



Distribution, range use and population characteristics of mule deer associated with the Schafer Creek winter range, Bridger Mountains, Montana
by William Floyd Steerey

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 in the Bridger Mountains of southwestern Montana from June 1976 through April 1978. Objectives were (1) to obtain data on yearlong distribution, range use and population characteristics of mule deer associated with the Schafer Creek winter range and (2) to compare findings with those of earlier studies of deer associated with the nearby Armstrong winter range. Vegetation of the Schafer Creek study area was described as consisting of 5 habitat series, comprising 18 distinct habitat types. Series were: Idaho fescue with 2 habitat types covering 1.7% of the area; big sagebrush with 2 habitat types covering 2.6% of the area; Douglas fir with 7 habitat types covering 61.9% of the area; subalpine fir with 5 habitat types covering 30.7% of the area and; limber pine with 1 habitat type covering 2.9% of the area. Nine adult females and 3 adult males were radio-collared and monitored from the ground and 53 fixed-wing flights. An additional 17 mule deer were neck-banded. Movement from the winter range by marked animals ranged from 0 to 29 km and averaged 4.8 km. Three holding areas were delineated on two major travel corridors which were used by deer arriving on and departing from the winter range. Associations among adult females appeared to affect summer, fall and winter distributions. Home range size of radio-collared deer was: 111 ha for females and 387 ha for males during the mild winter of 1976-77; 178 ha for females and 152 ha for males summer-early fall and; 58 ha for females during the more severe winter of 1977-78. Three radioed deer summering in heavily forested habitats had significantly smaller home ranges than 8 others of broken timber habitats. Deer appeared to habitually use the same winter and summering areas. Douglas fir habitats were the most important in winter, spring and fall, and ranked second to subalpine fir in summer. Douglas fir/ Idaho fescue was the most used habitat type in winter while subalpine fir/virgin's bower appeared to be the most important summer type. Closed canopy habitats were important during spring and fall migrations. Females with fawns occurred with greater than expected frequencies in certain habitat types (PIFL/JUCO and PSME/FEID) during summer-early fall but not during the 1977-78 winter. Forbs and browse were the most important summer forage classes used while browse, grass and forbs, respectively, were the most important winter forage classes. There was an apparent 10-20% increase in population and an increase in fawn production from the 1976-77 winter to 1977-78. Winter mortality was approximately 17-19% in 1976-77, consisting primarily of fawns, and was estimated at a minimum of 15%, including 34% of all fawns in 1977-78. Noted differences between the Schafer and Armstrong areas were: more Douglas fir and subalpine fir habitats with shrub understories on the Schafer summer area; no bitterbrush and much more Douglas fir/snowberry habitats on the Schafer Creek winter range and; smaller home ranges and generally higher winter survival on the Schafer Creek winter range.

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ASSOCIATED WITH THE SCHAFER CREEK WINTER RANGE,
BRIDGER MOUNTAINS, MONTANA

by

WILLIAM FLOYD STEEREY

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

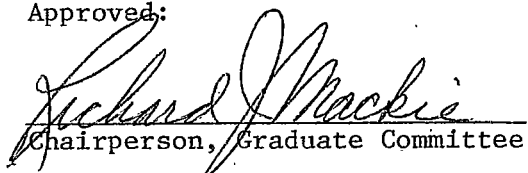
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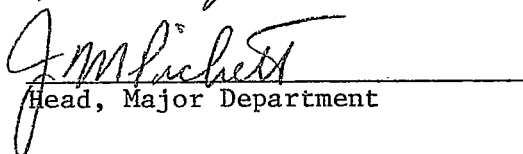
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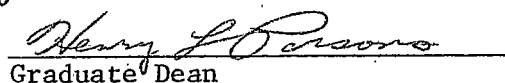
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ABSTRACT

A study was conducted in the Bridger Mountains of southwestern Montana from June 1976 through April 1978. Objectives were (1) to obtain data on yearlong distribution, range use and population characteristics of mule deer associated with the Schafer Creek winter range and (2) to compare findings with those of earlier studies of deer associated with the nearby Armstrong winter range. Vegetation of the Schafer Creek study area was described as consisting of 5 habitat series, comprising 18 distinct habitat types. Series were: Idaho fescue with 2 habitat types covering 1.7% of the area; big sagebrush with 2 habitat types covering 2.6% of the area; Douglas fir with 7 habitat types covering 61.9% of the area; subalpine fir with 5 habitat types covering 30.7% of the area and; limber pine with 1 habitat type covering 2.9% of the area. Nine adult females and 3 adult males were radio-collared and monitored from the ground and 53 fixed-wing flights. An additional 17 mule deer were neck-banded. Movement from the winter range by marked animals ranged from 0 to 29 km and averaged 4.8 km. Three holding areas were delineated on two major travel corridors which were used by deer arriving on and departing from the winter range. Associations among adult females appeared to affect summer, fall and winter distributions. Home range size of radio-collared deer was: 111 ha for females and 387 ha for males during the mild winter of 1976-77; 178 ha for females and 152 ha for males summer-early fall and; 58 ha for females during the more severe winter of 1977-78. Three radioed deer summering in heavily forested habitats had significantly smaller home ranges than 8 others of broken timber habitats. Deer appeared to habitually use the same winter and summering areas. Douglas fir habitats were the most important in winter, spring and fall, and ranked second to subalpine fir in summer. Douglas fir/Idaho fescue was the most used habitat type in winter while subalpine fir/virgin's bower appeared to be the most important summer type. Closed canopy habitats were important during spring and fall migrations. Females with fawns occurred with greater than expected frequencies in certain habitat types (PIFL/JUCO and PSME/FEID) during summer-early fall but not during the 1977-78 winter. Forbs and browse were the most important summer forage classes used while browse, grass and forbs, respectively, were the most important winter forage classes. There was an apparent 10-20% increase in population and an increase in fawn production from the 1976-77 winter to 1977-78. Winter mortality was approximately 17-19% in 1976-77, consisting primarily of fawns, and was estimated at a minimum of 15%, including 34% of all fawns in 1977-78. Noted differences between the Schafer and Armstrong areas were: more Douglas fir and subalpine fir habitats with shrub understories on the Schafer summer area; no bitterbrush and much more Douglas fir/snowberry habitats on the Schafer Creek winter range and; smaller home ranges and generally higher winter survival on the Schafer Creek winter range.

INTRODUCTION

Ecology of mule deer (*Odocoileus hemionus* Rafinesque) in the Bridger Mountain Range was first studied by Wilkins (1957) in the vicinity of the Armstrong winter range in 1955-56. Since 1971, studies have continued on the Armstrong area (Schwarzakoph 1973, Bucsik 1974, Hamlin 1974, Mackie et al. 1976, Pac 1976, Morton 1976, Mackie and Stewart 1976, Hamlin 1977, Mackie and Knowles 1977, Youmans 1977, Mackie et al. 1978, Youmans in prep.), In 1975, they were expanded to compare ecological characteristics of mule deer populations and deer ranges throughout the Bridger Mountain complex.

Observations by Mackie, Hamlin and Munding (1976) and Mackie, Pac and Jorgensen (1978) have indicated possible range-related differences in population characteristics of mule deer associated with different winter ranges in the Bridger Mountains. One of these differences was apparently higher fawn production and/or survival among deer wintering along the southern portion of the west slope of the Bridger Range as compared with the Armstrong area on the northern portion.

This study was established during the summer of 1976 to determine mule deer range, range use and population characteristics on the southern area and to compare findings with similar information from the Armstrong area. Data were obtained through full-time field work during the summers of 1976 and 1977 and the winter of 1977-78 and part-time, intermittent studies at other times from June 1976 to April 1978.

DESCRIPTION OF THE STUDY AREA

The Bridger Mountain Range (Fig. 1) lies immediately northeast of Bozeman, Montana, extending northwesterly in a gently curving arc for approximately 37 km. McMannis (1955) describes the Bridger Range as being formed primarily of steeply dipping Paleozoic sediments (limestone) with a narrow strip of Precambrian metamorphics along the west front. This strip becomes wider south of a fault passing through Ross Pass and includes much of the area on which this study was conducted.

The study area was located on the west slope of the Bridgers approximately 13 km north of Bozeman and 12 km due east of Belgrade, Montana. The area is bounded on the east by the Bridger Divide, on the north by the Jones-Ross Creek Divide, on the west by the Gallatin Valley floor and on the south by the Middle Cottonwood-Walton-Sypes Creek Divide. It encompassed approximately 51 km². The Schafer Creek winter range comprised approximately 7.2 km² as a strip about 1.6 km wide between Middle Cottonwood Creek and Miser Canyon (Figs. 1 and 4). This strip occurs on a mountainous convexity, or toe, that extends westward into the valley floor, as does the intensively studied Armstrong area, 14.5 km north.

Elevations of the study area range from about 1525 m, where the mountains meet the valley floor, to 2793 m on Saddle Peak along the Bridger Divide. Elevational limits of the winter range are 1525 m to 2190 m; however, the majority of winter deer use occurs below

1980 m.

Five major permanent streams occur on the area; Middle Cottonwood, Schafer, Bostwick, Truman and Jones Creeks. All flow in a general east to west direction; and all, except Schafer Creek, originate along the Bridger Divide. This creates a series of distinct east-west ridges and extensive steep slopes of northerly and southerly aspect. Typical of the interior are many limestone outcrops, ledges and talus slopes.

At low elevations on the winter range (1525 m to 2190 m) forest cover consists of stands of Douglas fir (*Pseudotsuga menziesii* (Mirbel) Frenc.) on north-facing slopes. Douglas fir extends upward to dominate all aspects of the summering area to an elevation of about 2195 m. At higher elevations subalpine fir (*Abies lasiocarpa* (Hook) Nutt.) and limber pine (*Pinus flexilis* James.) predominate as either relatively open forest or dense clumps of trees with mountain meadows between them.

The vegetation on the southerly and westerly slopes of the winter range tends to be open shrub-grassland or open Douglas fir-bunchgrass communities. Dominant shrubs were big sagebrush (*Artemisia tridentata* Nutt.) and Rocky Mountain juniper (*Juniperus scopulorum* Sarg.). Dominant bunchgrasses were bluebunch wheatgrass (*Agropyron spicatum* (Pursh) Scribn. and Smith) and Idaho fescue (*Festuca idahoensis* Elmer). The

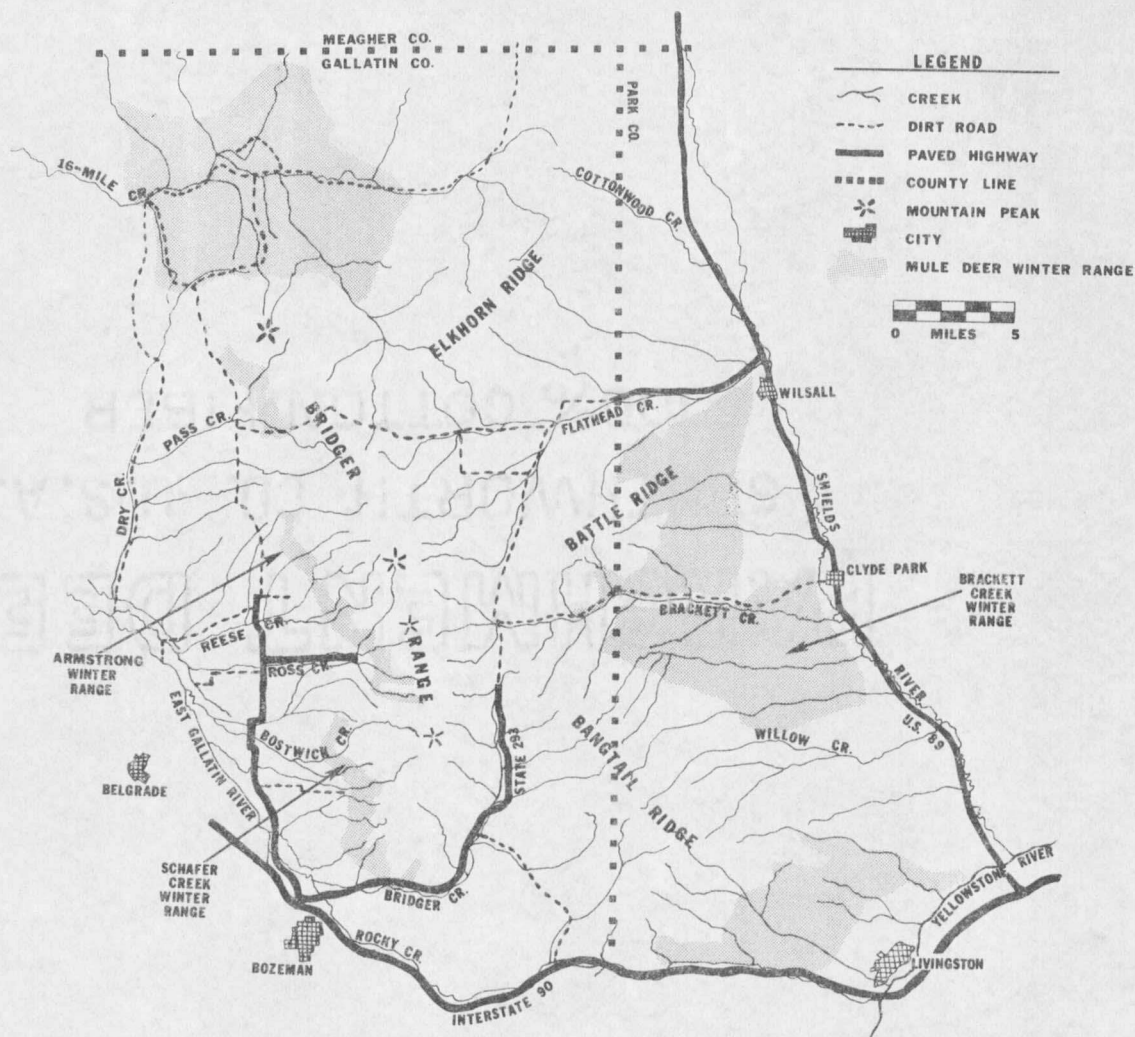


Figure 1. Map of the Bridger Mountain Range showing major features and locations of primary study areas.

open Douglas fir-bunchgrass communities occurred in all drainages at elevations less than 2073 m; above this bunchgrasses are replaced by elk sedge (*Carex geyeri* Buott.).

Approximately 86 percent of the study area is federally owned and administered by the U.S.D.A., Forest Service, Gallatin National Forest. Sixty-five percent of the Schafer Creek winter range is privately owned. At present access into the area is through private lands; however, a U.S. Forest Service access road following Middle Cottonwood Creek is under consideration. Livestock are grazed at least seasonally over the entire area. The National Forest lands include four cattle allotments permitting a total of 103 head of cattle from July 1 through October 15 in the area from Jones Creek south to Middle Cottonwood Creek (R. Duncan, U.S. For. Ser., Bozeman Ranger District (Pers. Comm.)). There has been no extensive logging on the area, which is currently classified as non-commercial forest-land. The area is relatively inaccessible and human activity is very minor throughout the year, except during hunting season when there is moderate hunting pressure in the Middle Cottonwood drainage.

In addition to mule deer, the area is also used by small numbers of elk (*Cervus canadensis nelsoni*), mountain goats (*Oreamnos americanus*), moose (*Alces alces shirasi*) and black bear (*Ursus americanus*).

Climatological data (U.S. Department of Commerce) from two U.S. Weather Bureau Stations, Belgrade FAA (airport) and Montana State

University at Bozeman, for the period of January 1977 through April 1978 are presented in Table 1. Although both of these stations are not on the study area (Fig. 1), they may be indicative of climatic conditions. The 30 year mean annual temperature was 5.4°C and 6.2°C , and precipitation was 34 cm and 47.5 cm for Belgrade and Bozeman, respectively. The annual temperature for 1977 was 5.7°C and 7.1°C , and precipitation was 39.7 cm and 52.7 cm for Belgrade and Bozeman, respectively; 1977 was therefore somewhat warmer and wetter than average. Approximately the same amount of precipitation occurred during the period January-April 1978 but temperatures were colder than the same period for 1977. This resulted in greater snow depth and more days of snow cover in 1978. Both January-April periods were warmer and considerably drier than normal as indicated by 30 year means.

Table 1. Climatological data of the U.S. Department of Commerce weather stations, Belgrade FAA (airport) and Montana State University weather stations.

Month	Weather Station	Temperature °C		Precipitation cm		Snowfall cm	Maximum Snow Depth cm	Days of Snow on Ground ≥ 2.5 cm.
		Mean	30 Yr. Mean	Mean	30 Yr. Mean			
Jan 77	Bel ¹	-10.3	- 8.7	1.70	1.68	33.3	20.3	31
	MSU ²	- 6.5	- 6.2	1.52	2.34	34.3	22.9	31
Feb	Bel	- 2.6	- 4.9	.23	1.04	2.5	2.5	10
	MSU	1.0	- 3.2	.15	1.65	2.5	7.6	12
Mar	Bel	- 1.8	- 2.2	3.94	2.21	39.4	10.2	20
	MSU	- 0.6	- 1.2	6.07	3.66	68.6	20.3	29
April	Bel	8.1	5.1	.89	2.95	3.6	2.5	1
	MSU	8.9	5.5	1.45	4.52	14.5	20.3	6
May	Bel	9.9	10.4	6.50	5.33	5.1		
	MSU	10.2	10.4	9.75	6.78	8.6		
June	Bel	17.3	14.3	5.89	6.78			
	MSU	17.3	14.2	5.61	8.18			
July	Bel	19.1	19.2	2.16	2.79			
	MSU	18.6	19.1	5.69	3.30			
Aug	Bel	17.6	18.3	3.51	2.92			
	MSU	17.7	18.3	5.41	3.48			
Sept.	Bel	12.4	12.4	7.62	3.53			
	MSU	13.3	12.9	7.32	4.47			

Table 1. (continued)

Month	Weather Station	Temperature °C		Precipitation cm		Snowfall cm	Maximum Snow Depth cm	Days of Snow on Ground $\geq$ 2.5 cm
		Mean	30 Yr Mean	Mean	30 Yr Mean			
Oct	Bel	7.1	6.9	2.59	2.54			
	MSU	8.4	7.7	3.66	3.71			
Nov	Bel	- 1.7	0.7	2.06	2.06	13.5		
	MSU	- 0.2	0.3	3.02	3.20	30.5	20.3	11
Dec	Bel	- 7.2	- 5.8	2.59	1.50	29.0	20.3	22
	MSU	- 3.8	- 3.8	3.02	2.11	32.3	20.3	22
Jan 78	Bel	- 8.8	- 8.7	2.06	1.68	19.1	20.3	31
	MSU	- 5.4	- 6.2	2.62	2.34	34.8	30.5	31
Feb	Bel	- 6.7	- 4.9	2.03	1.04	19.8	22.9	28
	MSU	- 3.2	- 3.2	2.21	1.65	38.4	27.9	28
Mar	Bel	0.7	- 2.2	.99	2.21	9.9	20.3	19
	MSU	2.9	- 1.2	1.88	3.66	11.7	25.4	19
April	Bel	6.7	5.1	1.88	2.95	2.5	2.5	1
	MSU	7.2	5.5	2.36	4.52	3.6		
30 yr Mean	Bel	5.4		34.00				
	MSU	6.2		47.50				
1977 Mean	Bel	5.7		39.70				
	MSU	7.1		42.70				
Jan-Apr 30 yr $\bar{X}$	Bel	- 2.7		7.87				
	MSU	- 1.3		12.17				

∞

Table 1. (continued)

Month	Weather Station	Temperature °C		Precipitation cm		Snowfall cm	Maximum Snow Depth cm	Days of Snow on Ground $\geq$ 2.5 cm
		Mean	30 Yr Mean	Mean	30 Yr Mean			
Jan-Apr 1977 $\bar{X}$	Bel MSU	- 1.6		6.76				
		0.7		9.19				
Jan-Apr 1978 $\bar{X}$	Bel MSU	- 2.0		6.96				
		0.4		9.07				

¹Belgrade FAA, airport

²Montana State University at Bozeman

METHODS

Habitat Determination and Vegetation Analysis

Plant communities of the study area were tentatively delineated through field reconnaissance on both the winter range and the summer range. Final classification of habitat types followed Pfister, et al. (1974, 1977) for forest types, and Mueggler and Händl (1974) for shrub and grassland types. Some additions were necessary where vegetative characteristics encountered were not described by these authors. Tentative plant communities and habitat types were outlined on copies of aerial photographs in the field, and later refined to construct a habitat type map of the study area. A planimeter was used to measure the land areas of the various habitat types.

Vegetative characteristics of habitat types on the winter range were measured using 33 permanent transects established on representative sites within one to four stands of each type. Transects consisted of ten points 15 m apart, in a straight line perpendicular to the fall line of the slope. Any deviations from this brought about by local conditions were outlined on the back of field data sheets to facilitate future relocation of the transect points. The points were used as the center of a 4 x 10 dm frame to estimate shrub canopy cover. A 2 x 5 dm frame, located in the lower right corner of the larger plot frame, was used to estimate canopy coverage of grasses and forbs. Canopy coverage estimates followed Daubenmire (1959). Coverage classes were: class 1 = 0-1%; class 2 = 1-5%, class 3 = 5-25%;

class 4 = 25-50%; class 5 = 50-75%; class 6 = 75-95%; and class 7 = 95-100%.

Tree and shrub densities were estimated using the point-centered quarter technique (Cotton and Curtis 1956). Forest canopy cover was estimated at two points along each permanent transect using a spherical densiometer (Lemon 1956). Four readings were made at each point, then averaged for a stand estimate. Exposure and percent slope were estimated using a Keuffel and Esser pocket transit. Elevations were determined in the field with a Thommen pocket altimeter and later cross checked with a U.S.G.S. topographic map. Common and scientific names of plants encountered and collected followed Booth and Wright (1966), Booth (1972), and Hahn (1973).

Mule Deer Habitat Use, Movements, and Population Characteristics

Both ground and aerial observations of mule deer were recorded as to time, habitat type where deer were first seen, physiognomy of the immediate area if nontypical for that habitat type, number of animals, age, sex when possible, activity, marking, exposure, relative slope, and elevation.

All observations were recorded on copies of aerial photographs and later assigned Universal Transverse Mercator (UTM) grid system coordinates to facilitate movement and habitat usage analysis by computer.

To provide data on year-long movements and habitat use, 12 adult mule deer (3 males, 9 females) were fitted with radio transmitter collars in March 1977, while they were on the winter range. These deer were relocated weekly from the air from April 1977 through April, 1978, and periodically from the ground throughout the year. Some attempt was made on nearly all relocations to achieve visual contact, to confirm the exact location, determine the habitat type being used, and obtain supplemental information about associations with other deer and/or fawns. In addition there was a maximum of 26 neckbanded mule deer on the study area during spring and summer 1977. Nine of these were marked in the spring of 1975 (Mackie Pers. Comm.) and 17 in March and April, 1977. Neckbands were made of "Armortite" material painted with identifying symbols (Mackie, et al. 1976).

