



Distribution, movements and habitat use of mule deer associated with the Bracket Creek winter range,
Bridger Mountains, Montana
by Harvey Evan Nyberg

A thesis submitted 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 from March 1978 to April 1979 in the Bridger Mountains, Montana. Objectives were to determine the distribution, movements, habitat use, food habits and population characteristics of mule deer associated with the Brackett Creek winter range. A total of 114 mule deer were marked, 18 with radio collars. Mule deer generally occupied two seasonal ranges: winter-spring and summer-fall. Movements between these ranges were usually abrupt and direct and did not involve the use of holding areas. Mule deer were distributed throughout the winter range in early winter. From mid-January to mid-February most were concentrated on a primary use area comprising about 37 percent of the total winter range. In winter, the movements of all but one of the deer centered on a series of subseasonal ranges. Polygon home ranges, standard diameters and average activity radii of 8 radio-collared mule deer averaged 12.9 km², 3.3 km and 1.4 km, respectively, and differed significantly with those of mule deer on other Bridger Mountain winter ranges. During summer, mule deer were distributed throughout the study area. Average polygon home ranges, standard diameters and average activity radii of 9 radio-collared mule deer were 2.9 km², 1.5 km and 0.6 km, respectively and appeared to be larger than those reported on other Bridger Mountain ranges. During winter, sagebrush, grassland and agricultural cover types received 37, 43 and 14 percent of all recorded use. Mule deer selected the Douglas fir type during the early, severe portion of the winter. The sagebrush, agricultural and Douglas fir cover types were most important during summer, receiving 27, 23 and 18 percent, respectively, of recorded use by mule deer. Browse, forbs, and grasses received, respectively, 48, 33 and 19 percent of total utilization at winter mule deer feeding sites and accounted for 56, 9 and 35 percent by volume of the contents of 38 rumen samples. During summer, browse received 69 percent of recorded use and forbs and grasses 24 and 7 percent, respectively, at 5 mule deer feeding sites. Lincoln Index population estimates of 2352 and 1642 were calculated for early and late winter, respectively. The mid-summer population was estimated as at least 2866 animals. Densities of mule deer were calculated to be 12/km², 23/km² and 16/km² during summer, early winter and late winter, respectively. On the primary winter range, the density of mule deer approached 62/km². An initial fawn:doe ratio of 150 fawns:100 does was noted for 8 radio-collared does though fawn production for the entire herd was less. Overwinter mortality totaled about 10 percent of all adults and 58 percent of all fawns present in early winter or about 30 percent of the entire herd. The Brackett Creek population was dominated by young and middle-prime aged deer. Maximum ages of deer handled during the study were 10 1/2 for females and 8% for males. Examination of reproductive tracts indicated production below that observed in 1978 and below the long term average for mule deer in the Bridget Mountains.

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DISTRIBUTION, MOVEMENTS AND HABITAT USE OF MULE DEER
ASSOCIATED WITH THE BRACKETT CREEK WINTER RANGE,
BRIDGER MOUNTAINS, MONTANA

by

HARVEY EVAN NYBERG

A thesis submitted in partial fulfillment
of the requirements for the degree

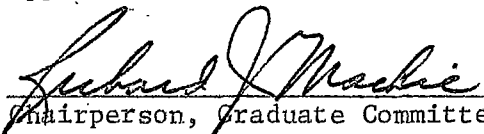
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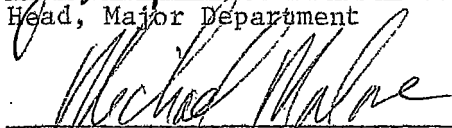
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ABSTRACT

A study was conducted from March 1978 to April 1979 in the Bridger Mountains, Montana. Objectives were to determine the distribution, movements, habitat use, food habits and population characteristics of mule deer associated with the Brackett Creek winter range. A total of 114 mule deer were marked, 18 with radio collars. Mule deer generally occupied two seasonal ranges: winter-spring and summer-fall. Movements between these ranges were usually abrupt and direct and did not involve the use of holding areas. Mule deer were distributed throughout the winter range in early winter. From mid-January to mid-February most were concentrated on a primary use area comprising about 37 percent of the total winter range. In winter, the movements of all but one of the deer centered on a series of subseasonal ranges. Polygon home ranges, standard diameters and average activity radii of 8 radio-collared mule deer averaged 12.9 km², 3.3 km and 1.4 km, respectively, and differed significantly with those of mule deer on other Bridger Mountain winter ranges. During summer, mule deer were distributed throughout the study area. Average polygon home ranges, standard diameters and average activity radii of 9 radio-collared mule deer were 2.9 km², 1.5 km and 0.6 km, respectively and appeared to be larger than those reported on other Bridger Mountain ranges. During winter, sagebrush, grassland and agricultural cover types received 37, 43 and 14 percent of all recorded use. Mule deer selected the Douglas fir type during the early, severe portion of the winter. The sagebrush, agricultural and Douglas fir cover types were most important during summer, receiving 27, 23 and 18 percent, respectively, of recorded use by mule deer. Browse, forbs, and grasses received, respectively, 48, 33 and 19 percent of total utilization at winter mule deer feeding sites and accounted for 56, 9 and 35 percent by volume of the contents of 38 rumen samples. During summer, browse received 69 percent of recorded use and forbs and grasses 24 and 7 percent, respectively, at 5 mule deer feeding sites. Lincoln Index population estimates of 2352 and 1642 were calculated for early and late winter, respectively. The mid-summer population was estimated as at least 2866 animals. Densities of mule deer were calculated to be 12/km², 23/km² and 16/km² during summer, early winter and late winter, respectively. On the primary winter range, the density of mule deer approached 62/km². An initial fawn:doe ratio of 150 fawns:100 does was noted for 8 radio-collared does though fawn production for the entire herd was less. Overwinter mortality totaled about 10 percent of all adults and 58 percent of all fawns present in early winter or about 30 percent of the entire herd. The Brackett Creek population was dominated by young and middle-prime aged deer. Maximum ages of deer handled during the study were 10½ for females and 8½ for males. Examination of reproductive tracts indicated production below that observed in 1978 and below the long term average for mule deer in the Bridger Mountains.

INTRODUCTION

In the Bridger Mountains, Montana, mule deer (*Odocoileus hemionus* Rafinesque) occupy three broadly different types of winter ranges. Ranges along the west slope comprise a narrow band of steep, south-and southwest-facing, open slopes dissected by timbered draws and canyon walls. East side winter ranges consist of extensive open ridges and rolling sagebrush-grass plains, with timber restricted to certain stream bottoms and north-facing slopes at the upper margins. A "breaks" type winter range, characterized by closely interspersed, open ridges and brushy to semi-open-timbered draws and creek bottoms, occurs along the north end. General population studies, conducted throughout the Bridger Mountains since 1974 (Mackie et al, 1978), have indicated that mule deer population characteristics differ according to winter range type. Populations associated with east side and north end winter ranges have consistently included higher and more variable proportions of fawns and fewer adult males than those associated with west slope winter ranges.

The ecology of mule deer populations associated with west slope winter ranges has been studied intensively (Wilkins 1957, Schwarzkopf 1973, Bucsis 1974, Hamlin 1974, Morton 1976, Pac 1976, Mackie et al. 1976, Mackie and Stewart 1976, Mackie and Knowles 1977, Mackie, Pac and Jorgensen 1978, 1979, Steerey 1979, Youmans 1979). This study represents the first intensive investigation of a mule deer population associated with an east side winter range. Specific objectives were

to determine the distribution, movements, food and range use habits and population characteristics of the Brackett Creek mule deer herd and compare results with findings from other investigations of mule deer in the Bridger Mountains and elsewhere. Field studies began in March 1978 and were conducted full time from June 1978 through March 1979.

DESCRIPTION OF STUDY AREA

The Bridger Mountains are located in southwestern Montana immediately northeast of Bozeman (Fig. 1). The main range extends in a gentle arc northwesterly for approximately 37 km and is attended by the Elkhorn, Battle and Bangtail ridges.

The study area (Fig. 2) comprised the north end of the Bangtail Ridge or plateau and its adjoining easterly foothills, a land area of approximately 31,500 hectares. The precise boundaries were Bridger Canyon on the west, the Brackett Creek road on the north, the Shields River on the east and an imaginary line connecting the Stone Creek-School Gulch divide and the Bangtail Creek-Willow Creek divide on the south. The Bangtail Ridge extends approximately 19 km southeast from the confluence of the three forks of Brackett Creek and is composed of variously tilted Morrison Formation shales and sandstones. The foothills are characterized by alternating sagebrush valleys and rocky sandstone outcrop ridges or hilltops and dissected by numerous intermittent streams flowing to the northeast (Fig. 3). Elevations varied from 2,435 m on the Bangtail Ridge to 1,402 m near the confluence of Kay Creek and the Shields River.

The study area is drained in three directions by nine major continuously flowing streams.

Approximately 15 percent of the area was public land owned and administered by the U. S. Forest Service, Gallatin National Forest. National Forest lands occurred in a checkerboard pattern at higher

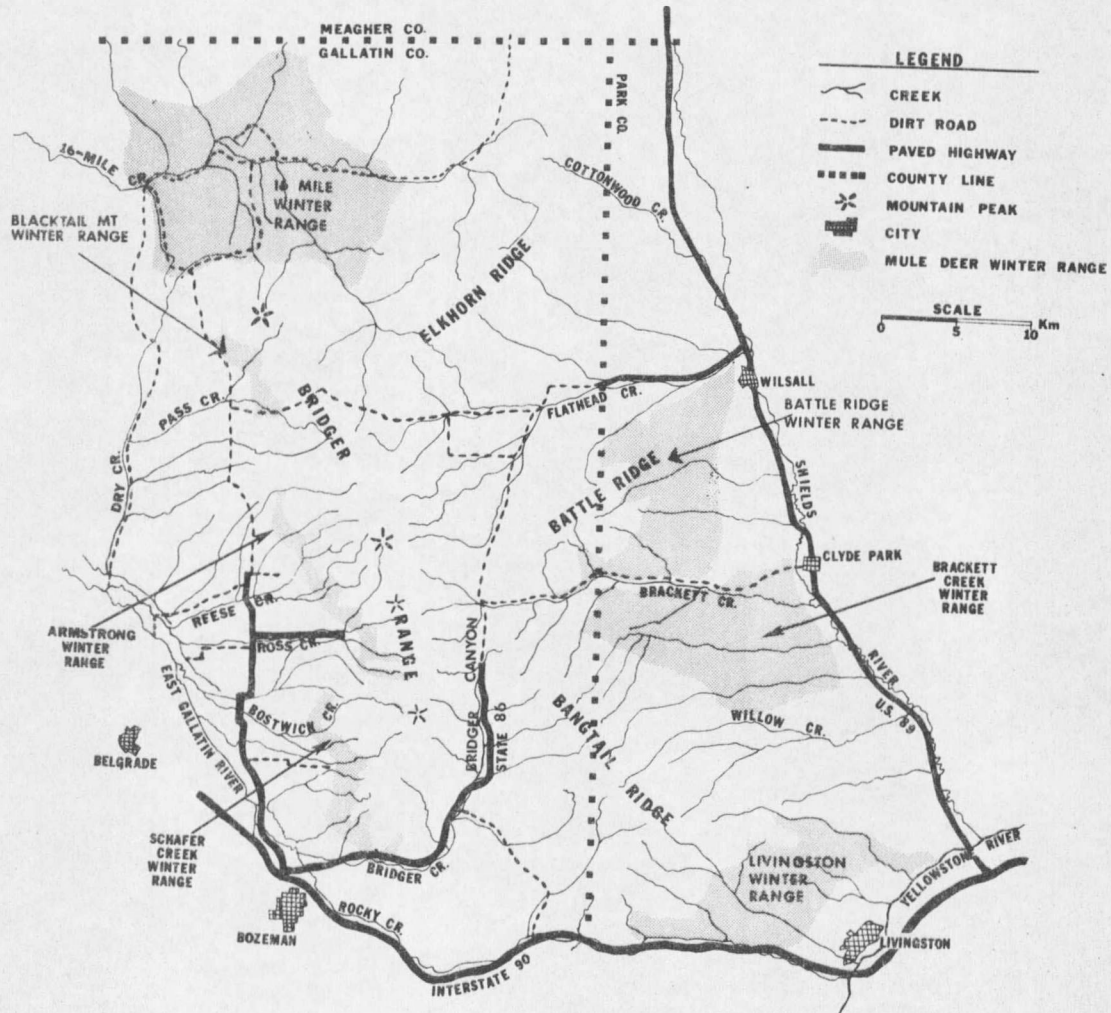


Figure 1. Map of the Bridger Mountains complex showing major features and location of the study area.

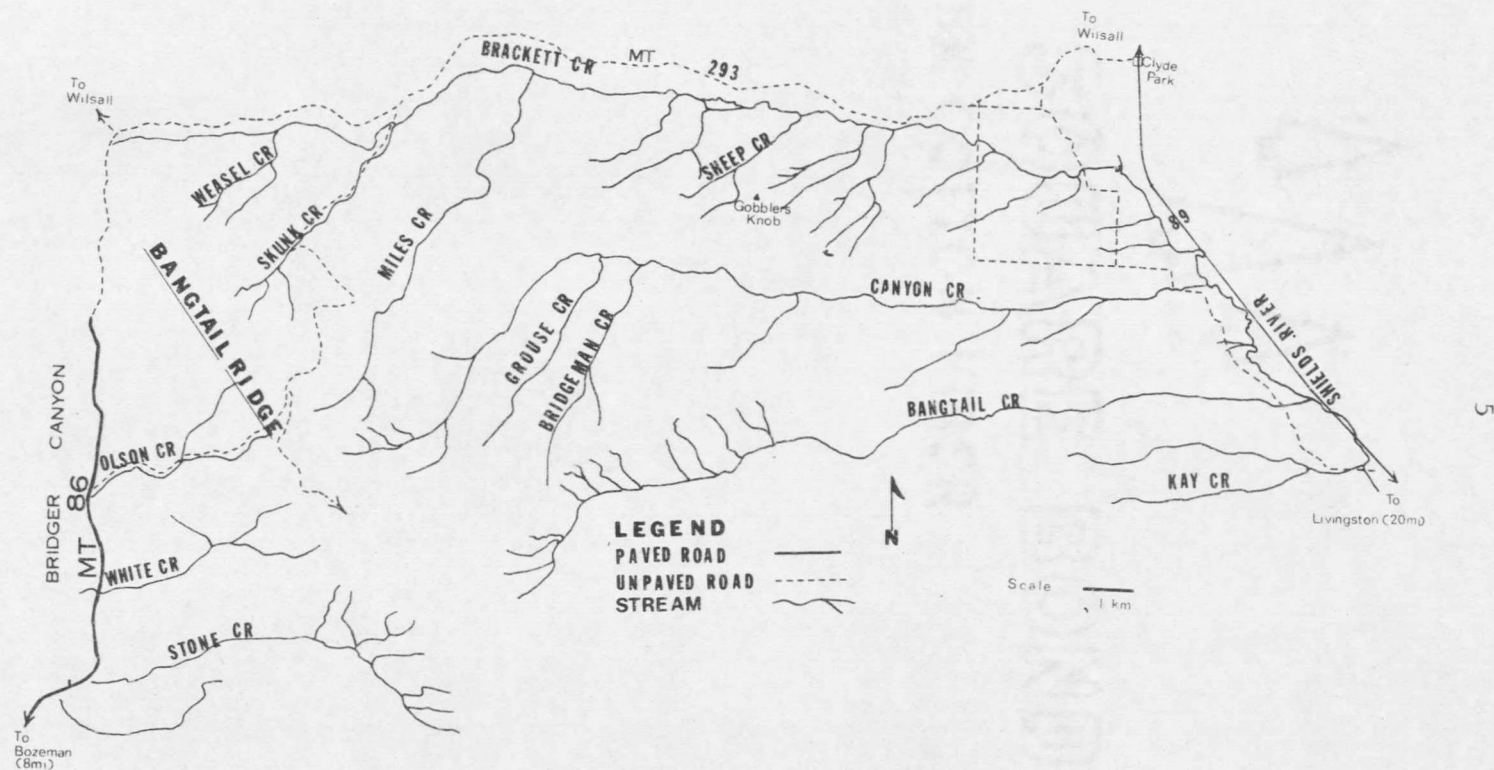


Figure 2. Map of the study area (including major continuous streams, trails, and topographic points).

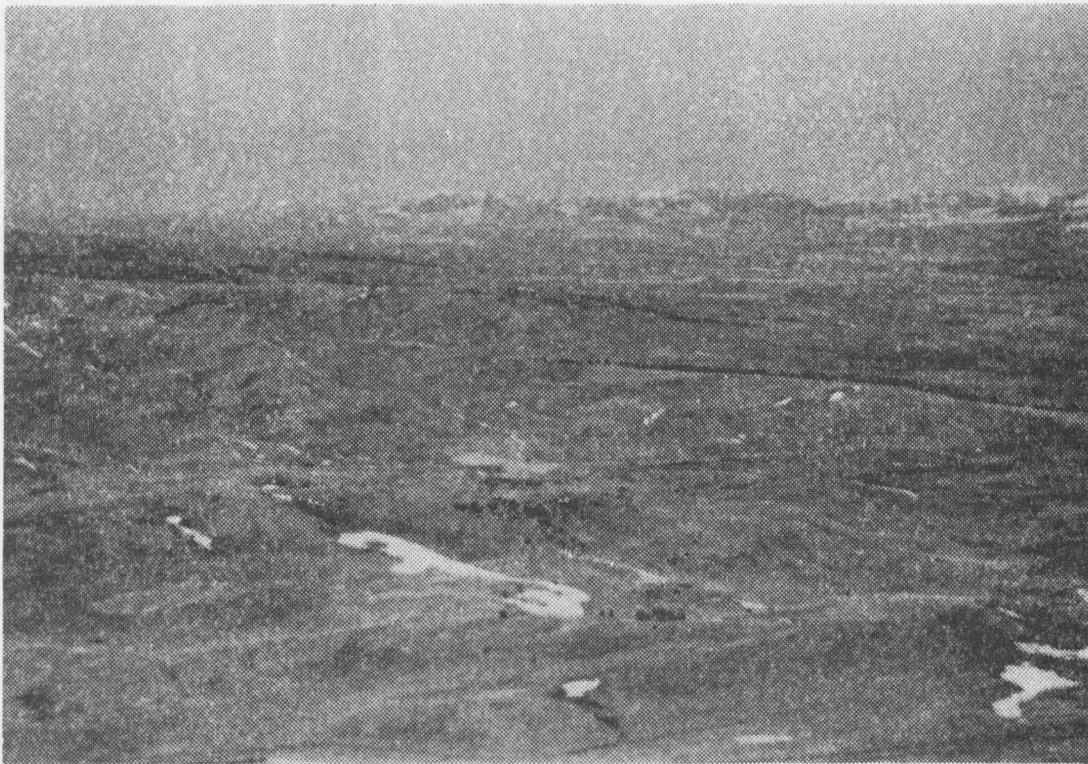


Figure 3. Aerial view of the foothills winter range.

elevations along Bangtail Ridge. Public access to this portion of the study area, which served primarily as summer-fall range for mule deer, was limited to three seasonal truck trails. One public road, Calcite road, occurred on the eastern part of the winter range.

Elk (*Cervus canadensis*) commonly occur on the Bangtail Ridge during summer and fall. Small numbers of moose (*Alces alces shirasi*) may use the area throughout the year. White-tailed deer (*Odocoileus virginianus*) occur along major streams during spring, summer and fall and along the Shields River, on the eastern boundary of the study area, throughout the year. The entire area was grazed by cattle, while a portion of the summer range was also grazed by one band of approximately 2,000 domestic sheep.

Thirty-eight broad vegetative cover types (see Appendix, Table 17) have been tentatively delineated on the study area (Jorgensen, unpubl. data). For this study, these were grouped into seven broad ecological types (Table 1 and Fig. 4) based on general vegetative, physiographic and topographic similarities:

Grassland Type.--A grassland type occurred on rocky, sandstone derived soils generally below 1,830 m. This type typically occupied hilltops or ridgetops and upper slopes between sagebrush dominated valleys (Fig. 3). It was found on all aspects, but especially on the northwest, and on slight to moderate slopes. The major grasses were blue-bunch wheatgrass (*Agropyron spicatum*), Idaho fescue (*Festuca*

Table 1. Vegetational and physiographic characteristics of the major ecological cover types on the Brackett Creek winter range.

