frequency (% occurrence among rumen samples).

[4]tr=trace, % of monthly or seasonal diet less than .5%.

TABLE 6. SUMMER, FALL AND WINTER FOOD HABITS OF MULE DEER BY VEGETATION ZONE AS DETERMINED FROM THE EXAMINATION OF 76 FEEDING SITES DURING THE PERIOD JUNE 1972 TO MARCH 1973.

	SUMMER			FALL		WINTER	
	1250[2]	2294	50	524	652	3798	567
	8 sites	18 sites	1 site	5 sites	7 sites	31 sites	6 sites
Taxa[1]	Alpine	Spruce-Fir	Douglas Fir	Spruce-Fir	Douglas Fir	Douglas Fir	Bunch-Grass Prairie
GRASS AND GRASS-LIKE PLANTS:	4/63[3]	2/39		1/2	5/43	38/90	24/50
FORBS:							
Achillea millefolium	6/63	1/17				tr/3[4]	tr/17
Agoseris glauca	10/63	8/50					
Aquilegea flavescens	16/25	18/56					
Arabis nuttallii	2/25						
Arnica cordifolia	5/13	2/22		4/2			
Artemisia ludoviciana						tr/10	17/17
Astragulus miser	1/13	tr/6					
Aster spp.		5/17					
Balsomorrhiza sagittata					1/14	14/74	17/67
Cirsium spp.					7/29	tr/3	
Claytonia lanceolata	tr/13	1/28					
Cymopteris bipinatus	2/13						
Delphinium bicolor		tr/6		4/2			
Delphinium occidentale							
Erythronium grandiflorum		7/28					
Erigeron glabellus	5/25	1/17					
Helianthella uniflora	2/25					tr/3	
Heracleum lanatum		2/6		51/60			
Linum usitatissimum	2/25						
Lomatium cous	2/38						
Lupinus argenteus		3/6		9/2			tr/17
Medicago sativa							27/33
Osmorhiza occidentale				15/60			
Penstemon fruticosa					10/29		
Polemonium pulcherrimum	1/13	tr/6					
Potentilla gracilis							
Ranunculus eschscholtzii	2/38	4/28					
Senecio serra		3/6					
Senecio triangularis	tr/13	3/22		12/80			
Taraxicum officinale	1/13	tr/17				tr/3	
Tragapogon dubius						1/42	3/50
Trifolium haydenii	15/63						
Valeriana dioca		1/11					
Viola nuttallii	1/13	25/33					
Unidentified Forbs	5/63	3/33		5/2		tr/26	
Total Forbs	78/100	87/94		100/100	18/43	15/84	64/100
BROWSE:							
Artemisia tridentata					21/14	28/71	12/33
Juniperus scopulorum						5/26	
Prunus virginiana					12/29	1/13	
Purshia tridentata					19/14	11/61	
Ribes setosum	20/38	5/6			20/29		
Salix bebbiana		5/6					
Sambucus spp.					5/14		
Vaccinium membranaceum			100/100				
Total Browse	20/38	10/11	100/100		77/86	45/94	12/33

[1]Includes taxa occurring at a level of at least .5% in at least one season in one zone. Plants occurring at less than this level include the following: *Antennaria* spp., *Artemisia frigida, Cirastium arvense, Colomia linearis, Frittilaria pudica, Mertensia longiflora, Sedum* spp., *Abies lasiocarpa, Rosa* spp., *Symphoricarpus* spp., and lichens.

[2]The number of instances of use per season in a vegetation zone.

[3]Percent of seasonal diet in a vegetation zone/frequency (percent occurrence among samples).

[4]tr=trace, percent of diet is less than .5%.