When considering movements, home range calculations, and habitat use, seasons were determined for radioed animals as follows: spring began when an animal was first relocated off of the winter range and ended when that animal was established on its summer range; summer-early fall covered the entire period of time an animal was on its summer range. Summer lasted until the first snows and/or killing frosts, and early fall ended with the animal's departure from the summer home range. Late fall covered the time of migration to the winter range. Winter extended from the time an animal became established on the winter range to the time of its departure.

To relate seasons to other mule deer, average seasonal dates were determined from movements of radio-collared animals with the following results:

Winter 1976-77	Ended April 30
Spring	May 1 - June 4
Summer	June 5 - August 26
Early Fall	August 27 - November 14
Late Fall	November 15 - December 20
Winter 1977-78	December 21 - April 30

In using this method, seasons would probably vary slightly from year to year due to weather conditions which influence deer movements.

Home range and movement data were analyzed by the minimum area (Mohr 1949) method. Also, relative use of areas by mule deer was documented as the areas were habitat typed.

Population estimates were derived as Lincoln (Overton and Davis 1969) and Schnabel (Overton 1965) indices from observations of marked and unmarked animals during winter and early spring. Aerial and ground observation provided estimates of fawn:female, fawn:adult, and male:female ratios for the population.

Food Habits

Food habits of mule deer were determined by examination of 24 feeding sites and the contents of five rumens of mule deer found dead

on the winter range. Feeding sites were examined as soon as possible, or practical, after being used by mule deer. Instances of plant use were recorded as described by Cole and Wilkins (1958). Rumen samples were analyzed according to the technique of Wilkins (1957). When practical, availability of plant species present at feeding sites on the summer range was determined by recording canopy cover and frequency of species in 10 to 20, 2 x 5 dm frames at the site. On the winter range, availability was estimated from data collected at the nearest permanent transect of the habitat type in which the feeding site occurred.

RESULTS AND DISCUSSION

Vegetation

On the winter range, three series of habitat types (h.t.s hereafter) were recognized. These included an Idaho fescue grassland series comprised of two h.t.s, a big sagebrush shrub grassland series, also with two h.t.s, and a Douglas fir tree series comprising four types, one of which has two phases. In addition, a mock-orange (*Philadelphus lewissii* Pursh.) h.t., was identified to occur locally within larger stands of other h.t.s, on the winter range.

Three series were found to occur on the summer range: Douglas fir, subalpine fir, and limber pine which together comprised a total of 13 h.t.s, one of which occurred as two distinct phases.

Eighteen h.t.s (Table 2) were then identified and described for the entire study area. Of these, four, PSME/SYAL, PSME/VAGL, ABLA/CLPS, and ABLA/VAGL, comprised two-thirds of the area; and PSME/SYAL alone covered 43.8 percent of the winter range. Table 3 lists the h.t.s and the areas they comprise on the winter and summer ranges as well as the entire study area as a whole. Figures 2 and 3 depict the distribution and relationship of h.t.s on the area; while Tables 4, 5, 6 and 7 present data showing understory species composition as the mean canopy coverage and frequency of occurrence of plant taxa among all frames read and their constancy of occurrence among all sites sampled for each h.t.



Figure 2. Distribution of habitat types occurring on the north half of the Schafer Creek study area.



Figure 3. Distribution of habitat types occurring on the south half of the Schafer Creek study area.

Table 2. Key to figures 2 and 3 and list of major habitat series and types, of the Schafer Creek study area.

KEY: Arabic numerals denote habitat series.

Letters denote habitat types within series.

1. *Festuca idahoensis* Series

- | | |
|---|-----------|
| 1A: <i>Festuca idahoensis</i> / <i>Agropyron spicatum</i> | FEID/AGSP |
| 1B: <i>Festuca idahoensis</i> / <i>Agropyron smithii</i> | FEID/AGSM |

2. *Artemisia tridentata* Series

- | | |
|---|-----------|
| 2A: <i>Artemisia tridentata</i> / <i>Festuca idahoensis</i> | ARTR/FEID |
| 2B: <i>Artemisia tridentata</i> / <i>Agropyron spicatum</i> | ARTR/AGSP |

3. *Pseudotsuga menziesii* Series

- | | |
|---|-------------|
| 3A: <i>Pseudotsuga menziesii</i> / <i>Festuca idahoensis</i> | PSME/FEID |
| 3B: <i>Pseudotsuga menziesii</i> / <i>Agropyron spicatum</i> | PSME/AGSP |
| 3C: <i>Pseudotsuga menziesii</i> / <i>Calamagrostis rubescens</i> -
<i>Calamagrostis rubescens</i> phase | PSME/CARU |
| 3D: <i>Pseudotsuga menziesii</i> / <i>Carex geyeri</i> | PSME/CAGE |
| 3E: <i>Pseudotsuga menziesii</i> / <i>Symphoricarpos albus</i> -
<i>Calamagrostis rubescens</i> phase | PSME/SYAL-C |
| 3F: <i>Pseudotsuga menziesii</i> / <i>Symphoricarpos albus</i> -
<i>Agropyron spicatum</i> phase | PSME/SYAL-A |
| 3G: <i>Pseudotsuga menziesii</i> / <i>Physocarpus malvaceus</i> -
<i>Calamagrostis rubescens</i> phase | PSME/PHMA |
| 3H: <i>Pseudotsuga menziesii</i> / <i>Vaccinium globulare</i> -
<i>Vaccinium globulare</i> phase | PSME/VAGL |

4. *Abies lasiocarpa* Series

- | | |
|---|-----------|
| 4A: <i>Abies lasiocarpa</i> / <i>Arnica cordifolia</i> | ABLA/ARCO |
| 4B: <i>Abies lasiocarpa</i> / <i>Calamagrostis rubescens</i> | ABLA/CARU |
| 4C: <i>Abies lasiocarpa</i> / <i>Carex geyeri</i> -
<i>Pseudotsuga menziesii</i> phase | ABLA/CAGE |
| 4D: <i>Abies lasiocarpa</i> / <i>Clematis pseudoalpina</i> | ABLA/CLPS |
| 4E: <i>Abies lasiocarpa</i> / <i>Vaccinium globulare</i> | ABLA/VAGL |

5. *Pinus flexilis* Series

- | | |
|---|-----------|
| 5A: <i>Pinus flexilis</i> / <i>Juniperus communis</i> | PIFL/JUCO |
|---|-----------|

Table 3. Spacial composition of the Schafer Creek Study Area by habitat type.

	km ²	mi ²	Hectares	Acres	% Entire ¹ Area	% WR ²	% SR ³
Entire Area	50.8	19.6	5083.5	12556.4	--	--	--
Principal							
Winter Range	2.3	1.4	230.0	915.0	4.5	32	--
Total							
Winter Range	7.2	2.8	714.8	1765.6	14.1	--	--
Summer Range	42.8	16.5	4282.9	10578.8	84.4	--	--

SERIES							

FEID Series	0.9	0.3	86.8	214.4	1.7	12.1	--
ARTR Series	1.3	0.5	131.1	323.8	2.6	18.4	--
PSME Series	31.4	12.1	3143.0	7761.6	61.9	67.9	61.0
ABLA Series	15.6	6.0	1561.0	3854.5	30.7	--	36.4
PIFL Series	1.5	0.6	149.7	369.3	2.9	--	3.5

HABITAT TYPES							

FEID/AGSM	0.2	0.1	15.2	37.5	0.3	2.1	--
FEID/AGSP	0.7	0.3	71.6	176.9	1.4	10.0	--
ARTR/FEID	1.0	0.4	99.9	246.9	2.0	14.0	--
ARTR/AGSP	0.3	0.1	31.2	77.1	0.6	4.4	--
PHLE/SYAL	OCCURS ON SMALL LOCAL SITES OFTEN LESS THAN .5 HA IN SIZE						
PSME/FEID	3.6	1.4	358.5	885.6	7.1	12.4	6.3
PSME/AGSP	1.5	0.6	146.2	361.1	2.9	8.2	2.0
PSME/CAGE	1.7	0.7	171.6	423.9	3.4	--	4.0
PSME/CARU	1.8	0.7	178.6	441.2	3.5	--	4.2
PSME/SYAL-C	7.8	3.0	776.5	1918.0	15.3	36.3	12.0
PSME/SYAL-A	2.4	1.0	238.4	588.9	4.7	7.2	3.4
PSME/VAGL	9.6	3.7	955.5	2360.1	18.8	3.5	21.7
PSEM/PHMA	0.8	0.3	81.5	201.3	1.6	--	1.9
ABLA/ARCO	0.3	0.1	27.2	67.1	0.5	--	0.6
ABLA/CLPS	7.3	2.8	726.1	1793.5	14.3	--	17.0
ABLA/CARU	0.6	0.2	56.0	138.3	1.1	--	1.3
ABLA/CAGE	0.5	0.2	48.2	119.1	1.0	--	1.1
ABLA/VAGL	7.0	2.7	703.1	1736.6	13.8	--	16.4
PIFL/JUCO	1.5	0.6	149.7	369.8	2.9	--	3.5
PSME/FEID & PSME/SYAL-A	2.4	0.9	235.5	581.7	4.6	--	5.5

¹Totals may not equal 100% due to rounding and planimeter errors.²WR=Winter Range³SR=Summer Range

Table 4. Mean percent canopy coverage/frequency of occurrence/constancy of important¹ plant taxa in grass and shrubland habitat types on the Schafer Creek study area.

		Habitat Types ²				
		FEID/AGSP	FEID/AGSM	ARTR/FEID	ARTR/AGSP	PHLE/SYAL
	# Sites	3	2	3	5	1
TAXA	# Frames	30	20	30	50	10
GRASSES AND SEDGES:						
Agropyron smithii			4/.50/1.0			
Agropyron spicatum		7/.37/1.0	2/.15/1.0	13/.47/1.0	20/.58/1.0	10/.10/1.0
Bromus carinatus		1/.03/.33		2/.07/.33		
Bromus tectorum		9/.73/1.0	4/.40/1.0	1/.13/1.0	12/.72/1.0	5/.20/1.0
Bromus spp			Tr ³ /.10/.5			
Danthonia unispicata			3/.15/.50			
Festuca idahoensis		8/.23/.67	6/.25/1.0	11/.40/1.0	3/.08/.60	
Koeleria cristata		4/.30/1.0	2/.25/1.0	4/.50/1.0	6/.26/.80	
Poa pratensis		13/.30/.33	43/.80/1.0	4/.13/.33		
Poa sandbergii		1/.03/.33		1/.23/1.0	1/.12/.80	
Poa spp		5/.27/.67				
Stipa Comata		2/.07/.67				
Unidentified grasses			1/.05/.50			
TOTAL GRASSES ⁴		51/1.0/1.0	70/1.0/1.0	34/.87/1.0	38/.92/1.0	15/.30/1.0
FORBS:						
Achillea millefolium		7/.50/1.0	5/.35/1.0	6/.33/1.0	3/.24/1.0	2/.10/1.0
Alyssum alyssoides		4/.90/1.0	1/.10/.50	2/.43/1.0	3/.82/1.0	
Apocynum androsaemifolium				2/.10/.33		
Artemisia ludoviciana		2/.10/1.0	7/.30/.50		1/.02/.20	
Aster pansus			4/.10/.50			
Aster spp				1/.03/.33		
Balsamorhiza sagittata		13/.30/1.0	7/.10/.50	11/.33/1.0	17/.32/.80	2/.10/1.0
Brodiaea grandiflora				Tr/.03/.33		
Cerastium arvense		11/.67/1.0		9/.63/1.0	7/.58/1.0	

Table 4. (continued)

TAXA	# Sites # Frames	Habitat Types				
		FEID/AGSP	FEID/AGSM	ARTR/FEID	ARTR/AGSP	PHLE/SYAL
		3 30	2 20	3 30	5 50	1 10
FORBS: (continued)						
Chrysopsis villosa		4/.27/1.0	7/.10/.50	1/.03/.33		
Collomia linearis		Tr/.13/1.0			1/.14/.80	
Comandra umbellata		1/.03/.33	5/.30/1.0	3/.17/1.0	2/.12/.60	
Epilobium paniculatum		1/.20/.67	1/.20/.50	1/.03/.33	1/.18/.60	
Galium triflorum					1/.02/.20	7/.30/1.0
Gaura coccinea		1/.03/.33	3/.15/.50			
Helianthella uniflora			3/.05/.50			
Hieracium cynoglossoides		1/.03/.33				
Lactuca serriola			1/.05/.50			2/.20/1.0
Linum perrene		2/.03/.33	Tr/.05/.50			
Lithospermum ruderales			1/.10/1.0			
Lupinus spp		2/.10/.67	Tr/.10/.50	8/.23/1.0	4/.16/.60	
Monarda fistulosa			Tr/.05/.50			
Phacelia linearis		1/.33/1.0		1/.23/.67	1/.40/1.0	
Polygonum douglasii				Tr/.13/1.0	1/.04/.20	
Solidago missouriensis						4/.10/1.0
Tragopogon dubius		4/.23/.67	6/.45/1.0	2/.17/.67	1/.14/1.0	
Unidentified forbs				Tr/.07/.33	Tr/.06/.40	
TOTAL FORBS		42/1.0/1.0	43/.95/1.0	43/.97/1.0	36/.98/1.0	26/.60/1.0
SHRUBS AND TREES:						
Amelanchier alnifolia						2/.10/1.0
Artemisia tridentata				24/.60/1.0	11/.36/1.0	
Clematis ligusticifolia						8/.20/1.0
Philadelphus lewisii						35/.50/1.0
Prunus virginiana						6/.20/1.0
Rhus radicans						1/.10/1.0
Rhus trilobata						9/.10/1.0

Table 4. (continued)

TAXA	# Sites # Frames	Habitat Types				
		FEID/AGSP	FEID/AGSM	ARTR/FEID	ARTR/AGSP	PHLE/SYAL
		3 30	2 20	3 30	5 50	1 10
SHRUBS AND TREES (continued)						
Rosa nutkana			6/.15/.50		Tr/.04/.40	2/.10/1.0
Rubus idaeus						2/.10/1.0
Symphoricarpos albus						7/.10/1.0
TOTAL BROWSE		00/ 00/ 00	6/.15/.50	24/.60/1.0	11/.40/1.0	54/.70/1.0
Selaginella densa		1/.03/.33			1/.04/.40	
Moss						14/.40/1.0
Lichens					Tr/.06/.40	
TOTAL VEGETATION		66/1.0/1.0	84/1.0/1.0	76/1.0/1.0	70/1.0/1.0	63/.70/1.0
Bareground		31/.80/1.0	8/.50/1.0	18/.70/1.0	22/.72/1.0	00/ 00/ 00
Rock		2/.23/1.0	4/.25/1.0	3/.13/.67	6/.38/1.0	50/.70/1.0
Litter		69/1.0/1.0	84/1.0/1.0	80/1.0/1.0	69/.98/1.0	60/7.0/1.0

¹Taxon which obtained a minimum coverage of .5% or frequency of .05.

²See Table 2 for habitat type abbreviations

³Less than .5% canopy cover or frequency of .05.

⁴Mean of the total plant class among sites.

Table 5. Mean percent canopy coverage/frequency of occurrence/constancy of important¹ plant taxa in Douglas fir-grass habitat types on the Schafer Creek study area.

		Habitat Type ²			
		PSME/FEID	PSME/AGSP	PSME/CARU	PSME/CAGE
	# Sites	5	6	1	2
TAXA	# Frames	60	60	20	40
GRASSES AND SEDGES:					
Agropyron spicatum		11/.42/1.0	13/.40/1.0		5/.20/1.0
Bromus carinatus		1/.07/.40		7/.35/1.0	7/.25/1.0
Bromus tectorum		2/.23/.60	6/.35/1.0		
Calamagrostis rubescens				14/.35/1.0	2/.08/.50
Carex geyeri		1/.05/.20		56/.95/1.0	54/.80/1.0
Carex spp		1/.07/.30			
Elymus cinereus				Tr ³ /.05/1.0	1/.03/.50
Festuca idahoensis		11/.52/1.0			
Koeleria cristata		3/.18/.60	1/.12/.50		
Poa pratensis		1/.02/.20			
Poa sandbergii			2/.12/.67		
Poa spp		1/.13/.20			1/.03/.50
Stipa comata		3/.07/.20			
Stipa occidentalis		1/.02/.20			
TOTAL GRASSES ⁴		33/.92/1.0	22/.68/1.0	73/1.0/1.0	63/.90/1.0
FORBS:					
Achillea millefolium		5/.33/1.0		3/.25/1.0	8/.33/1.0
Agoseris galauca		1/.02/.20		1/.10/1.0	
Alyssum alyssoides		1/.35/1.0	1/.32/1.0		
Alyssum desertorum		1/.02/.20			
Antennaria racemosa				14/.30/1.0	1/.03/.50
Antennaria spp		1/.03/.40			
Aquilegia flavescens					1/.03/.50
Arenaria congesta		1/.08/.40			
Arnica cordifolia				11/.45/1.0	1/.13/1.0

Table 5. (continued)

		Habitat Types			
		PSME/FEID	PSME/AGSP	PSME/CARU	PSME/CAGE
	# Sites	5	6	1	2
TAXA	# Frames	60	60	20	40
FORBS: (continued)					
Artemisia campestris			1/.03/.17		
Artemisia frigida			1/.05/.17		
Artemisia ludoviciana			1/.02/.17		
Aster conspicuus				4/.10/1.0	4/.15/1.0
Aster novae-angliae				18/.50/1.0	
Balsamorhiza sagittata	14/.28/1.0	11/.22/.50	8/.15/1.0		8/.20/1.0
Cerastium arvense	9/.52/1.0	3/.18/.83			2/.10/1.0
Chrysopsis villosa	2/.07/.40	3/.20/.83			
Cirsium undulatum	1/.03/.40	3/.20/.83			
Comandra umbellata	1/.03/.40	1/.02/.17			
Disporum trachycarpum	1/.02/.20				
Epilobium paniculatum	Tr/.05/.40	1/.05/.50			
Eriogonum umbellatum	1/.02/.20				
Fragaria vesca				13/.45/1.0	1/.05/.50
Fragaria virginiana					4/.13/.50
Helianthella uniflora				1/.05/1.0	2/.05/1.0
Hieracium cynoglossoides	Tr/.05/.40	1/.07/.33	3/.20/1.0		Tr/.05/.50
Lupinus spp	3/.07/.20			5/.15/1.0	5/.13/1.0
Osmorhiza chilensis					2/.10/1.0
Phacelia hastata	1/.08/.40	Tr/.07/.33			1/.03/.50
Phacelia linearis	1/.12/.40	Tr/.10/.67			Tr/.08/.50
Polygonum douglasii	1/.12/.60	Tr/.05/.33			
Potentilla spp	1/.02/.20				
Solidago missouriensis	1/.05/.20				
Thalictrum venulosum					1/.08/.50
Tragopogon dubius	1/.13/.60				

Table 5. (continued)

		Habitat Types			
		PSME/FEID	PSME/AGSP	PSME/CARU	PSME/CAGE
	# Sites	5	6	1	2
TAXA	# Frames	60	60	20	40
FORBS: (continued)					
Valeriana spp				3/.15/1.0	
Viola nuttallii				Tr/.05/1.0	
Unidentified forbs		1/.03/.40	Tr/.07/.50		1/.08/.50
TOTAL FORBS		33/.95/1.0	20/.75/1.0	59/1.0/1.0	37/.85/1.0
SHRUBS AND TREES:					
Amelanchier alnifolia					Tr/.05/.50
Artemisia tridentata		6/.15/.60	1/.02/.17		
Berberis repens					2/.05/.50
Juniperus communis				1/.05/1.0	
Juniperus scopulorum		5/.08/.40	4/.03/.33		
Prunus virginiana		1/.03/.40			
Pseudotsuga menziesii				Tr/.05/1.0	Tr/.10/.50
Rhus trilobata			2/.03/.33		
Spiraea betulifolia					8/.40/1.0
Symphoricarpos albus		1/.05/.40	2/.12/.50	2/.05/1.0	1/.05/.50
TOTAL BROWSE		12/.33/1.0	7/.22/.83	2/.10/1.0	11/.45/1.0
Selaginella densa		6/.20/.60	2/.07/.33		
Moss			2/.05/.50		
Lichens		1/.10/.40			
Woodsia scopulina		1/.05/.40			
TOTAL VEGETATION		64/1.0/1.0	44/.92/1.0	82/1.0/1.0	74/1.0/1.0

Table 5. (continued)

TAXA	# Sites # Frames	Habitat Types			
		PSME/FEID	PSME/AGSP	PSME/CARU	PSME/CAGE
		5 60	6 60	1 20	2 40
Bareground		24/.60/1.0	15/.53/1.0	8/.35/1.0	4/.28/1.0
Rock		7/.30/1.0	22/.65/1.0	3/.25/1.0	8/.33/1.0
Litter		67/1.0/1.0	69/1.0/1.0	87/1.0/1.0	81/1.0/1.0

¹Taxon which obtained a minimum coverage of .5% or frequency of .05.

²See Table 2 for habitat type abbreviations.

³Less than .5% canopy cover.

⁴Mean of the total plant class among sites.

Table 6. Mean percent canopy coverage/frequency of occurrence/constancy of important¹ plant taxa in Douglas fir-shrub and limber pine habitat types on the Schafer Creek study area.