Cover Type	Sub Strate	Slope (Degrees)	Aspect	Elev (m)	Major Plant Species Present			
					Grasses	Forbs	Shrubs	Trees
Grassland	SS-RS ¹	0-20 ² (0-40+)	NW (all)	1524-1829	Agsp, Feid ⁴	Basa, Chvi	Artr, Rosa spp Prvi, Jusc	Pifl
Sagebrush	SS-NRS	10-20 (0-40+)	NW, SE (all)	1524-1829 (to 1905)	Agsp, Koma, Feid, Popr	Luar, Anro, Trdu, Astrag spp	Artr, Jusc Amal, Putr	Psme, Pifl
Limber Pine	SS RS	20-30 (0-40+)	Var S	1524-1601	Agsp, Koma, Orhy, Brte	Acmi, Basa, Heun, Meof	Jusc, Artr Rhtr, Oppo	Pifl, Psme
Douglas Fir ³	Var.	0-40	Var N& SE	1524-1829	Feid, Koma, Popr, Agsp	Luar, Ciar, Taof, Arco 2	Artr, Jusc, Ribes, Rowo	Psme
Swales a)	NRS	10-20 (0-40+)	Var N&E	1524-1829	Popr, Phpr, Elci	Gevi, Mofi, Deoc, Ciar	Symph. spp, Artr, Rowo	Psme
b)	NRS	5-20 (0-30)	Var N&E	2134-2363	Feid, Carex spp, Brca, Agca	Gevi, Acmi Coli		Psme, Pico
Creek Bottom	NRS	0-10	Various	1524-1829	Popr, Phpr, Brca, Elci	Gevi, Aster spp Ciar, Senecio spp	Salix, Alin Cost, Potr	Picea, Psme
Agricultural	NRS→ RS	0-20	Various	1524-1829	Brin, Dagl, Hovu, Trae	Mesa		

¹ SS=Sandstone, RS=Rocky Soil, NRS=Non-rocky Soil.

² Usual condition (total range).

³ Douglas fir type on winter range only, on summer range see Appendix, Table 17.

⁴ See Appendix, Table 18 for key to four letter plant species names.

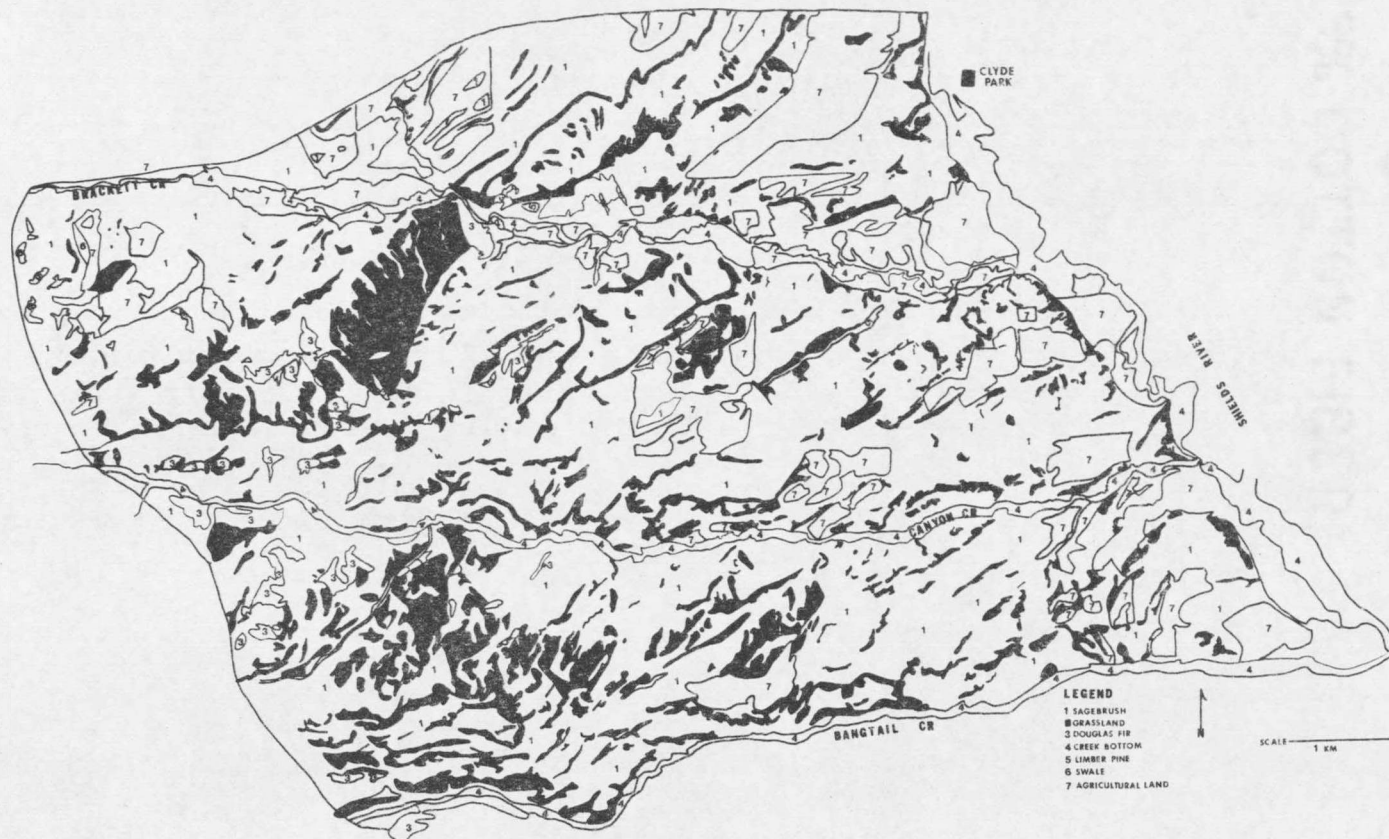


Figure 4. Distribution of ecological cover types on the Brackett Creek winter range.

idahoensis), prairie junegrass (*Koeleria macrantha*), and needle and thread (*Stipa comata*). Arrowleaf balsamroot (*Balsamorhiza sagittata*), hairy goldenaster (*Chrysopsis villosa*), silvery lupine (*Lupinus argenteus*) and fringed sagewort (*Artemisia frigida*) were the most important forbs noted. Big sagebrush (*Artemisia tridentata*), rose (*Rosa* spp.), chokecherry (*Prunus virginiana*) and Rocky Mountain juniper (*Juniperus scopulorum*) were the most common shrubs present. Limber pine (*Pinus flexilis*) was present on many of the more rocky sites of this type as scattered individuals.

Sagebrush Type.---Sagebrush cover types were associated with non-rocky soils derived from sandstones, usually below 1,830 m elevation. The sagebrush type occurred on all slopes and all exposures, but was most common on 10-20 degree slopes of northwest and southeast aspect.

Bluebunch wheatgrass, prairie junegrass, Idaho fescue and Kentucky bluegrass (*Poa pratensis*) were the most important grasses. The most important forbs were silvery lupine, rosy pusseytoes (*Antennaria rosea*), salsafy (*Tragopogon dubius*) and milkvetch (*Astragalus* spp.).

Big sagebrush was the most important shrub followed by Rocky Mountain juniper and western serviceberry (*Amelanchier alnifolia*). Antelope bitterbrush (*Purshia tridentata*) occurred on sites of this type on the north end of the study area only. Douglas fir (*Pseudotsuga menziesii*) and limber pine occurred as scattered individuals.

Limber Pine Type.---Limber pine cover types were restricted to moderately

steep (20-30°) rocky (sandstone), usually south-facing slopes at elevations below 1,600 m on the winter range. These sites were dominated by limber pine, Rocky Mountain juniper, big sagebrush and bluebunch wheatgrass. Douglas fir trees were usually present. Prairie junegrass, indian ricegrass (*Oryzopsis hymenoides*) and cheatgrass (*Bromus tectorum*) were other important grasses. A variety of forbs were found, especially common yarrow (*Achillea millefolium*), arrowleaf balsamroot, Rocky Mountain helianthella (*Helianthella uniflora*) and yellow sweetclover (*Melilotus officinalis*). Skunkbush sumac (*Rhus trilobata*) and prickly pear cactus (*Opuntia polyacantha*) were also important shrubs.

Douglas Fir Type.--The Douglas fir type was restricted on the winter range primarily to certain stream bottoms and slopes of northerly aspect. On intermediate and summer ranges it was the dominant type, occurring as various cover types (Appendix, Table 17) on all slopes and exposures and at all elevations.

On winter range sites, Idaho fescue and, occasionally, big sagebrush were also dominant species. Other important grasses included prairie junegrass, Kentucky bluegrass and bluebunch wheatgrass. Silvery lupine, Canada thistle (*Cirsium arvense*), dandelion (*Taraxacum officinale*) and ballhead sandwort (*Arenaria congesta*) were the most important forbs. Other important shrubs were Rocky Mountain juniper, woods rose (*Rosa woodsii*) and gooseberry (*Ribes* spp.). Individual

cover types occurring at higher elevations were vegetationally diverse, depending upon local site conditions and other factors. Vegetative and physiographic characteristics of these are described in Appendix, Table 17.

Swale Type.---The swale type included moist meadows and brushy draws which differed somewhat in vegetational composition by elevation. At higher elevations (2,135-2,360 m) the type was found on slight to moderate (0-20°) slopes of various northerly and easterly exposure and presented a general grass-forb aspect. Idaho fescue, sedges (*Carex* spp.) and sticky geranium (*Geranium viscosissimum*) usually were dominant species. Other common grasses included California brome (*Bromus carinatus*) and bearded wheatgrass (*Agropyron caninum*). Timber oatgrass (*Danthonia intermedia*) was also frequently present. Common yarrow and narrow-leaved collomia (*Collomia linearis*) were important forbs. Scattered Douglas fir and lodgepole pine (*Pinus contorta*) trees usually were also present. Swales of lower elevations exhibited a shrubby aspect, dominated by snowberry (*Symphoricarpos* spp.) and exotic grasses including Kentucky bluegrass and timothy (*Phleum pratense*). Basin wildrye (*Elymus cinereus*) was also abundant while important forbs included sticky geranium, wild bergamot (*Monarda fistulosa*), western larkspur (*Delphinium occidentale*) and Canada thistle. Douglas fir trees again were usually present.

Creek Bottom Type.---Creek bottoms throughout the study area were

dominated by willow (*Salix* spp.), mountain alder (*Alnus incana*) and a wide variety of exotic and native grasses and forbs characteristic of moist sites. Red-osier dogwood (*Cornus stolonifera*) and aspen (*Populus tremuloides*) were common shrubs. The most important grasses were Kentucky bluegrass, timothy, California brome and basin wildrye. Sticky geranium, aster (*Aster* spp.), Canada thistle and groundsel (*Senecio* spp.) were the most important forbs. Douglas fir and occasionally spruce (*Picea* spp.) trees were also found in creek bottoms.

Agricultural Type.---The agricultural type included grainfields and hayfields occurring at elevations below 1,830 m. The most common plant species present were smooth brome (*Bromus inermis*), orchard-grass (*Dactylis glomerata*), barley (*Hordeum vulgare*) and alfalfa (*Medicago sativa*).

Climatological data for the 1978-79 winter and long term means are presented in Table 2. Although data from the Wilsall station may not be entirely applicable to conditions on the study area, they are presented to show general trends and the relative severity of the 1978-79 winter. The 30-year average annual temperature at Wilsall 8ENE is 5^o C. January is usually the coldest month with an average temperature of -6.9^o C, while July is warmest averaging 16.7^o C. Average annual precipitation at Wilsall 8ENE is 52 cm. An average of 223 cm of snow falls during the November-April period with greater

Table 2. Climatological data for two weather stations established on the Brackett Creek winter range during winter 1978-79 and for the U. S. Department of Commerce weather station, Wilsall 8ENE, MT.

Month	Sta	Temperature °C	Precipitation cm	Snowfall cm	Max. Snow Depth cm	Days on Ground
November	Wil	-3.8/-0.8/30 ¹	5.6/2.9/20	82.6/30.7/20	40.6/16.5/19	25/9.1/14
	Lef	-2.8				25
	Pek	-5.9				25
December	Wil	-10.1/-4.6/30	3.0/2.3/20	35.6/42.4/19	50.8/29.2/15	30/26.3/16
	Lef	-10.6				31
	Pek	-7.8				31
January	Wil	-12.8/-6.9/30	2.3/2.5/21	45.7/43.9/20	71.1/43.2/16	31/30.5/15
	Lef	-13.0				31
	Pek	-11.1				31
February	Wil	-5.2/-3.9/30	2.5/1.9/21	50.8/30.7/20	-- /37.3/17	11/26.9/15
	Lef	-4.2				45.7
	Pek	-4.4				
March	Wil	-.4/-2.2/30	3.5/3.4/21	33.0/45.7/19	66.0/42.7/17	--/29.3/12
	Lef	0.0				51.1
	Pek	-0.6				19.8
April	Wil	1.0/3.8/30	3.4/4.4/21	12.7/29.0/19	45.7/24.6/19	0/11.1/14
	Lef	4.1				0.0
	Pek	3.6				0.0

¹Data for 1978-79 winter/long term average/number of years averaged.

than 2.5 cm of snow on the ground for an average of 133 days.

The climatological data for the 1978-79 winter indicate that during the November 1978-February 1979 period temperatures were much below average. Snowfall was above average in November and average to above average from December through February. These conditions combined resulted in much greater than average snow depths. Weather conditions moderated to provide a period of rapid melting after mid-February and the winter range was relatively snow free during late winter.

METHODS

Habitat Analysis

Vegetational cover and habitat types on the study area were defined by Jorgensen (1977) in conjunction with Bridger Mountain mule deer habitat studies. The habitat sites selected for study appeared as recognizable units on air photographs. Each unit was visited and measurements of its elevation, slope, aspect and substrate were recorded. The cover type of a site was designated by visually determining the two plant species with the greatest canopy coverage. The remaining plant species were listed in their order of apparent abundance. Additional habitat units that appeared from air photos to be similar to those initially chosen for study were visited and described to determine the reliability of cover typing from aerial photos. Habitat types were assigned following Pfister et al. (1974) for forested habitats and Meuggler and Handl (1974) and Jorgensen (1977) for grassland and shrubland habitats. Plant names followed Hitchcock and Cronquist (1973) whenever possible or Booth (1972), Hahn (1973) or Booth and Wright (1959).

Climatological data for the winter range were obtained from two Department of Fish, Wildlife and Parks' weather stations, which were established on the study area in November 1978, and the U. S. Department of Commerce weather station at Wilsall 8ENE, MT. The Department of Fish, Wildlife and Parks' weather stations consisted of standard rain gauge, recording hydrothermograph and anemometer.

Deer Trapping

A total of 112 mule deer (see Appendix, Table 19) were marked on the study area during two trapping periods. During March and April 1978, 31 deer were captured using cannon nets as described by Mackie et al. (1976). In early March 1979, 81 deer were captured by a helicopter drive net technique. Twelve of the deer trapped in 1978 and 6 of those captured in 1979 were fitted with radio-transmitter collars. The others were marked with 4-inch vinyl neckbands of Armortite materials bearing Tuff-flex painted symbols. In addition, two fawns captured by hand during the 1978 summer were marked with colored ear flags.

Movements, Distribution, Habitat Use

The movements, distribution and habitat use of mule deer were determined by aerial and ground observations. Aerial surveys using Piper supercub aircraft were made at approximately weekly intervals to relocate radio-collared and other marked animals. Data recorded for all observations included: time, vegetation cover type, slope and aspect. Group size, composition and any specific markings were recorded for all visual observations. All relocations of marked deer were precisely marked on aerial photos. On some flights during winter when large numbers of deer (up to 700) were observed, only the general locations of groups of unmarked deer were recorded. Seasonal dates used in analysis of movements and habitat use were based on mule

deer activity according to the method described by Steerey (1979). Locations of observed marked mule deer were converted into Universal Transverse Mercator coordinates to facilitate computer analysis of data.

Detailed data on winter habitat use were obtained by intensive ground observations of individual marked deer for one or two day periods at irregular intervals. Locations and routes of travel were recorded on large scale aerial photos.

Daily and seasonal polygon home ranges (Mohr 1947), standard diameters (Harrison 1958) and average activity radii (Hayne 1949) were calculated. Average activity radii were used for statistical comparisons whenever possible to prevent bias due to differences in sample sizes.

Indices of association (Knight 1970) were calculated for selected pairings of individual marked deer.

Food Habits

The food habits of mule deer were determined by visiting 28 recent feeding sites and recording instances of plant use as described by Cole and Wilkins (1958). Supplementary data were provided by analysis, following Wilkins (1957), of 38 rumen samples collected from deer found dead on the study area. Forage preferences were assessed subjectively by consideration of extent of use in relation to occurrence at each site.

Population Characteristics

Early and late winter helicopter sex and age classification surveys (Mackie et al. 1978) and two late winter fixed-wing age classification surveys provided information on population composition and for computation of Lincoln indices (Overton and Davis 1969) of population size. Additional data concerning population composition, fawn production and mortality were gathered by sex and age classifications of deer observed, found dead and handled during trapping operations.

Deer Harvest

Information on mule deer harvest was gathered from hunter questionnaires returned to three voluntary check boxes on the area, field contacts with hunters and conversations with local landowners. Landowners were contacted prior to the opening of the general hunting season to determine potential hunter access.

RESULTS

Movements, Distribution, Home Ranges

Winter-Spring (25 December 1978 to 10 May 1979)

Distribution

During early winter of 1977-78 and 1978-79, mule deer were distributed across an area of approximately 10,200 hectares within an elevational range of 1,402 to 1,830 m (Fig. 5). This total winter range (Fig. 5) included the Brackett Creek drainage below Miles Creek and all but the timbered upper portions of Canyon and Bangtail Creeks.

Mule deer distributional changes on the winter range were not followed during the 1977-78 winter. During 1978-79, however, most of the mule deer population became concentrated along lower Brackett Creek below Gobblers Knob by mid-winter. This Primary or Critical Winter Range (Fig. 5) encompassed approximately 3,750 hectares or about 37 percent of the total winter range area. Concentration on the primary use area was most evident from mid-January to mid-February, a period of about 30 days. Thereafter, deer again became dispersed across the entire area as the weather moderated and snow depths decreased on the winter range.

Mule deer occupied the Brackett Creek winter range for a period of approximately 6 months. The nine radio-collared mule deer arrived on the winter range in 1978-79 during a period of 3 months, November-January, although all but one (No. 2118 which arrived on 26 January

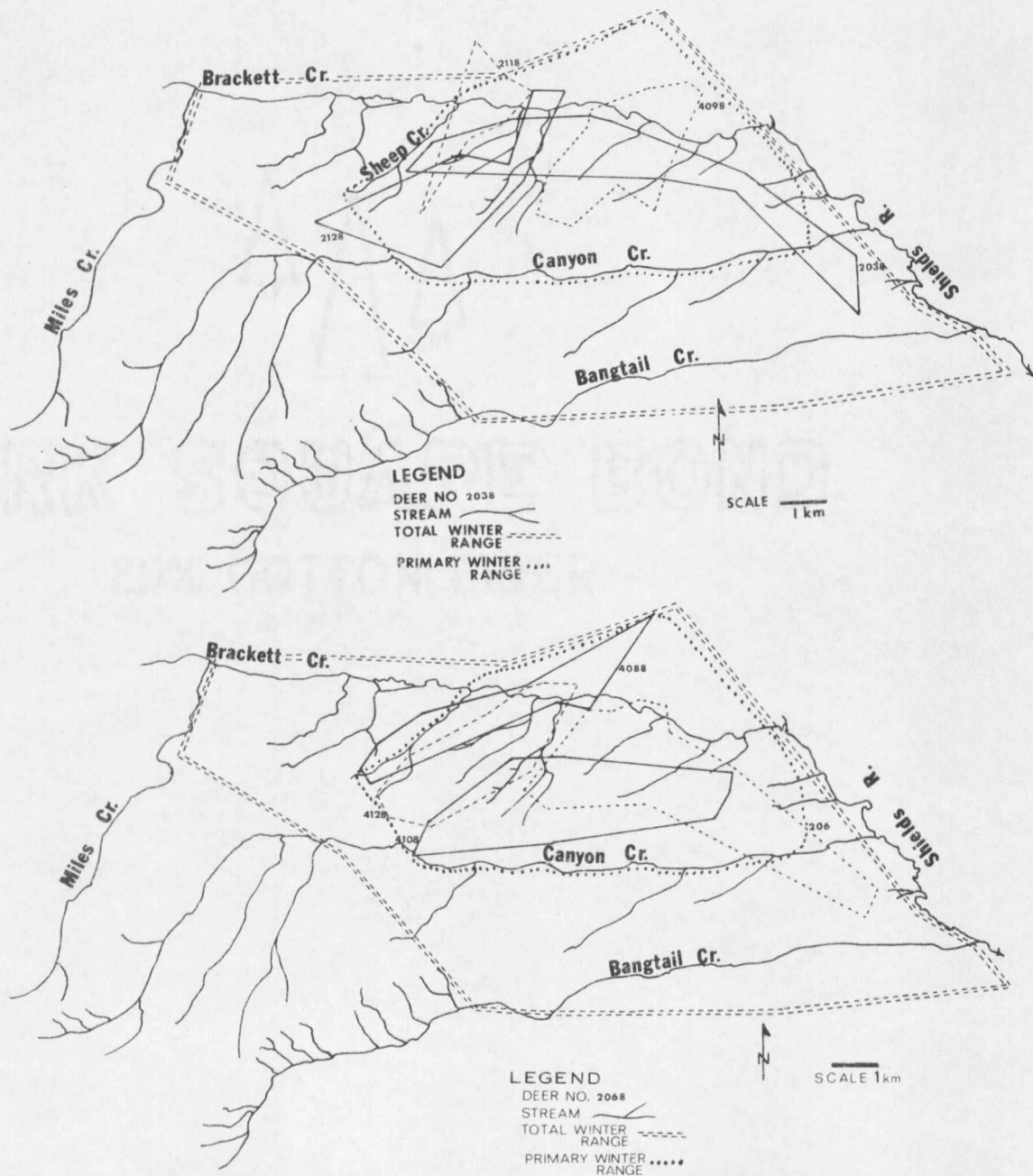


Figure 5. Distribution of the polygon home ranges of 8 radio-collared mule deer does on the Brackett Creek winter range during 1978-79 and outline of the borders of the total and primary winter ranges.