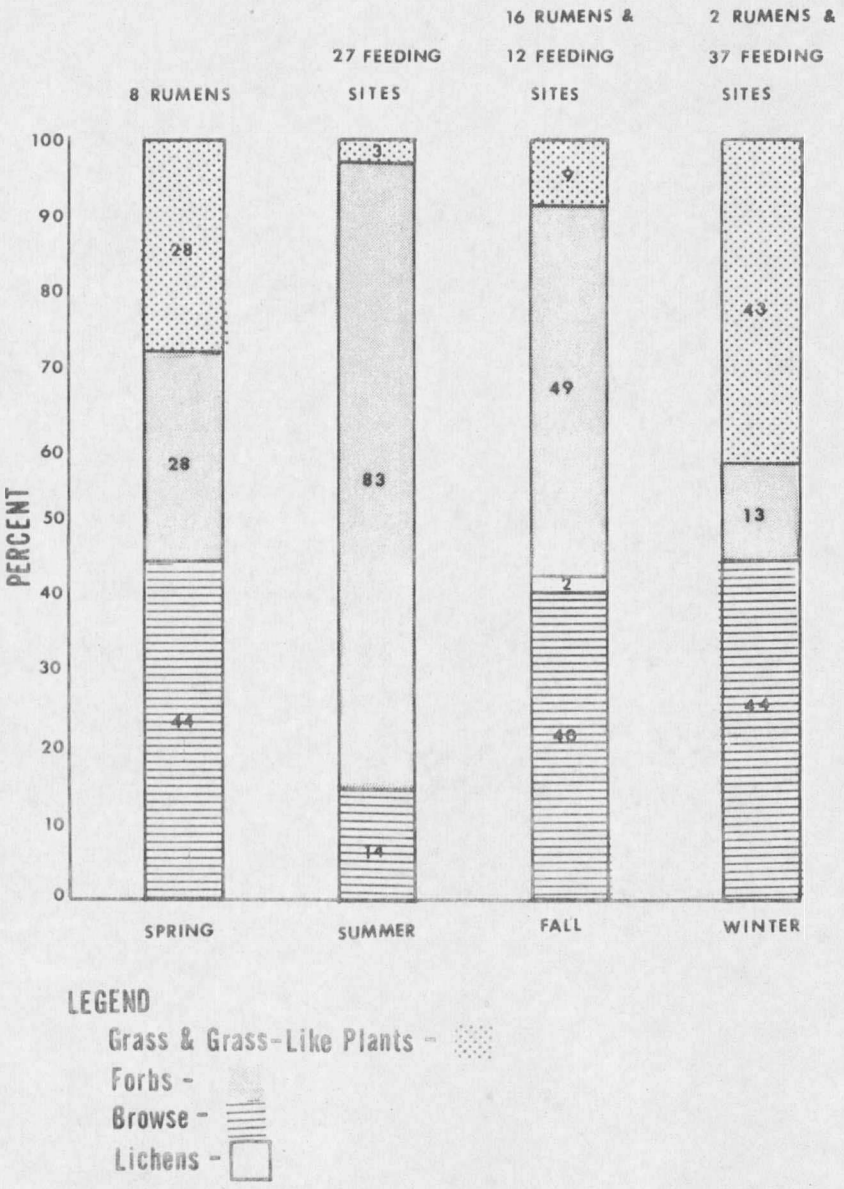


Figure 16. Percent Grasses, Forbs, and Browse occurring in the year-long diet of mule deer as determined from the examination of 26 rumens and 76 feeding sites.

In spite of scarcity in both basins where my observations were made, browse constituted 14 percent of the summer diet. Redshoot gooseberry and bebb willow received most of the browsing usage. Mule deer began to use bebb willow in early August but vacated the willow bottom when cattle entered the basins. Redshoot gooseberry was readily sought out by mule deer. It grew beneath and around stands of spruce-fir but did not appear in my vegetation samples.

Use of grass was minor during summer.

Fall: Forbs, browse and grass constituted 55, 42 and 3 percent of the instances of use at 12 feeding sites and 44, 36 and 16 percent of the contents of 16 rumen samples respectively. Lichens constituted four percent of the contents of rumens.

Forty-two percent of the feeding sites for the season including all of those for October were examined in the Spruce-Fir Zone (Table 6). Important forbs were cow parsnip, western sweetroot, arrowleaf groundsel, tall larkspur and silvery lupine. Flower heads of these plants, standing above the snow in the meadows were the plant parts eaten. Although available in the summer, these plants were not utilized to any extent. All feeding sites examined during November and December were in the Douglas Fir Zone. Shrubby penstemon and thistle (*Cirsium* spp.) were important forbs in this zone. Extensive use of shrubby penstemon was observed throughout the Douglas Fir Type.

Important browse plants at feeding sites were redshoot gooseberry, chokecherry, big sagebrush and bitterbrush, with the latter two species becoming important late in the season.

Use of grass remained minor, although usage at one feeding site in November consisted entirely of green Idaho fescue. This site was on a south-facing ridge in the Sagebrush-Bitterbrush Type.