TAXA	# Sites # Frames	Habitat Types ²				
		PSME/SYAL CARU Phase	PSME/SYAL AGSP Phase	PSME/VAGL	PSME/PHMA	PIFL/JUCO
		7	2	5	2	2
		70	30	80	60	40
GRASSES AND SEDGES:						
Agropyron caninum						2/.08/.50
Agropyron spicatum			11/.33/1.0			Tr ³ /.03/.50
Bromus carinatus			2/.27/1.0			1/.05/.50
Bromus tectorum	1/.01/.14		2/.30/1.0			
Calamagrostis rubescens	30/.53/.86		2/.03/.50	28/.63/1.0	34/.60/1.0	2/.05/.50
Carex geyeri	3/.09/.29		14/.33/.50	2/.08/.40	8/.20/1.0	
Carex spp	1/.04/.29		Tr/.07/.50			
Festuca idaoensis			6/.17/1.0			
Poa sandbergii			Tr/.07/.50			
Poa spp	1/.10/.57		2/.13/.50			1/.15/1.0
TOTAL GRASSES ⁴		39/.79/1.0	42/.97/1.0	30/.70/1.0	41/.72/1.0	4/.35/1.0
FORBS:						
Achillea millefolium			2/.27/1.0		1/.02/.50	5/.20/.50
Agoseris glauca						5/.33/.50
Allium spp						1/.08/.50
Alyssum alyssoides			1/.10/1.0			
Anemone multifida						3/.20/.50
Antennaria racemosa	6/.40/.71			12/.49/1.0	5/.30/1.0	2/.13/.50
Antennaria spp			1/.07/.50			
Aquilegia flavescens						2/.15/.50
Arabis nuttallii						1/.40/1.0
Arenaria congesta			Tr/.07/.50			
Arnica cordifolia	1/.13/.57		5/.23/.10	11/.36/1.0	10/.47/1.0	

Table 6. (continued)

TAXA	# Sites # Frames	Habitat Types				
		PSME/SYAL CARU Phase	PSME/SYAL AGSP Phase	PSME/VAGL	PSME/PHMA	PIFL/JUCO
		7	2	5	2	2
		70	30	80	60	40
FORBS: (continued)						
<i>Arnica latifolia</i>						1/.05/1.0
<i>Artemisia michauxina</i>						1/.08/.50
<i>Aster conspicuus</i>		2/.10/.43			3/.12/1.0	6/.38/.50
<i>Aster spp</i>						1/.03/.50
<i>Astragalus miser</i>						3/.15/1.0
<i>Astragalus spp</i>					2/.01/.50	
<i>Balsamorhiza sagittata</i>			5/.13/.50			
<i>Bupleurum americanum</i>						2/.18/.50
<i>Campanula rotundifolia</i>						4/.35/1.0
<i>Cerastium arvense</i>			3/.33/1.0			Tr/.08/.50
<i>Chimaphila umbellata</i>				2/.06/.40		
<i>Chrysopsis villosa</i>			2/.03/.50			
<i>Cirsium foliosum</i>						3/.13/.50
<i>Claytonia perfoliata</i>			1/.27/.50			
<i>Collinsia parviflora</i>			3/.37/.50			
<i>Collomia linearis</i>			Tr/.07/.50			
<i>Crepis atrabarba</i>			2/.17/.50			
<i>Disporum trachycarpum</i>		2/.14/.86	1/.03/.50		7/.30/1.0	
<i>Erythronium grandiflorum</i>					1/.07/.50	
<i>Frageria vesca</i>		6/.40/.86	3/.10/.50	1/.04/.60	5/.33/1.0	
<i>Frageria virginiana</i>			2/.03/.50			
<i>Frasera speciosa</i>						2/.10/.50
<i>Galium boreale</i>						9/.65/1.0
<i>Hedysarum sulphurescens</i>				1/.03/.20		
<i>Helianthella uniflora</i>			1/.03/.50			
<i>Heuchera parvifolia</i>		Tr/.06/.57				
<i>Hieracium albiflorum</i>				3/.38/.80		

Table 6. (continued)

TAXA	# Sites # Frames	Habitat Types				
		PSME/SYAL CARU Phase	PSME/SYAL AGSP Phase	PSME/VAGL	PSME/PHMA	PIFL/JUCO
		7	2	5	2	2
		70	30	80	60	40
FORBS: (continued)						
Hydrophyllum capitatum			1/.10/.50			
Linum perenne						Tr/.08/.50
Lomatium cous						2/.25/1.0
Lupinus sulphureus	2/.06/.43					
Lupinus spp			2/.07/.50	1/.01/.20	4/.07/1.0	
Myosotis sylvatica			2/.03/.50			
Osmorhiza chilensis				1/.05/.40		
Penstemon spp						1/.05/.50
Phacelia linearis			Tr/.10/.50			
Pyrola secunda				3/.25/.80		1/.03/.50
Pyrola virens				1/.01/.20		2/.23/.50
Sedum lanceolata			Tr/.07/1.0			1/.08/.50
Senecio canus						1/.13/.50
Senecio spp						3/.25/1.0
Smilacina racemosa	1/.03/.29					
Taraxacum officinale						1/.05/.50
Thalictrum venulosum					2/.05/.50	
Townsendia parryi						1/.10/.50
Tragopogon dubius			1/.07/.50			
Trifolium haydenii						4/.18/.50
Valeriana spp	1/.03/.25				2/.13/.50	
Viola nuttallii						1/.03/1.0
Zigadenus elegans						4/.18/.50
Unidentified forbs	1/.07/.29					
TOTAL FORBS		22/.80/1.0	28/.90/1.0	37/.81/1.0	36/.87/1.0	43/.98/1.0

Table 6. (continued)

		Habitat Types				
		PSME/SYAL CARU Phase	PSME/SYAL AGSP Phase	PSME/VAGL	PSME/PHMA	PIFL/JUCO
	# Sites	7	2	5	2	2
TAXA	# Frames	70	30	80	60	40
SHRUBS AND TREES:						
Acer glabrum		3/.04/.43		1/.04/.40		
Amelanchier alnifolia				2/.05/.60	1/.05/1.0	
Arctostaphylos uva-ursi				2/.03/.20		
Berberis repens		1/.04/.43		1/.10/.80	1/.07/1.0	Tr/.05/.50
Clematis columbiana		1/.06/.43			2/.07/1.0	
Juniperus communis						9/.15/1.0
Lonicera utahensis				2/.04/.60		
Physocarpus malvaceus					22/.38/1.0	
Prunus virginiana		1/.01/.14	1/.03/.50			
Pseudotsuga menziesii				1/.10/.60		
Rosa spp				1/.03/.20		
Shepherdia canadensis				1/.01/.20		4/.08/.50
Spiraea betulifolia		12/.53/1.0		14/.60/1.0	23/.62/1.0	1/.08/.50
Symphoricarpos albus		15/.59/1.0	10/.30/1.0	1/.03/.40		
Vaccinium membranaceum				31/.78/1.0		
TOTAL BROWSE		30/.84/1.0	10/.40/1.0	48/.91/1.0	49/.93/1.0	16/.13/.50
Selaginella densa			3/.10/1.0			
Moss		14/.83/1.0	11/.30/1.0	26/.79/1.0	59/.93/1.0	
Lichens		4/.43/1.0				
Woodsia scopulina		3/.26/.43	3/.20/1.0			
TOTAL VEGETATION		75/1.0/1.0	66/1.0/1.0	74/.99/1.0	88/1.0/1.0	52/1.0/1.0
Bareground		1/.06/.57	15/.43/1.0	1/.03/.40	00/ 00/ 00	12/.30/1.0
Rock		4/.19/.86		2/.19/.80	1/.03/.50	21/.75/1.0
Litter		74/1.0/1.0	74/1.0/1.0	85/1.0/1.0	78/1.0/1.0	78/1.0/1.0 (one site)

¹Taxon which obtained a minimum of .5% or frequency of .05.²Mean of the total plant class among sites.³Less than .5% canopy cover.⁴Mean of the total plant class among sites.

Table 7. Mean percent canopy coverage/frequency of occurrence/constancy of important¹ plant taxa in subalpine fir habitat types on the Schafer Creek study area.

		Habitat Types ²				
		ABLA/ARCO	ABLA/CLPS	ABLA/CARU	ABLA/CAGE PSME Phase	ABLA/VAGL
TAXA	# Sites # Frames	1 25	2 40	2 60	1 20	4 80
GRASSES AND SEDGES:						
Agropyron spicatum				1/.02/.50		
Bromus carinatus	Tr ³ /.08/1.0			2/.10/.50	1/1.5/1.0	
Calamagrostis rubescens			2/.10/.50	21/.60/1.0	1/.05/1.0	2/.09/.25
Carex geyeri			4/.10/.50	37/.62/1.0	38/.75/1.0	12/.30/.75
Elymus cinereus				5/.13/1.0		6/.21/.50
Festuca idahoensis					1/.05/1.0	
Poa spp	2/.12/1.0		1/.15/.50		1/.10/1.0	2/.06/.25
Unidentified grasses						3/.19/.50
TOTAL GRASSES ⁴		2/.20/1.0	6/.35/1.0	60/.97/1.0	39/.85/1.0	24/.64/1.0
FORBS:						
Achillea millefolium	4/.20/1.0		2/.08/1.0	4/.23/.50	7/.40/1.0	
Agoseris glauca			3/.15/1.0			
Allium brevistylum	3/.28/1.0		1/.10/.50			
Anemone multifida			1/.08/1.0			
Antennaria racemosa			Tr/.08/.50	4/.28/1.0	1/.05/1.0	1/.09/.50
Aquilegia falvescens	4/.20/1.0		4/.10/.50	3/.10/.50		
Arabis nuttallii	4/.60/1.0		2/.08/.50			
Arnica cordifolia	25/.76/1.0		20/.60/1.0	12/.52/1.0	22/.65/1.0	30/.84/1.0
Arnica latifolia			4/.15/1.0		1/.15/1.0	
Aster conspicuus			3/.10/.50	9/.27/1.0		7/.19/.75
Aster engelmannii			7/.23/.50	1/.02/.50		
Aster novae-angliae				4/.17/.50		
Aster spp	3/.12/1.0		8/.40/.50			
Astragalus miser			1/.08/1.0			

Table 7. (continued)

TAXA	# Sites # Frames	Habitat Types				
		ABLA/ARCO	ABLA/CLPS	ABLA/CARU	ABLA/CAGE PSME Phase	ABLA/VAGL
		1 25	2 40	2 60	1 20	4 80
FORBS: (continued)						
Balsamorhiza sagittata				1/.02/.50	6/.25/1.0	
Besseyia wyomingensis			1/.03/.50			
Campanula rotundifolia	Tr/.08/1.0					
Castilleja miniata	2/.08/1.0					
Catilleja pulchella			2/.10/1.0			
Cerastium arvense				1/.02/.50	Tr/.05/1.0	
Chimaphila umbellata						2/.10/.75
Cirsium foliosum			3/.08/.50			
Claytonia lanceolata				6/.80/1.0		
Collinsia parviflora					1/.05/1.0	
Delphinium bicolor					1/.25/1.0	
Erigeron spp					1/.05/1.0	
Erythronium grandiflorum					1/.05/1.0	1/.03/.25
Fragaria vesca				6/.25/1.0	1/.05/1.0	1/.06/.25
Frasera speciosa			4/.10/1.0			1/.03/.25
Galium boreale	10/.32/1.0		9/.45/1.0	5/.20/1.0		1/.04/.25
Galium triflorum						1/.04/.50
Geranium viscosissimum			1/.03/.50			
Goodyera oblongifolia				2/.07/.50		3/.19/.75
Habenaria spp					Tr/.05/1.0	
Hieracium albiflorum				2/.13/.50		2/.23/.75
Hieracium cynoglossoides				1/.02/.50	2/.10/1.0	
Hydrophyllum capitatum					1/.15/1.0	
Lomatium cous					Tr/.05/1.0	
Lupinus caudatus					2/.45/1.0	
Lupine spp				3/.13/.50		
Mertensia oblongifolia	1/.04/1.0		1/.03/.50			

Table 7. (continued)

TAXA	# Sites # Frames	Habitat Types				
		ABLA/ARCO	ABLA/CLPS	ABLA/CARU	ABLA/CAGE PSME Phase	ABLA/VAGL
		1 25	2 40	2 60	1 20	4 80
FORBS: (continued)						
<i>Osmorhiza chilensis</i>			4/.28/1.0	1/.07/1.0		4/.26/1.0
<i>Pedicularis paysoniana</i>	1/.04/1.0					
<i>Pedicularis racemosa</i>			4/.13/.50			
<i>Potentilla</i> spp	1/.12/1.0		Tr/.05/.50			
<i>Pyrola secunda</i>			2/.18/1.0			4/.21/1.0
<i>Ranunculus</i> spp	5/.24/1.0					
<i>Senecio crassulus</i>	7/.24/1.0		2/.20/.50			
<i>Silene parryi</i>	1/.04/1.0					
<i>Taraxadum officinale</i>	1/.08/1.0		1/.05/1.0			1/.03/.50 ^w
<i>Thalictrum occidentale</i>	7/.20/1.0			15/.37/1.0		9/.29/1.0 ^w
<i>Thalictrum venulosum</i>			27/.48/1.0			
<i>Trifolium haydenii</i>	9/.48/1.0		9/.23/1.0			
<i>Valeriana dioica</i>	4/.20/1.0					
<i>Valeriana</i> spp				1/.02/.50		
<i>Viola nuttallii</i>			1/.08/1.0		2/.15/1.0	
<i>Zigadenus elegans</i>	2/.08/1.0					
<i>Zigadenus venosus</i>					1/.10/1.0	
TOTAL FORBS		62/.88/1.0	70/.93/1.0	50/.97/1.0	46/.95/1.0	48/.95/1.0
SHRUBS AND TREES:						
<i>Abies lasiocarpa</i>	16/.40/1.0		9/.20/.50	2/.07/.50	5/.05/1.0	5/.24/1.0
<i>Acer glabrum</i>						1/.04/.25
<i>Berberis repens</i>			1/.03/.50	1/.10/1.0		
<i>Clematis columbiana</i>				2/.10/1.0		2/.10/.25
<i>Clematis</i> spp			1/.03/.50			
<i>Lonicera utahensis</i>						2/.03/.25

Table 7. (continued)

		Habitat Types				
		ABLA/ARCO	ABLA/CLPS	ABLA/CARU	ABLA/CAGE PSME Phase	ABLA/VAGL
	# Sites	1	2	2	1	4
TAXA	# Frames	25	40	60	20	80
SHRUBS AND TREES: (continued)						
Picea spp			1/.05/.50			
Pseudotsuga menziesii						1/.11/.50
Ribes setosum	2/.04/1.0					
Rosa spp						1/.04/.25
Shepherdia canadensis						1/.01/.25
Spiraea betulifolia			1/.03/.50	11/.48/1.0		9/.30/1.0
Symphoricarpos albus				1/.05/.50		2/.04/.25
Vaccinium membranaceum						39/.76/1.0
Vaccinium scoparium						2/.05/.25
TOTAL BROWSE		17/.44/1.0	11/.25/.50	16/.55/1.0	5/.05/1.0	50/.86/1.0 ³⁴
Selaginella densa					3/.40/1.0	
Moss	13/.48/1.0		3/.28/1.0	5/.25/.50	1/.10/1.0	13/.51/1.0
Lichens					1/.35/1.0	
Polystichum lonchitis						Tr/.01/.25
TOTAL VEGETATION		76/1.0/1.0	75/.98/1.0	80/1.0/1.0	70/1.0/1.0	78/.99/1.0
Bareground		00/ 00/ 00	00/ 00/ 00	3/.15/1.0	7/.30/1.0	1/.06/.50
Rock		12/.48/1.0	1/.18/1.0	4/.20/1.0	9/.50/1.0	
Litter		85/1.0/1.0	91/1.0/1.0	88/1.0/1.0	80/1.0/1.0	95/1.0/1.0

¹Taxon which obtained a minimum coverage of .5% or frequency of .05.

²See Table 2 for habitat type abbreviations.

³Less than .5% canopy cover.

⁴Mean of the total plant class among sites.

Festuca idahoensis/Agropyron smithii (FEID/AGSM)

(Idaho fescue/western wheatgrass h.t. (Mueggler 1974))

This h.t. occurred at the base of the mountains on gentle rolling or flat footslopes of the winter range at elevations below 1585 m. In most areas the original Idaho fescue/western wheatgrass (*Agropyron smithii* Rydb.) community has been replaced by agricultural crops or seeded pasture or is grazed heavily by domestic livestock. Bucsis (1974) also described this h.t. in the Bridger Mountains 14.5 km north on the Armstrong winter range. It was a relatively minor h.t., currently making up only 2.1 percent of the winter range (Table 3). Low-growing vegetation was well developed, with grasses having a mean canopy coverage of over 69 percent (Table 4). Major grasses were Idaho fescue, western wheatgrass, cheatgrass brome (*Bromus tectorum* L.), and Kentucky bluegrass (*Poa pratensis* L.). The latter, possibly due to grazing influences (Bucsis 1974), was by far the predominant grass, averaging 43 percent canopy cover for the two sites sampled. Principle forbs were western yarrow (*Achillea millefolium* L.), cudweed sagewort (*Artemisia ludoviciana* Nutt.), arrowleaf balsamroot (*Balsamorhiza sagittata* (pursh) Nutt.), golden-aster (*Chrysopsis villosa* (pursh) Nutt.), and common salsify (*Tragopogon dubius* Scop.). Shrubs occurred as small thickets of nootka rose (*Rosa nutkana* Presl.) and chokecherry (*Prunus virginiana* L.) or as stringers of willows (*Salix* spp) along ditches and small streams.

Festuca idahoensis/Agropyron spicatum (FEID/AGSP)

Idaho fescue/bluebunch wheatgrass h.t. (Mueggler 1974)

This was the typical grassland type of the area. It was found throughout the winter range, but was especially prevalent north of the mouth of Bostwick Canyon where it appeared to replace big sagebrush dominated h.t.s. It occurred on southerly and westerly exposures at elevations between 1890 m and 1645 m. It comprised 10 percent of the winter range. Small stands may also be found on the summer range as openings on steep dry southerly and westerly exposures within larger stands of other h.t.s. Grass cover was primarily bunch grasses such as Idaho fescue, bluebunch wheatgrass and Junegrass (*Koeleria cristata* (L.) Pers.). Important forbs were western yarrow, arrowleaf balsamroot, field chickweed (*Cerastium arvense* L.), pale alyssum (*Alyssum alyssoides* L.), and common salsify. Shrubs were of minor importance, occurring as very widely scattered big sagebrush and/or Rocky Mountain juniper plants.

Artemisia tridentata/Festuca idahoensis (ARTR/FEID)

Big sagebrush/Idaho fescue h.t. (Mueggler 1974)

The aspect of this type was a sagebrush grassland with conspicuous amounts of Idaho fescue and bluebunch wheatgrass and widely scattered Douglas fir and Rocky Mountain juniper. The type was generally found on the winter range at elevations from 1768 m to 2360 m. It comprised 14 percent of the winter range. The big sagebrush/Idaho fescue h.t.

appeared similar to the big sagebrush/bluebunch wheatgrass h.t.; however, Idaho fescue had a canopy coverage of 5 percent or more (Mueggler 1974) and the total vegetative cover was better developed as a result of greater shrub and forb cover (Table 4) than in the ARTR/AGSP h.t. Also, ARTR/FEID generally occurred at higher elevations and/or in more mesic situations, such as the heads of the small east-west drainages along the mountain front and along ridges that collect considerable amounts of snow.

Important grasses were bluebunch wheatgrass, Idaho fescue and Junegrass. Conspicuous forbs were arrowleaf balsamroot, field chickweed and lupine (*Lupinus* spp). Big sagebrush was the only conspicuous shrub.

Artemisia tridentata/*Agropyron spicatum* (ARTR/AGSP)

Big sagebrush/Bluebunch wheatgrass h.t. (Mueggler 1974)

The aspect of this type was very similar to the ARTR/FEID h.t. Important differences between the two h.t.s included a less conspicuous occurrence of arrowleaf balsamroot, more open vegetation with bare ground more prevalent, and generally drier site conditions for the ARTR/AGSP h.t. (Table 4). The ARTR/AGSP h.t. was found on the winter range south of Bostwick Creek at elevations between 1615 m and 1890 m on steep, well drained, south to west slopes. Rock outcrops and loose, unstable soils were common site characteristics. The type comprised 4.4 percent of the winter range. Principal grasses

recorded were bluebunch wheatgrass, Junegrass, and cheatgrass brome. Major forbs included: arrowleaf balsamroot, field chickweed, lupine and pale alyssum. Big sagebrush was the dominant shrub with nootka rose occurring in lesser amounts.

Philadelphus lewisii/*Symphoricarpos albus* (PHLE/SYAL)

Mockorange/Common snowberry h.t.

This was a distinct, though very minor type on the study area. It occurred on steep, stable talus slopes of westerly and southerly exposures at the bases of major slopes and small draws below 1753 m. It resembled the *Acer glabrum*/*Philadelphus lewisii* h.t. on the Armstrong winter range (Bucsis 1974). The total area occupied was not measured because stands generally were found on small (less than .5 ha) local sites within other h.t.s.

Scattered Douglas fir trees may provide a tall open overstory but the patchy dense shrub understory 1-1½ m in height, is characteristic. The presence of soil at the surface was limited and exposed rock made up over 49 percent of the substrate at the one site sampled (Table 4). This explains the limited forb and grass cover. Wherever the type occurred, mockorange was the most abundant shrub. Other shrub species were numerous and included common snowberry (*Symphoricarpos albus* (L) Blake), skunkbush sumac (*Rhus trilobata* Nutt.), chokecherry, and Rocky Mountain maple (*Acer glabrum*). Important grasses were bluebunch wheatgrass and cheatgrass brome. Forb diversity

was great with many species occurring among different sites but with only three to four being important at any one site. Conspicuous forbs included arrowleaf balsamroot, bedstraw (*Gallium trifidum* L.), goldenrod (*Solidago* spp), and western yarrow.

Pseudotsuga menziesii/*Festuca idahoensis* (PSME/FEID)

Douglas fir/Idaho fescue h.t. (Pfister et al. 1977)

This type was similar in appearance and vegetational composition to the PSME/AGSP and PSME/SYAL-AGSP h.t.s. The presence or abundance of one or more species often was the criteria used in selecting one type over another. The PSME/FEID and PSME/SYAL-AGSP types occurred on less droughtly sites with PSME/AGSP occurring on steep warm dry sites along the mountain front and on some of the major south slopes along the lower portions of the larger canyons. This type comprised 12.4 percent of the winter range and 7.1 percent of the study area.

The understory was dominated by Idaho fescue and bluebunch wheatgrass while needle-and-thread (*Stipa comata* Trin & Rupr.) and Junegrass occurred in lesser amounts (Table 5). Cheatgrass brome was common. The major shrubs were big sagebrush and Rocky Mountain juniper. The greater abundance of big sagebrush in this type also separated it from the two similar open-canopy Douglas fir types. Principal forbs were arrowleaf balsamroot, field chickweed, western yarrow, lupine, golden-aster, pale alyssum, along with many species occurring in minor amounts (Table 5).

Pseudotsuga menziesii/Agropyron spicatum (PSME/AGSP)

Douglas fir/Bluebunch wheatgrass h.t. (Pfister et al. 1977)

Douglas fir/bluebunch wheatgrass h.t. was the dry counterpart of the Douglas fir/Idaho fescue h.t. Understory vegetation was less well developed with a greater amount of bare ground, and big sagebrush was absent except for widely scattered individuals or small groups of plants. This type was restricted to the mountain front except in Jones Creek where it occurred on the north side of the creek from the mouth of the canyon upstream for approximately 2 km. Elevations ranged from 1494 m to 2042 m. The type comprised 2.9 percent of the entire study area and 8.2 percent of the winter range. The overstory consisted of scattered Douglas fir with an occasional limber pine and had a canopy coverage averaging 69.5 percent for two sites measured.

The major grass was bluebunch wheatgrass, with cheatgrass brome and Sandberg bluegrass also conspicuous. Idaho fescue was not encountered in plots on four of six of the sites sampled. The principal shrub was Rocky Mountain juniper with lesser amounts of skunkbush sumac and common snowberry. The more abundant forbs included arrowleaf balsamroot, golden-aster, field chickweed and pale alyssum.