1979) were there by 29 December 1978. Departure of radio-collared deer from the winter range generally occurred during a 25-day period from mid-May to early June. In 1979, one radioed doe moved off the winter range in late April while a radioed buck moved off the winter range on 15 July (Rosgaard, pers. comm.).

Movements and Home Ranges

Seasonal polygon home range sizes, standard diameters and average activity radii of 12 radio-collared and 8 neckbanded mule deer are presented in Tables 3 and 4, respectively. The seasonal maximum, minimum and average distances between aerial relocations of radio-collared deer are presented in the Appendix, Table 20.

The movements of all but one of the eight radio-collared does on the winter range centered around two or more distinct "activity centers" (subseasonal home ranges). Generally, those reflected their distribution during early winter (January to mid-February), late winter (mid-February to mid-March) and spring (mid-March to mid-May) periods. Movements about each activity center were characterized by distinct patterns of range use which were related to weather and snow conditions. The length of time that the activities of individual deer centered around each activity center varied greatly; however, four patterns were apparent (Fig. 6). These included use about a single activity center during the entire winter, use of separate early winter, late winter and spring ranges, use of a

Table 3. The seasonal polygon home range sizes (km²), standard diameters (km) and average activity radii (km) of radio-collared mule deer on the Brackett Creek study area.

Deer #	Summer 1978			Winter 1978-79		
	HR ¹	SD ¹	AAR ¹	HR	SD	AAR
2038	1.33	1.12	0.52	19.45	6.11	2.79
2068	0.52	0.84	0.39	13.83	2.82	0.91
2108	2.88 ²	1.70	0.74	0.87	1.35	0.59
2118	5.06	1.81	0.81	9.42	2.42	0.89
2128	0.47	0.65	0.27	8.85	2.40	0.96
4078	--- ³	---	---	15.05	6.26	2.91
4088	1.20 ⁴	---	---	11.97	4.21	1.81
4098	12.33 ⁵	3.85	1.34	6.63	2.02	0.82
4108	1.39	1.30	0.61	27.39	4.46	1.97
4118	3.22 ⁶	1.40	0.56	---	---	---
4128	1.33	1.33	0.60	5.26	2.02	0.87
4018	0.87 ⁷	0.88	0.39	---	---	---
$\bar{X}$	2.94	1.49	0.62	12.85	3.31	1.38
S	3.599	0.908	0.300	7.375	1.472	0.730
N	11	10	10	8	8	8

¹HR=Polygon Home Range, SD=Standard Diameters, AAR=Average Activity Radius

²Radio failed 6-22-78, included here because it remained in an area where it was frequently observed.

³4078 left the study area in June 1978 and wasn't resighted until December 1978 on Wilsall winter range. Winter range data not included in statistics.

⁴4088 had two activity centers 7.7 km apart. Polygon HR is the sum of the area at each activity center, other parameters not calculated.

⁵4098 was a yearlong resident of the winter range, seasonal range sizes were calculated on the basis of herd mean season dates.

⁶4118 killed on summer range 11-24-78.

⁷4018 marked on Schafer Creek winter range, summered on Brackett Creek study area.

Table 4. Winter home range sizes (km^2), standard diameters (km) and average activity radii (km) of 8 neckbanded mule deer relocated more than 10 times each during the 1978-79 winter on the Brackett Creek winter range.

Deer #	Sex	HR	SD	AAR
0048	♂	8.77	2.19	0.89
0068	♂	6.08	2.41	1.09
0218	♂	7.17	3.35	1.15
0298	♂	4.28	3.21	1.49
0018	♀	4.67	2.13	0.94
0198	♀	0.29	0.82	0.36
0208	♀	3.46	2.35	0.85
0308	♀	10.74	6.20	2.06
$\bar{X}$		5.68	2.83	1.104
S^2		10.6417.6	9.2530	0.251
S		3.26	3.04	0.50

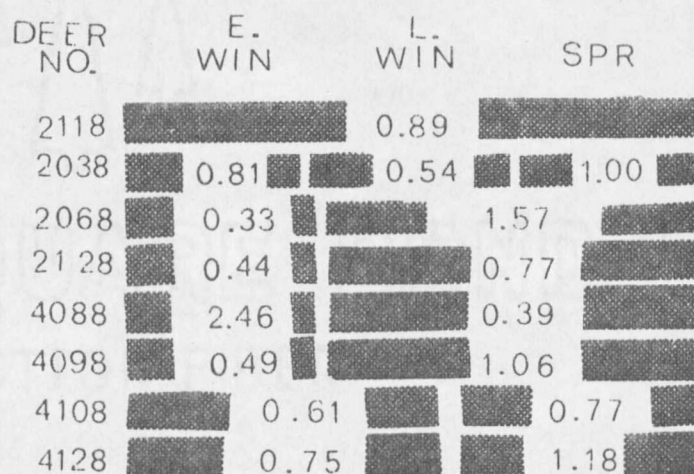


Figure 6. Periods of use and average activity radii (km) of sub-seasonal ranges occupied by radio-collared mule deer on the Brackett Creek winter range during 1978-79.

separate early winter and combined late winter-spring range and use of a combined early-late winter and a distinct spring range.

During January and early February, mule deer activity generally centered in areas of heavier cover. This period was characterized by sub-normal temperatures, normal to above normal snowfalls and above normal snow depths. Daily movements were generally limited and associated with feeding in or adjacent to cover.

A period of warming temperatures and rapid snowmelt in mid-February resulted in rapidly decreasing snow depths which allowed deer to use a larger portion of the winter range. Four of the nine radio-collared deer established new activity centers moving an average of 1.2 km to areas used thereafter as late winter-spring ranges. Another deer moved 4.8 km to a late winter range.

The three radioed deer which established separate spring ranges moved an average of 4.3 km from their previous activity center. In general, these spring ranges were located at higher elevations on the winter range than previously-used range areas and may have represented some upward movement following "green-up".

Average activity radii of radio-collared deer on late winter and spring ranges were slightly larger (Fig. 6) than those of early winter but the differences were not statistically significant ($t=0.22$, 13 df). One deer, 4088, which exhibited the opposite trend, seemed to make test movements to the late winter-spring range before establishing

that range.

The mean polygon home range sizes, standard diameters, and average activity radii for eight radio-collared mule deer does on the Brackett Creek winter range were 12.9 km², 3.3 km and 1.4 km, respectively. Average activity radii of eight neckbanded mule deer (Table 4) on the Brackett Creek winter range during 1978-79 ($\bar{X}=1.10$ km) did not differ significantly ($P=0.40$) from those of radio-collared deer.

The daily and two-day movements of marked deer on the winter range are summarized in the Appendix, Tables 21 and 22, respectively. Only average activity radii were compared statistically. During early winter the mean daily AAR was 0.24 km with wide variation between and among individuals as well as occasionally between observation periods for the same individual. Commonly, deer established somewhat repetitious patterns of use in areas adjacent to activity centers (see Appendix, Fig. 15).

Although mean daily AAR's for early and late winter, 0.24 and 0.33 km, respectively, were not statistically different ($P\leq 0.10$) there was an apparent trend toward greater movement in late winter.

The mean AAR's for 18 two-day and 41 one-day observation periods were 0.37 km and 0.29 km, respectively. The differences were not statistically significant ($P\leq 0.10$). That finding supported the subjective impression of repetitious use of the same local areas.

In winter mule deer were active during all parts of the day (see Appendix, Fig. 16). Intensively observed deer were active approximately 57 percent of the total observation time. The percent of time individual deer were active varied from 33 to 67 percent (Fig. 7, see also Appendix, Fig. 16). Individuals observed 4 or more days were active 50 to 67 percent of the total time observed. The winter home range of the least active deer was immediately adjacent to a haystack. Its lower daytime activity may have been compensated by greater nocturnal activity. The amount of midday activity by deer was generally greatest during the mid-winter period and declined after March as weather moderated (Fig. 8, see also Appendix Fig. 16).

Summer-Fall (11 May 1978 to 25 December 1979)

Distribution

Mule deer were distributed throughout the study area during summer. The Brackett Creek summer range encompassed an area of 24,360 ha, and primarily included that portion of the Bangtail Ridge north of an imaginary line connecting the Stone Creek-School Gulch divide and the Bangtail Creek-Willow Creek divide and adjacent foothills above 1,707 m elevation. All but three of the radio-collared deer summered within these boundaries (Fig. 9). One of those was a year-long resident on the winter range. Another spent the summer using an area which spanned the upper elevational limits of winter

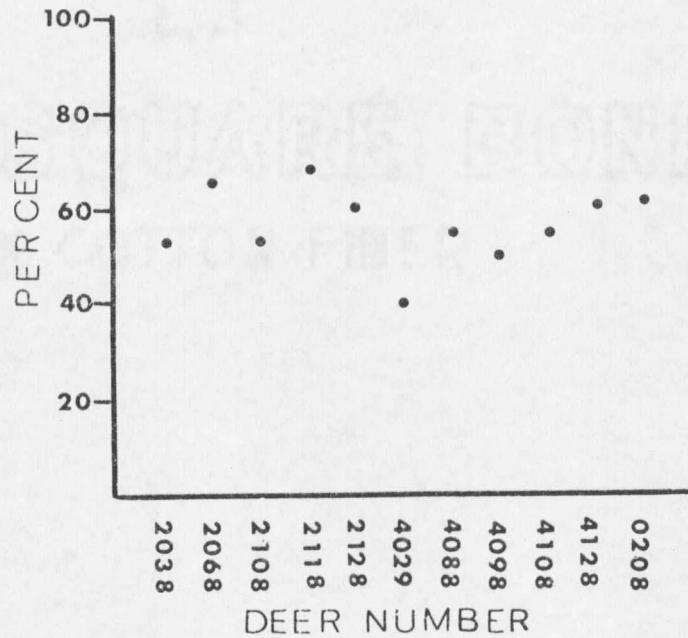


Figure 7. Percent of day time active for marked deer observed for full day periods during winter 1978-79.

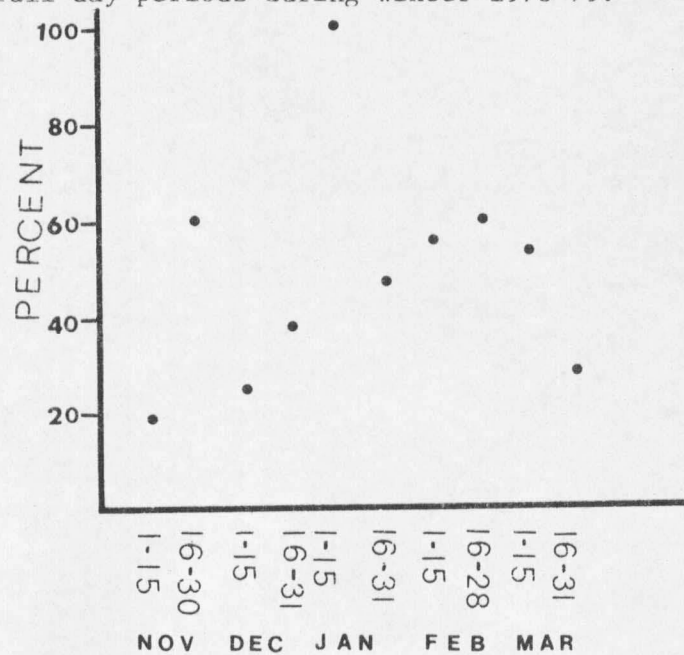


Figure 8. Percent of time active during mid-day, 1000-1400 hours, for marked deer observed for full day periods during winter 1978-79.

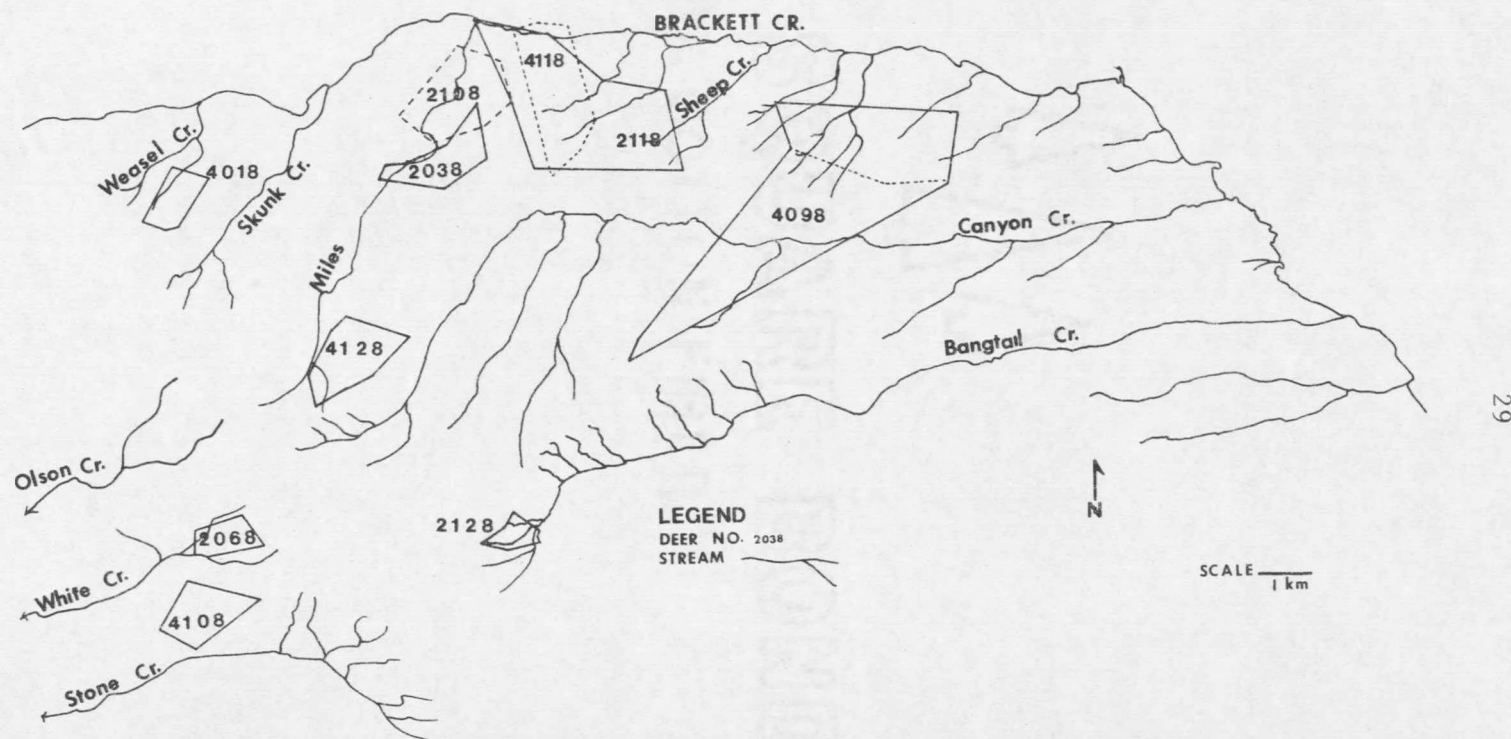


Figure 9. Distribution during summer of polygon home ranges of 10 radio-collared mule deer does from the Brackett Creek study area and one radio-collared doe from the Schafer Creek study area.

range and the lower portion of the summer range. Still another occupied two distinct summer ranges, one of which was outside these boundaries on the main Bridger Range.

Distributional changes were not apparent within or between the summer and fall periods. Radio-collared mule deer remained on their typical summer ranges until late fall or early winter, well after snow had begun to accumulate on the area.

Movements and Home Ranges

Radio-collared mule deer moved an average of 9.4 km to summer range and 11.7 km back to the winter range. Movements to and from the summer range were abrupt and direct, almost always occurring between relocation flights. Because of the rapidity of these inter-seasonal movements, specific travel routes were not determined and interseasonal "holding areas" (Pac 1976) were not apparent. However, it seemed that Brackett Creek deer migrated along ridges between major drainages.

The mean polygon home range sizes, standard diameters and average activity radii for 11 radio-collared mule deer were 2.94 km², 1.49 km and 0.62 km, respectively, during summer (Table 3). One deer, 4098, was a year-long resident on the winter range except for a 30-day period in May and June when it moved onto the Canyon Creek-Bangtail Creek divide, presumably to fawn. This was the only radioed deer thought to have had a separate fawning range. Because of this

movement, its average activity radius for the summer season was statistically larger ($P < 0.02$) than the population mean. Another deer, 4088, a doe approximately $4\frac{1}{2}$ years old, used two distinct summer home ranges the geographic centers of which were separated by a distance of 7.7 km. Movement between these, which occurred four times, required crossing the Bangtail Ridge and Bridger Canyon. It spent an average of 38 days per period on each of the two home ranges.

An additional six deer, four does and two bucks, were radio-collared on the Brackett Creek winter range during winter 1978-79. Generally these deer distributed themselves through the summer range as described for deer in 1978. One deer however, 4029, a buck approximately $3\frac{1}{2}$ years old, moved to a summer range on Battle Ridge north of the study area. The original radio-collared does returned in 1979 to the same approximate summer-fall home ranges that they occupied during 1978.

Some dispersal from the Brackett Creek herd range seemed to occur during the study. An approximately $4\frac{1}{2}$ -year-old doe, radio-collared on the Brackett Creek winter range in 1978, left the study area in June 1978. This animal was relocated in December 1978 and subsequently wintered 13 km north of the study area near Wilsall. A yearling buck, marked as a fawn in 1978, was sighted 5.5 km west of Livingston and approximately 20 km south of the study area in both

December 1978 and March 1979.

Associations Between Individual Marked Deer

Winter activity centers and summer home ranges of marked deer were widely distributed. As a result, individual marked deer were only rarely observed in association with one another. Exceptions included a doe and her fawn on summer range and two doe:yearling male groups and two adult does on winter range. The coefficient of association for the doe and her fawn during summer was 0.65 (Table 5). Two adult does were as closely associated, 0.63. Coefficients for the others were somewhat lower. Generally, the coefficients were higher for ground than aerial observations.

Table 5. Coefficients of association among marked deer on the Brackett Creek study area during 1978-79.

Deer Involved	Coefficients of Association		
	Total	Ground	Air
($\frac{1}{2}$ M) 0328-4118 ($5\frac{1}{2}$ F) ¹	0.65	0.71	0.57
($7\frac{1}{2}$ F) 0198-0208 ($6\frac{1}{2}$ F)	0.63	0.62	0.67 ²
($1\frac{1}{2}$ M) 0048-4098 ($4\frac{1}{2}$ F)	0.50	0.48	0.52
($1\frac{1}{2}$ M) 0218-2038 ($3\frac{1}{2}$ F)	0.45	0.54	0.44

¹Doe and her fawn on the summer range

²Based on only two total observations

Habitat Use

Winter-Spring (25 December 1978 to 10 May 1979)

Mule deer were most often observed on the grassland, sagebrush and agricultural types. From December to March, these types received 47, 34 and 13 percent of all observed use, respectively (Fig. 10). Use of other types was irregular and generally insignificant.

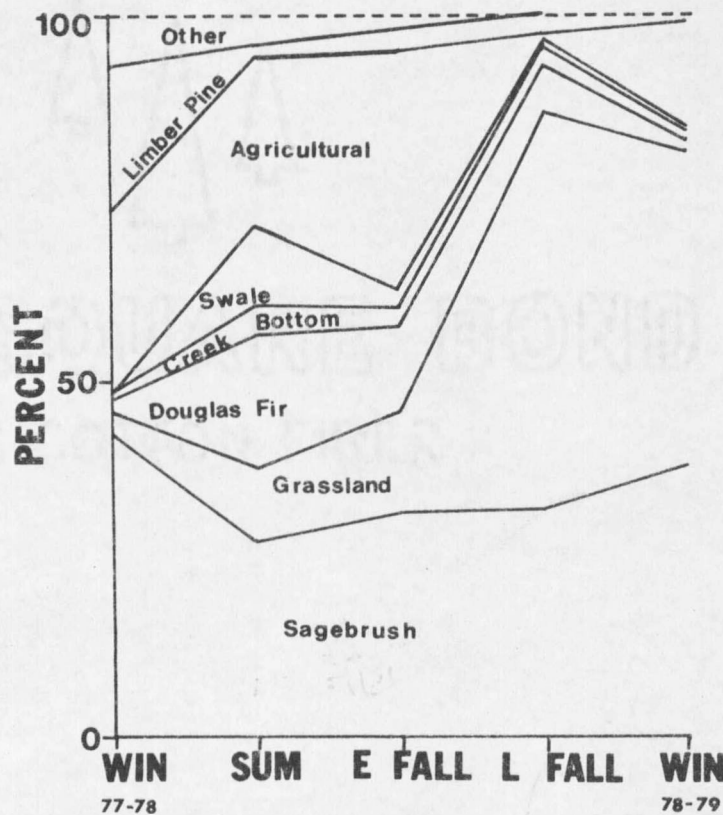


Figure 10. Yearlong trends in percentages of mule deer using the major ecological cover types recognized on the Brackett Creek study area.