Important forbs in the 16 rumens were showy aster, aster spp., alfalfa, shrubby penstemon and cow parsnip. Alfalfa was found in only two rumens. Both were from deer taken by poachers in early October within the Bunchgrass Prairie Zone.

Snowberry, Oregon grape and common juniper were important browse plants in samples obtained early in the season. All of these browse plants were characteristic of the Douglas Fir Type. Snowberry constituted 27 percent of the rumen contents in October.

Grass and grass-like plants in rumens constituted 16 percent of the contents. All grass was green due to a fall greenup. Some of this green grass may have been elk sedge, which was abundant in the understory of the Douglas Fir Type and was observed to be used by deer. Lichens were utilized in every month of the season but decreased in December due to a shift of distribution of deer from the Douglas Fir Type to more open, shrubby types on south-facing slopes

Winter: Browse, forbs and grass constituted 42, 21 and 35 percent of the instances of use at feeding sites and 46, 4 and 50

percent of the contents of rumen samples respectively. Eighty-four percent of the feeding sites were recorded in the Douglas Fir Zone. Big sagebrush and bitterbrush were important browse plants. Seasonal use of big sagebrush increased from fall to winter. Use of bitterbrush decreased from January to March.

Arrowleaf balsamroot, cudweed sagewort, common salsify and alfalfa were important forbs with the former utilized most. All of these species except alfalfa were utilized as dry forbs. Use of alfalfa consisted of new green growth in late March.

Grass was of major importance at this time due primarily to the mild and relatively snow-free winter. Green grass on the snow-free, south-facing slopes was utilized extensively as early as January. The green grass was short and as a consequence deer feeding periods were extended throughout the diurnal period to obtain sufficient amounts of forage. Important grasses were bluebunch wheatgrass, Idaho fescue, cheatgrass and junegrass constituting 23, 28, 30 and 10 percent respectively of the total use of grass at feeding sites.

Rumen samples were from two winter-killed deer. Douglas fir constituted 27 percent of the rumen contents. Big sagebrush and Rocky Mountain juniper were next in importance. Wilkins (1957) noted a decrease in use of bitterbrush and a corresponding increase in use of big sagebrush, Rocky Mountain juniper and Douglas fir as winter progressed. My data supported this (Tables 4 and 5).

Alfalfa was the only forb of importance. It had been taken as dry forage from hay stacks.

Most grass from the two rumens was dry.

Spring: Eight rumens from winter-killed deer were obtained in the early spring of 1972. Browse, forbs and grass constituted 44, 27 and 28 percent of the early spring diet respectively. Big sagebrush, Rocky Mountain juniper and Douglas fir were important browse plants.

Unidentified forbs, alfalfa, cow parsnip and arrowleaf balsamroot were important forbs. Use of arrowleaf balsamroot was noted to be extensive when it began new growth in late May. Alfalfa was also used extensively as groups of 100 or more deer fed in the fields throughout the day.

Grass was utilized in the Agriculture Type within the Bunchgrass Prairie Zone and consisted of smooth brome and orchard grass. After mid-May, mule deer left the fields and began to use types at higher elevations.

During this same period in 1973, five rumen samples were obtained from winter-killed deer, (Hamlin, personal communication, May 1973). All samples contained the same characteristic forage as noted in the eight samples taken the previous year and by Wilkins in 1956 for late winter. This forage was big sagebrush, Douglas Fir, Rocky Mountain juniper, dry grass and dry forbs. By referring to the food classes of Leopold (1933), it appeared that the majority of the rumen contents

of winter-killed deer consistently contained emergency and stuffing foods for this area. These were Douglas Fir and Rocky Mountain juniper and dry grass and dry forbs respectively. The staple food, big sagebrush, was also present. Bitterbrush did not appear in these rumens at this time suggesting it was a preferred food.

Food habits throughout the year closely paralleled those reported by Wilkins (1957) for this same area in the early 1950's.

Condition, Productivity and Population Estimates

Condition: A kidney fat index was calculated for each of 18 deer. For 14 hunter-killed deer taken in November the average kidney fat index was .84 (Table 7). Values for males, females, fawns and adults were 1.06, .64, .39 and .94 respectively. For four winter-killed deer found caught in fences in April the average index was .08 which is well below the 30 percent value which is critical for utilization of bone marrow fat (Ransom 1965).