Pseudotsuga menziesii/Calamagrostis rubescens, Calamagrostis rubescens phase (PSME/CARU-CARU Phase)

Douglas fir/pinegrass h.t. pinegrass phase (Pfister et al. 1977)

This type was found only on the summer range. This type was

measured as 4.2 percent of the summering area, but this did not include many sites, too small to measure, scattered across the area. Locally it occurred in all major drainages on minor slopes of all exposures and small benches at elevations between 1950 m and 2316 m. Typically, stands closely resembled Pfister et al.'s (1977) pinegrass phase; however, elk sedge usually was the dominant understory species with a canopy coverage slightly higher than that of pinegrass (*Calamagrostis rubescens* Buckley) (Table 5). Pac (1976) also described this type and phase for the Bridger range.

The overstory usually was dominated by Douglas fir with scattered limber pine occurring on calcareous sites and occasional whitebark pine on sites with a granitic substrate. Understory species included elk sedge, pinegrass, aster spp, heartleaf arnica, raceme pussytoes and woodland strawberry. Shrubs were of minor importance.

Pseudotsuga menziesii/*Carex geyeri* (PSME/CAGE)

Douglas fir/Elk sedge h.t. (Pfister et al. 1977)

This was another relatively open Douglas fir type found on dry, steep slopes of the summer range on all but east and northeast exposures. It comprised 4 percent of the summering area at elevations between approximately 1950 m and 2360 m. The PSME/CAGE and PSME/CARU habitat types are very similar, the former probably occurring on sites where pinegrass can not achieve a coverage of five percent or more (Pfister et al. 1977). Total vegetation and forb cover

of PSME/CAGE was less developed compared with PSME/CARU (Table 5).

Douglas fir was dominant in the overstory with scattered white-bark pine. The understory was made up primarily of elk sedge which had a mean canopy coverage of 53 percent in the two stands examined. Principle forbs were western yarrow, arrowleaf balsamroot, showy aster (*Aster conspicuus* Lindl.) and lupine. White spiraea (*Spiraea betulifolia* Pall.) and Oregon grape (*Berberis repens* Lindl.) were the major shrubs.

Pseudotsuga menziesii/*Symphoricarpos albus* (PSME/SYAL)

Douglas fir/Common strawberry h.t. (Pfister et al. 1977)

This type is one of the more common h.t.s of Montana (Pfister et al. 1977). It was well represented on the study area as well as in portions of the Bridger Range described by Bucsik (1974) and Pac (1976). It covered approximately 20 percent of the entire area at elevations ranging from 1524 m to about 2195 m.

Two phases of this type were identified based on vegetative composition of the understory (Pfister et al. 1977). These were the pinegrass phase and the bluebunch wheatgrass phase.

The pinegrass phase typically occurred on the north slopes of the winter range where it was found in all drainages. It comprised 36.6 percent of the winter range. On summer range, it occurred on all exposures and in most instances gradually lapses into forest habitat types characterised by *Vaccinium* understories. The overstory

in all cases is a closed canopy of Douglas fir, which had a mean canopy coverage of 95 percent for seven sites measured. Lodgepole pine (*Pinus contorta* Cougl.) was present in small numbers. The striking features of the understory were a low, evenly distributed shrub layer of common snowberry and white spiraea and a well developed grass layer, primarily of pinegrass with a lesser amount of elk sedge. Characteristic forbs of this phase were woodland strawberry (*Fragaria vesca* L.), raceme pussytoes (*Antennaria racemosa* Hook.), showy aster, sulfur lupine (*Lupinus sulphureus* Dougl.), rough-fruited fairybell (*Disporum trachycarpum* (Wats.) B. & H.) and Rocky Mountain woodsia (*Woodsia scopulina* D.C. Eaton.).

The bluebunch wheatgrass phase was characterized by a much more open overstory than the pinegrass phase and occurred on drier, southerly and westerly exposures. It covered 7.2 percent of the winter range and 4.7 percent of the entire study area. Typically this phase was associated with Douglas fir/bunchgrass h.t.s in an intricate mosaic. The PSME/SYAL-AGSP phase occurred where trees were more clustered with either the PSME/FEID or PSME/AGSP h.t.s being found where the tree cover was more open and/or the site more droughty. This probably reflects a transitional zone between types and/or environments (Pfister et al. 1974), and made delineation of these types difficult.

The overstory consisted of Douglas fir interspersed with widely scattered limber pine. Shrubs included common snowberry, scattered

thinly over the more open areas and in patches under areas with a well developed Douglas fir canopy. A number of other species occurred in small amounts. Important grasses were elk sedge, bluebunch wheatgrass, and Idaho fescue. Pinegrass was present in small amounts where a good snowberry cover occurred. A diversity of forbs occurred with both moist and dry forms present. Principal forbs were arrowleaf balsam-root, heartleaf arnica (*Arnica cordifolia* Hook.). Woodland and Virginia strawberry (*Fragaria virginiana* Duch.) and field chickweed.

Pseudotsuga menziesii/*Physocarpus malvaceus*, *Calamagrostis rubescens*
Phase (PSME/PHMA, CARU Phase)

Douglas fir/Ninebark h.t. pinegrass phase (Pfister et al. 1977)

This type was represented on the study area by a single stand located in the lower third of Middle Cottonwood Canyon. This stand comprised 1.6 percent of the area and ranged in elevation from 1585 m to 1860 m. The overstory was comprised of a closed canopy of almost pure Douglas fir, with some lodgepole pine and a few limber pine trees found on rock outcrops and near ridges. The shrubby understory was made up of a patchy layer of ninebark (*Physocarpus malvaceus* (Greene) Kuntze.), 1-1½ m tall, with a lower layer of white spiraea and common snowberry evenly distributed between the taller patches. Pinegrass, together with a lesser amount of elk sedge, formed a well developed grass layer. Important forbs were heartleaf arnica, rough-fruited fairybell, woodland strawberry, raceme pussytoe;

rattlesnake plantain (*Goodyera oblongiflora* Raf.) and lupine.

Pfister et al. (1977) indicated that this phase may be transitional to the PSME/CARU or PSME/AGSP habitat type. Considering the amount of common snowberry and pinegrass present the stand observed could also represent a transition to the PSME/SYAL-CARU phase h.t. which was prevalent on forested north slopes in the vicinity of the study area. South of the study area, however, ninebark is a more common plant.

Pseudotsuga menziesii/Vaccinium globulare, *Vaccinium globulare* Phase (PSME/VAGL, VAGL phase)

Douglas fir/Blue huckleberry h.t. Blue huckleberry Phase (Pfister et al. 1977)

Other than the combined phases of PSME/SYAL this was the most abundant h.t. on the area (19 % of the study area). Combined with *Abies lasiocarpa/Vaccinium globulare* h.t., the *Vaccinium*-dominated types covered 32.5 percent of the study area (Table 6). The Douglas fir/blue huckleberry type was found in all major drainages, primarily on the summer range, on all exposures and declivities, and at elevations ranging from 1707 m to 2195 m. All stands encountered were typical of the *Vaccinium globulare* phase (Pfister et al. 1977).

Douglas fir was the indicated climax species in the overstory, but usually shared or ranked second in dominance to lodgepole pine. Understories were dominated by an evenly distributed shrub layer

comprised of thinleafed huckleberry (*Vaccinium membranaceum* Dougl.) with lesser amounts of white spiraea. Pfister et al. (1977) accepts *V. membranaceum* as being *V. globulare*. A well developed pinegrass layer occurred under the shrub layer. Conspicuous forbs of the type were raceme pussytoes, heartleaf arnica, side-bells wintergreen (*Pyrola secunda* L.) and white hawkweed (*Hieracium albiflorum* Hook.). A ground moss was also an important part of the vegetational composition.

Abies lasiocarpa/Arnica cordifolia (ABLA/ARCO)

Subalpine fir/Heartleaf arnica h.t. (Pfister et al. 1977)

The ABLA/ARCO type was a very minor h.t. which covered less than one percent of the area. Like other subalpine fir h.t.s, it was found only on the summer range. Only a single site at the head of Bostwick Creek was encountered. This site was a gentle north slope with a steep incline to the east and a lesser incline on the west. The elevation ranged from 2256 m to 2438 m.

Vegetational composition was very diverse, though there was a marked paucity of grasses. Subalpine fir and spruce (*Picea* spp.) co-dominated in the overstory with Douglas fir and limber pine occurring in lesser amounts. Together, these species formed a closed canopy. Spruce was more abundant in this type than in any other. Over 15 percent of the ground cover was shrubby subalpine fir, with other shrubby species being of only minor importance. Twenty-three species of forbs were encountered in the 25, 2 X 5 dm plot frames examined (Table 7).

The more conspicuous forbs were heartleaf arnica, northern bedstraw, haydens clover (*Trifolium haydenii* Porter.), western meadow rue (*Thalictrum occidentale* Gray.), and thickleaf groundsel (*Senecio crassulus* Gray.). Spotted frasera (*Frasera speciosa* Dougl.) was also quite noticeable but was not encountered in sampling.

Abies lasiocarpa/*Calamagrostis rubescens* (ABLA/CARU)

Subalpine fir/Pinegrass h.t. (Pfister et al. 1977)

Subalpine fir/pinegrass h.t. appeared to replace PSME/CARU (Pfister et al. 1977) at higher elevations and/or on cooler, more moist sites. Where noted, it was limited to west-through-south exposures at elevations of 2164 m to 2438 m. This was a fairly minor summer range type, comprising only 1.3 percent of the summering area. The aspect was one of open forest with a well developed grass understory. Pfister et al. (1977) reported a luxuriant mat of pinegrass and elk sedge in young open stands, as was the case for the site near the head of Bostwick Creek. In all cases, overstory and reproduction were dominated by Douglas fir, with scattered mature or young subalpine fir throughout. Lodgepole pine was a minor component of the overstory. A grass layer of pinegrass and elk sedge characterized the understory. White spiraea was the dominant shrub with lesser amounts of Oregon grape. Western meadow rue and heartleaf arnica were conspicuous forbs with showy aster, woodland strawberry and northern bedstraw found in lesser amounts (Table 7).

Abies lasiocarpa/*Carex geyeri*, *Pseudotsuga menziesii* Phase (ABLA/CAGE, PSME Phase)

Subalpine fir/Elk sedge, Douglas fir phase (Pfister et al. 1977)

This type may occur on some of the driest sites on which subalpine fir occurs (Pfister et al. 1977). It was a minor type, covering only 1.1 percent of the summer range, and was found only in the head of Middle Cottonwood drainage on a major, steep south-facing slope between 2164 m and 2500 m. Pfister et al. (1977) recognized two phases of this type, an elk sedge phase in which subalpine fir and lodgepole pine are the only major tree components, and a Douglas fir phase which occurs on warmer sites has a greater forb component, and is dominated by Douglas fir. Only the Douglas fir phase occurred on the area; however, subalpine fir was well represented in the overstory with lesser amounts of whitebark pine, lodgepole pine and limber pine. Shrubs were of minor importance. Important forbs included heartleaf arnica, arnica (*Arnica latifolia* Bong.), western yarrow, arrowleaf balsamroot, and houndtongue hawkweed (*Hieracium cynoglossoides* Arv.).

Abies lasiocarpa/*Clematis pseudoalpina* (ABLA/CLPS)

Subalpine fir/Virgin's bower h.t. (Pfister et al. 1977)

This was one of the four major h.t.s on the study area comprising 14.3 percent of the study area (Table 3). Stands occurred at elevations from 2134 m to the Bridger crest, where trees become stunted at about 2713 m. Typically the type was found on steep, dry, south to northwest slopes on calcareous substrates. Its aspect

was either one of clumps of trees interspersed with forb meadows, or of open forest having a well developed forb understory interspersed with subalpine fir-spruce thickets. Subalpine fir is indicated as the climax species (Pfister et al. 1977) but in stands on the study area this species shares the overstory with Douglas fir, limber pine and spruce. The abundance of Douglas fir decreased with elevation while limber pine increased in dominance on the drier south slopes and convex west slopes. Subalpine fir and spruce achieved greatest densities on concave west slopes and northerly aspects. Heartleaf arnica, *Arnica latifolia*, spotted fraseria, northern bedstraw, western meadowrue, Hayden's clover and mountain sweetroot (*Osmorhiza chilensis* Hook & A.) were principle forbs. Shrub and grass species sampled appeared to be inconsistent (Table 7) in occurrence. The interspersed forb meadow portions of this type resemble Pac's (1976) description of the Krummholz h.t. elsewhere in the Bridger mountains.

Abies lasiocarpa/Vaccinium globulare (ABLA/VAGL)

Subalpine fir/Blue huckleberry h.t. (Pfister et al. 1977)

Subalpine fir/blue huckleberry was another of the major h.t.s, covering nearly 14 percent of the study area. Stands occurred in all major drainages and on all slopes and exposures over a wide elevational range from 1890 m to 2530 m. This type is similar to PSME/VAGL with which it shared many of the same species, except for the occurrence of subalpine fir, which moved in at higher elevations and on

cooler, more moist sites. Douglas fir was the dominant tree in most stands with subalpine fir and lodgepole pine occurring in about equal amounts as co-dominants. This type also seemed to occur on sites that were beyond the ecological tolerance limits of pinegrass. While total grass cover was about the same as in the PSME/VAGL h.t., there was a shift from pinegrass to elk sedge (Table 7). As in the PSME/VAGL h.t. thinleaf huckleberry and white spiraea formed a distinct shrub layer. At seeps and in other wet areas, dense patches of mountain alder (*Alnus sinuata* (Regel) Rydg.) were common. Other important species found were heartleaf arnica, showy aster, rattlesnake plantain, western meadow rue, mountain sweetroot, and side-bells wintergreen.

Pinus flexilis/*Juniperus communis* (PIFL/JUCO)

Limber pine/common juniper h.t. (Pfister et al. 1977)

The PIFL/JUCO h.t. occupied approximately 3 percent of the area, occurring on generally convex, dry west to south slopes at elevations above 2073 m. It appeared similar in composition to stands of the ABLA/CLPS h.t. on drier sites, but apparently was too dry and/or warm for subalpine fir. The transition between these two h.t.s seems to be very broad with some widely scattered subalpine fir occurring in a PIFL/JUCO stand. Among stands examined the overstory generally was dominated by limber pine with Douglas fir as a co-dominant. At higher elevations almost pure stands of limber pine were found. The under-story was the most diverse encountered of any of the habitat types

sampled. Conspicuous shrubs included common juniper (*Juniperus communis* L.) throughout the stands and Canadian buffaloberry (*Shepherdia canadensis* Nutt.) in all but the highest stands. Forbs were very diverse, many occurring in small amounts. However, northern bedstraw, roundleaf harebell (*Campanula rotundifolia* L.), milkvetch (*Astragalus miser* Dougl.), Nuttall rockcress (*Arabis nuttallii* Robin.), and *Arnica latifolia* appeared to be consistently common (Table 6).

General vegetative characteristics of the study area resembled those described for the Bridger Range in the vicinity of the Armstrong winter range, about 14.5 km to the north (Fig. 1), by Schwarzkoph (1972), Bucsis (1974) and Pac (1976). The principle differences observed were the lack of antelope bitterbrush (*Purshia tridentata* (pursh.) DC) habitats on the Schafer winter range and the lack of both whitebark pine (*Pinus albicaulis* engelm.) habitats and extensive alpine areas on associated summer range. Vegetational data also indicated several, possibly important differences between the two areas.

Summer range on Schafer Creek included approximately 80 percent more area covered by Douglas fir and subalpine fir habitat types (Table 8). It included more area dominated by shrub understory (62 % vs 44 %) and less with grass-forb understory (36 % vs 49 %). Because shrub-dominated habitats tended to have well developed overstories, the Schafer Creek range may also have included a higher proportion of closed-canopy forest than the Armstrong area.

Table 8. Vegetative comparisons of Schafer Creek study area and the Armstrong area.

Habitat	<u>Schafer Creek</u> %	<u>Armstrong</u> %
Summer Range ¹		
Douglas fir	61	36
Subalpine fir	34	20
Shrub understory	62	44
Grass-forb understory	36	49
Winter Range ²		
Closed and semi-closed forest	48	48
Grassland	12	14
Shrubland	18	36
Open Douglas fir and/or Rocky Mountain juniper	21	3
Snowberry understory	44	7

¹Armstrong data from Pac (1976).

²Armstrong data from Bucsis (1974).

Winter range on the two areas appears to include proportionately similar amounts of both closed or semi-closed forest types and grassland types (Table 8). Low shrub (big sagebrush, bitterbrush) habitats appeared about twice as extensive on the Armstrong winter range, covering 36 percent of that area (Bucsis 1974) as compared with 18 percent of the Schafer Creek winter range. Open Douglas fir-juniper habitats, however, were more abundant on the Schafer area. There also was a distinct difference in the occurrence of snowberry habitat, which comprised nearly 44 percent of the Schafer Creek winter range but only 7 percent of the Armstrong winter range (Table 8).

Distribution, Movement and Home Range

Dispersal from the winter range in 1977 began in late April and extended through mid-May. All radio-marked deer which eventually left the winter range had done so by May 22. Figure 4 shows general areas in which marked mule deer were observed after they left the winter range. The approximate average movement from the winter range to these points was 4.8 km. Dispersal distances ranged from essentially zero for one female, which remained on the winter range, to 29 km for a yearling male. Except for this buck, which may not have returned to the winter range, the average movement was 3.7 km.

Two major routes (Fig. 4) were used by deer leaving the winter range in spring and returning during fall. The north ridge of Bostwick Canyon was used by deer traveling to the north end of the study area and into the Bostwick drainage. The ridge forming the Schafer-Middle Cottonwood Creek and Bostwick-Middle Cottonwood Creek divides was used by deer moving to the south and into the Middle Cottonwood drainage. Travel corridors used during spring appeared to be wider and less well defined than those followed during the fall migration.

Robinette (1966) pointed out the tendency of deer to "tarry" at certain points along migration routes while Bertram and Remple (1977) described definitive holding areas which were considered as "key" spring and fall habitats for migrating mule deer of the North Kings herd in California. Three such concentration or "holding" areas,



Figure 4. Aerial photo showing boundaries of the total Schafer Creek winter range and principal winter area together with travel corridors, holding areas and general locations of marked mule deer after departure from the winter range.

(Bertram and Remple 1977, Pac 1976) were identified; one on the Bostwick route and two on the Middle Cottonwood route. The Bostwick holding area was large and linear, with apparently lower deer densities than the two smaller Middle Cottonwood areas. The eastern Middle Cottonwood area was used primarily in fall while the others received both spring and fall use. Enduring snow cover and the lack of early spring growth on the eastern Middle Cottonwood holding area probably reduced its early spring use by deer. Pac (1976) identified and described similar holding areas along migration routes used by mule deer associated with the Armstrong winter range; however, these areas typically were on southerly and westerly slopes typified by relatively open habitat types. On the Schafer Creek study area, northerly slopes and *Vaccinium* habitat types were common components of holding areas.

All deer with continuously functioning radio-collars appeared to follow the same routes in spring and fall with the exception of one adult male. This animal (ch 4-4) followed a circular route using the Bostwick corridor for spring travel and the Middle Cottonwood corridor in the fall. Movements of radio-collared deer appeared to generally represent movements of the entire winter range herd in the timing of departure and arrival on the winter range.

Though deer were able to cross the Bridger divide anywhere along the east boundary of the study area, only one marked animal (ch 3-7)

used the east slope during the study. This doe moved to the head of Middle Cottonwood creek in early June and subsequently was relocated June 16, 2.5 km northeast on the east side of Saddle Peak. On June 30 the doe was back at the June 16 location to remain on the west slope apparently for the duration of the study period. Immediately following the termination of field studies, two marked animals were known to have crossed the Divide. One, a female radio-collared in April 1978, moved 15.7 km east from the winter range to summer at the head of Weasel Creek. The other, a 2½ year-old male, was shot by a hunter 7 km southeast in Beasley Creek (Mackie pers. comm.). In October many tracks were observed crossing Ross Pass into the head of Jones Creek. Hamlin (1974) also observed this and concentrations of deer north of Ross Pass.

Winter and summer-early fall activity centers and polygon home ranges of radio-collared deer are shown in Figures 5 and 6, respectively. These data indicated some association among certain adult females throughout the year, except during the fawning and early summer periods, as documented by Miller (1974) among blacktail deer. Five of nine radioed females (chs 3-3, 3-6, 3-7, 3-8 and 4-3), and a neckbanded female (number 2277) shared the same portion of the winter range and subsequently moved to the same area in the head of Middle Cottonwood Creek to summer. Summer activity centers all fell within a circle with a radius of 240 m and winter 1977-78 activity

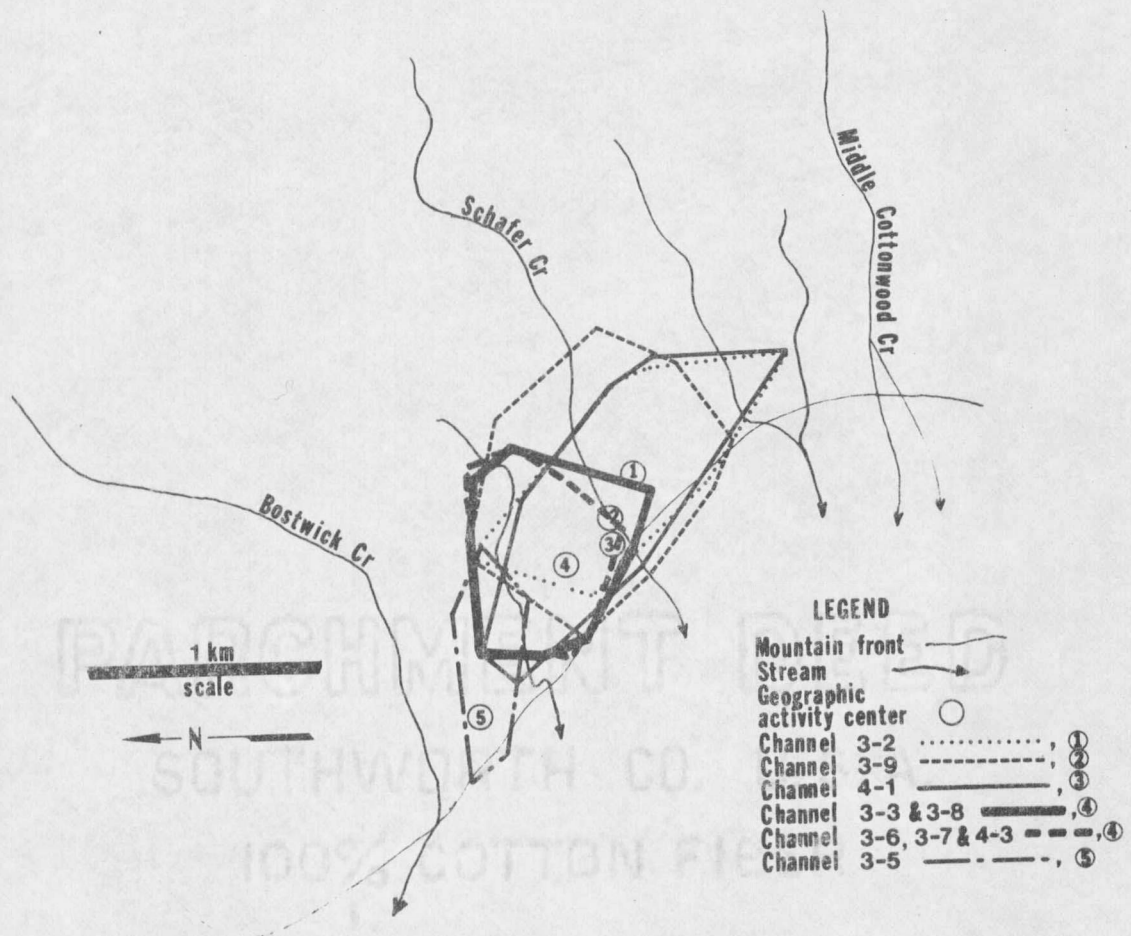


Figure 5. Activity centers and polygon home ranges of radio-collared mule deer on the Schafer Creek winter range 1977-78.