Grasslands received the greatest use during December when 59 percent of all observations occurred on this type (Fig. 11). Use remained high through February then declined steadily from the time of general "green-up" in March through May.

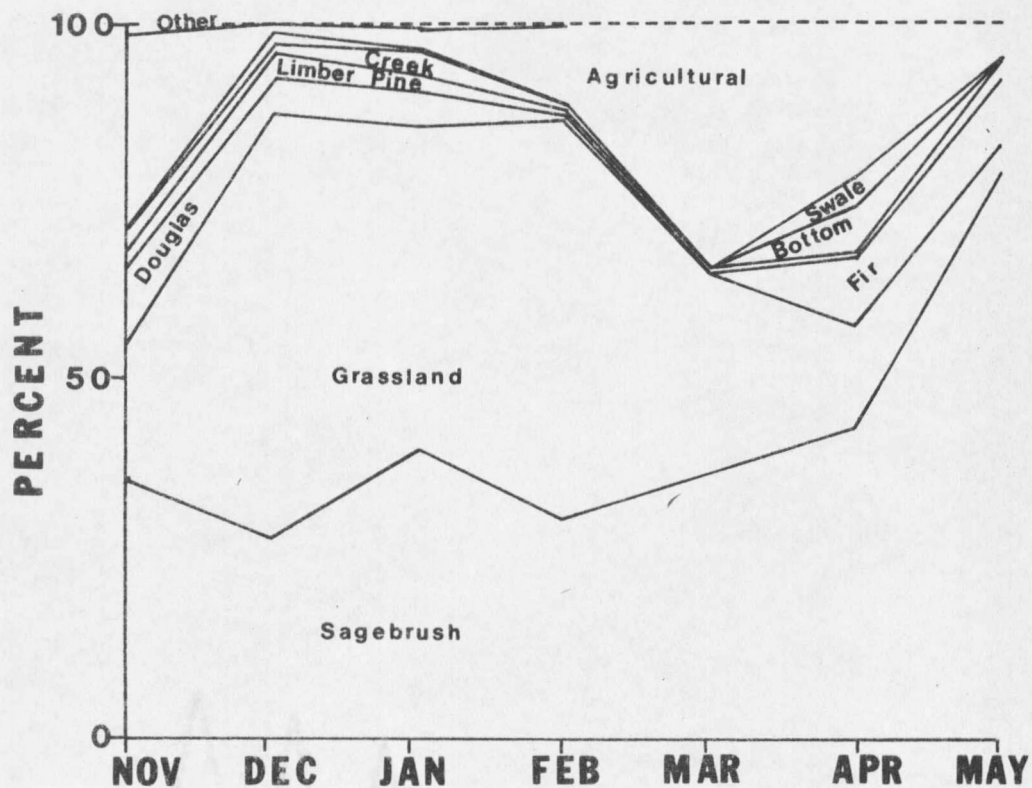


Figure 11. Habitat use by months by mule deer on the Brackett Creek winter range for fall and winter determined by combined ground and aerial observations (see text).

Use of the sagebrush type increased from 28 percent in December to 40 percent in January (Fig. 11). Its importance declined somewhat in February, but increased again during March and April to a peak of

79 percent in May.

Usage of the agricultural type, which appeared strongly influenced by snow depths, increased steadily from a low of 1 percent in December to a high of 35 percent in March, then declined to 5 percent in May.

During the period of peak use in March, groups of 100 or more deer were commonly seen on hayfields. Some members of these groups remained in the fields throughout the day alternately feeding and bedding.

The minor Douglas fir cover type received moderate use in November, when it accounted for 11 percent of all observations, and in April and May, when 10 percent of all observed use occurred on this type (Fig. 11). Relatively minor use was recorded during December-February; and no use was recorded for March. The actual use of Douglas fir may have been greater than that recorded due to observational bias for more open habitats.

Use of major cover types, especially the sagebrush, grassland and Douglas fir types by marked deer differed from that recorded in general observations (Table 6) especially during December and March. In December, marked mule deer made less use of sagebrush and greater use of Douglas fir cover types than that recorded for all deer. Marked deer used the sagebrush type more and the grassland type less than the population as a whole in March. These differences may at least partially have reflected the nonrandom method of observing the marked deer.

Table 6. The percentages of all mule deer and marked mule deer using major ecological cover types on the Brackett Creek study area by months during 1978-79.

Month	Artr	Agsp	Psme	Ag Lands
December	29.9/8.0 ¹	63.5/66	5.1/26.0	1.4/ ---
January	43.3/50.0	48.8/45.4	4.9/4.6	3.1/ ---
February	32.4/22.8	55.5/60.9	0.2/ ---	11.9/16.3
March	37.1/63.3	28.3/4.5	---/ ---	34.6/32.1
Dec.-Mar.	35.7/36.0	49.0/44.2	2.6/7.7	12.8/12.1

¹Habitat use as percent of observations of all deer/observations of radioed deer only.

Summer (10 May to 18 October)

Summer habitat use was determined from observations of 1,003 deer made during aerial relocation flights, random ground observations and intensive observations of certain marked deer on lower elevation summer range.

Overall, the sagebrush, agricultural and Douglas fir types were most important receiving 27, 23 and 18 percent of all observed use, respectively (Fig. 10). Swales received 11 percent of all recorded use; though most of this usage was by marked deer on the lower summer range. Grasslands received 10 percent of all observed use during summer. Agricultural lands were important in late summer with 83 percent of all observations on the type occurring after mid-September.

Other minor cover types used during summer were lodgepole pine, subalpine fir and clearcuts which cumulatively received 5 percent of all observed use.

Fall (19 October to 24 December)

During early fall the use and importance of the timbered and swale types generally declined (Fig. 10). Use of agricultural, sagebrush and grassland types increased and accounted for 33, 31 and 14 percent of all observed use, respectively. The grassland and agricultural types were primarily important as feeding sites. Radio-collared deer also seemed to make increased use of open habitats adjacent to timber.

Trends in habitat use during late fall were related to snow depths. Use of the swale type declined as these sites became snow-filled in early November. Use of agricultural types declined to 1 percent; while use of grassland types, especially on rocky windswept ridges, increased to 55 percent of all observed use. Grass dominated ridges were the only relatively snowfree sites on the area and 75 percent of all deer observed on this type were feeding. The percentage of deer observed in the Douglas fir type declined from 13 percent in early fall to 6 percent, due largely to the movement of deer onto the winter range where this type had a very restricted distribution (Fig. 4). Since timbered types collectively occupied only about 2 percent of the winter range on which most observations were made, their

proportionately higher use during late fall suggested that those types may have been selected for then. The sagebrush type remained important receiving 31 percent of all use.

Food Habits

Winter

Browse was the most important forage class in winter and accounted for 48 percent of total utilization at feeding sites (Table 7). Grasses and forbs received 33 and 19 percent of total observed use, respectively.

Table 7. Monthly percentages of use, January-March, of the major forage classes at 23 mule deer feeding sites derived from observations and from 38 rumen samples on the Brackett Creek study area during 1979.

	January (12/14) ¹	February (3/13)	March (8/11)	Total (21/38)
Grass	5.0/44.3 ²	24.0/30.3	70.2/29.2	33.1/34.6
Forbs	25.8/6.8	13.5/7.8	17.5/12.4	18.9/9.0
Browse	69.4/48.7	62.3/62.0	12.2/58.4	48.0/56.4

¹Number of (feeding sites/rumen samples).

²Percent use of major forage classes at feeding sites/percent volume in rumen samples.

In January, browse received 69 percent of all recorded use at feeding sites (Table 7). The most important species overall were big sagebrush, willow, skunkbush sumac, red-osier dogwood and limber pine

which received 23, 16, 9, 9 and 7 percent of all observed use, respectively (Table 8). Big sagebrush received consistently high utilization in all cover types. Willow and red-osier dogwood were important on creek bottom sites. Limber pine received 15 percent of all utilization at feeding sites on grassland-rocky ridges and 7 percent of observed use on sagebrush cover types. Skunkbush sumac and Rocky Mountain juniper, which received 4 percent of all recorded use, were locally important on certain sagebrush dominated sites.

Forbs accounted for 26 percent of all instances of use in January. Hoods phlox (*Phlox hoodii*), fringed sagewort and rosy pussytoes were the most important species, receiving 5, 4 and 4 percent respectively, of all recorded use. Grasses were relatively unimportant, receiving 5 percent of all observed use.

Browse continued to be the most important forage class receiving 62 percent of observed use in February. Utilization of grasses increased while that of forbs decreased. Use of individual species was similar to that observed in January. Dried grasses constituted 48 percent of observed use at two February feeding sites in the grassland type where deer seemed to select dried grasses over dried forbs, especially fringed sagewort. Use of forbs declined to 14 percent of total utilization. Utilization of fringed sagewort continued at January levels. Canada thistle received moderate usage at feeding sites on grassland sites.

Table 8. Percentage use of forage species by cover types and months at 23 mule deer feeding sites examined on the Brackett Creek winter range during 1979.
Trace amounts are less than 0.5 percent.

Species	# Sites	January				February			March				Over- all $\bar{X}$	
		Artr ¹	Agsp	Cr Bot	Jan $\bar{X}$	Agsp	Cr Bot	Feb $\bar{X}$	Artr	Agsp	Ag	Mar $\bar{X}$		
		7	4	2		2	1		4	1	3			
Grasses														
Agropyron cristatum								20.6		32.9	17.8		5.9	
Agropyron spicatum		1.0			tr								tr	
Oryzopsis hymenoides		1.6			0.5								tr	
Unidentified Dry			12.4		4.1	47.9		24.0	10.3	8.7		6.3	11.5	
Green									27.6	47.1	63.5	46.1	15.4	
Total Grass		2.6	12.4		5.0	47.9		24.0	58.5	55.8	96.3	70.2	33.1	
Forbs														
Allium cernuum			tr		tr								tr	
Antennaria rosea		1.5	9.3		3.6	0.8		tr		4.1		1.4	1.7	
Arenaria congesta			1.2		tr	0.8		tr					tr	
Arenaria hookeri			7.8		2.6	3.0		1.5					1.4	
Artemisia biennis			tr		tr								tr	
Artemisia frigida		tr	12.1		4.0	7.8		3.9	3.5	12.0		5.2	4.4	
Aster spp.		tr	tr	tr	tr								tr	
Astragalus spp.			tr		tr								tr	
Chenopodium fremontii			tr		tr								tr	
Chrysopsis villosa			0.5		tr								tr	
Cirsium arvense						5.3		2.7					0.9	
Cirsium spp.		tr			tr								tr	
Cruciferae spp.		1.6			0.5								tr	
Cryptantha celosioides						1.7		0.9					tr	
Cynoglossum officinale			0.7		tr								tr	
Erigeron spp.			tr		tr								tr	
Geranium viscosissimum									0.5			tr	tr	
Happlopappus acaulis			0.9		tr								tr	
Happlopappus spp.			3.9		1.3	1.1		0.6					0.6	

Table 8. (continued)

Species	# Sites	January				February			March				Over- all $\bar{X}$
		Artr ¹	Agsp	Cr Bot	Jan $\bar{X}$	Agsp	Cr Bot	Feb $\bar{X}$	Artr	Agsp	Ag	Mar $\bar{X}$	
		7	4	2		2	1		4	1	3		
Forbs (continued)													
Hyanocyanus niger		0.5			tr		1.0	0.5					tr
Lupinus argenteus		1.7			0.6								tr
Lupinus spp.			2.0		0.7								tr
Medicago sativa		tr			tr						3.2	1.1	tr
Melilotus officinalis		0.5			tr				1.1			tr	tr
Phlox hoodii			14.4		4.8	3.3		1.6	10.0	17.6		9.2	5.2
Potentilla hippiana			tr		tr								tr
Sedum lanceolata									tr			tr	tr
Selaginella densa		0.6	tr		tr								tr
Senecio serra							tr	tr					tr
Tragopogon dubius		tr		3.5	1.2								tr
Allectoria spp.		0.6			tr								tr
Unid. forb		2.4	4.6	1.9	3.0	1.3		0.7					1.2
Total Forb		10.1	61.7	5.5	25.8	25.5	1.4	13.5	15.5	33.8	3.2	17.5	18.9
Browse													
Amalanchier alnifolia		tr		2.2	0.7								tr
Artemisia tridentata		43.7	10.8	13.9	22.8	18.8		9.4	15.9	10.5		5.3	12.5
Crysothamnus nauseosus									3.7			1.2	tr
Cornus stolonifera				26.3	8.8		29.3	14.7					7.8
Juniperus scopulorum		7.2			2.4	7.8	7.9	7.9	6.4			2.1	4.1
Pinus flexilis		7.0	15.0		7.3								2.4
Prunus virginiana		1.4		2.5	1.3								tr
Pseudotsuga menziesii		tr			tr				tr			tr	tr
Rhus trilobata		27.1			9.0		1.0	0.5					3.2
Rosa woodsii		tr		2.5	0.8								tr
Salix spp.				47.1	15.7		60.3	30.2					15.3
Total Browse		87.2	25.9	95.0	69.4	26.6	98.5	62.3	26.1	10.5		12.2	48.0

¹Ecological cover types: Artr=sagebrush; Agsp=grassland; Cr Bot=Creek bottom; Ag=Agricultural.

In March, green grasses became available throughout the winter range. Feeding sites in sagebrush and grassland cover types showed that the use of green grasses comprised 46 percent of total utilization. Grasses received 96 percent of all observed use at sites on hayfields and seeded pastures, while alfalfa received 3 percent of the total usage. One feeding site conducted in an alfalfa-smooth brome hayfield showed deer to be selecting green grass over alfalfa. Feeding on browse species declined markedly to 12 percent; while utilization of dried forbs continued at a moderate level, 20 percent of the total recorded instances of use.

Rumen samples collected during winter showed greater use of browse, less use of forbs and more consistent use of grasses than that observed at feeding sites (Table 7).

Browse formed 56 percent of the volume of the rumen contents. Big sagebrush, Rocky Mountain juniper and limber pine comprised 27, 14 and 6 percent, respectively (see Appendix, Table 23). The increase in the apparent importance of juniper in rumen samples compared to feeding sites may have reflected the difficulty of determining recent use of this plant during feeding site examination.

Grasses comprised 35 percent of the rumen contents. The greater utilization and importance of grasses in rumen samples as compared to feeding sites probably was due to use of hay by deer along Brackett Creek where most samples were collected. Three

rumen samples collected in January (2) and February (1) contained an average of 84 percent barley, 95 percent of which was straw.

Forbs accounted for 9 percent of the ruminal contents. Alfalfa, fringed sagewort and hooded phlox were the most important forbs.

Summer

Five mule deer feeding sites were examined during the summer (Table 9), all in the swale cover type. Browse was the most important forage class, forming 69 percent of the diet. Rocky Mountain maple, woods rose and western snowberry were important species, respectively accounting for 23, 22 and 9 percent of total instances of use. Leaves and small branch tips were the plant parts utilized. Utilization of individual browse species was a function of availability. Maple was the primary food taken at the one site where it occurred. Woods rose was common and consistently eaten at all sites examined, but heavily utilized only where other apparently more preferred species did not occur.

Forbs constituted 24 percent of the recorded instances of use. Sticky geranium was the single most important species. Utilization of geranium at feeding sites approached 100 percent.

Use of grasses was restricted to seedheads and amounted to 7 percent of the total recorded use for summer.

Table 9. Instances of use, aggregate percentages of use and constancy of use of forage species by months at 5 mule deer feeding sites examined on the Brackett Creek study area during 1978. Trace amounts are less than 0.1 percent per month and 0.5 percent of total recorded use.

	August 1 site 613	September 4 sites 1024	Total Agg. Percent
Grasses			
<i>Bromus carinatus</i>		105/10.3/ 50	5.2
<i>Elymus canadensis</i>	19/ 3.1/100 ¹		1.6
Total Grasses	19/ 3.1	105/10.3	6.7
Forbs			
<i>Aster conspicuus</i>		1/ 0.1/ 25	tr
<i>Cirsium arvense</i>	14/ 2.3/100		1.2
<i>Crepis atrabarba</i>	3/ 0.5/100		tr
<i>Delphinium occidentale</i>	51/ 8.3/100		4.2
<i>Geranium viscosissimum</i>		226/22.1/ 75	11.1
<i>Malva moschata</i>	22/ 3.6/100		1.8
<i>Melilotus officinalis</i>		11/ 1.1/ 25	0.6
<i>Silene scouleri</i>	1/ tr /100	13/ 1.3/ 50	0.7
<i>Tragopogon dubius</i>	55/ 9.0/100		4.5
Total Forbs	146/23.8	251/24.5	24.2
Browse			
<i>Acer glabrum</i>	282/46.0/100		23.0
<i>Amelanchier alnifolia</i>	81/13.2/100		6.6
<i>Artemisia tridentata</i>		6/ 0.6/ 25	tr
<i>Berberis repens</i>	6/ 1.0/100	6/ 0.6/ 25	0.8
<i>Populus tremuloides</i>		4/ 0.4/ 25	tr
<i>P. tricocarpa</i>		87/ 8.5/ 25	4.3
<i>Prunus virginiana</i>	4/ 0.6/100	45/ 4.4/ 50	2.5
<i>Ribes</i> spp.		14/ 1.4/ 25	0.7
<i>Rosa woodsii</i>	69/11.3/100	336/32.8/100	22.1
<i>Spiraea betulifolia</i>	1/ tr /100		tr
<i>Symphoricarpos albus</i>	5/ 0.8/100	170/16.6/ 50	8.7
Total Browse	448/73.1	668/65.2	69.2

¹Instances of use/aggregate percentage of use/constancy of use.

Population Characteristics

Population Size and Trend

A total of 1,120 mule deer was observed on the Brackett Creek winter range during the December 1978 helicopter survey (Table 10). This included 10 (48%) of 21 marked deer known to be in the population at the time. During the March helicopter survey, 1,057 deer were counted, including 65 (64%) of 101 marked deer which were thought to have been present. On two additional aerial surveys, made with a fixed-wing aircraft in mid-March, after the helicopter survey, 623 and 561 deer were counted. Percentages of marked deer observed were 31 and 35, respectively.

Lincoln Indices calculated from the helicopter survey data provided estimates of 2,352 mule deer on the area during early winter and 1,642 in late winter (Table 11). Similar calculations for the fixed-wing surveys suggested late winter numbers as 2,030 and 1,619 deer. The first fixed-wing estimate may not be valid since the complete winter range was not surveyed.

Although the Lincoln Index estimate of 2,352 for early winter was derived using a small sample of marked animals, other calculations suggested somewhat similar numbers. For example, overwinter mortality estimates derived from carcass counts and the change in observed fawn: adult ratios from early to late winter suggested total overwinter mortality of about 30 percent. This included approximately 10 percent

Table 10. Sex and age classifications of the Brackett Creek mule deer herd obtained from early and late winter helicopter survey flights.

Dates of Survey	Total	AD	YG	♀♀	♂♂	Unc.	YG: 100 ♀♀	YG: 100 AD	♂♂ : 100 ♀♀
E. Win 1974-75	299 ¹						49.4	44.4	11.3
E. Win 1975-76	560 ¹						32.5	31.0	5.0
E. Win 1977-78	978	589	389	525	64		74.1	66.0	12.2
L. Win 1977-78	509 ¹	297	152			60		51.2	
E. Win 1978-79	1120	659	447	581	78	14	76.9	67.8	13.4
L. Win 1978-79	1057	806	251					31.1	

¹Incomplete survey.

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Table 11. Lincoln Index estimates of the Brackett Creek mule deer population during winter, 1978-79.

Data Source	Marked	Seen	Total No. Seen	Population Estimate
Early Winter Helicopter Survey (Dec. 1978)	21	10	1120	2,352
Late Winter Helicopter Survey (March 1978)	101	65	1057	1,642
3-15-79 Fixed-Wing Survey ($\bar{c}$ Radio) ¹	101	31	623	2,030
3-24-79 Fixed-Wing Survey ($\bar{s}$ Radio)	101	35	561	1,619

¹ $\bar{c}$ Radio=with radio; $\bar{s}$ Radio=without radio.

of all adults and 58 percent of all fawns present in early winter. Thus, on the basis of a late winter population of 1,630, about 700 deer must have died. This would suggest an early winter population of about 2,330. Similarly, it may be calculated from the 10 percent adult and the 58 percent fawn mortality and late winter age ratios that a late winter population of 1,630 comprised of 1,244 adults and 386 fawns required about 1,382 adults and 919 fawns, or a total of 2,301 total deer in early winter.