A total of 37 winter-killed deer was found during the springs of 1972 and 1973. Nineteen were found in 1972 which was a more severe winter than 1973 when 18 were found. Twenty-one were fawns. The others, 15 females and one male all appeared to be very old deer. Examination of the mandibular dentition of nine indicated ages of 10-12 or 12+ years. The femur bone marrow of all winter-killed deer was bright red in color and jelly-like in consistency. Compression values for two

TABLE 7. SEX, AGE AND KIDNEY FAT INDICES FOR 18 MULE DEER.

Date of Collection[1]	Sex	Assigned Age	Kidney Fat Index[2]	Remarks
4/16/72	♀	>12	.05	Winter-kill
4/16/72	♂	½	.12	Winter-kill
4/16/73	♀	10-12	.08	Winter-kill
4/22/73	♀	10-12	.06	Winter-kill
10/26/72	♂	3½	1.72	Hunter-kill
10/28/72	♂	2½	.69	Hunter-kill
10/28/72	♀	½	.38	Hunter-kill
11/4/72	♀	½	.06*	Hunter-kill
11/7/72	♂	1½	.52	Hunter-kill
11/7/72	♂	½	.40	Hunter-kill
11/9/72	♂	2½	1.67	Hunter-kill
11/11/72	♂	2½	1.95	Hunter-kill
11/18/72	♀	3½	.46	Hunter-kill
11/19/72	♀	2½	.69	Hunter-kill
11/21/72	♀	-	.05*	Hunter-kill
11/22/72	♂	-	.50	Hunter-kill
11/23/72	♂	4½	.37	Hunter-kill
11/25/72	♀	-	.78	Hunter-kill

*Hunters apparently cut away kidney fat. These were not used in computing the average index.

[1]Collections are arranged by month and day regardless of year.

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

marrows were 30 and 40 percent indicating fat content of less than one percent (Greer 1969).

Productivity: All mule deer observed were classified as to sex and age (Table 8). Data for the period August 15 to September 15 were considered as most indicative of reproductive success. Based on a sample of 113 animals obtained during ground observations the fawn/doe ratio during this period in 1972 was 57/100. Low fawn/doe ratios are characteristic of poor range conditions (Julander 1961 and others). The fawn/doe ratio on the winter range in December 1972 was 68/100. According to Gruel and Papez (1963) the population on the winter range may not be the same population as on the summer range but may consist of a population from several different summer ranges.

Fawn/adult ratios, based on ground observations from January to April, 1972 fell from 44/100 to 36/100 respectively. Counts from a helicopter along the entire west slope including the study area revealed ratios of 36/100 on January 3 and 28/100 on March 28, 1972. Fawn/adult ratios based on ground observations during this same period in 1973 fell from 36/100 in January to 27/100 in March. All these data point to a loss of 8-9 fawns/100 does during the winter period. This loss was confirmed by the discovery of 21 winter-killed fawns on the study area.

The indicated male/female ratio in June was 117/100. This apparent excess of males was probably due to the difficulty of observing

TABLE 8. SEX AND AGE CLASSES OF MULE DEER AS DETERMINED BY GROUND AND AERIAL OBSERVATIONS FROM JANUARY 1972 TO APRIL 1973.

Time Period	Total Obs.	♂	♀	Fawns	Uncl.	Males 100 Females	Fawns: 100 Females	Fawns: 100 Adults	Ground &/or Air
January 1972	401	50	228	123	-	22	54	44	Ground
February 1972	653	26	420	207	-	6	49	46	Ground
March 1972	583	-	405	178	-	-	-	44	Ground
April 1972	323	-	237	86	-	-	-	36	Ground
June 1972	35	14	12	-	6	117	-	-	Ground
July 1972	82	37	33	2	10	112	6	2	Ground
August 1972	223	87	78	38	20	112	49	23	Ground
September 1972	73	25	27	20	1	54	74	38	Ground
October 1972	114	21	44	34	10	48	77	58	Grd&Air
November 1972	144	23	58	38	25	40	66	46	Grd&Air
December 1972	529	101	209	143	76	48	68	46	Grd&Air
January 1973	1324	165	655	291	213	25	44	36	Grd&Air
February 1973	1020	60	650	187	123	9	29	26	Ground
March 1973	574	2	354	96	122	-	-	27	Ground
April 1973	233	-	176	47	-	-	-	27	Ground
*January 3, 1972	671	139	354	178	-	39	50	36	Helicopter
*March 28, 1972	666	-	519	147		-	-	28	Helicopter

*Flight covers west slope of Bridger Mountains from "M" hill to study area.

secretive does with new-born fawns and the fact that males arrive at the meadows where observations were made earlier than females with young. Parturition is thought to occur in the Douglas Fir Zone at lower elevations (Wilkins 1957). The ratio fell and leveled off around 48/100 in the fall. Low male/female adult ratios may be characteristic of over-used ranges (Gunvalson 1952).