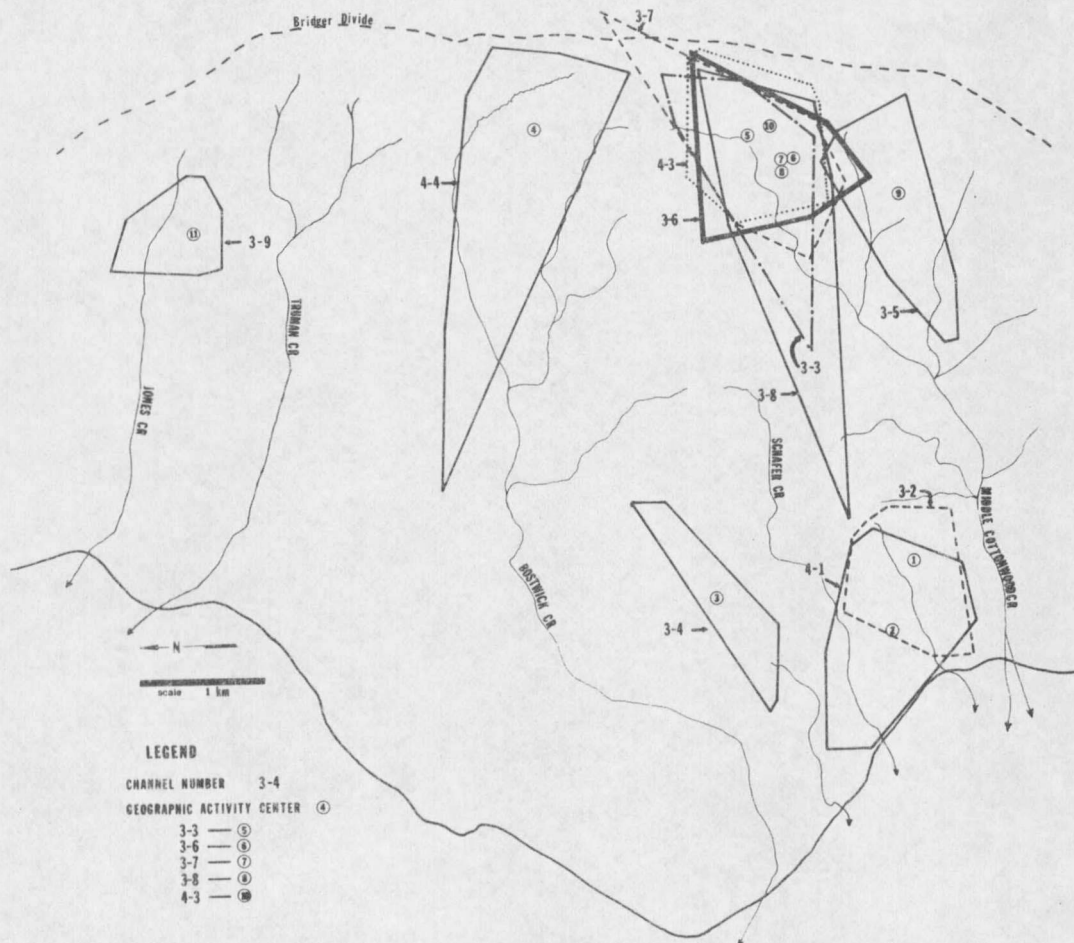


Figure 6. Summer-early fall activity centers and polygon home ranges of radio-collared mule deer associated with the Schafer Creek winter range.

centers of all six females coincided (Figs. 5 and 6). The mean coefficient of association (Knight 1970) of these females for the winter of 1977-78 was .65 with a range of .51 to .82 for the 15 possible associations. Two other radio-collared females (chs 3-2 and 4-1), with a coefficient of association of .62 for late winter 1976-77, spent spring through fall in close proximity to one another on and just east of the winter range. For the winter of 1977-78 these two animals had a coefficient of association of .56. One of these females was also apparently associated with a neckbanded adult female and a male neckbanded as a fawn. All three were observed together April 1977. Later, during the summer, the male was observed bedded within 500 m of the two females which were bedded within 50-100 m of one another. Upon return to the winter range, their mean coefficient of association was .62, when the male was one and one half years old. Appendix Table 24 lists coefficients of association for 16 marked mule deer observed regularly during the winter of 1977-78.

It may be possible that close associations among some animals result from parent-offspring relations which in turn result in development of traditional group movement and seasonal distribution patterns. Hamlin (pers. comm.) has observed neckbanded and radio-collared mule deer, in the Missouri River breaks, to form apparent family groups during late summer-early fall. These groups last

through the winter and into May and form again the following late summer.

Home range size, standard diameters (Harrison 1958) and average activity radii (Hayne 1949) by season for radio-collared deer are listed in Tables 9 and 10 respectively. Table 11 lists winter 1977-78 home range size, average activity radii and standard diameter for 13 neckbanded deer for which there were more than 10 observations. Home ranges include all points of relocation unless otherwise specified.

Though the number of males for which data were available is low, it appeared generally that, males had larger home ranges, activity radii and standard diameters than did females (Tables 9, 10 and 11). Exceptions to this were radioed males, which had smaller average home ranges and standard diameters in summer; however, values for these males fell within the range of female values (Tables 9 and 10). Neckbanded adult males also had significantly ($P < .05$) smaller average home ranges as well as activity radii and standard diameters than females during winter (Table 11). If data for one neckbanded adult male, relocated five times in summer, are included in the calculations for radio-collared males during summer, only home range size was smaller than females during that period. The tendency for males to have larger home ranges than female deer is well documented in the literature.

Table 9. Seasonal range size in hectares for radioed collared mule deer associated with the Schafer Creek winter range.

	Late Winter 1976-77	Spring Migration	Summer	Early Fall	Late Fall & Hunting Season	Winter 1977-78
Females	ha	ha	ha	ha	ha	ha
3-2	200	6	50	40	37	68
4-1	100	20	73	126	30	77
3-9	100	381	39	29	-	93
3-3	100	92	37	51	53	60
3-6	100	186	207	113	2	43
3-7	100	102	120	93	23	44
3-8	100	156	53	335	1	58
4-3	100	537	100	121	7	48
3-5	100	62	73	50	28	34
$\bar{X}$	111	171	84	106	23	58
Males						
4-4	60	765	66	658	292	-
3-4	700	101	37	67	28	-
4-2	400	39	-	-	-	-
$\bar{X}$	387	302	52	363	160	-
$\bar{X}$ all	180	204	78	153	50	58

Table 10. Seasonal average activity radius and standard diameter, in meters, for radio-collared mule deer associated with Schafer Creek winter range.

Channel	Late Winter 1976-77		Spring		Summer		Early Fall		Summer- Early fall		Late Fall		Winter 1977-78	
	AAR ¹	SD ²	AAR	SD	AAR	SD	AAR	SD	AAR	SD	AAR	SD	AAR	SD
3-2	200	500	170	390	470	1030	300	700	350 ³	850	360	780	340	780
4-1	200	510	240	560	420	960	590	1300	580 ⁴	1260	300	680	310	800
3-9	200	540	1340	2780	310	730	250	550	280	640	-	-	350	800
3-5	200	500	720	1480	360	840	550	1270	450	1100	990	2020	250	650
3-3	200	420	590	1370	270	690	610	1500	380	1080	490	1080	260	590
3-6	400	900	1110	2380	640	1750	490	1120	600	1510	230	520	240	540
3-7	200	520	1030	2180	530	1520	500	1100	540	1380	430	860	240	530
3-8	500	1130	1430	3030	320	710	840	2170	540	1480	440	920	270	610
4-3	400	990	1930	4110	360	950	580	1220	450	1080	490	1030	250	560
$\bar{X}$ ♀	278	668	951	2031	409	1020	523	1214	463	1153	466	986	279	651
4-2	500	1080	1000	2150	-	-	-	-	-	-	-	-	-	-
4-4	300	580	2480	5340	430	930	1260	3070	750	2050	1130	2420	-	-
3-4	500	1090	790	1730	430	1020	460	1030	530	1220	360	860	-	-
$\bar{X}$ ♂	433	971	1423	3073	430	975	860	2050	640	1635	745	1640	-	-
$\bar{X}$	317	730	1069	2292	413	1012	585	1366	495	1241	522	1117	279	651

¹ Average Activity Radius

² Standard Diameter

³ Spring-Summer-Fall

⁴ Summer-Fall

Table 11. Home range size, in hectares, average activity radius and standard diameter, in meters, for neckbanded mule deer on the Schafer Creek winter range, 1977-78.

Animal Number	Home Range (ha)	Average Activity Radius (m)	Standard Diameter (m)	Number of Observations
Adult Females				
2217	30	200	480	35
2277	60	300	580	39
2077	60	400	870	27
2157	40	200	570	21
2085	50	300	670	26
2075	50	300	760	22
2287	20	300	650	14
$\bar{X}$ ♀	44	286	654	26
Adult Males				
2045	10	200	380	20
2067	30	400	740	15
2237	20	200	470	19
$\bar{X}$	20	267	530	15
Yearling Males				
2207	70	300	780	39
2167	50	300	670	21
2087	40	300	770	25
$\bar{X}$	53	300	740	28
$\bar{X}$ ♂	37	283	635	23
$\bar{X}$ All	41	285	645	25

For the entire year (March 20, 1977 to April 27, 1978) the radio-collared deer collectively ranged over an area of 49 km² (standard diameter of 4.8 km) around a common geographic activity center situated near the head of Jackrabbit Creek on the

upper limits of the winter range. This represents the minimum area required for the Schafer winter range herd to maintain itself. This minimum area, of course, increases with the inclusion of the marked animals known to have used areas east of the Bridger Mountain divide during the summer of 1978. A closer representation of the true "herd range" size would be obtained with more marked animals.

The overall mean spring home range size of 204 ha was partially dependent on the distance any particular deer migrated away from the winter range. Also inflating spring home range size was the tendency of deer to wander enroute to their respective summer ranges. Average activity radii for females and males was 951 m and 1423 m respectively (Table 10). These averages were much larger than those reported for deer associated with the Armstrong winter range (Appendix Table 26), but fall within the range of spring average activity radii reported by Hamlin (1974) and Mackie et al. (1976).

Summer home ranges averaged 84 ha for females and 52 ha for two adult males (one radio ceased to function in May). Pac (1976) reported a mean home range of 107 ha for five radio-collared females associated with the Armstrong range for approximately the same annual time period. Other studies reported 311 ha for a female on a prairie-breaks area of Montana (Knowles 1975), and 40 ha for mule deer summering in the mountains of western Montana (White 1960). Average activity radii for this time period were 409 m for females and 430 m for males.

Three adult females (chs 3-2, 3-6 and 3-7) moved off of their "normal" home range during June and returned by June 30. One of these females moved approximately one km west, another moved one km northeast and the third moved over the Bridger divide as previously mentioned. None of these areas was used during the remainder of the summer. In all cases, these movements occurred at the time of expected fawn drop, and it is possible that they were associated with fawning. If this was the case, the fawns would have had to make substantial moves while still quite young, particularly that of the female crossing the divide. Dood (1978) reported fawns being able to make extended moves while very young on a prairie-breaks area.

Mean home range sizes, average activity radii and standard diameters increased for both males and females during early fall. By this time the growing season had ended, first snows had occurred, and deer made rapid short-term moves to areas that were snow free. Also the two radioed females that summered on the winter range may have been displaced during the first three weeks of hunting season. An adult female had ranged in the vicinity of an aspen patch since July where it was joined by another female on October 12. Both deer were relocated in this area October 18, four days prior to hunting season. By October 27, after hunting began, both moved approximately .5 km north to a heavily forested north slope along Schafer Creek. On November 16 both had returned to the pre-hunting location.

For the summer-early fall period the average home range size was 173 ha for all radio-marked deer (females 178 ha, males 152 ha). Three deer (females 3-2 and 3-9 and male 3-4) which summered in pre-dominately closed-canopy habitats, had significantly smaller home ranges ($P < .05$) (Fig. 6) and moved significantly less ($P < .05$) between relocations (Fig. 7) than eight others which summered on areas of broken timber cover. The restricted usage of a heavily forested area by one male caused the mean summer-early fall home range size of males to be less than that for females; however, the average activity radius, standard diameter and mean distance between relocations were larger for males, (Table 10, Fig. 7 and Appendix Table 25); indicating males were more mobile within their home ranges than were females. Summer-early fall activity radii were larger than Pac (1976), Hamlin (1974) and Schwarzkoph (1973) have reported for deer in the Bridger Mountains (Appendix Table 26), while home range size may be more comparable (Pac 1976). All radio-collared females returned to the same summer areas in 1978 as used in 1977 (Pac pers. comm.).

The average late fall home range size was 23 ha for females and 160 ha for males. These were the smallest home ranges recorded for any season and probably reflect the directness of movement towards the winter range, concentration on holding areas and a limited number of relocations. As noted earlier, travel corridors were apparently much narrower in fall than in spring though the same general routes were

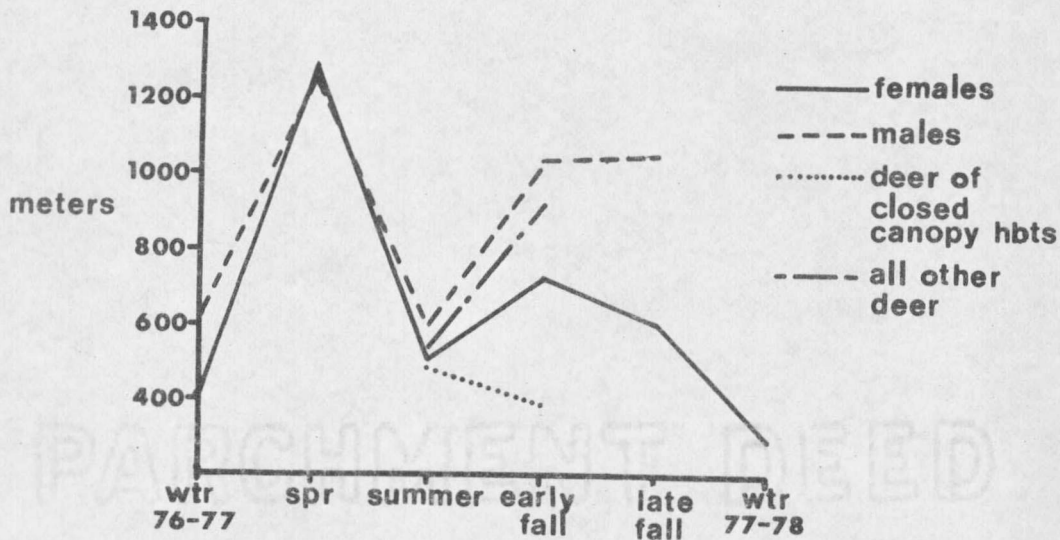


Figure 7. Mean distance between relocations for radio-collared mule deer associated with the Schafer Creek winter range by season.

followed. An adult, 5 year-old, male (ch 4-4) had a large fall home range of 290 ha, possibly due to rutting movements. This buck moved an average of 1.5 km between fall relocations (Appendix Table 25) and was in a different area of the Middle Cottonwood drainage at each relocation. Another older buck, about $8\frac{1}{2}$ years old (ch 3-4) did not exhibit such drastic fall movements averaging only .6 km between relocations, with all being on or very close to its summer home range. Average activity radii increased, during late fall, from the means for the summer, but decreased from early fall (Table 10). Standard diameters also decreased after early fall.

Average home range size of radioed deer for the winter 1976-77 was 180 ha. Weather and snow conditions were very mild and data were obtained only during the last month of winter when deer were beginning to move about prior to leaving the winter range. During this period three males had an average home range of 387 ha, which was significantly greater ($P < .05$) than 111 ha for nine females. During the 1976-77 winter, the largest (700 ha) and the smallest (60 ha) home ranges recorded were for males. Average activity radii and standard diameters were also significantly greater ($P < .05$) for males.

The winter of 1977-78 was more severe than the previous winter (Table 1). Twenty-two marked mule deer (16 females, 6 males) had an average home range of 48 ha. Male and female neckbanded deer and female radio-collared deer had home ranges of 37, 44, and 58 ha respectively (Tables 9 and 11). Home ranges of radioed females were significantly smaller ($P < .05$) during the 1977-78 winter than the 1976-77 winter. There was no significant difference ($P > .05$) between neckbanded males and females; however, neckbanded does had significantly ($P < .10$) smaller winter home ranges than radio-collared does. This was probably due to the low ability to observe and identify non-radio marked deer. Home ranges among radio-collared females which remained on the Armstrong winter range averaged 109 ha for winter 1976-77 and 87 ha during the winter 1977-78 (Youmans in prep.). Yearling males had significantly ($P < .05$) larger home ranges (53 ha) than adult males (20 ha). Adult

males were relatively sedentary on the winter range while yearling males were still associated and travelled with female-fawn groups. Schwarzkoph's (1973) data for the Armstrong area indicated smaller average activity radii and home ranges for two yearling males than for two adult males, contrary to the findings of this study.

All radio-marked females returned in 1977-78 to the same portion of the winter range that had been used the previous winter. However, three (chs 3-2, 3-9 and 4-1) showed home range shifts during the course of the winter (Fig. 8). All three initially used the same area south of Schafer Creek where slopes are 20-25° with a west-southwesterly exposure. When snow depth reached 35-45 cm and became somewhat compacted, between January 20 and February 5, they moved approximately 500 m northwest across Schafer Creek, where slopes were steeper, more southerly in exposure, and snow accumulation was less. Gilbert et al. (1970) reported snow depth of 45 cm or more precluded range use and caused concentrations of mule deer in Colorado. By March 17, when snow cover was beginning to break, all returned to re-establish home ranges with activity centers within 100 m of their early winter activity centers.

These movements were typical of virtually all deer which used the area between Schafer and Middle Cottonwood Creeks in early winter. From December 21 to the end of January, 276 deer were observed south of Schafer Creek prior to heavy snow accumulation. From February 1 to

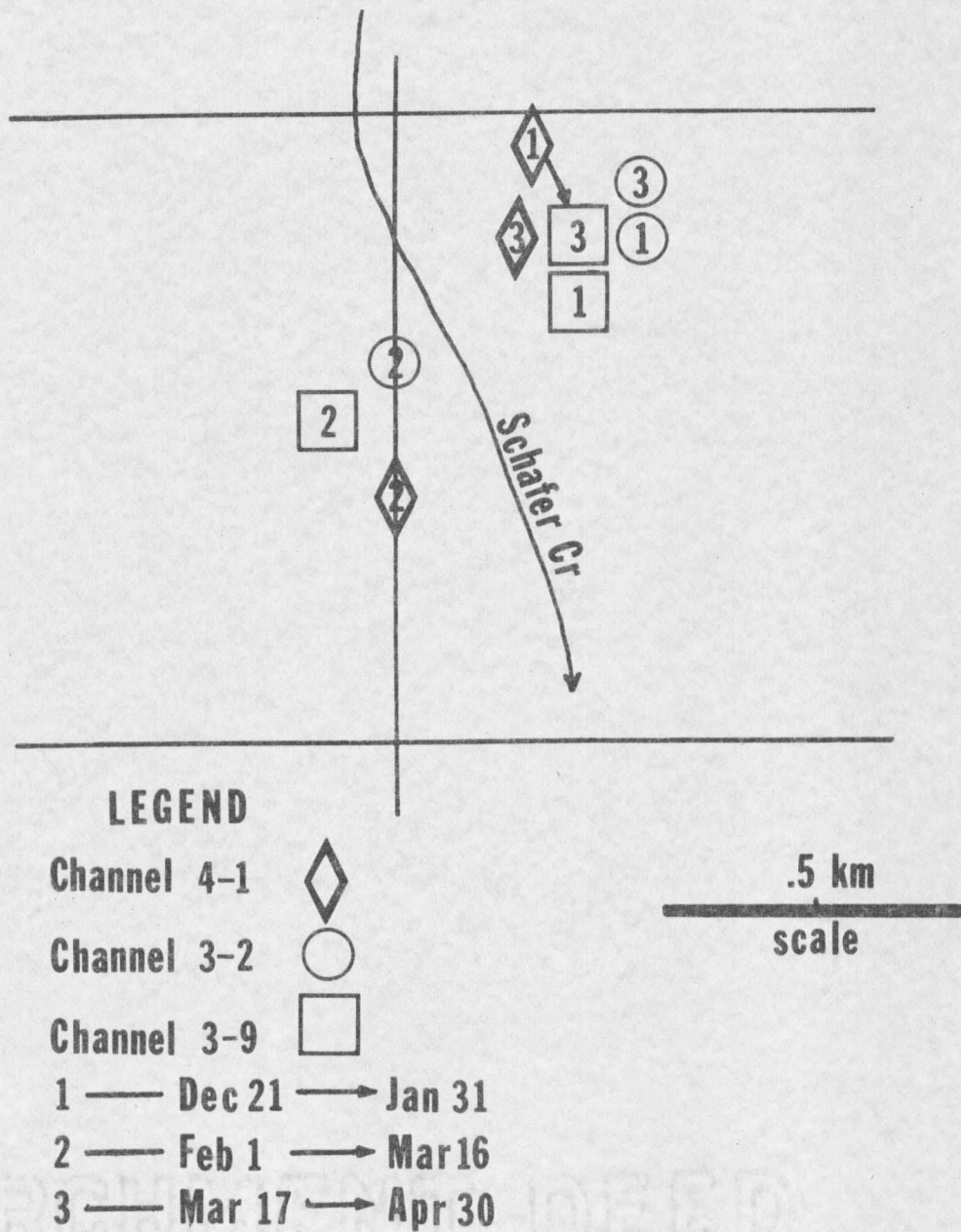


Figure 8. Shifts of activity centers by three female mule deer on the Schafer Creek winter range 1977-78.