A mid-summer population estimate may be made by back calculating from the above assuming negligible adult mortality and fawn mortality as indicated by monthly sex and age classifications (Table 12). An early winter population which included 1,382 adults and 919 fawns as proposed above would have required a late summer population of at least 1,382 adults and 1,484 fawns or a minimum total of 2,866 animals. More adults would in fact have been present since the early winter population estimate was made after hunting losses occurred.

Densities

Estimated mule deer densities on the study area were $12/\text{km}^2$ during summer and $23/\text{km}^2$ and $16/\text{km}^2$ during early and late winter, respectively. Mule deer densities on the primary use area may have approached $62/\text{km}^2$. In local areas on the primary winter range, however, densities approaching $78/\text{km}^2$ were recorded.

Table 12. Sex and age classifications of mule deer on the Brackett Creek study area by months during 1978-79

Date	Total	Ad	Yg	♀♀	♂♂	Unc	Yg: 100 FF	Yg: 100 Ad	♂♂: 100 Ad
June	53	42	7	42	--	4	16.7	16.7	--
July	109	81	27	76	5	1	35.5*	33.3	6.6
August	56	34	16	33	1	6	48.5	47.1	3.3
September	239	126	97	118	8	16	82.2	77.0	6.8
October	445	177	181	163	14	87	111.0	102.3	8.6
November	500	220	241	205	15	39	117.6	109.5	7.3
December	1248	679	466	619	60	103	75.3	68.6	9.7
January	2604	1276	568	--	(81)	760	--	44.5	--
February	2377	1297	359	--	(20)	714	--	27.7	--
March	1792	861	272	--	(13)	666	--	31.6	--

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*Fawn production by radio marked mule deer does indicated a minimum fawn production of 150 Yg:100 ♀♀.

Fawn Production and Survival

Eight of the 10 radio-collared does on the study area were known to produce 12 fawns (Table 13). The fawning success of two does could not be determined. At least 75 percent of the known fawns survived into mid-October. Of the three fawns not known to survive, one died during late summer and survival of the other two could not be determined because the radio-collar worn by their mother malfunctioned. Four of the radio-collared does which were seen with fawns in mid-October were observed alone in early winter which implied that their fawns may have died during the fall. After mid-September, deer became more concentrated and doe:fawn pairs could not be distinguished readily.

Table 13. Reproductive performance of 11 radio-collared mule deer does on the Brackett Creek study area during 1978.

Deer #	Date Fawns	Last Seen	Last Seen
	First Seen	With 1 Fawn	With 2 Fawns
2038	6- 9 (2) ¹		10-18 ²
2068	7-22 (1)	10-10 ²	
2108	7-13 (2)		7-22 ³
2118	7-29 (1)	11-24	
2128	8-29 (1)	10-18 ²	
4088	--		
4098	6-21 (1)	11-24	
4108	--		
4118	7- 2 (2)	9-17 (3-15-79) ⁴	8-13
4128	7-26 (2)		10-30 ²
4018 ⁵	9-24	10- 3	

FF:100. producing does (Brackett Cr. radioed deer only) 12:8 = 150

¹Date fawns first seen (number of fawns).

²Deer was seen at a later date alone which may imply loss of fawns.

³These fawns could not be located after their mother's radio-collar ceased to function on 22 June 1978.

⁴Fawn last seen on 15 March 1979 about 4 months after her mother died.

⁵Deer was radio-collared on Schafer Cr. winter range and returned there 30 October.

Age ratios recorded for the population as a whole (Table 12) were lower than those for radio-collared deer during summer and early fall. Observed fawn:doe ratios increased monthly from June to November, when a maximum ratio of 117.6 fawns per 100 does was recorded. Classifications showed a steady and sharp decline in fawn:adult ratios from 110 fawns per 100 adults in November to 32 fawns per 100 adults in March (Table 12). Additional fawn mortality occurred in April and May but could not be quantified. At least 7 of 138 fawns found dead on the winter range died after classifications ceased in late March.

Mortality

Population trends and age classification through the 1978-79 winter indicated that substantial mortality occurred through the winter and early spring period. A total of 201 mule deer carcasses was found during routine winter observations and four subsequent dead deer searches along lower Brackett Creek and two tributary streams. These carcasses doubtless represented only a portion of the total mortality which accrued since the total area searched encompassed only 2684 hectares or about 26 percent of the total winter range. Also, it is unlikely that all deer dying within this area were located. The sampling efficiency of a dead deer search on the Armstrong winter range on the west slope of the Bridger Mountains was only 77 percent (Mackie et al. 1976) and only 52

percent of the estimated fawn losses were accounted for by the carcass count.

Nearly three-fourths (73.6%) of the carcasses examined were those of fawns (Table 14). Of those for which sex could be determined, 42 percent were males and 58 percent were females. The adults included 23 percent males, 50 percent females and 27 percent unclassified. Adult female carcasses included animals from $1\frac{1}{2}$ through $10\frac{1}{2}+$, except $3\frac{1}{2}$ year-olds. The ages of adult male carcasses ranged from $1\frac{1}{2}$ through $8\frac{1}{2}$, except $5\frac{1}{2}$ - $7\frac{1}{2}$ year-olds.

Table 14. Sex and estimated age of deer found dead on the Brackett Creek winter range during 1978-79.

Sex	$\frac{1}{2}$	$1\frac{1}{2}$	$2\frac{1}{2}$	$3\frac{1}{2}$	$4\frac{1}{2}$	$5\frac{1}{2}$	$6\frac{1}{2}$	$7\frac{1}{2}$	$8\frac{1}{2}$	$9\frac{1}{2}$	10+	Ad	Unc	
MM	33	3	1	2	1	-	-	-	2	-	-	2	-	44
FF	46	2	3	-	4	3	4	1	1	1	1	4	-	70
Unc	69	1	-	-	-	-	-	-	-	-	-	13	4	87
														201

Calculations based on the proportions of fawns and adults among carcasses examined and the change in fawn:adult ratios between December and March indicated that total mortality was approximately 30 percent. This included approximately 10 percent of the adults and 58 percent of the fawns which occurred on the area in early winter. Using these data and the late winter estimate of approximately 1630 deer on the area, it was calculated that nearly 700 deer died.

Expansion of carcass counts along Brackett Creek to the entire winter range suggested a minimum total loss of 763 deer.

Causes of death were assigned to 58 of the 201 carcasses found on the winter range (Table 15). Of these, 22 (38%) apparently died solely of starvation. Predation appeared to be the proximal cause of death of 20 (34%) animals, however examination of those carcasses indicated that malnutrition usually was also a factor. Fifteen (26%) died of accidental causes, including motor vehicles, fences, drowning and a haystack accident. One death was believed due to a gunshot wound received during the 1978 hunting season.

Table 15. Cause of death for 58 mule deer found on the Brackett Creek winter range during 1978-79.

Cause	Number	Percent
Winterkill (starvation)	22	38
Dogs (2 known, 9 suspected)	11	19
Coyotes	9	16
Motor Vehicles	6	10
Fences	6	10
Others: Caught in haystack	1	2
Hunter cripple	1	2
Drowning	2	3
	<u>58</u>	<u>100</u>

Both sex and date of death were determined for 25 fawn carcasses (Fig. 12). Of these, 72 percent were males and 28 percent were females. Eighty percent died between 11 January and 20 February

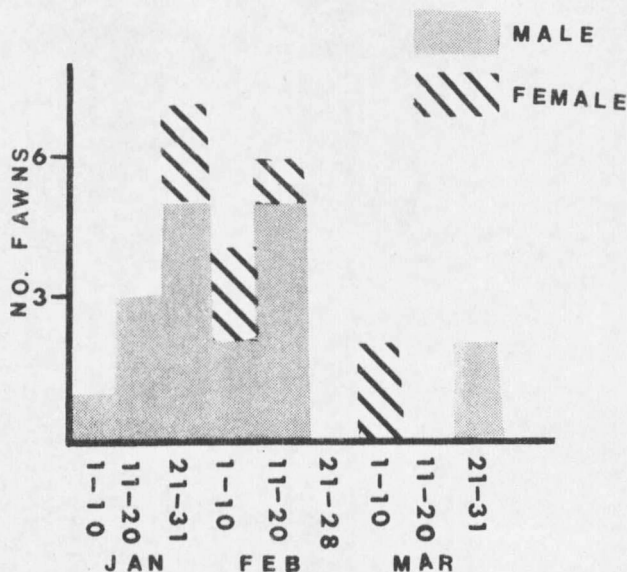


Figure 12. The distribution of fawn deaths for which a date could be established during the winter of 1978-79.

after substantial mortality had already occurred among fawns. This, plus the fact that female fawns predominated in the total carcass collection (Table 16), indicated that early winter mortality was greater among females, while the male fawns, which remained in greater numbers in the population until mid-winter, died later.

Domestic dogs were believed responsible for 11 of the predator kills (Table 16). On 24 January 1979, a group of 16 deer were observed being harassed by two domestic dogs, a black labrador and a small blue-heeler cross. The labrador chased a fawn downhill in

Table 16. Description of deer believed killed by domestic dogs on the Brackett Creek winter range during the 1978-79 winter.

Collection Number	Sex	Age	Condition	Wounds
10HN79	FF	Fawn	fair	hamstrung, hind quarter partially consumed*
12HN79	MM	Fawn	poor	side wound (observed)*
13HN79	MM	Fawn	poor	side wound
14HN79	MM	Fawn	poor	side wounds
15HN79	MM	Fawn	poor	side wound, broken neck
17HN79	MM	Fawn	poor	hamstrung, hind quarter partially consumed, side wound
18HN79	FF	Fawn	poor	hamstrung, hind quarter partially consumed, side wound
19HN79	MM	Fawn	poor	hamstrung, hind quarter partially consumed, side wound
31HN79	FF	4½	good	broken neck (deep snow)
37HN79	FF	Fawn	poor	hamstrung, hind quarter partially consumed
41HN79	MM	Fawn	poor	broken neck

*known dog kills

8-12+ inches of snow out of sight into the creek bottom. The still-warm carcass of a buck fawn was later retrieved from Brackett Creek. A large patch, 6-8 inches in diameter, had been torn from the right side of the animal just behind the shoulder. Frothy blood was present in the air passages and the wound. Three coyotes were

present but not active participants, and seemed uneasy because of the activities of the dogs. A female fawn was known to have been killed as it fed on hay in a farmyard. This animal had been hamstrung and the hind quarters partially consumed when found. Several other deer found with broken necks, but otherwise untouched, were also classified as probable dog kills. Most of the dog killed deer were fawns in poor condition (Table 16); but, one was a 4½ year-old doe in good condition. This deer was found in deep snow with a broken neck.

Two neckbanded deer, 0068 a yearling male and 0209 a female fawn, died during the first 5 days of May. Another neckbanded deer, 0279 a 9+ year-old doe, died sometime after mid-March. These deaths may indicate that at least some and possibly substantial mortality occurred well after the winter and after deer were using new green forage.

Known nonwinter mortality of adult deer was limited to that of two marked deer. A yearling male was road killed on the winter range, 26 May 1978. The second, a 5½ year-old doe, was killed on about 22 November, probably by a coyote.

Sex and Age Structure

Aerial classifications in early winter (Table 10) indicated that the Brackett Creek population was dominated by adult females and fawns. Males comprised only 7 percent of all deer seen in

December 1978. Similarly low proportions of males were observed in early winter classifications in 1974, 1975 and 1977 (see Appendix, Table 24). Mackie et al. (1978) reported generally lower male:female ratios among adult mule deer classified on winter ranges along the east side of the Bridger Range than on the west slope winter ranges. While adult males have rather consistently comprised about 7 percent of the early winter population, the proportion of adult females in the herd has declined since 1975, apparently due to the increased numbers of fawns surviving to winter.

The age class distribution of 101 mule deer for which ages were determined at the time of trapping, and 178 deer found dead during winter, 1978-79, is shown in Figure 13. These data suggested that the population was dominated by very young and middle-prime aged deer. The maximum age recorded for males was approximately $8\frac{1}{2}$ while the oldest female was $10\frac{1}{2}$; however, very few "old" deer ($8\frac{1}{2}+$ years) occurred within either sex. Young animals (fawns and yearlings) were especially dominant among males where very few individuals $2\frac{1}{2}$ years or older were recorded. Aerial classification of males also indicated a preponderance of young, since yearling bucks comprised at least 34 percent of all adult males seen in early winter 1978-79.

In-utero Productivity

Reproductive tracts of seven winterkilled mule deer does were examined. Three of these tracts were complete. The pregnancy rate

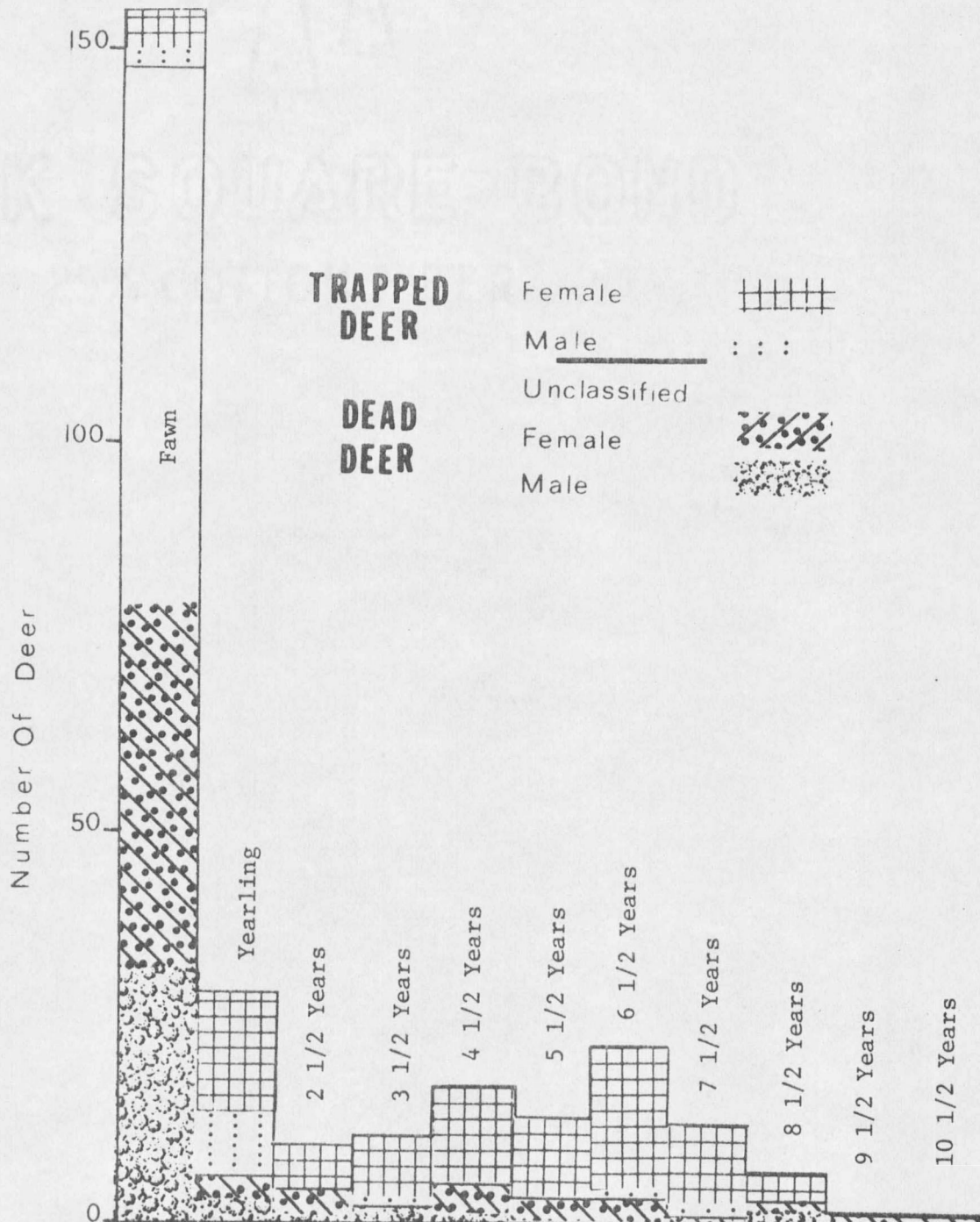


Figure 13. The sex and age composition of the Brackett Creek mule deer herd based on data from trapped deer and carcasses found on the winter range during 1978-79.

was 0.83, which was less than that usually reported for mule deer (Robinette 1955). No pregnant fawns were found among 46 female fawns found dead on the winter range. The indicated fetal rate was 1.2 fetuses per pregnant doe. This was lower than the 1.5 fawns per doe observed with radio-collared does during the summer of 1978 and suggested that productivity during 1979 may be less than that observed during 1978. The observed fetal rate of 1.2 was also less than that, 1.44, reported by Mackie et al. (1978) for mule deer in the Bridger Mountains as a whole.

Deer Harvest

Thirteen mule deer bucks were known to be harvested on the study area during the 1978 general hunting season. Those included four each of 4, 3 and 2 point bucks and one doe. Hunter access was generally limited to National Forest lands on the Bangtail Ridge. Only two landowners, who controlled about 5 percent of the private lands within the study area, allowed hunting. Most of this land was on the lower winter range where no real concentrations of deer formed until near the end of the hunting season.

DISCUSSION AND CONCLUSIONS

The movements of radio-collared deer on the Brackett Creek study area centered on two "seasonal" ranges, winter-spring and summer-fall. Inter-seasonal movements were abrupt and direct and did not involve the use of distinct spring and fall ranges or "holding" areas as reported for mule deer from previous studies in the Bridger and other mountain ranges (Pac 1976, Bertram and Rempel 1977, Steerey 1979).

Also in possible contrast with other studies, the timing and rate of inter-seasonal movements or migrations did not closely coincide with the accumulation of snow on summer range in fall or its disappearance in spring. In fall, marked mule deer remained on their typical summer range for an average of about 30 days after snow began accumulating. The only known exceptions were three radio-collared animals which moved off their summer-fall range within one week after the first major snowstorm of the season. All three summered across a major divide from the winter range. Steerey (1979) noted that radio-collared mule deer summering east of the Bridger Divide moved back toward the winter range with the first snowstorm, before those on west slope summer ranges. In spring, radioed deer did not follow the "green-up" or receding snowline from the winter range. Radio-collared animals remained distributed throughout the winter range for an average of approximately 45 days after the area became snowfree, and well after movement towards or onto summer ranges was possible.

The mean winter average activity radii of radio-collared animals

on Brackett Creek, 1.38 km, were significantly larger than those reported for other areas in the Bridger Mountains (see Appendix, Table 25). General comparisons of other measures of home range size also indicated larger home ranges on Brackett Creek.

Winter polygon home ranges, which averaged 12.85 km^2 for eight radio-collared mule deer, were much larger than those reported elsewhere for mule deer in any type of habitat (see Appendix, Table 25). That probably reflected the fact that mule deer on Brackett Creek predominantly used a series of sometimes widely separated activity centers or subseasonal home ranges. Inclusion of all activity centers in a single winter polygon home range greatly increased the amount of area used by these deer (see Appendix, Fig. 15) and probably overestimated the average home range, at least for comparison with other studies. Youmans (1979) reported that home ranges of two of nine radio-marked deer on the Armstrong winter range, also in the Bridger Mountains, were enlarged by use of more than one activity center.

The use of a series of activity centers or subseasonal ranges may have been at least partially due to the area's function as both winter and spring range for mule deer. This was suggested by the late winter-early spring shift in activity centers of four radio-collared deer. Two deer moved to the eastern edge of the winter range, apparently to take advantage of early green-up, and two moved higher on the winter range as if following the green-up to a spring

"holding area", but within the limits of the winter range.

During summer, average activity radii of marked animals on the Brackett Creek study area were about intermediate to those reported for mule deer in other areas (see Appendix, Table 25). Among Bridger Mountain deer, animals on Brackett Creek appeared to have generally larger average activity radii than reported by Steerey (1979) and larger polygon home ranges than reported by Pac (1976), but the differences were not statistically significant ($P=.07$ and $P=.14$, respectively). For other areas, polygon home range sizes were larger than reported for all but the Missouri River Breaks.

Generally the larger summer home ranges for deer on Brackett Creek as compared with those from the Armstrong and Schafer Creek ranges could be related to differences in the composition and juxtaposition of summer range vegetation. For example, both Pac (1976) and Steerey (1979) noted the importance of the *Abies lasiocarpa* series to mule deer in late summer. That series, which characteristically occurs on cool, moist sites and may provide succulent, high-quality, late-summer forage for mule deer, comprised 20 percent and 34 percent of the Armstrong (Pac 1976) and Schafer Creek (Steerey 1979) herd summer ranges, respectively, but only about 10 percent of the Brackett Creek summer range. Also, the series was evenly distributed across the Armstrong herd summer range (Pac 1976), whereas on Brackett Creek it was restricted to the northwest corner of Bangtail Ridge (Jorgensen

pers. comm.).