Although no significance can be attached to the small sample a low ovulation incidence of 1.0 was determined by counting corpora lutea in ovaries obtained from two pregnant winter-killed does. The frequency of fertilization was 1.0. Examination of ovaries from two hunter-killed does taken on November 19th and 25th revealed no corpora lutea or large graffian follicles. Measurements of two embryos taken in April when compared to a whitetail deer growth curve (Cheatum and Morton 1946) indicated conception dates of November 27th and December 13th.

Population Estimates: Population estimates of mule deer using the Armstrong winter range between Bill Smith and North Cottonwood creeks were derived from data provided by aerial flights, ground observations and by observation of neck-banded deer. An average estimate of 175 was obtained from eight flights in the period December through February. An average estimate of 171 was obtained from three thorough, day-long ground counts in February (Table 9). A method based on observations of neck-banded deer, similar to that used by

TABLE 9. POPULATION ESTIMATES OF MULE DEER UTILIZING THE ARMSTRONG WINTER RANGE BASED ON EIGHT FLIGHTS AND THREE GROUND COUNTS OF THE AREA.

Date	Air Count	Ground Count	Helicopter or Fixed-Wing
December 14	140		Fixed-Wing
December 30	195		Fixed-Wing
January 3	173		Helicopter
January 11	190		Fixed-Wing
January 28	248		Fixed-Wing
February 7	188		Helicopter
February 13		166	
February 15		203	
February 19	170		Fixed-Wing
February 27		143	
March 28	93		Helicopter
Totals	1397	512	
Average	175	171	
Grand Total	1909		
Average	174		

Geiss (1956), was used to estimate the population (Table 10). Several estimates were made from January to April as the number of neck-banded deer increased. A final average estimate of 173 came surprisingly close to the other two estimates.

Average Activity Radii and Home Ranges in Winter and Early Spring

Thirteen marked females and eight males provided data on movements (Table 11). Four of five deer marked during the winter of 1972 were accounted for in 1973. One adult female and two yearling males

TABLE 10. POPULATION ESTIMATES OF MULE DEER UTILIZING THE ARMSTRONG WINTER RANGE BASED ON OBSERVATIONS OF NECK-BANDED DEER.

Time Period	Number of Observation Periods	Total Number of Deer Obs.	Number of Banded Deer Obs.	Number of Deer Banded	Frequency of Obs.	Pop. Est.
Jan. 10-13	2	72	6	7	.43[1]	84[2]
Jan. 15-27	8	369	20	9	.28	165
Jan. 29	1	14	1	10	.10	140
Jan. 31	1	89	5	11	.46	194
Feb. 1-6	4	151	15	12	.31	122
Feb. 8-9	2	85	4	14	.14	304
Feb. 11-20	5	467	46	16	.58	161
Feb. 22-Apr. 15	17	1367	109	17	.38	212
					Ave. of 8 pop. est's =	173

[1]Frequency of observation = $\frac{\text{Number of Bands Observed}}{\text{Number of Banded Deer x Number of observation days}}$

[2]Population Estimate = $\frac{\text{Average Number of Deer Observed}}{\text{Frequency of Observation}}$

TABLE 11. AVERAGE ACTIVITY RADIUS, IN YARDS, FOR 21 INDIVIDUALLY MARKED MULE DEER.