March 16 only 68 deer were observed on the area, with no deer recorded from February 20 to March 13. After snow melt had begun (mid-March) from March 17 to April 27, 212 deer were observed. Mackie et al. (1976) also described movement to a "primary winter use area" for the Armstrong winter range. The primary winter use area of the Schafer winter range extended from Schafer Creek north along the mountain front to approximately 1.6 km north of Bostwick Creek (Fig. 4) and included approximately 334 ha.

There may be differences in range use by mule deer between the Armstrong and Schafer areas. Winter home range size may tend to be smaller on the Schafer winter range. Also deer on the Armstrong area generally had larger winter activity radii (Appendix Table 26) and standard diameters indicating greater mobility within their home ranges. The smaller home ranges, activity radii and standard diameters observed on the Schafer winter range may be due to deer entering the winter on a higher nutritional plane, to lower winter range densities, or to the range better meeting the life requirements and reducing energy costs of the deer and thereby allowing them to survive on a smaller area. Hamlin (1974) reported fawns and females of the Armstrong area to enter the winter with omental fat reserves close to a critical level and Pac (1976) reported substantial fall losses of fawns. The general steady increase in fawn ratios from late summer to early winter (Fig. 9) could be an indication that fall ranges and holding areas, on the

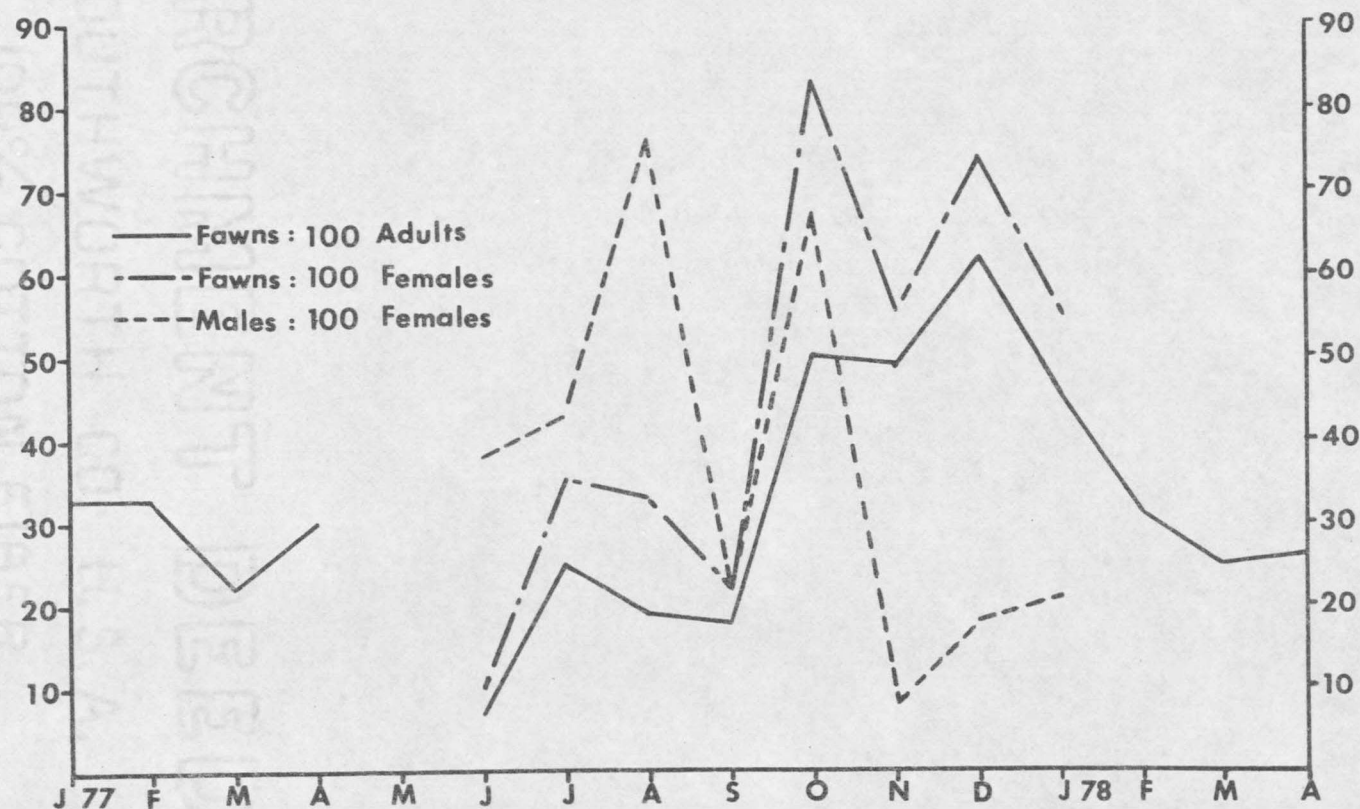


Figure 9. Observed fawn and male ratios on the Schafer Creek study area January 1977 - April 1978.

Schafer study area, were allowing deer to arrive on the winter range in good physical condition. Densities on the Schafer winter range were lower, and over winter mortality also appeared to be lower as was indicated by Mackie et al. (1976). These factors would indicate the Schafer winter range can better carry deer through the winter. Sanderson (1966) and Robinette (1966) stated that with better habitat requirements at hand home ranges should be smaller. It would follow that survivability would be enhanced.

Habitat Use

Monthly and seasonal estimates of mule deer usage of various habitat types, based on all observations and relocations of deer on the Schafer Creek study area, are presented in Tables 12 and 13. Table 13 also lists seasonal preference indices for habitat types. These data were calculated by dividing the percentage of all observations and/or relocations in a type by the percentage of the total winter range (winter) or the total study area (spring, summer and fall) on which that type occurred.

The combined observational (aerial and ground, marked and unmarked animals) and relocation data appeared to provide the best estimate of habitat usage. Frequencies of use of the various types, calculated as the following groups: mule deer observed from the air, from the ground, radio-collared animals, for all other deer observed, and the total

Table 12. Monthly frequencies of use of habitat types and series by mule deer associated with the Schafer Creek winter range.

Habitat Type ¹	Jan 77/ Jan 78	Feb 77/ Feb 78	Mar 77/ Mar 78	Apr 77/ Apr 78	May 77	June 77	July 77	Aug 77	Sept 77	Oct 77	Nov 77	Dec 77
Agriculture	0/1 ²	0/1	7/1	0/0								
FEID/AGSM	0/2	0/1										2
FEID/AGSP	5/3	8/Tr	3/3	2/0	4							6
ARTR/AGSP	0/12	39/10	6/20	29/19							Tr	22
ARTR/FEID	51/14	29/9	17/25	14/24	2		2	1			7	15
PSME/AGSP	0/24	16/31	22/25	10/15	5	2	1	1				21
PSME/FEID	30/39	0/40	45/22	16/24	22	8	11	9	13	5	15	22
PSME/SYAL-A	14/2	8/5	1/2	11/4	4		2	3	1	2	2	1
PSME/SYAL-C	0/3	0/3	0/1	18/14	43	20	13	12	18	25	16	10
PSME/CARU					3	5	11	1	2		1	
PSME/CAGE							7	5		2	Tr	
PSME/VAGL				0/Tr	7	11	2	1		4	20	
ABLA/VAGL					9	9	10	17	13	16	27	
ABLA/CAGE					1	2	1		18	2	5	
ABLA/CLPS						38	35	43	24	22	2	
ABLA/ARCO						1		1				
PIFL/JUCO						2	4	7	10	22	1	
FEID	5/5	8/1	3/3	2/0	4							8
ARTR	51/26	68/19	23/45	43/43	2		2	1			7	37
PSME	44/68	24/79	68/50	55/57	84	46	47	32	34	38	54	54
ABLA					10	50	46	61	55	40	34	
PIFL						2	4	7	10	22	1	

¹ See Table 2 for h.t. abbreviations

² Percent of all observations and/or relocations of mule deer for that month

Table 13. Seasonal frequency of use of habitat types and series and preference indices (see text) for mule deer associated with the Schafer creek winter range.

Habitat Type ¹	Winter 77/Winter 78 % Pref. ²	Spring % Pref.	Summer % Pref.	Early Fall % Pref.	Summer- Early fall % Pref.	Late Fall % Pref.
Agriculture	4/1 ³		Tr			
FEID/AGSM	0/1 (0/.47)					
FEID/AGSP	4/2 (.4/.2)	4 (2.86)				
ARTR/AGSP	14/16 (3.18/3.64)					1 (1.67)
ARTR/FEID	22/18 (1.57/1.29)	2 (1.0)	1 (.5)		1 (.50)	8 (4.0)
PSME/AGSP	15/26 (1.83/3.17)	5 (1.72)	1 (.34)		1 (.34)	
PSME/FEID	31/32 (2.50/2.58)	22 (3.1)	10 (1.4)	12 (1.69)	10 (1.41)	18 (2.54)
PSME/SYAL-A	6/3 (.83/.42)	4 (.85)	2 (.43)	2 (.43)	2 (.43)	4 (.85)
PSME/SYAL-C	5/3 (.14/.08)	43 (2.81)	14 (.92)	18 (1.18)	16 (1.05)	16 (1.05)
PSME/CARU		3 (.86)	7 (2.0)	1 (.29)	5 (1.43)	1 (.29)
PSME/CAGE			5 (1.47)	1 (.29)	3 (.88)	
PSME/VAGL	0/Tr	7 (.37)	4 (.21)	3 (.16)	4 (.21)	23 (1.22)
ABLA/VAGL		9 (.65)	11 (.8)	18 (1.30)	14 (1.01)	25 (1.81)
ABLA/CAGE		1 (1.0)	1 (1.0)	14 (14.0)	6 (6.0)	1 (1.0)
ABLA/CLPS			38 (2.66)	19 (1.33)	31 (2.17)	2 (.14)
ABLA/ARCO			1 (2.0)		Tr	
PIFL/JUCO			5 (1.72)	12 (4.14)	7 (2.41)	1 (.34)
FEID	4/3 (.33/.25)	4 (2.35)				
ARTR	36/34 (1.96/1.85)	2 (.77)	1 (.39)		1 (.39)	9 (3.46)
PSME	57/64 (.84/.94)	84 (1.36)	43 (.69)	37 (.60)	41 (.66)	62 (1.00)
ABLA		10 (.33)	51 (1.66)	41 (1.66)	51 (1.66)	28 (.91)
PIFL			5 (1.72)	12 (4.14)	7 (2.41)	1 (.34)

¹ See Table 2 for h.t. abbreviations

² Habitat preference Index: $\frac{\% \text{ use}}{\% \text{ area}}$

³ Percent of all observations and/or relocations of mule deer for that season

combined data. These calculations differed considerably within and between seasons (Table 14). Aerial observations and relocations of radio-collared deer indicated use of more types as well as generally greater use of heavily forested habitat types and areas than ground observations. However, the concentration of effort on radio-marked deer undoubtedly also influenced the overall observed distribution of habitat usage, and may have introduced some bias. For example, the intensive monitoring of five radio-collared does, which were closely associated on both the winter and summer range, may have exaggerated the importance of habitat types frequented by these animals and resulted in underestimation of types used by other deer on the study area.

In general, it appeared that mule deer used all of the habitat types available, at least to some extent and/or at some time of the year. During the course of field studies, evidence of current deer use (tracks, beds, pellet groups, and/or foraging) was noted in all habitat types and on all parts of the study area during the June-October periods. The only exception was the *Pseudotsuga menziesii*/*Physocarpus malvaceus* (PSME/PHMA) h.t. along the lower portion of Middle Cottonwood Creek, where some past use, but only very limited current use was recorded. Mule deer fecal pellet frequencies (Table 15), recorded incidental to habitat typing, also indicated use of all types with the exception of PSME/PHMA and *Philadelphus lewisii*/*Symphoricarpos albus* (PHLE/SYAL) h.t.s. No deer were directly observed in either of these

Table 14. Seasonal frequencies of use of habitat types for mule deer associated with the Schafer Creek winter range. Data are percentages in each type as determined by aerial/ground observations and by relocation of radio-marked deer/all other deer observed.

Habitat Type ¹	Winter 1976-77		Spring ²		Summer		Early Fall		Summer-Early Fall		Late Fall		Winter 1977-78	
Agricul.	0/4	0/4			0/1	0/Tr			0/Tr	0/Tr			1/1	1/1
FEID/AGSM													Tr/1	Tr/1
FEID/AGSP	4/4	0/4	4/-	4/4									3/2	0/3
ARTR/AGSP	17/13	16/14									1/- ³	0/1	17/15	20/15
ARTR/FEID	17/23	7/22	2/-	0/4	2/1	1/2	1/0	1/Tr	1/1	8/-	5/9	16/19	9/19	
PSME/FEID	10/36	13/33	22/-	15/26	8/11	3/16	13/0	9/15	11/10	4/15	18/-	11/20	26/33	33/31
PSME/AGSP	15/5	13/15	5/-	1/9	1/2	2/1			1/1	1/Tr			24/26	27/25
PSME/SYAL-A	12/4	9/6	4/-	1/6	1/3	1/3	2/4	2/2	1/3	1/3	4/-	2/4	4/2	Tr/3
PSME/SYAL-C	21/2	41/1	43/-	39/44	17/12	17/10	17/22	19/14	17/13	18/11	16/-	30/12	9/1	9/2
PSME/CARU			3/-	7/0	4/9	4/8	1/0	1/1	2/8	3/6	1/-	0/1		
PSME/CAGE					3/6	5/5	1/4	0/2	2/6	3/3				
PSME/VAGL			7/-	17/0	6/2	4/2	4/0	5/0	5/1	4/1	23/-	25/22	0/Tr	0/Tr
ABLA/VAGL			9/-	10/7	17/6	18/7	19/13	16/21	18/6	17/10	25/-	18/27		
ABLA/CLPS				1/0	36/41	37/42	16/39	22/13	26/40	30/30	2/-	5/1		
ABLA/ARCO				1/0	1/0	1/0			1/0	Tr/0				
ABLA/CAGE			1/-	1/0	2/1	4/0	15/13	19/7	8/2	10/2	1/-	0/1		
PIFL/JUCO					2/7	5/5	13/4	8/16	7/7	6/8	1/-	5/0		

¹See Table 2 for h.t. abbreviations.

²Spring aerial only.

³Late fall, aerial and ground combined.

Table 15. Frequency of occurrence of mule deer fecal pellets among 2 x 5 decimeter plots and constancy among sites sampled as representative habitat types on the Schafer Creek study area.

FEID/AGSM ¹ (2) ² .10/.50	FEID/AGSP (3) .63/1.0	ARTR/FEID (3) .47/1.0	ARTR/AGSP (5) .44/1.0	PHLE/SYAL (1) 0/0	PSME/FEID (5) .35/.80
PSME/AGSP (6) .45/1.0	PSME/CARU (1) .05/1.0	PSME/CAGE (2) .10/1.0	PSME/SYAL-A (2) .30/1.0	PSME/SYAL-C (7) .17/71	PSME/VAGL (5) .04/.60
PSME/PHMA (2) 0/0	ABLA/CLPS (2) .30/.50	ABLA/CARU (2) .12/1.0	ABLA/CAGE (1) .30/1.0	ABLA/VAGL (4) .15/1.0	PIFL/JUCO (2) no data

¹See Table 2 for habitat type identifiers.

²Number of sites.

types or in the *Abies lasiocarpa/calamagrostis rubescens* (ABLA/CARU) h.t.

Seasonal Habitat Use

Winter (Jan. 1-Apr. 30, 1977 and Dec. 21-Apr. 30, 1978)

Pseudotsuga menziesii/Festuca idahoensis (PSME/FEID) was the most used h.t. and *Artemisia tridentata/Agropyron spicatum* (ARTR/AGSP) was the most preferred type for both winter periods. Together the PSME/FEID, *Pseudotsuga menziesii/Agropyron spicatum* (PSME/AGSP), *Artemisia tridentata/Festuca idahoensis* (ARTR/FEID) and ARTR/AGSP h.t.s were the most preferred and received the majority of use (82% in 1976-77 and 94% in 1977-78) by mule deer through the winter (Table 13). During the

relatively mild winter of 1976-77 recorded usage was highest in the PSME/FEID type followed by the ARTR/FEID, PSME/AGSP and ARTR/AGSP types. *Artemisia tridentata*/*Agropyron spicatum* appeared to be the most preferred h. t. followed by PSME/FEID, PSME/AGSP and ARTR/FEID. Aerial and telemetry observations (Table 14) indicated that the overall importance of PSME/FEID and ARTR/FEID may have been overestimated in ground observations; however, the former were not made until the last month of winter. Also no deer were observed using the PSME/FEID type during February, a particularly snow-free period. The highest use of ARTR/FEID was recorded in January, after which usage steadily declined through the remainder of the winter. Use of *Festuca idahoensis*/*Agropyron spicatum* (FEID/AGSP) was relatively minor and appeared to decrease after a peak in February.

The winter of 1977-78 was more severe; though recorded snowfall was less, colder temperatures (Table 1) resulted in greater snow accumulation on the winter range. Southerly and westerly slopes had 50 percent, or less snow cover for only a maximum of 69 days as compared to 85 such days during 1976-77. As in 1976-77, PSME/FEID had the greatest recorded use followed by PSME/AGSP, ARTR/FEID and ARTR/AGSP types (Table 13). Also like the previous winter, ARTR/AGSP appeared to be the most preferred type, followed by PSME/AGSP, PSME/FEID and ARTR/FEID. The first three of these types received approximately equal use, while ARTR/FEID was used somewhat less, as deer were

arriving on the winter range in December. Recorded use of the ARTR types decreased in January and was the lowest of the winter period in February, the month of most persistent snow cover. This was followed by increased usage in March, as snow cover began to break. April use was about the same as that for March. Observed use of PSME/FEID and PSME/AGSP increased in January and peaked in February, followed by a decrease in March. Usage of PSME/FEID remained relatively steady in April while PSME/AGSP further decreased. It appears that there was a compensating relationship between the ARTR and two PSME types. During both winters the *Pseudotsuga menziesii*/*Symphoricarpos albus-calamagrostis rubescens* phase (PSME/SYAL-C) h.t. was of relatively minor importance until April, when it received its greatest use. In 1976-77 importance of this type increased substantially with the initiation of aerial flights; however, earlier ground surveys indicated a moderate degree of use, for feeding and bedding, had taken place. In 1978, prior to April, snow accumulation in this type was substantial, often 45 cm or more. Ground surveillance indicated that any use which occurred was primarily for bedding along the upper slopes, and travel from one south slope to another.

The most notable difference in habitat usage between winters was the apparent shift in 1977-78 to greater usage of PSME/AGSP and less use of ARTR/FEID and greater preference of PSME/AGSP and less of PSME/FEID than during the milder winter of 1976-77. Also minor habitats

received a greater amount of the total usage in 1976-77. The ARTR/FEID h.t. occurs on sites which tend to hold snow, probably explaining the overall decline of use during 1977-78, particularly in January and February. On the other hand areas occupied by the PSME/AGSP type were among the first to lose snow cover and possibly were the warmest sites on the winter range, along with large rock outcrops, many of which were on PSME/AGSP sites. Although these factors may explain the observed difference in use between ARTR/FEID and PSME/AGSP, they do not explain the increase in preference for PSME/AGSP compared with PSME/FEID, which supports more herbaceous vegetation (grass and forbs) as well as browse (Table 5). It is possible, however, that the PSME/AGSP h.t., with less snow, provided greater availability of green succulent forage. Mackie et al. (1976) indicated habitat use may shift during winters due to availability of green grasses. Overall, snow cover appears to have been the major factor influencing changes in habitat use between the two winters.

Spring (May 1-June 5)

Dispersal from the winter range was under way and use of closed-canopy h.t.s (PSME/SYAL-C, *Pseudotsuga menziesii/Vaccinium globulare* (PSME/VAGL) and *Abies lasiocarpa/Vaccinium globulare* (ABLA/VAGL)) increased to a total of 59 percent of the recorded use. The most used h.t. was PSME/SYAL-C with PSME/FEID being the only other type of singular importance (Table 13). The two types with a *Vaccinium* understory

(PSME/VAGL and ABLA/VAGL) combined, ranked third in habitat use. The PSME/FEID h.t. had the highest recorded preference index, followed by FEID/AGSP, PSME/SYAL-C and PSME/AGSP. This indicated a preference for more open h.t.s on which "green-up" was more advanced, providing better foraging conditions for deer leaving the winter range. Bertram and Remple (1977) and Pac (1976) attributed use of open areas during spring mule deer migrations to advanced plant phenology and improved forage conditions.

Summer (June 6-August 26)

The *Abies lasiocarpa/Clematis pseudoalpina* (ABLA/CLPS) h.t. appeared to be the most used type, receiving twice the recorded use of any other habitat type for this time period. This may be an over-estimation, due to distribution and concentration of marked animals in the head of Middle Cottonwood Creek (Fig. 4) where the majority of summer observations took place. Aerial and telemetry-aided observations also indicated that use of this type may have been overestimated (Table 14). *Pseudotsuga menziesii/Symphoricarpos albus-Calamagrostis rubescens* phase and ABLA/VAGL h.t.s were ranked second and third in habitat use. Receiving highest preferential use was ABLA/CLPS followed by *Pseudotsuga menziesii/Calamagrostis rubescens* (PSME/CARU), *Pinus flexilis/Juniperus communis* (PIFL/JUCO) and *Pseudotsuga menziesii/Carex geyeri* (PSME/CAGE); all of these were relatively open timber types with grass-forb understories. Use of PSME/SYAL-C decreased

substantially after June, possibly reflecting the general eastward and upward movement of the herd as it left the winter range. Use of PIFL/JUCO steadily increased through early summer and into October.

Early Fall (Aug. 27-Nov. 14)

A distinct shift in habitat usage was observed. *Abies lasiocarpa*/*Clematis pseudoalpina* continued to be the most used h.t., but its usage decreased to half of that for summer. The ABLA/VAGL and *Pseudotsuga menziesii*/*Symphoricarpos albus* - *Agropyron spicatum* phase (PSME/SYAL-A) h.t.s increased in importance to approximately the same level of use as ABLA/CLPS. A dramatic increase in the use of *Abies lasiocarpa*/*Carex geyeri* (ABLA/CAGE) was observed; however, much of this was due to use by radio-collared animals (Table 14). The PIFL/JUCO received its highest usage of the year. The ABLA/CAGE h.t. appeared to be highly preferred, while a high degree of preference was also recorded for PIFL/JUCO. The PSME/FEID h.t. ranked third in preference. Importance of ABLA/CLPS h.t. decreased steadily after August (Table 12). Dramatic movements of deer out of this type onto ABLA / CAGE were observed following the first two snowstorms of the year, which resulted in a depth of 3 cm or more above 2130 m. This probably explains the high degree of use and preference of the minor ABLA / CAGE h.t. (1 % of the study area) and may be an example of weather and/or behavior caused habitat selection rather than forage related selection. After snow had melted on the

ABLA/CLPS h.t. deer returned to their "normal" home ranges and types used prior to the storms. Radio-collared deer summering below 2072 m did not appear to experience this pattern of habitat usage. Bertram and Rempel (1977) documented the same pattern of movement for mule deer of the North Kings deer herd in California. The general increase in importance of forested types with shrub understories after August apparently reflected changes in plant phenology which resulted in a shift in food habits from succulent forbs to browse. Wilkins (1957) documented this shift in food habits, while Pac (1976) reported a similar pattern of habitat use for at least some deer during late summer-early fall (August-October).