Other factors possibly causing or contributing to the use of larger summer home ranges on Brackett Creek include livestock grazing, logging and the generally more open nature of habitats used by deer during summer.

The entire Brackett Creek summer range was grazed by cattle for about 90 days, from mid-June to mid-September. A portion of the area was also grazed by one band of approximately 2,000 domestic sheep, although none of the radio-collared deer had home ranges within this area. Mackie (in press) cited several studies which suggest that livestock may interfere with deer use of all available habitat, cause increased deer movements and exclude deer use in some areas. One example of that involved a radio-collared doe during my study. After cattle were placed in the pasture used by the doe in mid-September 1978, she consistently avoided them by movement to and use of areas where the cattle did not occur.

Many areas on the summer range had been or were being logged; large clearcuts, up to 256 ha, occurred in every major drainage. In contrast, only one clearcut area occurred within the main summer range of the mule deer herd associated with the Armstrong winter range and the primary Schafer Creek herd range has not been logged in recent times. The importance of the ratio and juxtaposition of cover to forage areas is well documented. Black et al. (1979) reported that

optimum mule deer habitat contained a ratio of 40 percent cover to 60 percent foraging areas. Short et al. (1977) noted that mule deer preferred open blocks of less than 50 ha as foraging areas in a pinyon pine-juniper habitat.

The Bangtail Ridge summer range may be generally more "open" than its counterparts on the main Bridger Range. In addition to the large clearcuts a series of large open meadows occurred on divides between the major drainages and in the wide creek bottoms. Open grassland and shrub cover types occupied certain westerly aspects while open Douglas fir cover types were found on many of the south- and southwest-facing slopes. A band of primarily open habitat also occurred on the summer range-winter range border. Mule deer movements may be more extensive in open habitats as the animals move longer distances to utilize required resources or to achieve visual isolation, an important component of security. Severson and Carter (1978) found that home ranges of mule deer on an open Northern Great Plains habitat were considerably larger than generally reported for mountainous areas.

During winter, mule deer on Brackett Creek used the open sagebrush, grassland and agricultural cover types extensively. Timbered types received only minor use. The latter may have received somewhat greater use than recorded, due to observational bias toward more open habitats, and probably were selected for. The pattern of habitat usage by mule deer on the Brackett Creek winter range closely resembled

that reported for mule deer on a northern prairie habitat (Dusek 1971). Previous studies of mule deer in the Bridger Mountains (Steerey 1979, Youmans 1979), other mountain foothills (Bertram and Remple 1977) and river breaks habitats (Komberec 1976, Mackie 1970) have indicated much greater use of timbered types. Lovaas (1958) reported that mule deer in the Little Belt Mountains, Montana, used areas with scattered timber except during cold snowy periods when they concentrated in large herds on both prairie and dense timber cover types.

Differences in habitat use on the Brackett Creek and other Bridger Mountain winter ranges probably were due to vegetative and topographic variation. The Brackett Creek winter range was characterized by low relief with alternating sagebrush dominated valleys and rocky, rounded grassland ridges. Only a few creek bottom sites and north-facing hillsides were occupied by timbered cover types. In contrast, the Armstrong and Schafer Creek winter ranges were comprised of steep south- and southwest-facing open hillsides dissected extensively by timbered draws and north-facing slopes.

The apparent selection of Brackett Creek deer for the grassland type, which was used heavily for feeding from December to March, may be somewhat exaggerated. Intensive observations of marked animals indicated that mule deer spent comparatively more time on sites of this type per feeding period than they spent on sagebrush dominated sites although most feeding periods included some use of both types.

Because of this, deer observed during a feeding period were more likely to be seen and recorded on grassland sites.

Agricultural sites on the winter range received their greatest use in February and March. Findings of other mule deer studies in the Bridger Mountains (Hamlin 1974, Schwarzkoph 1973) have also indicated important use of agricultural types; but mostly during April and May.

During the summer, mule deer predominantly used sagebrush, Douglas fir and agricultural cover types. However, the recorded relative importance of these types may have been biased by the nature of my observations. The importance of timbered (Douglas fir) cover types, in particular, was again probably underestimated. Seventy percent (7 of 10) of the radio-collared mule deer does summered primarily in Douglas fir cover types and all used this type to some extent. Other studies in the Bridger Mountains (Schwarzkoph 1973, Hamlin 1974, Pac 1976, Steerey 1979) also have reported greater use of timbered cover types than indicated by my observations. Findings of this study correspond more closely with those of Mackie (1970) and Knowles (1975) in the Missouri River Breaks, Montana, where mule deer used timber cover types, primarily ponderosa pine (*Pinus ponderosa*), at percentages similar to those reported here for Douglas fir. General observations indicated that open habitats were important as feeding sites while timbered types served a variety of functions;

providing escape and bedding cover and feeding areas.

Mule deer in local areas on the lower summer range made extensive use of hayfields after mid-September when vegetation in the area had become disiccated. Various authors (Schwarzkopf 1973, Pac 1976) have noted the importance of a late summer source of succulent forage. Limited evidence from relocations of marked deer suggested that hayfields may have attracted deer from considerable distances. One radioed doe was sighted on a hayfield approximately 0.8 km from her typical summer home range. Use of the hayfield did not constitute a late summer distribution shift as she continued to use her typical summer home range for approximately 90 days after the sighting.

The food habits of mule deer on Brackett Creek generally conformed with those reported for other studies of mule deer in the Bridger Mountains (Steerey 1979, Schwarzkoph 1973, Wilkins 1957). The order of importance of forage classes was browse, grasses and forbs. Browse was most important during January and February (Table 7). Forbs were most important during January while grasses became very important after February. During March, grasses were the most important and browse the least, Steerey (1979) and Schwarzkoph (1973) noted that green grass was available and eaten throughout the winter on certain protected sites on steep south- and southwest-facing slopes on other Bridger Mountain winter ranges. This did not

occur on the Brackett Creek winter range; and all use of grasses recorded at feeding sites prior to the general green-up in March involved dried grasses.

Utilization of dried grasses increased from January to February, probably due to the declining availability of preferred forbs.

Carpenter et al. (1979) presented empirical evidence that mule deer chose preferred forages while they were available. One exception to this trend occurred in mid-February when deer selected dried grasses instead of fringed sagewort, a preferred forb which was available at the feeding site.

Browse utilization declined as the weather moderated in late February. Initially this may have reflected availability of other forages as snow depth decreased. Carpenter et al. (1979) reported that the use of shrubs increased and the use of understory species decreased as snow depths increased. After early March, however, the light use of browse was more likely due to selection for new green forage.

Big sagebrush accounted for 12 percent of all observed use at mule deer feeding sites and an average of 27 percent by volume in rumen samples. Wallmo et al. (1977) suggested that utilization of big sagebrush in excess of 30 percent of the diet may be detrimental to the nutritional health of mule deer because of inhibition of gastric function by the aromatic compounds in the plant tissue. Use

of big sagebrush approached 30 percent during January, at a time when the diet of mule deer also contained significant amounts of limber pine and Rocky Mountain juniper. The latter also contain high concentrations of aromatic compounds. Thus, it is possible that this diet contributed to the high level of mortality observed among mule deer on the area in early winter.

Observations at feeding sites indicated that the degree of use of some preferred forbs, especially fringed sagewort and Hood's phlox, during winter may have been underestimated. It usually was difficult to determine recent use of these plants and in many cases deer used the entire plants.

Winter rumen samples mainly contained browse and grasses. Forbs accounted for less than 10 percent by volume. Similar trends have been reported on the Armstrong (Schwarzkoph 1973) and Schafer Creek (Steerey 1979) winter ranges. Much lower levels of utilization of grasses have been reported for the Missouri Breaks (Mackie 1970, Hamlin 1978) and northern prairie (Dusek 1971). However, Morris and Schwartz (1957) found mule deer on the National Bison Range, Montana, to extensively utilize grasses during early (November-December) and late (February-March) winter.

The limited data on summer food habits indicated that browse was important. Forbs received moderate usage while grasses received only minor use. Those findings also contrasted with those reported

for mule deer in other parts of the Bridger Range (Steerey 1979, Pac 1976, Hamlin 1974, Schwarzkoph 1973).

The importance of browse in the summer diet probably reflected plant phenology and the time the data were obtained. All summer feeding sites were examined after mid-August when forbs in the vicinity of these sites were desiccated. References to mule deer use of browse on mountain foothill summer ranges in late summer are common.

Early winter population surveys (Table 10) and estimates (Table 11) indicated that the Brackett Creek mule deer herd has increased substantially and possibly has more than doubled since 1975. Mule deer have generally increased throughout the Bridger Mountains since 1976 (Mackie et al. 1979), with the greatest increases occurring in populations associated with east side and north end winter ranges.

Following the severe winter of 1974-75 the fawns comprised only about 23 percent of the Brackett Creek population. Since 1976, the proportion of fawns in the early winter population has increased to stabilize at about 40 percent; however, during this period, proportions of fawns as low as 23 percent in early winter, apparently were sufficient for population increase. Mackie et al. (1978) noted that populations on the Armstrong winter range composed of 20-25 percent fawns were able to maintain stability. Sharply increased numbers of mule deer on Brackett Creek in 1978 and 1979 reflected high fawn

production and survival in those years.

Based on the observations of marked animals, the efficiency of the early and late winter helicopter sex and age classification surveys was about 48 and 65 percent, respectively, during 1978-79. Intensive fixed wing age classification flights in late winter, 1979, indicated about 33 percent efficiency. However, both types of surveys produced similar population estimates (Table 11). The estimated efficiency of the helicopter survey compared favorably with those made by Mackie et al. (1978, 1979) for the Armstrong winter range despite dramatic differences in the terrain and counting conditions between the two areas.

Average early and late winter mule deer densities were 23 and 16/km², respectively (see Appendix, Table 26) for the total Brackett Creek winter range. These densities were lower than those reported for other Bridger Mountain winter ranges (Steerey 1979). Average densities of mule deer on the primary use area, 62/km², were comparable to those for the Schafer Creek winter range during the severe 1977-78 winter (Steerey 1979) and probably exceeded them in local areas with heavy cover. During summer, the density of mule deer within the Brackett Creek herd range was about 12/km².

Radio-collared deer produced a ratio of at least 150 fawns per 100 does. Fawn production by all does was probably somewhat less. The maximum observed ratio of 118 fawns per 100 does was recorded

during November classifications (Table 12), after some summer-fall mortality had occurred. Some of the difference between fawn:doe ratios recorded for radio-collared does and for all does was due to differences in the age structures of these two groups. All radio-collared deer were prime adults ($2\frac{1}{2}$ to $7\frac{1}{2}$) while the population as a whole contained a higher proportion of non-producing yearling and first breeders. Prime-adults were considered the most productive herd segment (Robinette 1957). Mackie et al. (1978) reported in-utero production of only 100 fawns:100 yearling does in the Bridger Mountains.

The 1978-79 winter was unusually severe (Mackie et al. 1979). Approximately 30 percent of all deer, 10 percent of all adults and 58 percent of all fawns, which occurred on Brackett Creek in early winter died before mid-March. The total winter-spring mortality was even higher. Seven (5%) of 138 fawns and five (10%) of 49 adults found dead on the winter range died after mid-March. More may have died after field studies ceased in late-March. Significant late winter fawn mortality, amounting to about 20 percent of the total on the Armstrong winter range occurred between mid-March and May (Mackie et al. 1979).

Mortality among mule deer in the Bridger Mountains during the 1978-79 winter was the highest recorded since 1974-75, when total mortality of 30-35 percent, including about 22 percent of adults and

85-90 percent of all fawns, was recorded on the Armstrong winter range (Mackie et al. 1979). Very little winter mortality was recorded on that area during 1975-76 and 1976-77, but moderate mortality of both adults (10-20%) and fawns (45-47%) occurred in 1977-78 (Mackie et al. 1978). Similar trends may have prevailed on the Brackett Creek winter range, though this cannot be ascertained from available data.

Female fawns may have died earlier in the winter than male fawns. Eighty-five percent of the fawn carcasses collected during January were those of males. Sex and age classifications suggested that substantial fawn mortality had occurred by this time. That and the fact that 58 percent of all fawn carcasses collected during the winter were of females suggested a preponderance of male fawns in the population at that time. A similar trend was noted among mule deer on the Armstrong winter range (Mackie et al. 1979), although the period of greatest mortality occurred two months later than on the Brackett Creek study area. Robinette (1957) suggested that female fawns may starve before male fawns in severe winters.

Proximal causes of death among deer whose carcasses were located varied widely. Domestic dogs were the proximal cause of death for 11 of 201 (6%) deer carcasses examined. The method of attack varied with animals being hamstrung, having the side torn out or having the neck broken. Carcasses never incurred more than

partial consumption. Brazda (1957) reported that the most common method of attack involved hamstringing the deer. Much dog related deer mortality has been credited to packs of free roaming dogs from cities or subdivisions (Colorado Div. Wildl. 1973). However, that which occurred on Brackett Creek was believed due to local ranch dogs.

The Brackett Creek mule deer herd was comprised primarily of young and middle prime aged animals. An age structure dominated by young animals is expected in a rapidly increasing population. Young males, one and two point bucks, comprised 75 percent (34 and 41%, respectively) of the adult males classified during the early winter classification survey. The oldest buck handled during this study was $8\frac{1}{2}$ years old while the oldest doe was $10\frac{1}{2}$. This suggested longevities similar to mule deer on the Armstrong range (Mackie et al. 1978). Other data, however, suggested that individuals may only rarely attain these ages.

Winter mortality usually follows a certain sequence: fawns then very old animals and finally prime aged deer die (Mackie et al. 1976). Adult mortality on Brackett Creek during 1978-79 (Table 14) was comprised mainly of "prime-aged" animals, rather evenly distributed among year classes. The absence of old and very old deer in both carcass and trap samples probably implied a scarcity of those animals in the population. Old and very old animals, especially females, have comprised substantial proportions of mule deer populations on the

Armstrong winter range during recent years (Mackie et al. 1978, 1979).

Limited data concerning in-utero productivity during 1978-79 indicated a ratio of 1.2 fetuses per producing doe. This was less than the 1.44 fetuses per producing doe recorded for the Bridger Mountains generally (Mackie et al. 1978) and for deer on a poor winter range in Utah (Julander 1961). The recorded pregnancy rate, 83 percent, also was lower than the "normal" rate of about 89 percent reported for mule deer (Robinette 1955).

The index of association of a known fawn:doe pair was 0.65 during summer. Indices of three other suspected close associations ranged between 0.44 and 0.63. Youmans (1979) reported similar findings on the Armstrong winter range, while Steerey (1979) reported much closer associations among certain mule deer on the Schafer Creek winter range. Indices of association based on ground observations only were usually greater than those for ground and aerial combined. Longer periods of observation from the ground as compared with aerial relocations probably accounted for this difference.

APPENDIX

Table 17. Vegetational and physiographic characteristics of cover types present on the Brackett Creek study area.

Cover Type	# Sites	Slope (deg)	Aspect ¹	Elev. (m)	Major Species Present			
					Grasses	Forbs	Shrubs	Trees
Agsp, Chvi ² Orhy	8	0-20	SE,SW,NW	1524- 1829	Agsp, Orhy Koma, Stco	Chvi, Arfr Luar, Arho	Artr, Oppo Rosa, Prvi	Pifl
Rhtr, Agsp Pifl, Jusc	18	10-40	SE	1524- 1829	Agsp, Koma Orhy, Brte	Meof, Alal Acmi, Asag	Jusc, Rhtr Artr, Oppo	Pifl
Posa, Arfr Koma	2	0- 5	Level-NW	1524- 1601	Posa, Koma Stco	Arfr, Chvi Acmi	Artr, Jusc Chna	
Agsp, Feid	12	0-20	NW, (W)	1524- 1829	Feid, Agsp Koma, Stco	Chvi, Luar Asag, Arfr	Artr, Oppo	Pifl
Agsp, Artr Putr	3	5-30	Var S	1524- 1829	Agsp, Posa Koma	Meof	Putr, Artr	
Artr, Agsp	9	10-40	SE, (NE)	1524- 1753	Agsp, Popr Phpr, Agda	Basa, Trdu Asdr, Meof	Artr, Amal Jusc, Syal	Psme
Artr, Feid Agsp	9	10-30	NE,NW	1524- 1829	Agsp, Feid Koma, Stco	Luar, Anro Asag, Coum	Artr, Amal Jusc	Pifl
Feid, Agsp	15	10-40	NE,N,NW	1524- 1982	Feid, Agsp Koma, Stco	Luar, Anro Chvi, Asag	Artri, Rowo Teca, Prvi	Pifl Psme
Agsp, Psme Basa	6	20-30	S,SE	1753- 1982	Agsp, Feid Popr	Basa, Trdu Anro, Acmi	Artr, Syal Jusc	Psme
Jusc, Pifl Artr	3	10-30	SW	1524- 1829	Feid, Agsp Koma	Basa, Heun Acmi	Artr, Jusc Ribes, Oppo	Psme Pifl
Anro, Feid	9	5-30	E,SE,SW	1829- 2134	Agsp, Feid Cage, Popr	Basa, Anro Lofa, Arlu	Artr, Amal	Psme
Arlu, Feid	3	5-20	S,SW	2210- 2287	Brca, Feid Stoc, Agca	Arlu, Lofa	No dom.	Psme

Table 17. (continued)

Cover Type	# Sites	Slope (deg)	Aspect	Elev. (m)	Major Species Present			
					Grasses	Forbs	Shrubs	Trees
Feid, Carex Luar	4	5-20	SW, (N,E)	2210- 2363	Feid, Brca Cage, Koma	Acmi	Various	Psme
Artr, Agda Agsp	3	5-30	SE, (NW)	1524- 1601	Agsp, Agda Koma, Brte	Chvi, Luar Alal	Artr, Oppo Jusc	
Artr, Feid Popr	17	0-30	NE, N, NW (SE)	1524- 1829	Feid, Koma Popr, Agsp	Acmi, Luar Anro, Arco	Artr, Amal Jusc, Rowo	Psme
Artr, Popr Phpr	18	5-30	SE, (SW, NW, E)	1524- 1905	Popr, Phpr Feid, Brca	Luar, Arlu Gevi, Trdu	Artr, Jusc Ribes, Rowo	Psme
Popr, Feid Luar	7	0-20	NW (Var S)	1677- 2134	Popr, Feid Phpr, Agsp	Luar, Cyof Arlu	Artr, Rosa Spp.	Pifl
Popr, Phpr Gevi	21	5-20	Var N, (S)	1372- 2287	Popr, Phpr Brca	Gevi, Cyof Ciar, Arlu	Syal, Rowo Artr, Ribes	Psme
Feid, Brca Gevi	13	5-20	E, (N,S)	1982- 2210	Feid, Carex Spp.	Gevi, Acmi Anro, Coli	Juco, Artr	Pico Psme
Popr, Phpr Symph spp.	13	5-40	Var N (S, SE)	1524- 1905	Popr, Phpr Brca, Elci	Gevi, Mofi Deoc	Syal, Artr Rowo, Prvi	Psme
Abla, Alnus	4	10-30	N, NE, E	1982- 2363	Caru, Cage	Arco-2, Asco Pych, Thve	Vagl, Spbe Rupa, Vasc	Pico Abla
Abla, Vagl	8	0-30	NE, N, NW	1829- 2287	Caru, Cage Elca, Brca	Arco-2, Thve Pych	Vagl, Vasc Spbe	Abla Psme Pico
Potr, Salix	3	0-30	NE, SE	1524- 1905	Popr, Phpr	Cyof	Syal, Potr Ribes spp.	
Picea, Phma	2	10-40	N	1753- 1829	Caru	Thve, Clps	Syal, Phma Spbe	Psme Picea

Table 17. (continued)

Cover Type	# Sites	Slope (deg)	Aspect	Elev. (m)	Major Species Present			
					Grasses	Forbs	Shrubs	Trees
Abla, Caru	7	0-30	NE,N,NW W,SW	1905- 2210	Elca, Brca Caru	Thve, Asco Luar	Syal, Rowo Juco, Samb.	Abla Psme
Psme, Jusc Prvi	1	0-5	Level	1524- 1601	Elca, Cage Brca	Ciar, Asch Pega	Syal, Spbe	Psme Abla
Abla, Cage Psme	1	10-20	S	2134- 2210	Elci, Popr Phpr	Smra, Gatr Arlu, Canu	Jusc, Acgl Syac	Psme
Abla, Vasc Caru	2	10-30	NW	2210- 2363	Caru, Cage Brca	Thve, Arco Osch	Vasc, Vagl Bere	Psme Pico Abla
Psme, Syal Agsp	11	5-40	SE,S,SW (NE,NW)	1524- 1982	Agsp, Popr Phpr, Brca	Basa, Acmi Heun, Trdu	Syal, Jusc Artr	Psme
Psme, Phma	7	10-40	NW,NE,N (SE,W)	1677- 2058	Popr, Phpr Caru, Elca	Asco, Thve Smra, Frvi	Rowo, Phma Syal, Spbe	Psme
Psme, Feid	11	5-40	NE,N,NW (SE)	1524- 1982	Feid, Popr Phpr, Agsp	Arco-2, Taof Frvi, Luar	Jusc, Artr Ribes, Rowo	Psme
Psme, Cage	3	5-20	NE,W (SW)	2134 2287	Cage, Mesp Caru	Thve, Arco-2 Pych, Anra	Bere, Vagl Syal	Psme Pico
Psme, Caru Caru	6	5-20	N,NW (E)	1982- 2287	Caru, Cage Agca, Brca	Lupine spp. Gevi, Basa	Spbe, Syal Bere, Rowo	Psme
Psme, Syal	23	0-40	N,NW	1601- 1982	Popr, Phpr Brca, Cage	Gevi, Thve Gabo, Heun	Syal, Spbe Rowo, Ribes	Psme
Psme, Vagl	11	0-30	NE,N,NW (W)	1829- 2363	Caru, Bromus spp. Fesu	Thve, Arco-2 Clps, Anro	Vagl, Spbe Bere	Psme Pico

Table 17. (continued)

Cover Type	# Sites	Slope (deg)	Aspect	Elev. (m)	Major Species Present			
					Grasses	Forbs	Shrubs	Trees
Psme, Syal Caru	30	0-40	E,NE,N (NW)	1677- 2287	Caru, Phpr Cage, Elca	Thve, Frvi Asco, Arco-2	Syal, Spbe Bere, Rowo	Psme
Popr, Phpr Meci	7	0-10	E,NE (W,NW)	1524- 1905	Popr, Phpr Carex spp.	Geri, Gevi Taof, Meci	Salix, Alin Syal, Ribes spp.	
Crsu, Amal	4	10-40	NE,E (SE)	1677- 1829	Popr, Elca Brca, Phpr	Cyof, Pega Circium spp.	Crategus Syal, Rowo, Amal	Psme

¹Usual aspects (other aspects).²See Appendix, Table 18 for key to four letter plant species names.