				WINTER			WINTER AND EARLY SPRING		
Deer No.	Capture	Sex	Assigned Age	No. of Observations	Dates of Observations	AAR[1]	No. of Observations	Dates of Observations	AAR
1	3/6/72	♀	Ad.	16	[3/6/72-3/31/72] [12/26/72-3/25/73]	462	20	[3/6/72-4/23/72] [12/26/72-4/21/73]	572
2	1/5/73	♀	Ad.	8	1/5/73-2/15/73	440	9	1/5/73-4/15/73	440
3	1/5/73	♀	Ad.	17	1/5/73-3/31/73	374	18	1/5/73-4/15/73	418
4	1/5/73	♀	Ad.	12	1/5/73-3/25/73	418	12	1/5/73-4/15/73	418
5	1/8/73	♀	Ad.	13	1/8/73-3/24/73	264	14	1/8/73-4/15/73	396
6	1/8/73	♀	Ad.	14	1/8/73-3/31/73	506	13	1/8/73-4/15/73	506
7	1/12/73	♀	Old Ad.	18	1/12/73-3/31/73	484	18	1/12/73-5/21/73	484
8	1/13/73	♀	Ad.	24	1/13/73-3/31/73	308	25	1/13/73-4/15/73	330
9	1/29/73	♀	Ad.	6	1/29/73-3/31/73	440	9	1/29/73-4/15/73	616
10	2/7/73	♀	Ad.	8	2/7/73-3/31/73	440	8	2/7/73-4/1/73	440
11	2/9/73	♀	Old Ad.	15	2/9/73-3/31/73	308	17	2/9/73-5/7/73	396
12	2/10/73	♀	Ad.	3	2/10/73-3/24/73	264	3	2/10/73-4/21/73	264
13	2/20/73	♀	Ad.	10	2/20/73-3/31/73	352	11	2/20/73-4/15/73	440
				Average for Females		389			440
14	2/20/72	♂	½	3	2/20/72-3/5/73	264	3	2/20/72-3/5/73	264
15	2/27/72	♂	½	13	[2/27/72-3/22/72] [1/10/73-3/31/73]	462	13	[2/27/72-3/22/72] [1/10/73-4/8/73]	462
16	3/27/72	♂	½	4	3/27/72-3/31/72	528	4	3/27/72-4/23/72	528
17	3/27/72	♂	½	20	[3/27/72-3/31/72] [1/31/73-3/31/73]	528	23	[4/7/72-4/23/72] [1/31/73-4/8/73]	550
18	1/11/73	♂	1½	3	1/11/73-1/24/73	572	3	1/11/73-1/24/73	572
19	2/7/73	♂	1½	13	2/7/73-3/31/73	396	13	2/7/73-4/8/73	396
				Average for Young Males		458			462
20	2/11/73	♂	Ad.	7	2/11/73-2/23/73	396	7	2/11/73-4/8/73	396
21	1/31/73	♂	Ad.	7	1/31/73-3/31/73	572	8	1/31/73-4/15/73	572
				Average for Adult Males		484			482
				Average for All Males		465			468
				Average for all Deer		418			448