The general shift in early fall, after the first killing frost and snow, was recorded not only as a change in habitat use (Table 13), but also as changes in fawn:female and male:female ratios among deer observed on the study area (Fig. 9). The decrease in the male:female ratio after August may have been due both to decreased usage of the high elevation ABLA/CLPS h.t. by males and a slight increase in numbers of females with fawns using this type. In August, 72 percent of all males were recorded in the ABLA/CLPS h.t. This decreased to 27 percent in September. The actual number of males recorded in all h.t.s decreased by 24 percent while female numbers remained constant. Radio-collared females as well as males became less visible during this time period (Fig. 10); however, males decreased 72-85 percent in the ABLA/CLPS

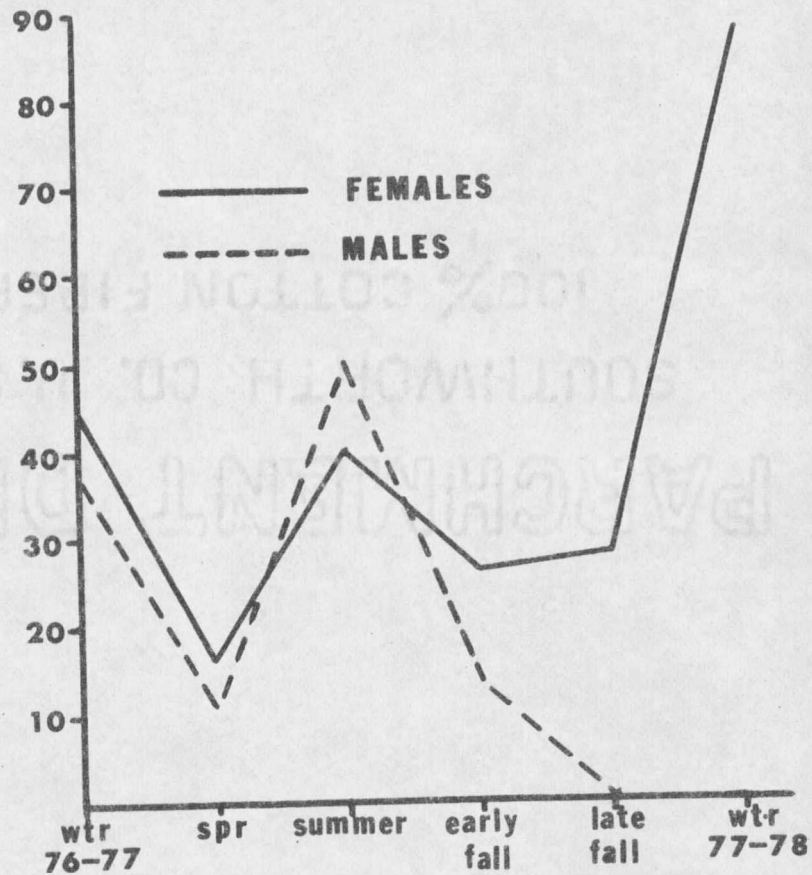


Figure 10. Percent visual relocations for radio-collared mule deer on the Schafer Creek winter range 1977-78.

h.t. as females and fawns decreased only 26-33 percent. If radio-collared deer are representative of all deer on the area, this would suggest that movement of males off of this type (high elevation habitats) rather than a substantial increase in numbers of females with fawns in late summer-early fall, was the cause of the changes. Heavy use of high elevation habitats by male mule deer in the Bridger range has been reported by Schwarzkoph (1973), Hamlin (1974) and Pac (1976). Hamlin and Pac also documented a decrease in the percentage of males observed and an increase in the percentage of females with fawns observed in these habitats in late summer. They attributed the change to a movement of females with fawns onto these types from either the east side of the Bridgers (Hamlin 1974) or from lower elevations of the west slope (Pac 1976).

Late Fall (Nov. 15-Dec. 20)

Habitat use during this period reflected movement of deer from summering areas towards the winter range and the arrival of the first deer onto the winter range. The most important h.t.s for the period were timbered with *Vaccinium* understories. The PSME/VAGL and ABLA/VAGL h.t.s, together, accounted for 48 percent of the late fall usage. The PSME/FEID and PSME/SYAL-C types were also important (Table 13). Habitat types typical of the winter range began to receive use; for example, ARTR/FEID received eight percent of the total use. This was the highest recorded since the previous winter. Because of its minor

occurrence on the study area as a whole, ARTR/FEID received the highest preferential use of the season. *Pseudotsuga menziesii*/*Festuca idahoensis*, which also received more use than at any time since spring, ranked second in preference. Closed-canopy habitats accounted for 64 percent of all observations and/or relocations. Bertram and Remple (1977) also reported high use and importance of heavy cover habitats during the fall period.

Yearlong trends in use and preference of forest and shrubland series (Tables 12 and 13) indicated that h.t.s of the *Pseudotsuga menziesii* series were the most important for use by mule deer during the winter, spring and late fall periods and ranked second through the summer and early fall. It was the second most preferred habitat for summer, early fall and third in spring and late fall. Pac's (1976) observations indicated that *Pseudotsuga menziesii* types collectively were most important for summer as well as spring and fall use on his study area on the north end of the Bridger range. The *Pinus flexilis* series was important only in summer and early fall when it ranked third in use and first in preference. Types of the *Artemisia tridentata* series were used to only a minor extent during all seasons except winter, when they ranked second in use and first in preference. Despite minor use ARTR was also the most highly preferred series for late fall. Due to its limited occurrence, the *Festuca idahoensis* series was of minor importance in use over the entire year; however, it had

the highest habitat preference index for spring.

Data were not adequate to indicate possible differential use of habitat types by sex and age of the animals generally. However, there was evidence that females with fawns may have occurred with greater frequency on certain h.t.s over others that were available during summer but not winter.

Numbers of fawns:100 females (100 adults for winter) recorded by h.t. in which more than ten females and/or fawns were observed, during summer, fall and winter periods are shown in Table 16. To test for possible differences in fawn:female ratios among habitat types it was assumed that the number of fawns per 100 females would be the same for all h.t.s if deer were evenly distributed. Chi-square tests were run for each season using the mean number of fawns:100 females for the season as the expected number of fawns:100 females for that season.

Chi-square values (Table 16) show a significant deviation ($P < .05$) in fawn numbers observed among h.t.s for all seasons except winter 1977-78. The high value for the winter of 1976-77 may be partially due to observer inexperience in classifying deer and the open conditions which may have permitted greater habitat selection than would normally occur in winter.

Over the summer-early fall period substantially more fawns per female than average were observed in the PIFL/JUCO h.t. than in any other type. Greater than expected numbers of fawns:100 females were

Table 16. Number of fawns per 100 females recorded by habitat type on the Schafer Creek study area.

Habitat Type ¹	Summer	Early fall	Summer-early fall	Late fall	Winter 1976-77	Winter 1977-78
Agric.	(0) ²	³	(0)	-	-	34 ⁴
FEID/AGSM	-	-	-	-	-	36
FEID/AGSP	-	-	-	-	25	36
ARTR/AGSP	-	-	-	(0)	36	31
ARTR/FEID	(25)	-	(25)	67	24	42
PSME/FEID	22	25	23	40	27	31
PSME/AGSP	(0)	-	(0)	-	16	37
PSME/SYAL-A	(133)	-	(100)	(75)	10	23
PSME/SYAL-C	19	13	18	29	0	30
PSME/CARU	5	-	5	-	-	-
PSME/CAGE	15	(0)	14	-	-	-
PSME/VAGL	(11)	(0)	6	31	-	(0)
ABLA/VAGL	18	13	15	57	-	-
ABLA/CLPS	11	12	12	(0)	-	-
ABLA/CAGE	(0)	7	6	(0)	-	-
PIFL/JUCO	42	29	34	-	-	-
Season $\bar{X}$	$\bar{X} = 18.9$	$\bar{X} = 16.5$	$\bar{X} = 15$	$\bar{X} = 44.8$	$\bar{X} = 19.71$	$\bar{X} = 33.33$
Chi-square Values	$\chi^2 = 43.21$	$\chi^2 = 26.41$	$\chi^2 = 47.74$	$\chi^2 = 24.66$	$\chi^2 = 43.7$	$\chi^2 = 6.98$
	n= 7	n= 6	n= 9	n= 5	n= 7	n= 9

¹ See Table 2 for habitat type identifiers

² Ten or fewer females and/or fawns observed, not included

³ No females or fawns observed

⁴ Fawn: 100 adults for winter

recorded for PSME/FEID. This may indicate a high preference by does with fawns for these types, or that does with home ranges on these types are more productive or successful in rearing fawns. Approximately the same number of fawns as the summer-fall means were observed in ABLA/VAGL and PSME/SYAL-C, two h.t.s in which deer are hard to observe. These two types make up nearly 30 percent of the study area and probably contribute the major portion of the herd's annual fawn crop.

The most used and preferred h.t. of the summer-early fall period, ABLA/CLPS, showed fewer fawns than the average observed. Hamlin (1974), as previously noted, reported that higher elevation habitats were used to a lesser extent by does with fawns than by females without fawns or by males. Fewer than the mean number of fawns were also recorded for the ABLA/CAGE and PSME/CARU h.t.s.

For late fall greater than average numbers of fawns were observed in the ABLA/VAGL and ARTR/FEID h.t.s, while about average numbers were recorded for PSME/FEID. For both winters, higher than average numbers of fawns were observed to use the ARTR/FEID type and lower than average used PSME/SYAL-A. The highest number of fawns:100 adults was recorded for ARTR/AGSP, a highly preferred h.t., and ARTR/FEID for the winters of 1976-77 and 1977-78, respectively, indicating this shrub series may be important to winter fawn survival. The even winter (1977-78) distribution of fawn ratios among h.t.s may be due to mule deer behavior manifested as group home ranges. Though females with fawns may prefer

certain "better" h.t.s the high densities of mule deer on the winter range may preclude this.

Food Habits

Information on mule deer food habits during early summer was obtained by examination of seven feeding sites. Winter food habits were derived from 17 feeding sites and contents of five rumens. Percentages of plant use by taxon and forage class (grass, forbs, browse) and the relative availability (frequency of occurrence and canopy coverage) of plant taxa utilized in various habitat types are presented in Table 17 for early summer and Table 18 for winter 1977-78. Rumen sample data are listed in Table 19.

These data indicate that utilization by general forage class was similar to that reported for deer associated with the Armstrong winter range during the same time periods (Wilkins 1957, Schwarzkoph 1973, Hamlin 1974, Pac 1976 and Morton 1976).

Summer

Forbs were the major forage class used during early summer 1977, comprising 88 percent of total utilization. Browse accounted for 11 percent and grass use was minor (Table 17). Utilization of 42 species was documented; however, the two most important species at each of the sites comprised an average 67 percent of the total use at each. Only two species, northern bedstraw and Nuttall violet (*Viola nuttallii*

Table 17. Percent use (U)/frequency of occurrence (O)/canopy coverage (C) of plant taxa used at summer feeding sites by habitat type.

FORAGE CLASS Species	Habitat Type ¹					Combined Total U
	ARTR/FEID U/O/C	PSME/FEID U/O/C	ABLA/CLPS U/O/C	ABLA/VAGL U/O/C	PIFL/JUCO U/O/C	
<u>GRASS</u>						
Agropyron sps					2/.2/ T	T
Phleum alpina					2/.2/ 2	T
TOTAL GRASSES					4	1
<u>FORBS</u>						
Agoseris glauca	2/ T/ T		12/.17/ 9	4/ .1/ T	7/.5/10	3
Aquilegia flavescens			12/ .2/ 7		8/.2/ 4	4
Arnica cordifolia			3/ .5/16	3/ .5/ 1		1
Arnica spp					1/.2/ 3	T
Aster conspicuus		1/.05/ 2				T
Astragalus spp			2/ .1/ 1	2/ .7/14	1/.3/10	1
Balsamorhiza sagitata	71/.2/10	9/ .4/12		1/ T/ T		8
Besseyia wyomingensis				6/ .3/ 2		T
Castilleja miniata			54/ T/ T			1
Comandra umbellata	15/.1/ 2					1
Delphinium bicolor				2/ T/ T		T
Epilobium angustifolium				2/ T/ T		T
Fragaria virginiana					13/.2/ 3	2
Galium boreal		2/.25/ 7	8/.37/14	38/1.0/15		8
Geranium viscosissium			3/ .4/ 8		17/.3/3.3	3
Helianthella uniflora			18/ .3/12	4/ .8/21		3
Hieracium cynoglossoides		42/.25/ 8				12
Lupinus spp	6/.3/ 9	20/ .3/ 6				6
Osmorhiza chilensis			1/ .2/ 4	2/ .5/ 6		T
Pedicularis paysoniana				3/ T/ T		T
P. racemosa			11/.25/ 7			3
Solidago missouriensis		26/.15/ 4				8

Table 17. (continued)

FORAGE CLASS Species	Habitat Type ¹					Combined
	ARTR/FEID U/O/C	PSME/FEID U/O/C	ABLA/CLPS U/O/C	ABLA/VAGL U/O/C	PIFL/JUCO U/O/C	Total U
<u>FORBS (continued)</u>						
Taraxacum officinale					1/.8/19	T
Thalictrum occidentale			7/.34/25		2/.3/ 7	3
Townsendia parryi	6/ T/ T		16/ .6/ 1		1/ T/ T	1
Trifolium haydenii			44/ .4/18			11
Valeriana spp			2/ T/ T			T
Viola nuttalli			26/ .4/ 4	27/ .5/ 2		6
Unidentified forbs			30/ .2/ T		2/ T/ T	1
TOTAL FORBS	100	99	90	93	54	88
<u>BROWSE</u>						
Ribes spp					2/.1/ 2	T
Rubus parviflorus			9/ .3/ 3			1
Shepherdia canadensis					37/.1/ 2	5
Spiraea betulifolia				7/ .9/11		1
Symphoricarpos albus		1/ T/ T	23/ .8/15			3
TOTAL BROWSE	0	1	10	7	43	11
Instances of use	100	415	585	110	201	1411

¹See Table 2 for h.t. identifiers.

Table 18. Monthly and total winter use in percent, by habitat type, of plant taxa which achieved greater than 1 percent use in one or more months or habitat types.

Habitat Type ¹		ARTR/AGSP				PSME/AGSP				PSME/FEID				ARTR/ FEID	PSME/ SYAL-C	PSME/ SYAL-A	Agricul- tural	Combined Totals ²			
Month		J	F	M	Wtr	J	F	M	Wtr	J	F	M	Wtr	F	F	F	J	J	F	M	Wtr
FORAGE CLASS	Number of sites	1	1	2	4	3	1	2	6	1	1	1	3	1	1	1	1	5	6	5	16
Species	Instances of use	337	1491	904	2732	1364	546	1318	3228	656	1332	798	2686	1418	1201	1039	812	2357	6927	3020	12304
GRASS																					
Agropyron spicatum		1	27	18	15	4	27	24	18	25	T ³	13	13	9		2		10/.8 ⁴	11/.83	18/1.0	13/.88
Bromus carinatus								8	3												
B. tectorum			1	T	1	1		2	1	T			T								
Bromus spp							14		5										2/.17		1/.06
Carex geyeri										46			15						8/.17		3/.06
Festuca idahoensis				10	3		42	15	19			8	3	3					15/.33	11/.6	9/.31
Koeleria cristata				3	1			1	T			4	1						3/.6		1/.19
Poa pratensis															3		21 ⁵		1/.17		T/.06
P. sandbergii				3	1			9	3	2		2	1	2				1/.2	T/.17	5/.6	2/.31
Poa spp							3	1	1										1/.17	T/.2	1/.13
TOTAL GRASS		1	29	34	21	5	86	62	51	27	46	26	33	14	3	2	21	11/.8	30/1.0	41/1.0	27/.94
FORBS																					
Achillea millefolium				T	T			1	T	2	T		1					1/.2	T/.17	T/.4	1/.25
Allium spp								2	1										1/.4		T/.13
Balsamorhiza sagittata	9	T	2	4	15	1	1	6	3			3	2	2				9/.8	1/.5	2/.8	4/.69
Cerastium arvense	1			T	T		1	1	T				T					1/.6		T/.2	1/.25
Chrysopsis villosa	3		11	5	10		1	4	25	3	10	13						13/.8	1/.17	7/.6	7/.5
Cirsium undulatum						T	1	1	1									T/.2	T/.17	T/.2	T/.19
Lactuca serriola							1		T								3	T/.17			T/.06
Lupinus spp						2			1									1/.2			T/.06
Melilotus officinales							3	10	4								26	1/.17	3/.2	1/.13	
Tragopogon dubius			4	1	T	1	5	2						T		T		T/.4	T/.5	3/.6	1/.5
Urtica dioica															4				1/.17		T/.06
Unidentified forb				1	T	1		T	1									T/.2		1/.6	1/.25
TOTAL FORBS		13	T	19	11	29	6	25	20	31	3	12	15	3	4	T	50	24/.6	3/1.0	19/1.0	15/.94
BROWSE																					
Acer glabrum								1	T						48	7	T		9/.33	T/.2	3/.19
Amelanchier alnifolia			T		T											22			4/.33		1/.13
Artemisia tridentata	82	64	48	61	9			3	38	30	62	43	66	23	50			43/.8	39/.83	37/.4	40/.69
Juniperus scopulorum	4			1	49		6	18		14		5						18/.80	2/.17	2/.2	7/.31
Philadelphus lewisii							2	1	4			1	2			13		1/.2	3/.33	1/.2	2/.25
Populus tremuloides						1		T										T/.20	T/.17		T/.13
Prunus virginiana						1	5	2	T			T					15	1/.40	2/.33		1/.19
Pseudotsuga menziesii	1			T						5		2	15					T/.2	7/.33		3/.19
Ribes cereum		2		1	3		3	2	2			1						2/.6	T/.17	1/.2	1/.31
Rosa spp		3		1	T	3		1								5		T/.4	2/.5		1/.25
Symphoricarpos albus									T		2	1						T/.2	3/.5		1/.25
TOTAL BROWSE		86	69	48	68	65	8	12	28	44	51	62	52	83	94	98	20	65/1.0	67/1.0	41/.6	58/.88
MOSS																					
			1		T	1												T/.2	T/.17		T/.13

¹For habitat type names see Table 2.

²Does not include agricultural site.

³Trace amount <.5% use.

⁴Percent of total use/frequency of use among feeding sites.

⁵Total of approximate equal use of *Poa pratensis*, *Agropyron cristatum*, and *Triticum aestivum*.

Table 19. Winter 1977-78 food habits determined from five rumen samples collected from predator involved mortalities.

FORAGE CLASS Species	February (3) ¹ % Vol/Freq ²	March (1) % Vol	April (1) % Vol	Season % Vol/Freq
<u>GRASS</u>	22 / 1.0	12	75	36 / 1.0
<u>FORBS</u>	3 / 1.0	4	5	4 / 1.0
<u>BROWSE</u>				
Artemisia tridentata	64 / 1.0	53	18	45 / 1.0
Berberis repens	1 / .33			T ³ / .2
Cornus stolonifera	T / .33			T / .2
Juniperus scopulorum	8 / 1.0	28	1	12 / 1.0
Populus spp		T	T	T / .4
Pseudotsuga menziesii	2 / 1.0	3	1	2 / 1.0
Pershia tridentata	T / .33			T / .2
TOTAL BROWSE	75 / 1.0	89	20	61 / 1.0
<u>LICHEN</u>	T / .33			T / .2

¹Number of rumen samples.

²Frequency of occurrence among rumens.

³Trace, less than .5 percent.

Pursh.), were recorded twice as one of the two most important forages utilized at a site. This plus the fact that there was no evident correlation between the degree of use of a particular forage species and either frequency of occurrence ($r=.10$) or canopy coverage ($r=.08$), would indicate a wide range of individual forage preference among mule deer. Other plants frequently receiving major use were pale agoseris (*Agoseris glauca* (Pursh.) D. Dietr.), yellow columbine (*Aquilegia flavescens* S. Wats.), arrowleaf balsamroot and lupine.

Winter

During winter browse, grass and forbs received 58, 27 and 15 percent, respectively, of the total utilization at feeding sites (Table 18) and comprised 61, 36 and 4 percent, respectively, of rumen contents (Table 19). Greater occurrence of grass and less of forbs in rumen contents as compared with feeding site data was also noted in data of Wilkins (1957) and Schwarzkoph (1973), and could be due to greater digestibility of forbs (Snider and Asplund 1974 and Short et al. 1974) and/or for the tendency of rumen analyses to emphasize the occurrence of coarse materials (Bergerud and Russel 1964).

Green forage was available throughout the 1977-78 winter and may have influenced overall feeding habits. Succulent grasses and/or forbs made up 13, 16 and 56 percent of the total recorded utilization for January, February and March, respectively (Table 20). During both the 1976-77 and 1977-78 winters, many deer were observed feeding on and about large steep rock outcrops which appeared to absorb solar radiation, creating warm microclimates and allowing plant growth throughout the winter. Schwarzkoph (1973) reported deer using green grass on snow-free slopes as early as January on the Armstrong winter range.

Big sagebrush was by far the major species utilized in all h.t.s in which feeding sites were examined, except the PSME/AGSP h.t. where it was of limited availability. It provided approximately 40-45 percent of the diet and accounted for nearly 70 percent of the browse used.

Table 20. Mean percent of all instances of use which were green grass and/or forbs at feeding sites by habitat type.

Month	Agric.	Habitat Type ¹				Combined Totals
		PSME/AGSP	PSME/FEID	ARTR/AGSP	ARTR/FEID	
Jan.	20	1	52	0	- ²	13
Feb.	-	80	0	0	15	16
Mar.	-	86	26	42	-	56
Season		28	26	11		27

¹See Table 2 for h.t. abbreviations.

²No feeding site during that month.

Rocky Mountain juniper was the only other browse species utilized to any extent. Bluebunch wheatgrass and Idaho fescue were the major grass species utilized; while golden-aster and arrowleaf balsamroot were the two most used forbs. Feeding was recorded on a total of 51 plant taxa, though only 5 received five percent or more of the total recorded utilization for the winter.