Table 18. Key to four letter plant species names used in Tables 1 and 17.

Abla	<i>Abies lasiocarpa</i>
Acmi	<i>Achillea millefolium</i>
Agca	<i>Agropyron caninum</i>
Agda	<i>A. dasystachyum</i>
Agsp	<i>A. spicatum</i>
Alin	<i>Alnus incana</i>
Alal	<i>Alyssum alyssoides</i>
Amal	<i>Amelanchier alnifolia</i>
Anra	<i>Antennaria racemosa</i>
Anro	<i>A. rosea</i>
Arco	<i>Arenaria congesta</i>
Arho	<i>A. hookeri</i>
Arco-2	<i>Arnica cordifolia</i>
Arfr	<i>Artemisia frgida</i>
Arlu	<i>A. ludoviciana</i>
Artr	<i>A. tridentata</i>
Asch	<i>Aster chilensis</i>
Asco	<i>A. conspicuous</i>
Aster	<i>Aster spp.</i>
Asag	<i>Astragulus agrestis</i>
Asdr	<i>A. drummondii</i>
Astra	<i>Astragulus spp.</i>
Basa	<i>Balsamorhiza sagittata</i>
Brca	<i>Bromus carinatus</i>
Brin	<i>B. inermis</i>
Brte	<i>B. tectorum</i>
Caru	<i>Calamagrostis rubescens</i>
Canu	<i>Carduus nutans</i>
Cage	<i>Carex geyeri</i>
Carex	<i>Carex spp.</i>
Chvi	<i>Chrysopsis villosa</i>
Chna	<i>Chrysothamnus nauseosus</i>
Ciar	<i>Cirsium arvense</i>
Cirsi	<i>Cirsium spp.</i>
Clps	<i>Clematis pseudoalpina</i>
Coli	<i>Collomia linearis</i>
Coum	<i>Commandra umbellata</i>
Cost	<i>Cornus stolonifera</i>
Crata	<i>Crataegus spp.</i>
Crsu	<i>Crataegus succelenta</i>
Cvof	<i>Cynoglossum officinale</i>

Table 18. (Continued)

Dagl	<i>Dactylis glomerata</i>
Deoc	<i>Delphinium occidentale</i>
Elca	<i>Elymus canadensis</i>
Elci	<i>E. cinereus</i>
Feid	<i>Festuca idahoensis</i>
Fesu	<i>F. subulata</i>
Frvi	<i>Frageria virginiana</i>
Gabo	<i>Galium boreale</i>
Gatr	<i>G. triflorum</i>
Geri	<i>Geranium richardsonii</i>
Gevi	<i>G. vicosissimum</i>
Heun	<i>Helianthella uniflora</i>
Hovu	<i>Hordeum vulgare</i>
Juco	<i>Juniperus communis</i>
Jusc	<i>J. scopulorum</i>
Koma	<i>Koeleria macrantha</i>
Lofa	<i>Lomatium farinosum</i>
Luar	<i>Lupinus argenteus</i>
Lupin	<i>Lupin</i> spp.
Mesa	<i>Medicago sativa</i>
Mesp	<i>Melica spectabilis</i>
Meof	<i>Melilotus officinalis</i>
Meci	<i>Mertensia ciliata</i>
Mofi	<i>Monarda fistulosa</i>
Oppo	<i>Opuntia polycantha</i>
Orhy	<i>Oryzopsis hymenoides</i>
Osch	<i>Osmorhiza chilensis</i>
Pega	<i>Perideridia gardneri</i>
Phpr	<i>Phleum pratense</i>
Phma	<i>Physocarpus malveceus</i>
Picea	<i>Picea</i> spp.
Pico	<i>Pinus contorta</i>
Pifl	<i>P. flexilis</i>
Popr	<i>Poa pratensis</i>
Posa	<i>P. sandbergii</i>
Potr	<i>Populus tremuloides</i>
Prvi	<i>Prunus virginiana</i>
Psme	<i>Pseudotsuga menziesii</i>
Putr	<i>Purshia tridentata</i>
Pych	<i>Pyrolla chlorantha</i>
Rhtr	<i>Rhus trilobata</i>
Ribes	<i>Ribes</i> spp.

Table 18. (Continued)

Rowo	Rosa woodsii
Rosa	Rosa spp.
Salix	Salix spp.
Sambu	Sambucus spp.
Senec	Senecio spp.
Smra	Smilacena racemosa
Spbe	Spiraea betulifolia
Stco	Stipa comata
Stoc	Stipa occidentalis
Syal	Symphoricarpos albus
Symph	Smyphoricarpos spp.
Toaf	Taraxacum officinale
Teca	Tetradymia canescens
Thve	Thalictrum venulosum
Trdu	Tragopogon dubius
Trae	Triticum aestivum
Vagl	Vaccinium globulare
Vasc	V. scoparium

Table 19. Sex and age description and status of 114 mule deer marked on the Brackett Creek winter range during 1978 and 1979.

Deer #	Date of Capture	Sex	Age	Marking	Trap type & Location	Status
0018	27 Mar 78	F	5½	Neckband	C.N. 2	OK
0028	"	F	3½	Radio 4-9.0	C.N. 2	OK
0038	"	F	6	Radio 4-10.05	C.N. 2	OK
0048	"	M	½	Neckband	C.N. 2	OK
0058	"	F	4½	Radio 4-7.5	C.N. 1	OK
0068	"	M	½	Neckband	C.N. 1	Dead (5-5-79)
0078	"	M	½	Neckband	C.N. 1	Dead (4-78)
0088	29 Mar 78	F	5½	Radio 2-6.25	C.N. 2	OK
0098	"	F	½	Neckband	C.N. 2	?
0108	21 Mar 78	F	5½	Neckband	C.N. 3	OK
0118	"	F	½	Neckband	C.N. 3	Dead (5-26-78)
0128	"	F	4½	Radio 2-9.2	C.N. 3	Dead (4-78)
0138	"	M	½	Neckband	C.N. 3	OK
0148	"	F	6½	Radio 2-10.2	C.N. 3	OK
0158	"	F	Ad	Radio 2-11.2	C.N. 3	OK
0168	"	M	½	Neckband	C.N. 3	OK
0178	5 Apr 78	F	6+	Radio 4-11.2	C.N. 3	Dead (11-22-78)
0188	7 Apr 78	M	½	Neckband	C.N. 3	?
0198	"	F	6½	Neckband	C.N. 3	OK
0208	"	F	5½	Neckband	C.N. 3	OK
0218	9 Apr 78	M	½	Neckband	C.N. 4	OK
0228	"	F	6½	Radio 4-12.3	C.N. 4	OK
0238	"	F	4½	Radio 2-12.25	C.N. 4	OK
0248	10 Apr 78	M	½	Neckband	C.N. 5	OK
0258	"	M	½	Neckband	C.N. 4	Dead (5-26-78)
0268	15 Mar 78	F	4½	Radio 4-8.3	C.N. 5	OK
0278	"	M	½	Neckband	C.N. 5	?
0288	"	M	½	Neckband	C.N. 5	OK
0298	"	M	6½	Neckband	C.N. 5	OK
0308	"	F	Ad	Neckband	C.N. 5	OK
0318	"	F	2½	Radio 2-2.4	C.N. 5	OK
0328	13 Jul 78	F	½	Ear flags	--	OK
0338	"	M	½	Ear flags	--	Dead (9-78)
0019	7 Mar 79	F	6½	Neckband	Helic Dr Net 1	OK
0029	"	M	1½	Radio 3-11.2	"	OK
0039	"	F	7½	Neckband	"	OK
0049	"	F	6½	Neckband	"	OK

Table 19. (Continued)

Deer #	Date of Capture	Sex	Age	Marking	Trap type & Location	Status
0059	"	F	4½	Neckband	"	OK
0069	"	F	8+	Neckband	"	OK
0079	"	F	4½	Neckband	"	OK
0089	"	F	1½	Neckband	"	?
0099	"	F	1½	Neckband	"	OK
0109	"	F	2½	Neckband	"	OK
0119	"	F	4½	Neckband	"	OK
0129	"	F	3½	Neckband	"	?
0139	"	F	4½	Neckband	"	OK
0149	"	F	6½	Neckband	"	OK
0159	"	F	5½	Neckband	"	OK
0169	"	F	5½	Neckband	"	OK
0179*	"	F	5½	Radio 2-9.3	"	OK
0189	"	F	5½	Neckband	"	OK
0199	7 Mar 79	F	1½	Neckband	Helic Dr Net 1	OK
0209	"	F	½	Neckband	"	OK
0219	"	M	6½	Neckband	"	OK
0229	"	F	2½	Neckband	"	OK
0239	"	F	1½	Neckband	"	OK
0249	"	F	6½	Neckband	Helic Dr Net 2	OK
0259	"	F	1½	Neckband	"	OK
0269	"	F	1½	Neckband	"	OK
0279	"	F	9+	Neckband	"	Dead (Spring '79)
0289	"	F	3½	Neckband	"	OK
0299	"	F	1½	Neckband	"	OK
0309	"	F	3½	Neckband	"	?
0319	"	F	3½	Neckband	"	OK
0329	"	F	½	Neckband	"	?
0339	"	F	3½	Neckband	"	OK
0349	"	F	1½	Neckband	"	OK
0359	"	M	1½	Neckband	"	OK
0369	"	F	6½	Radio 4-4.2	"	OK
0379	"	F	7½	Neckband	"	OK
0389	"	F	6½	Neckband	"	?
0399	"	F	6½	Neckband	"	?
0409	"	F	½	Neckband	"	OK
0419	"	F	Ad	Neckband	"	OK
0429	"	F	7½	Neckband	"	OK

Table 19. (Continued)

Deer #	Date of Capture	Sex	Age	Marking	Trap type & Location	Status
0439	"	M	1½	Neckband	"	OK
0449	"	F	1½	Neckband	"	OK
0459	8 Mar 79	F	6½	Neckband	Helic Dr Net 3	OK
0469	"	F	6½	Neckband	"	OK
0479	"	F	½	Neckband	"	?
0489	"	F	1½	Neckband	"	OK
0499	"	F	6½	Neckband	"	OK
0509	"	F	1½	Neckband	"	OK
0519	"	F	2½	Neckband	"	?
0529	"	F	2½	Neckband	"	OK
0539	"	F	1½	Neckband	"	OK
0549	"	F	3½	Radio 4-5.2	"	OK
0559	"	F	3½	Neckband	"	OK
0569	"	F	4½	Neckband	"	OK
0579	"	F	4½	Neckband	"	OK
0589	"	M	½	Neckband	"	OK
0599	"	M	3½	Radio 4-2.2	"	OK
0609	"	F	4½	Radio 4-6.2	"	OK
0619	"	F	7½	Neckband	"	OK
0629**	"	F	7½	Neckband	"	OK
0639	"	F	8½	Neckband	"	?
0649	"	F	2½	Neckband	Helic Dr Net 4	?
0659	"	F	6½	Neckband	"	OK
0669	"	F	4½	Neckband	"	?
0679	"	F	1½	Neckband	"	OK
0689	"	F	1½	Neckband	"	?
0699	"	F	8½	Neckband	"	OK
0709	"	F	2½	Neckband	"	OK
0719	"	F	6½	Neckband	"	OK
0729	8 Mar 79	F	6½	Neckband	Helic Dr Net 4	?
0739	"	M	1½	Neckband	"	?
0749	"	F	7½	Neckband	"	?
0759	"	F	4½	Neckband	"	?
0769	"	F	3½	Neckband	"	OK
0779	"	F	5½	Neckband	"	OK
0789	"	F	½	Neckband	"	OK

Table 19. (Continued)

Deer #	Date of Capture	Sex	Age	Marking	Trap type & Location	Status
0799	"	F	3½	Radio 3-12.25	"	OK
0809	"	F	6½	Neckband	"	OK
0819	"	F	4½	Neckband	"	OK

* Recapture of deer 0238 to replace malfunctioning radio

** Antlered doe

Table 20. Maximum, minimum and average distances (km) between aerial relocations for radio-collared mule deer does on the Brackett Creek study area.

Deer No.	Summer 1978			Winter 1978-79		
	Maximum	Mean	Minimum	Maximum	Mean	Minimum
2038	1.58	0.50	0.05	10.35	0.68	0.05
2068	0.93	0.50	0.10	5.94	1.86	0.30
2118	2.33	0.49	0.00	2.37	1.27	0.49
2128	0.65	0.37	0.00	4.50	1.11	0.05
4088				7.18	1.72	0.00
4108	1.27	0.49	0.11	5.68	1.39	0.05
4118	1.71 ¹	0.67	0.00	--	--	--
4128	1.91	0.86	0.07	3.15	1.37	0.34
4018	1.26	0.46	0.05	-- ²	--	--

¹Deer died on summer range.

²Deer returned to Schafer Creek winter range, therefore no data.

Table 21. Daily polygon home range size (km²), standard diameters (km), average activity radius (km) and minimum, maximum and average distance between relocations of marked mule deer, 1978-79.

Date	Deer #	HR*	SD*	AAR*	MAX	MIN	$\bar{X}$ Dis
6-22	2108	0.11	1.16	0.51	1.35	0.05	0.50
9-16	2118	0.02	0.33	0.15	0.28	0.06	0.14
11-3	2038	0.07	0.37	0.17	0.43	0.10	0.25
	$\bar{X}$	0.067	0.62	0.277			
11-21	2118	0.00	0.16	0.07	0.17	0.00	0.08
11-30	2118	0.08	0.57	0.25	0.67	0.00	0.28
12-12	2038	0.04	0.49	0.25	0.52	0.46	0.50
12-20	4088	0.04	0.35	0.14	0.44	0.05	0.17
12-26	2128	0.04	0.63	0.25	0.59	0.00	0.18
1-9	4088	0.02	0.44	0.21	0.49	0.00	0.24
1-10	4088	0.00	0.20	0.09	0.21	0.00	0.11
1-17	4098	0.24	0.73	0.30	0.55	0.23	0.44
1-22	2118	0.01	0.19	0.08	0.24	0.07	0.15
1-23	2128	0.78	1.29	0.49	1.94	0.00	0.42
1-24	2128	0.37	1.02	0.47	1.29	0.00	0.66
1-28	4088	0.07	0.71	0.34	0.56	0.00	0.20
1-28	4128	0.03	0.65	0.25	0.65	0.11	0.29
1-29	4088	0.15	0.63	0.30	0.51	0.00	0.21
2-4	2068	0.03	0.24	0.11	0.25	0.00	0.14
2-4	4098	0.07	0.50	0.20	0.80	0.06	0.25
2-5	2068	0.03	0.35	0.17	0.26	0.04	0.15
2-5	4098	0.01	0.77	0.37	0.88	0.00	0.39
	$\bar{X}$	0.112	0.551	0.241	0.55		
	S	0.1918	0.2967	0.1240			
2-11	2038	0.19	0.77	0.37	0.61	0.06	0.33
2-11	4108	0.20	0.73	0.33	0.92	0.17	0.54
2-12	2038	0.15	0.62	0.28	0.57	0.14	0.28
2-12	4108	0.50	1.25	0.54	1.24	0.10	0.42
2-14	2118	0.28	0.72	0.30	0.65	0.24	0.38
2-17	2118	0.39	1.14	0.53	1.32	0.00	0.61
2-17	4128	0.04	0.36	0.16	0.26	0.00	0.12
2-18	2118	0.05	0.34	0.16	0.29	0.00	0.29
2-18	4128	0.10	0.60	0.28	0.54	0.00	0.24
2-18	0208,0918	0.10	0.85	0.35	0.73	0.09	0.32

Table 21. (Continued)

Date	Deer #	HR*	SD*	AAR*	MAX	MIN	$\bar{X}$ Dis
2-25	2128	0.21	0.51	0.24	0.49	0.00	0.23
2-25	4088	0.25	0.57	0.27	0.52	0.00	0.21
2-26	2128	0.12	0.52	0.21	0.67	0.00	0.23
2-26	4088	0.19	0.61	0.24	0.50	0.04	0.21
2-26	2108	0.02	0.38	0.18	0.30	0.00	0.13
2-27	4098	0.83	2.13	1.04	2.24	0.04	0.65
2-28	4098	1.18	1.25	0.54	0.87	0.02	0.38
2-13	4108	0.04	0.65	0.29	0.74	0.00	0.28
3-14	4108	0.32	1.34	0.49	2.02	0.04	0.72
3-19	2038	0.07	0.47	0.19	0.54	0.00	0.13
3-20	2038	0.11	0.51	0.24	0.57	0.00	0.17
3-22	4028	0.04	0.47	0.22	0.53	0.40	0.47
3-23	4028	0.00	0.31	0.15	0.33	0.00	0.16
	$\bar{X}$	0.234	0.551	0.330	0.70		
	S	0.2785	0.4260	0.1970			
	All $\bar{X}$	0.180	0.66	0.29			
	S	0.2491	0.3828	0.1729			

*HR=Polygon Home Range, SD=Standard Diameters, AAR=Average Activity Radius

Table 22. Polygon home range sizes (km²), standard diameters (km) and average activity radii (km) for deer followed for two-day periods, during 1979.