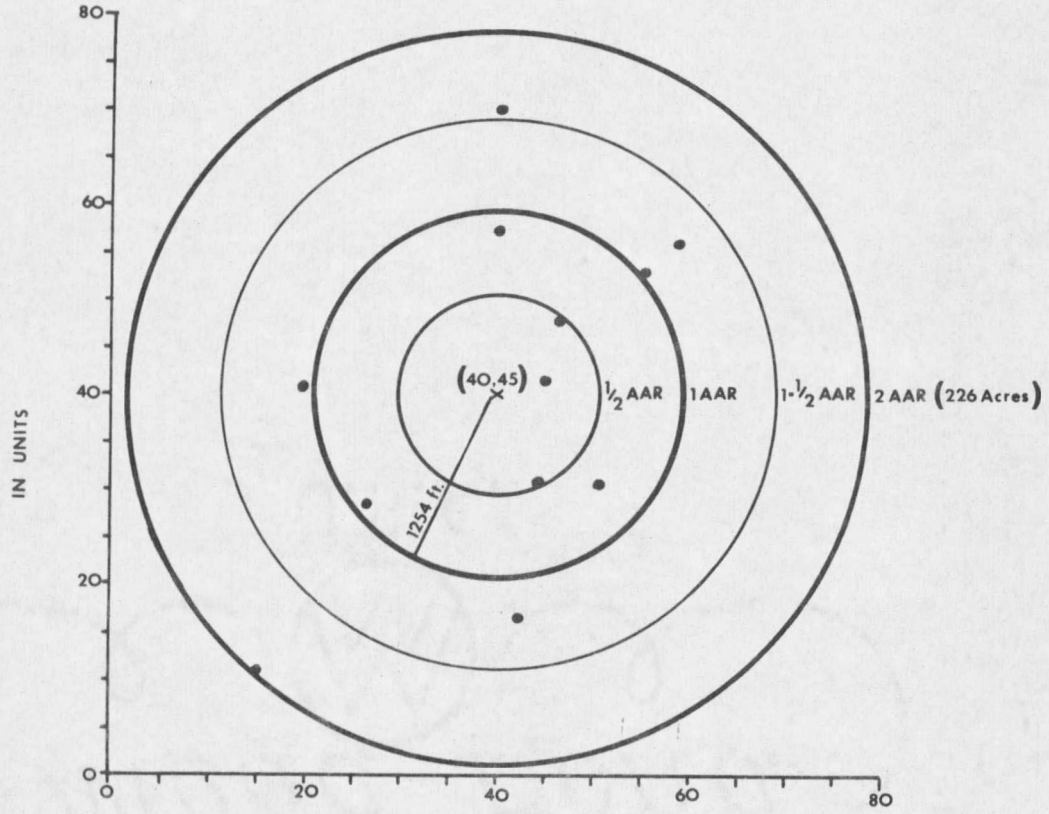
[1]AAR=Average Activity Radius

returned to the same winter range where they were marked the year before. The fourth, a yearling male, was shot on transitionary range during the fall hunting season approximately 3 1/4 miles southeast of the winter range trap site. None of the five marked deer were observed on the summer range in 1972 where my observations were made.

A total of 252 observations of marked deer was recorded. Average observations per marked deer was 11.5 with a range of 1-25.

An average activity radius (Fig. 17) was computed for each of those individuals which was observed at least three times. The center of activity was determined. Then the distance or radius from it to each observation point was measured (Hayne 1949). Data for females in winter were pooled and an average activity radius was determined to be 389 yards with a range of 264 to 506 yards (Table 11). Similar data pooled for males revealed an average activity radius of 465 yards, greater than females, with a range of 264 to 572 yards. Adult male average activity radius was 484 compared to 458 for males 1/2 and 1 1/2 years of age. Data for females, all males, adult males and young males in the winter and early spring period were 440, 468, 482 and 462 yards respectively. During this period, males exhibited a slightly larger activity radius than females.

Home range was described by Robinette (1966) as a proportion of activity within given distances from a center of activity. This



		X	Y	Radii
Observation No.	1	16	16	38
	2	20	45	20
	3	27	33	18
	4	40	62	17
	5	40	75	30
	6	43	22	24
	7	44	36	10
	8	45	46	5
	9	46	53	10
	10	51	36	14
	11	55	58	21
	12	58	61	25
Sum		485	543	232
$\bar{X}$		40	45	19 Units (1254 ft.)

Legend

× - CENTER of ACTIVITY
AAR-AVERAGE ACTIVITY RADIUS
1 UNIT = 66 FEET
80 UNITS = 1 MILE
● - OBSERVATION SITE

Figure 17. Observation sites and center of activity for female number 4 and values for determining center of activity and average activity radius.

concept recognized greater use per unit area near the center of an animal's home range and progressively less use with increasing distance from the center. In this concept, home range lacks definite limits or rigid boundaries but is described as a certain proportion of an animals' activities that occur within a given area circumscribed by a circle of a given radius. Since almost 100 percent of all observations fell into a multiple of twice the average activity radius (Table 12) winter home ranges were computed. Winter home ranges for females and males were 196 and 280 acres respectively. Average winter home range for adult males was 304 acres compared to 272 for young males. Average winter home range for all deer was 226 acres.

In early spring mule deer began to extend their range into the Bunchgrass Prairie Zone as previously discussed. Home range size for the period, winter and early spring for males and females was 284 and 251 acres respectively (Table 12). Average home range for adult males was 302 acres compared to 277 for young males. The average home range for all deer was 260 acres.

Information on winter home range size in the literature is scarce. Zalunardo (1968) in Oregon reported a range of movement on the winter range of 0-2.5 miles with a mean distance of 0.21 miles. Leopold *et al.* (1951) found that deer in the jawbone herd had a summer home range of 1/2 - 3/4 mile which he felt was twice as large as the winter home range. My data indicated a slightly larger winter home range

TABLE 12. PERCENTAGE OF OBSERVATIONS FALLING WITHIN GIVEN PROPORTIONS OF AVERAGE ACTIVITY RADII AND APPROXIMATE HOME RANGE SIZE FOR MALES AND FEMALES.

Fraction or Multiple of Ave. Act. Radius	Percentage of Observations							
	Winter				Winter & Early Spring			
	F		M		F		M	
½	22	(49)[1]	26	(70)	23	(63)	26	(71)
1	52	(98)	56	(140)	62	(125)	57	(142)
1½	85	(147)	83	(210)	84	(183)	82	(213)
2	98	(196)*	96	(280)*	95	(251)*	96	(284)*

[1]Acres

*Approximate home range size

with a mean diameter of .95 mile.

APPENDIX

TABLE 13. PERCENT OF OBSERVATIONS OF MULE DEER FROM THE AIR ON VEGETATION ZONES AND TYPES BY MONTH.

Vegetation Zone & Type	Jan.	Mar.	Aug.	Oct.	Nov.	Dec.	Jan.
BUNCHGRASS PRAIRIE ZONE							
Sagebrush-Grassland Type	65					15	3
Agriculture		100	50				
Grassland							
Creek Bottom							13
Total	65	100	50	—	—	15	16
DOUGLAS FIR ZONE							
Douglas Fir Type	4			90	38	23	18
Sagebrush-Bitterbrush					23	21	43
Grassland (Fescue-Wheatgrass)						7	6
Juniper	31					4	1
Bitterbrush						6	
Sagebrush-Grassland					6	23	17
Douglas Fir-Sagebrush Parks						1	
Lodgepole Pine				7	33		
Total	35	—	—	97	100	85	84
SPRUCE-FIR ZONE							
Spruce-Fir (Closed Canopy)							
Spruce-Fir (Open Canopy)			33				
Willow Bottom							
Sedge Meadow							
Sedge-Grass Meadow							
Grass-Forb Meadow			17	3			
Total	—	—	50	3	—	—	—
ALPINE ZONE							
Spruce-Fir (Open Canopy)							
Alpine Meadow							
Total	—	—	—	—	—	—	—
Total number of deer observations	81	20	6	31	96	252	158
% of Total deer Obs.	13	3	1	5	15	39	25

TABLE 14. NUMBER OF ELK AND WHITETAIL DEER OBSERVED IN EIGHT FLIGHTS.

Flights	Total Elk	Elk Males	Whitetails
Fixed-Wing Aircraft			
October 30, 1972	-	-	-
November 22, 1972	12	-	-
November 29, 1972	31	2	13**
December 14, 1972	8	-	-
December 30, 1972	30	1	93
January 11, 1973	11	-	104
January 28, 1973	6	-	108
February 19, 1973	23	-	39**
Total	121	3	357
Helicopter Flights (Dr. Mackie)			
January 3, 1972	2	2*	
February 7, 1973	11	-	
Total	13	2	

*Mature bulls

**Did not fly regular route along Reese Creek.

TABLE 15. CLIMATOLOGICAL DATA GATHERED BY THE U.S. DEPARTMENT OF COMMERCE FROM THE BELGRADE FAA, MONTANA WEATHER STATION AND FROM TWO HYGROTHERMOGRAPHS ON THE STUDY AREA.

Stations	J	F	M	A	M	J	J	A	S	O	N	D	Yearly Ave.
TEMPERATURE													
Belgrade FAA (21 yr ave)	17.2	23.8	28.6	40.2	50.7	58.7	66.6	65.5	54.4	44.2	30.9	21.3	41.9
Belgrade FAA (1972)	15.4	27.4	39.4	40.0	50.7	61.5	63.6	67.4	51.8	40.5	31.3	41.7	41.9
*Upper Station (Fall 1972 & Wntr 1973)	22.4	32.5	37.2							36.2	32.7	18.8	
**Lower Station (Fall 1972 & Wntr 1973)	22.0	27.4	32.2							38.8	33.6	20.3	
Upper & Lower Combined	22.2	30.0	34.7							37.5	33.2	19.6	
PRECIPITATION													
21 Yr Average	.66	.39	.84	1.14	2.22	2.51	1.03	1.13	1.17	1.06	.69	.53	13.43
1972	.49	.43	1.20	.65	1.36	2.69	1.58	1.57	1.40	1.85	.41	.39	14.02

* Elevation - 5,850 feet on south-facing slope in Douglas Fir Zone.

**Elevation - 5.250 feet in Armstrong Ranch yard in Bunchgrass Prairie Zone.

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