Date	Deer #	HR*	SD*	AAR*
1-9 to 10	4088	0.07	0.52	0.25
1-16 to 17	2068	0.03	0.28	0.25
1-16 to 17	4098	0.30	0.79	0.33
1-23 to 24	2128	1.51	1.29	0.53
1-28 to 29	4088	0.75	1.05	0.50
1-28 to 29	4128	0.24	0.76	0.34
2-4 to 6	2068	0.07	0.32	0.15
2-4 to 5	4098	0.30	0.68	0.30
$\bar{X}$				0.3325
S				0.1284
2-11 to 12	2038	0.43	0.68	0.31
2-11 to 12	4108	0.82	1.09	0.48
2-17 to 18	2118	0.58	1.09	0.49
2-17 to 18	4128	0.46	1.00	0.41
2-25 to 26	2128	0.38	0.54	0.23
2-25 to 26	4088	0.41	0.68	0.31
2-27 to 28	4098	2.51	1.84	0.85
3-13 to 14	4108	1.43	1.43	0.62
3-19 to 20	2038	0.16	0.50	0.23
3-22 to 23	4029	0.08	0.42	0.19
$\bar{X}$				0.412
S				0.2061
All $\bar{X}$		0.59	0.83	0.37
S		0.413	0.17	0.0301

*HR=Polygon Home Range, SD=Standard Diameters, AAR=Average Activity Radius

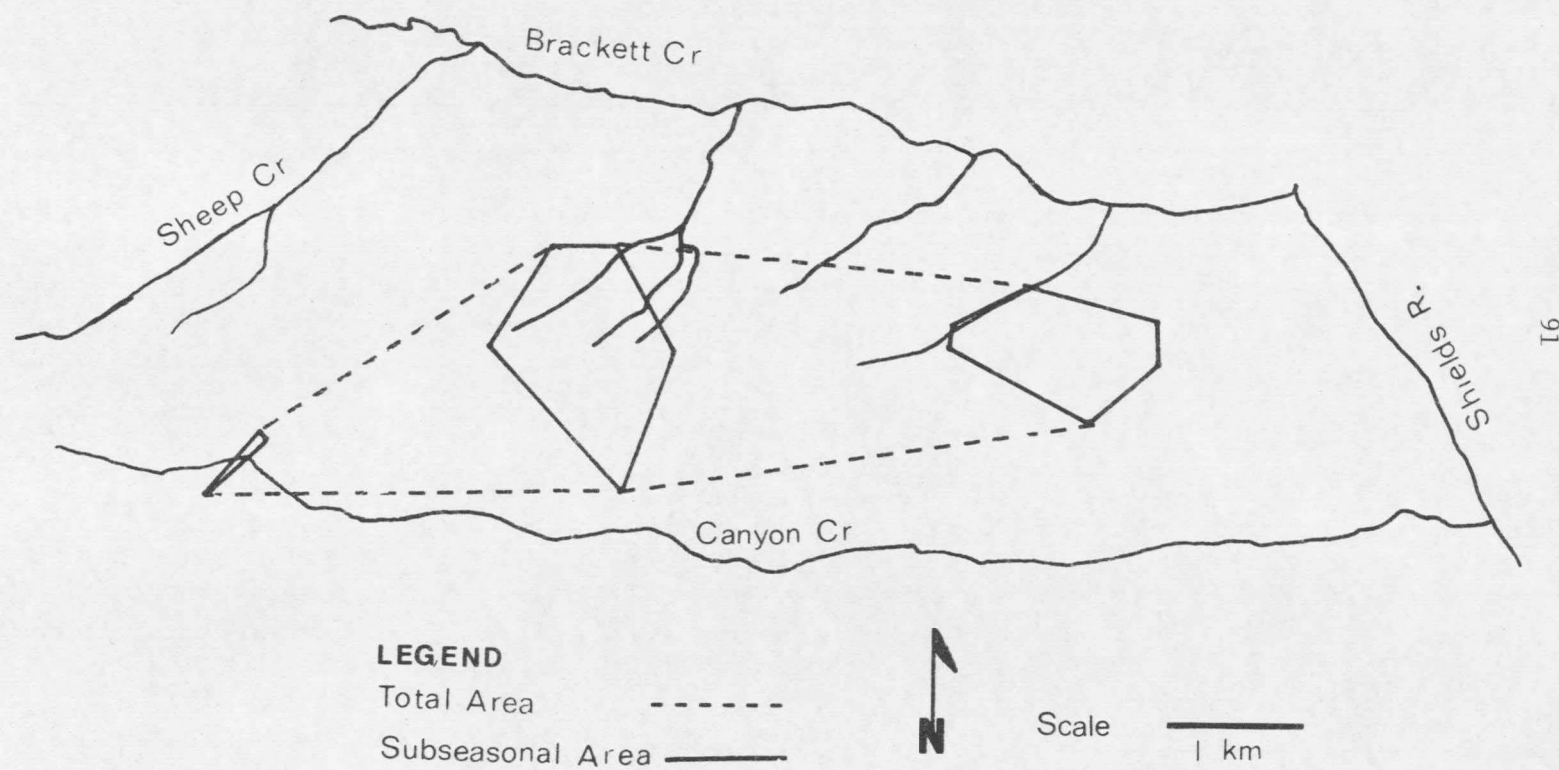
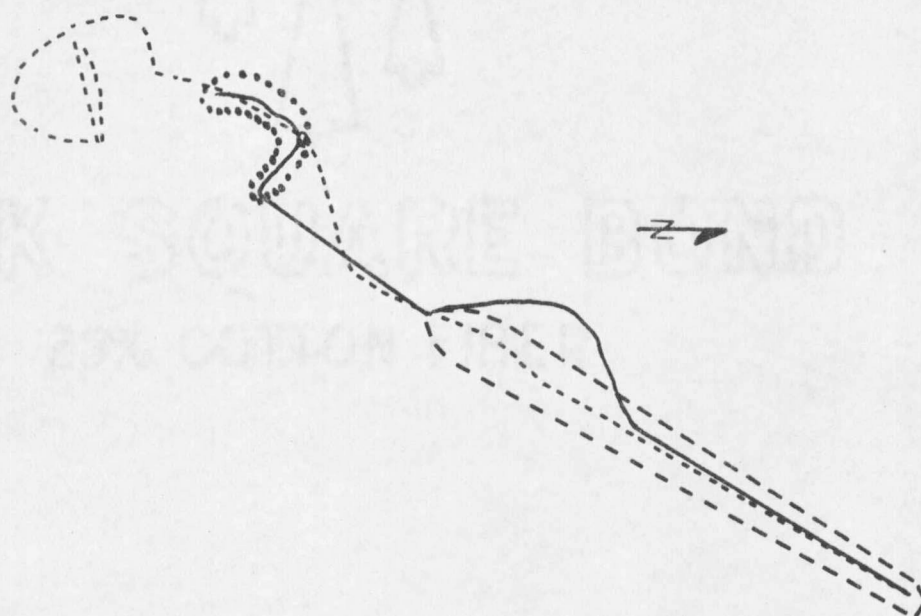


Figure 14. Total winter polygon home range and polygons of subseasonal ranges of mule deer doe 4108 in 1978-79.



LEGEND

Date	Direct Route	Area Used
12-26	—	•••••
1-23	- - -	- - -

Figure 15. The repetitious pattern of habitat use exhibited by radio-collared doe 2128 in early winter 1978-79.

Table 23. Percent by volume of the forage species found in rumen samples obtained from 38 mule deer found dead on the Brackett Creek winter range during 1979, by months. Trace amounts are less than 0.5 percent.

Species	Jan. %	Feb. %	Mar. %	Total %
Grasses				
Agropyron spicatum	0.6	tr	---	tr
Bromus inermis	---	1.3	---	tr
Hordeum vulgare (seeds)	0.6	tr	0.8	0.5
(stems)	11.4	6.0	8.1	8.5
Unidentified	31.6	22.6	20.3	25.3
Total grasses	44.3	30.3	29.2	34.6
Forbs				
Antennaria rosea	---	tr	0.6	tr
Artemisia frigida	---	tr	4.9	1.6
Cirsium arvense	---	tr	tr	tr
Eriogonum spp.	tr	---	tr	tr
Medicago sativa	2.7	6.5	0.7	3.3
Phlox hoodii	0.9	tr	5.4	2.1
Potentilla hippiana	---	tr	---	tr
Senecio serra	---	---	tr	tr
Solidago missouriensis	tr	---	---	tr
Unidentified forb	tr	0.6	tr	tr
Litter	3.0	---	---	1.0
Total forbs	6.8	7.8	12.4	9.0
Browse				
Acer glabrum	tr	---	---	tr
Artemisia tridentata	22.6	29.1	31.0	27.6
Berberis repens	---	---	tr	tr
Betula spp.	---	---	0.8	tr
Cercocarpus ledifolius	tr	---	---	tr
Cornus stolonifera	tr	tr	tr	tr
Juniperus scopulorum	15.6	15.7	9.0	13.4
Pinus flexis	6.3	12.9	tr	6.4
Populus spp.	---	tr	0.8	tr

Table 23. (Continued)

Species	Jan. %	Feb. %	Mar. %	Total %
<i>Prunus virginiana</i>	tr	tr	0.8	tr
<i>Pseudotsuga menziesii</i>	3.3	3.6	0.7	2.5
<i>Rhus trilobata</i>	tr	tr	---	tr
<i>Rosa woodsii</i>	---	---	0.5	tr
<i>Salix</i> spp.	tr	---	8.2	2.7
Unidentified browse	---	---	5.7	1.9
Total browse	48.7	62.0	58.4	56.4

Table 24. The sex and age composition of the Brackett Creek mule deer herd based on early winter (December) helicopter surveys.

Year	Proportion of the Population		
	♀♀	Fawn	♂♂
74-75	0.622	0.308	0.070
75-76	0.736	0.229	0.038
76-77	---	---	---
77-78	0.537	0.389	0.065
78-79	0.519	0.399	0.070

Table 25. Seasonal polygon home range sizes (km²), standard diameters (km) or average activity radii (km) from various studies of radio-collared mule deer in various types of habitats.

Source	Years	Type Habitat ¹	No. (Sex)	Polygon Home Range	Std. Dia.	AAR
<u>SUMMER</u>						
Nyberg '79	78	M.F.	10 (F)	2.94	1.49	0.62
Steerey '79	77	M.F.	9 (F)	0.84	1.02	0.41 ²
			3 (M)	0.78	0.98	0.43
Pac '76	75	M.F.	5 (F)	1.08 (T) ³	--	--
				0.52 (N) ⁴	--	--
Moir '78	74	R.B.	3 (F)	--	--	1.18
	73	R.B.	6 (F)	--	--	1.16
Knowles '75	75	R.B.	1 (F)	3.11	--	--
			2 (M)	6.80	--	--
Hamlin '78	77	R.B.	9 (F)	6.97 ⁵	--	--
	'77 76	R.B.	6 (F)	4.95	--	--
<u>WINTER</u>						
Nyberg '79	78-79	M.F.	7 (F)	12.85	3.31	1.38
Steerey '79	77-78	M.F.	9 (F)	0.58	0.65	0.28 ⁶
	76-77 ⁷	M.F.	9 (F)	1.11	0.67	0.28 ⁶
Youmans '79	77-78	M.F.	10 (F)	0.94	0.93	0.40 ⁶
	76-77	M.F.	7 (F)	1.20	1.33	0.60 ⁶
	77-78	M.F.	1 (M)	1.83	1.42	0.60
	76-77	M.F.	3 (M)	3.56	1.74	0.77
Moir '76	73-74	R.B.	11 (F)	--	--	0.77
Komberec '76	75-76	R.B.	1 (F)	3.05	--	--

¹M.F.=Mountain Foothills, R.B.=River Breaks.

²Mean not significantly different, $P < 0.07$.

³Total home range, nonsignificant difference, $P < 0.14$.

⁴Normal home range (includes area of intensive use only) nonsignificant difference, $P < 0.06$.

⁵Yearlong range for nonmigratory mule deer.

⁶Significant difference, $P < 0.01$.

⁷Data for late winter only.

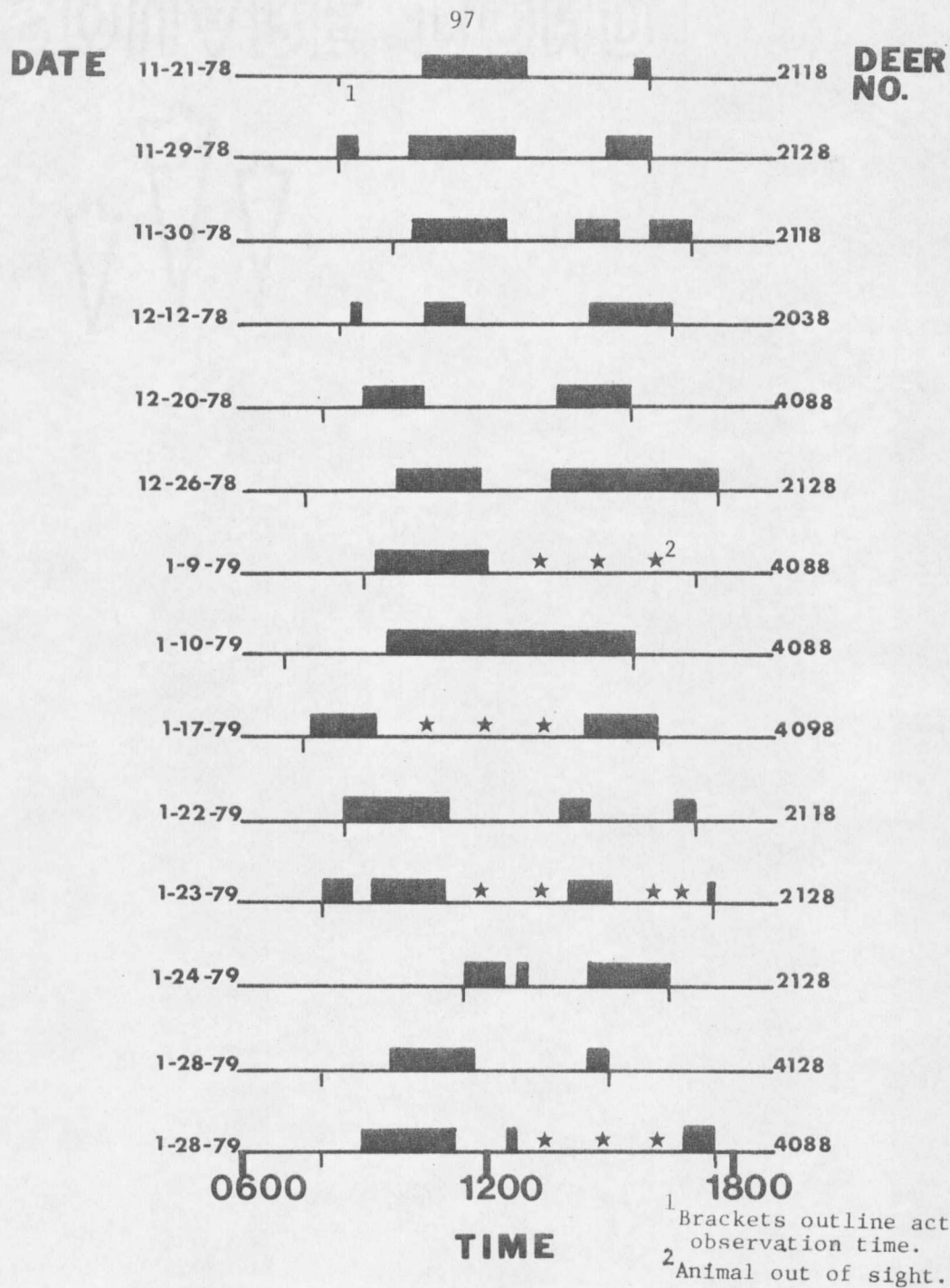


Figure 16. The activity patterns of marked mule deer observed for full day periods on the Brackett Creek winter range during 1978-79.

DATE

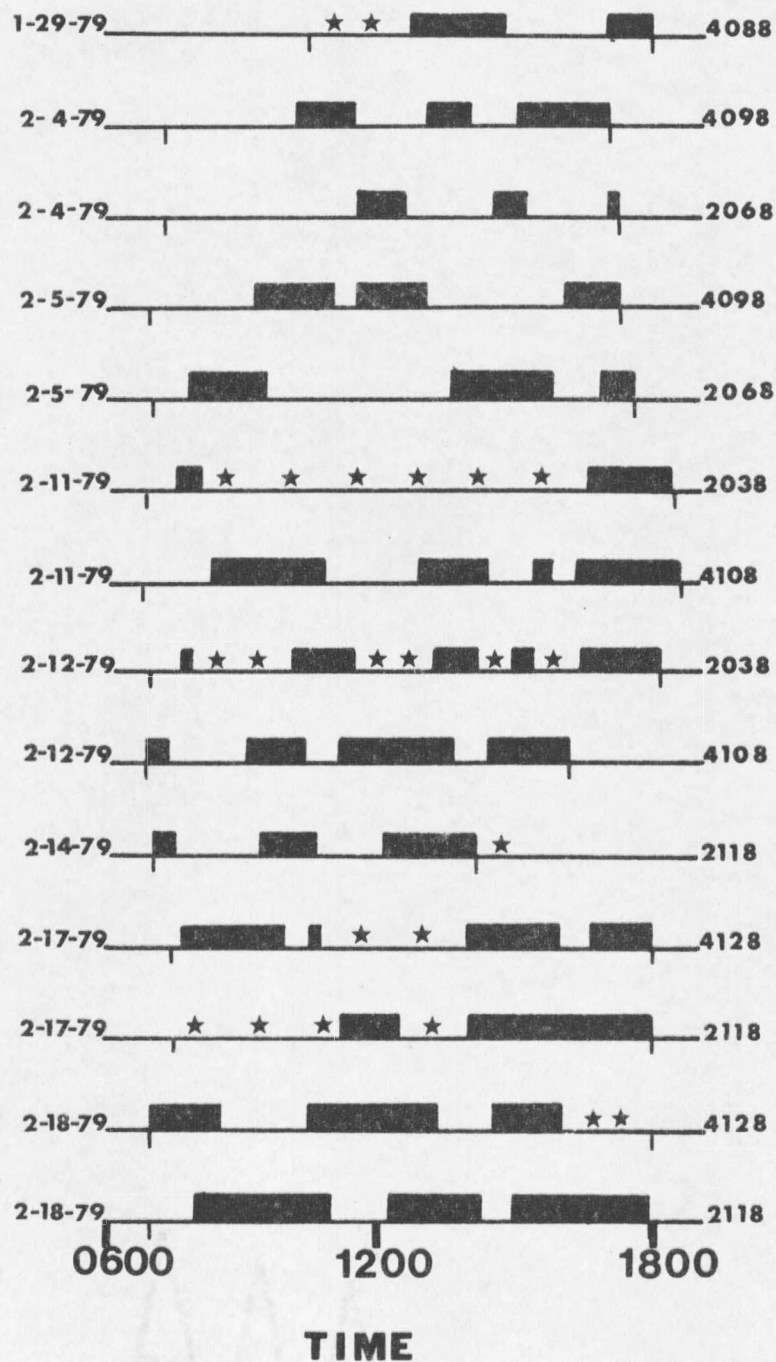
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Figure 16. (continued).

DATE

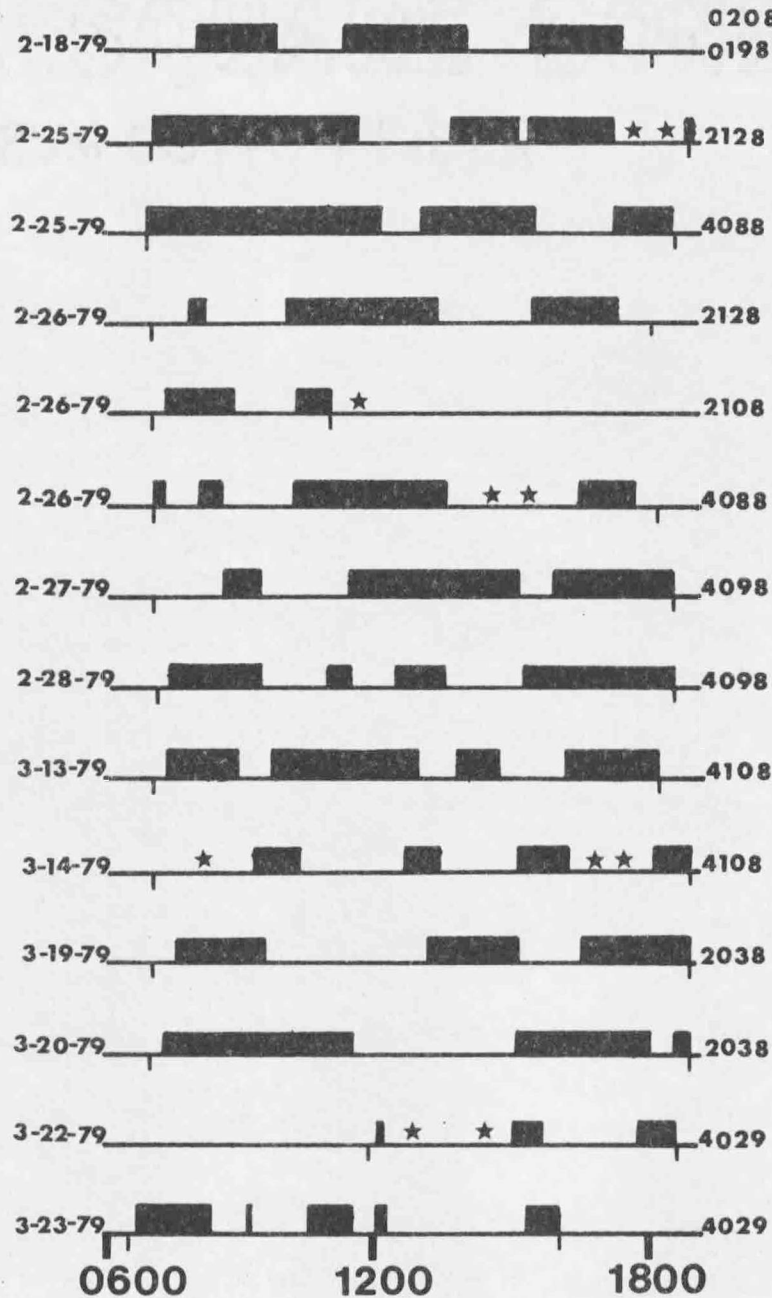
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Figure 16. (continued).

Table 26. The density of mule deer on winter ranges in the Bridger Mountains.

Winter Range	(Years)	Early Winter	Late Winter
Brackett Creek	(1978-79)	22.8	16.0
Schafer Creek ¹	(1977)	29.0	
	(1977-78)	34.0	30.0
Armstrong ¹	(1977)	39.0	
	(1977-78)	43.0	31.0

¹Data from Steerey 1979.

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