Browse and forb use were generally highest, and grass use lowest in January (Table 18). This was followed by a sharp decline of forb use in February that apparently was compensated for by an increase in grass utilization. Wallmo et al. (1977) indicated that, though high in protein, the occurrence of more than 20 percent big sagebrush in the diet would impair digestion, which deer may try to alleviate by increasing the use of grass which is more digestible but lower in protein. This, together with decreased availability of forbs in February, may explain

the shift from forbs to grass. In March, when new green growth was common, utilization of forbs increased substantially, grass use increased further and the importance of browse decreased.

Detritus was frequently eaten and may have been of some importance to wintering deer. Deer were observed to paw through snow, apparently to reach arrowleaf balsamroot plants, and eat the wet, partially rotted material (which probably also included other plant species). One adult male was observed to repeatedly, totally consume handsized wads of this material.

Population Characteristics

Population Size and Trend

Estimates of population size and composition were derived from data obtained during 129 ground observation periods and 53 aerial flights using a Piper Supercub. A total of 6,626 sightings of individual mule deer was recorded. Of these, 14 percent (944) were marked animals. Additional data were provided from four helicopter surveys of the winter range, two each during the winters of 1976-77 and 1977-78 (Mackie et al. 1978).

Prior to March 11, 1977 nine neckbanded mule deer were thought to be using the Schafer winter range (Mackie pers. comm.). These deer were trapped during late winter, 1975. Trapping efforts during March and April resulted in 28 and 9 additional marked animals on the area for 1977 and 1978, respectively. During each trapping period one

previously neckbanded deer was recaptured and fitted with a radio transmitter collar. Twelve animals were fitted with radio transmitters in 1977 and three in 1978, while 17 and 7 deer were marked with neckbands in 1977 and 1978, respectively. Appendix Table 27 lists the sex, age and marking device carried by mule deer captured and marked in 1977 and 1978. The total marked population after trapping efforts was 37 deer in 1977 and 35 in 1978.

Various estimates of mule deer numbers on the Schafer Creek winter range during the winters of 1976-77 and 1977-78 are presented in Tables 21 and 22, respectively. These data indicated that a minimum population of slightly more than 200 deer used the winter range from early January through March, 1977. Over 200 mule deer were on the winter range by early winter (December) 1977-78, and a population of about 240 was estimated from observations during the first half of March. This suggested a population increase of 10-20 percent from 1976-77.

Numbers of deer using the winter range apparently declined after late March or early April of both years. Mean estimates for April were 172 deer for 1977 and 216 for 1978. Movement off the winter range began during April and became pronounced in May. Of 107 mule deer observed or relocated using telemetry during May 1977, only 26 percent were on the winter range proper. Observations on the area during May 1978 (Pac, pers. comm.) indicated that dispersal had begun by May 15.

Table 21. Monthly population estimates for mule deer on the Schafer winter range 1976-77.

Month	Observation Periods	Mule Deer Observed	Population Estimates	95% Confidence Limits	Remarks
Jan 5	1	199			Helicopter survey
Mar 10	1	202			Helicopter survey
Mar 23,24	4	50	190	174-318	Schnabel estimate, Ground observations
Mar 25,26	2	48	211	197-319	Schnabel estimate, Ground observations
Mar	10	351	208		Average of all estimates
Apr 1-13	5	52	156	149-179	Schnabel estimate, aerial & ground obs.
Apr 21-28	3	81	187	180-206	Schnabel estimate, aerial & ground obs.
Apr	8	133	172		Average of Schnabel estimates
May	5	53	115	88-152	Schnabel estimate

Table 22. Monthly population estimates for mule deer on the Schafer winter range 1977-78.

Month	Observation Periods	Mule Deer Observed	Population Estimates	95% Confidence Limits	Remarks
Dec 19	1	200			Helicopter survey
Dec	3	181	217	187-252	Schnabel estimate, aerial observations
Jan	17	1459	220	209-232	Schnabel estimate, aerial & ground obs.
Feb	16	1161	210	198-223	Schnabel estimate, aerial & ground obs.
Mar 1-3	3	227	237	211-268	Schnabel estimate, aerial & ground obs.
Mar 6-15	9	1023	240	226-256	Schnabel estimate, aerial & ground obs.
Mar 16-28	6	629	203	188-220	Schnabel estimate, aerial & ground obs.
Mar	18	1929	227		Weighted average of Schnabel estimates
Apr	5	328	216		Average of five Lincoln estimates

Data in Tables 21 and 22, derived as Lincoln and Schnabel indices from ground and aerial observations of marked and unmarked deer and/or from direct helicopter counts, probably underestimated total numbers of deer using the winter range. Marked animals were heavily concentrated on one portion of the area, in the vicinity of Schafer Creek, and were not randomly distributed throughout the winter range. Also, data for the Armstrong winter range (Mackie et al. 1978) have indicated that aerial (helicopter) surveys in most cases count only 50-75 percent of the deer actually present. During 1977-78, observational efficiencies of early and late winter helicopter surveys along the west slope of the Bridger Range were estimated as about 47 percent and 59 percent, respectively. On this basis, the December 1977 count of 200 deer (Table 22) could indicate an actual population in excess of 400 animals (ca. 426) for the entire study area in early winter as compared with my estimate of about 240 in early March. The April 1978 helicopter survey was incomplete due to unfavorable conditions on the Schafer Creek area. If the same observational efficiencies applied to 1976-77 surveys, about 425 deer would have been present in early winter (January 1977) and about 340 in late winter (March 1977). Although the overwinter decrease (ca. 19%) for 1976-77 was similar to my estimate of a minimum 17 percent, from ground and fixed-wing aerial observations, the similarity of early winter population size between years indicated by helicopter counts conflicts with other data which suggested generally

greater numbers on the area in 1977-78 than in 1976-77. This difference may have been due to lower observational efficiency in the December 1977 survey as compared with the January 1977 count. Field observations and relocations of collared deer showed that many may not have been on the winter range at the time of the helicopter survey.

Using base population estimates of 208 animals for the winter of 1976-77 and 240 and 216 for early and late winter 1977-78, respectively, winter range densities were 29 mule deer per km^2 in 1977, 34 per km^2 in early winter 1978, and 30 per km^2 in late winter 1978. These were lower densities than occurred on the Armstrong winter range, as calculated from data of Mackie et al. (1978), for the same periods--39 deer per km^2 in 1977, 43 per km^2 in early winter 1977-78 and 31 per km^2 in late winter 1978.

These densities relate to the total Schafer Creek winter range, as used during 1976-77 when mule deer were widely dispersed. If only principal wintering areas, as used during much of the 1977-78 winter, are considered, densities are much higher--62 per km^2 in 1977, 72 per km^2 in early winter 1977-78 and 65 per km^2 in late winter 1978.

Age and Sex Composition and Trends

Data indicative of the age and sex composition of the Schafer Creek mule deer population and trends from January 1977 through April

1978 are presented in Table 23, Figures 9 and 11, and Appendix Table 28.

During early winter 1977, a ratio of 33 fawns:100 adults were obtained from both January and February ground observations. A helicopter survey on January 5 indicated 34 fawns:100 adults. At these ratios, fawns comprised about 25 percent of the population. By March the fawn:adult ratio had declined to approximately 22-25 fawns:100 adults, and fawns comprised only 18-20 percent of the population. Based on the minimal estimate of 208 deer on the area in March, only 37-42 fawns were carried into April. Classifications during April, though limited, suggested slightly higher ratios and survival than recorded in March.

New fawns were first observed during June. Although the proportion of fawns among deer observed increased through July, it decreased again through August and September (Table 23, Fig. 9); and it was not until October that observed fawn:doe and fawn:adult ratios equalled or exceeded those subsequently observed on the winter range. The high proportion of fawns for October was based on a very small observed sample and may not have been real. Thus, it cannot be concluded that a substantial decrease, if any, in the proportion of fawns on the area occurred from October to November. By December fixed-wing aerial observations indicated 74 fawns:100 females (62:100 adults) while a helicopter survey of the area on December 19 showed 49 fawns:100 does (40:100 adults).

Table 23. Sex and age classification of mule deer associated with the Schafer winter range determined by ground and aerial observations.

Month	Total ¹ No.	No.	No.	No.	No.	No.	Fawns: 100 Adults	Fawns: 100 Females	Males: 100 Females	Method of Observation
Observed	Adults	Females	Fawns	Males	Uncl.					
<u>1977</u>										
Jan 5	199	147	112	50	35	2	34	45	31	Helicopter survey
Jan	91	43	33	14	10	34	33	42	30	Ground
Feb	51	18		6		27	33			
Mar	321	68		15	7	238	22			Ground
Mar 10	202	162		40			25			Helicopter survey
Apr	135	30		9		96	30			Aerial & Ground
May	58	16	8	1	6	42	--			Aerial ² & Ground
June	38	29	21	2	8	7	7	10	38	Aerial & Ground
July	151	117	82	29	35	5	25	35	43	Aerial & Ground
Aug	98	81	46	15	35	2	19	33	76	Aerial & Ground
Sept	46	39	32	7	7		18	22	22	Aerial & Ground
Oct	15	10	6	5	4		50	83	67	Aerial
Nov	150	96	85	47	11	7	49	55	8	Aerial & Ground
Dec	181	109	92	68	17	4	62	74	18	Aerial
Dec 19	200	143	116	57	27		40	49	23	Helicopter survey
<u>1978</u>										
Jan	1459	987	814	446	173	26	45	55	21	Aerial & Ground
Feb	1161	858		267		36	31			Aerial & Ground
Mar	1680	1270		312		98	25			Aerial & Ground
Apr	253	144		37		72	26			Aerial & Ground
Apr 10	76	53		18		5	34			Helicopter survey

¹Total number observed when adequate classifications were made.

²Piper Supercub.

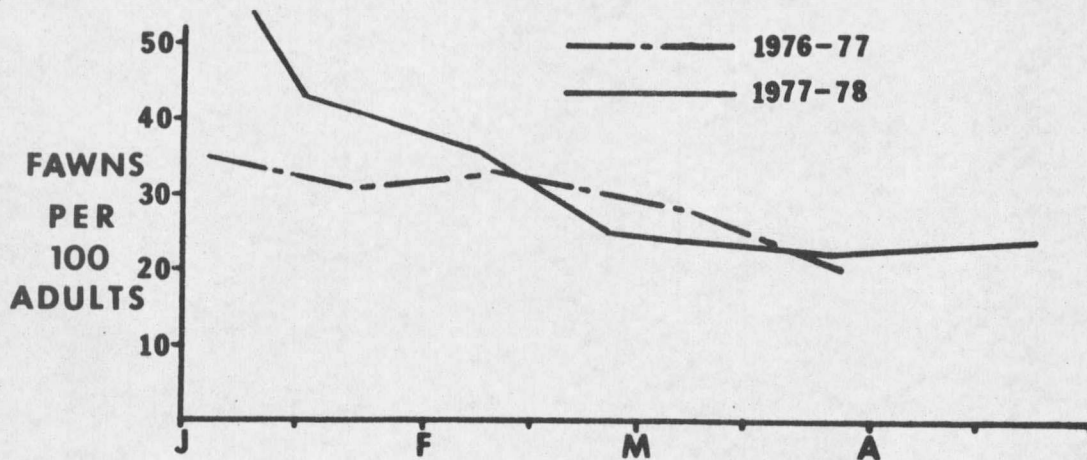


Figure 11. Averaged periodic estimates of fawns:100 adults on the Schafer Creek winter range.

A ratio of 45 fawns:100 adults was recorded from combined aerial and ground observations on the winter range during January 1978. Fawns thus comprised about 31 percent of the population. By March and April, the observed ratios declined to 25-26 fawns:100 adults or about 20 percent of the population; though a helicopter survey on April 10 recorded 34 fawns:100 adults (25% of the population). Using the April average population estimate of 216 total deer, 43 fawns were carried into May; only slightly more than were estimated for the area in March 1977.

Decreasing fawn:adult and percentages of fawns in the population indicated moderate fawn mortality, exceeding the losses experienced by the population as a whole, during both winters. However, the pattern

or timing of mortality differed. During the winter of 1976-77, the decrease in fawns did not begin until after the middle of February and much of it did not occur until mid-March or later (Fig. 11). In 1977-78, numbers of fawns observed decreased rapidly from a peak of 62:100 adults in December, through January and into the latter part of February when ratios of only 20-30 fawns:100 adults was recorded. Little or no apparent decrease occurred in March and April when observed ratios remained relatively stable. The percentages of fawns observed in the population also reflected the rapid early decrease and subsequent leveling off in late winter and early spring. The reason for the differences between ground-fixed wing aerial survey data and helicopter classifications, the latter showing a lower fawn:adult ratio for December and a higher ratio for April than the former, is not known. It is possible that helicopter surveys, covering a larger area intensively, classified more of the population than ground-fixed wing aerial surveys, both in December when some males and some females without fawns may not have moved onto the winter range proper and in April when deer were beginning to disperse and/or were using all parts of the winter range.

Early winter classifications indicated 30-31 males:100 females and 21-23 males:100 females (Table 23) among adults in the early winter populations of 1976-77 and 1977-78, respectively. This indicated a decrease in the proportion of males in the Schafer Creek population from 1977 to 1978 as was also suggested by Mackie et al. (1978) for

the Armstrong range. Proportions of males among deer observed during the summer and fall varied considerably (Fig. 9), generally increasing from June through August and then decreasing sharply in September to a low in November. Too few deer were classified in October to provide a realistic observed ratio for that month.

Mortality

At least seven mule deer were harvested during the 1976 hunting season. These included one adult male, one adult female and five unclassified animals. The only mortality documented during the winter of 1976-77 were two adult females that died as a result of trapping. Although as indicated earlier, changes in fawn:adult ratios indicated some mortality among fawns, no fawn carcasses were located. Known mortalities from May 1977 through April 1978 totaled 22 deer. Three of these were adult females, 13 were males, at least 2 were fawns and 5 could not be classified as to age or sex. Eight of the 22 were marked individuals, comprising 22 percent of the marked population. One additional neckband, placed on a female in 1975, was found near the original release site along with portions of a female skeleton that was at least one year old. This carcass was not included in the known mortalities.

Among known mortalities, one female (8-9 yr old) was found August 3, 1977 on the winter range. This animal apparently died

during the fawning season in the process of parturition. Hunter harvest (Oct.-Nov.) accounted for 13 mortalities, 12 antlered and 1 fawn male. Forty percent of the marked males (6 of 15) were shot. All mortalities were on or adjacent to the study area except a yearling male killed 33 km to the north. Seven carcasses found between February 14 and April 12, 1978 were suspected coyote involved mortalities. Five of these were recorded within the five day period, February 14-23. Of these one was an adult, one a fawn and the others could not be identified. Tracks and/or skid marks in the snow, or, in one instance, observation of coyotes actually in the process of killing a deer, were criteria used to involve coyotes with the mortality. One radio-collared female (ch 4-1) was found dead on the winter range April 4, 1978. The carcass was nearly entire and femur marrow was white and firm. Cause of death was not identified.

Total overwinter mortality of the population was estimated at 17-19 percent, for 1976-77, and was comprised primarily of fawns. A minimum of 15 percent of the mule deer on the area may have died during the winter of 1977-78, when fawn mortality from January through April was estimated at 34 percent. Some adult mortality also occurred. Mackie et al. (1978) reported little mortality of deer on the Armstrong winter range in 1976-77; while 20-27 percent died in 1977-78, including 45-47 percent of all the fawns and 10-20 percent of the adults on the area.

APPENDIX

Table 24. Coefficients of association for 16 marked mule deer on the Schafer Creek winter range 1977-78.

Channel or animal number	3-2	3-3	3-5	3-6	3-7	3-8	3-9	4-1	4-3	2277	2077	2217	2067	2087	2207	2045
3-2		.05	0	.09	.02	.07	.16	.56	.05	.12	.58	.06	0	.69	.12	0
3-3	.05		0	.54	.61	.65	.03	.22	.55	.71	.06	.41	0	.06	.24	0
3-5	0	0		0	0	0	0	0	0	0	0	0	.05	0	0	.16
3-6	.09	.54	0		.74	.67	.21	.23	.69	.51	.08	.45	0	.08	.25	0
3-7	.02	.61	0	.74		.70	.16	.21	.71	.65	.03	.46	0	.03	.20	0
3-8	.07	.65	0	.67	.70		.19	.24	.82	.61	.03	.50	0	.03	.13	0
3-9	.16	.03	0	.21	.16	.19		.16	.18	.21	.17	.14	0	.18	.59	0
4-1	.56	.22	0	.23	.21	.24	.16		.13	.21	.32	.16	0	.31	.29	0
4-3	.05	.55	0	.69	.71	.82	.18	.13		.53	.03	.42	0	.03	.16	0
2277	.12	.71	0	.51	.65	.61	.21	.21	.53		.07	.45	0	.07	.23	0
2077	.58	.06	0	.08	.03	.03	.17	.32	.03	.07		.11	0	.60	.17	0
2217	.06	.41	0	.45	.46	.50	.14	.16	.42	.45	.11		0	.07	.06	.04
2067	0	0	.05	0	0	0	0	0	0	0	0	0		0	0	.19
2087	.69	.06	0	.08	.03	.03	.18	.31	.03	.07	.60	.07	0		.10	0
2207	.12	.24	0	.25	.20	.13	.59	.29	.16	.23	.17	.06	0	.10		0
2045	0	0	.16	0	0	0	0	0	0	0	0	.04	.19	0	0	

Table 25. Mean distance between relocations, in meters, for radio-collared mule deer associated with the Schafer Creek winter range.

Channel	Winter 1976-77	Spring	Summer	Early Fall	Summer- Early fall	Late Fall	Winter Winter
Females							
3-2	300	290	370	400	400 ¹		300
4-1	200	300	520	700	610 ²		320
3-9	200	1600	500	300	400		300
3-5	400	900	500	800	600	600	300
3-3	300	900	400	700	600	200	300
3-6	600	1500	800	800	800	200	260
3-7	300	2200	500	800	600	400	270
3-8	800	1400	400	1400	800	900	300
4-3	600	2500	600	600	620	1100	280
Mean	411	1288	510	722	603	600	292
Males							
4-4	400	1300	600	1600	1100	1500	
3-4	600	1200	610	470	500	600	
4-2	900	1290					
Mean	633	1263	605	1035	800	1050	
Total Mean	467	1282	527	779	639	518	292

¹ Spring through fall

² Summer through fall

Table 26. Average activity radii, in meters, for marked mule deer in the Bridger mountains.

Source	Sex	Spring yr.	Summer yr	Fall yr	Winter yr
Schwarzkoph 1973	F				402 N(13) ¹ 72-73
	M				428 N(8) 72-73
Hamlin 1974	F	676 N(9) 73	314 N(1) 73	406 N(5) 73	
	M	785 N(3) 73	543 N(1) 73	575 N(1) 73	
Pac 1976	F	411 NR(6) 75	333 NR(4) 75	311 NR(2) 75	
	M		488 N(3) 75		
Mackie et al. 1976	F	396 75			363 73-74
	F				233 74-75
	M	423 75			326 73-74
	M				173 74-75
Youmans	F				580 R(9) 76-77
	F				380 R(12) 77-78
	M				640 R(5) 76-78
	M				760 R(3) 77-78
Steerey	F	951 R(9) 77	463 R(9) 77	466 R(9) 77	278 R(9) 76-77
	F		105 N(2) 77		279 R(9) 77-78
	F				286 N(7) 77-78
	M	1423 R(3) 77	640 R(2) 77	745 R(2) 77	433 R(3) 76-77
	M		1000 N(1) 77		283 N(6) 77-78

¹N= neckband, R= radioed, ()= number of animals

Table 27. Mule deer captured and marked on schaffer winter range 1977 & 1978.

Animal Number	Sex	Estimated Age at Capture	Marking Device	Method of Capture	Date of Capture
1977: SC-1-77	F	7-8	radio	Clover trap	3/12
SC-2-77	F	6-7	radio	Clover trap	3/13
*SC-10-75	M	7-8	radio	Clover trap	3/15
SC-3-77	F	4-5	radio	Clover trap	3/16
SC-4-77	F	5½+	radio	Clover trap	3/16
SC-5-77	F	6-7	radio	Clover trap	3/21
SC-6-77	M	6-7	neckband	Clover trap	3/21
SC-7-77	F	5½	neckband	cannon net	3/21
SC-8-77	M	½	neckband	cannon net	3/21
SC-9-77	F	mature	radio	cannon net	3/22
SC-10-77	F	6-7	radio	Clover trap	3/23
SC-11-77	M	2½	radio	cannon net	3/25
SC-12-77	M	½	neckband	cannon net	3/25
SC-13-77	F	mature	radio	cannon net	3/25
SC-14-77	F	3½	radio	Clover trap	3/27
SC-15-77	F	mature	neckband	cannon net	3/28
SC-16-77	M	½	neckband	cannon net	3/28
SC-17-77	F	8-9	neckband	cannon net	3/30
SC-18-77	M	5	radio	cannon net	3/30
SC-19-77	M	2½	neckband	cannon net	3/30
SC-20-77	M	½	neckband	cannon net	3/30
SC-21-77	F	5	neckband	cannon net	3/31
SC-22-77	F	4	neckband	cannon net	3/31
SC-23-77	M	2½	neckband	Clover trap	4/1
SC-24-77	M	½	neckband	cannon net	4/1
SC-25-77	F	5-6	neckband	cannon net	4/1
SC-26-77	F	½	neckband	cannon net	4/1
SC-27-77	F	2-3	neckband	cannon net	4/1
SC-28-77	F	3-4	neckband	cannon net	4/18
1978: SC-1-78	M	2½	neckband	Clover trap	3/4
SC-2-78	F	4-5	neckband	Clover trap	3/16
*SC-15-77	F	mature	radio	Clover trap	3/31
SC-3-78	F	3½	neckband	Clover trap	4/3
SC-4-78	F	2½	radio	Clover trap	4/3
SC-5-78	F	4½	neckband	Clover trap	4/11
SC-6-78	F	5½	neckband	Clover trap	4/12
SC-7-78	F	4½	neckband	Clover trap	4/19
SC-8-78	F	6½	radio	Clover trap	4/24
SC-9-78	F	3½	neckband	Clover trap	4/30

* Recaptured animal on which a new marking device was fitted.

Table 28. Mule deer population trends and sex and age classifications determined by winter helicopter surveys involving the Schafer Creek winter range 1972-78.

Date	Total Count	No. Adults	No. Females	No. Fawns	No. Males	No. Uncl.	Fawns: 100 Adults	Fawns: 100 Females	Males: 100 Females	Flight Boundaries and Remarks
1/3/72	284	201	170	80	31	3	40	47	18	Bridger Cr. to Ross Cr.
3/28/72	130	93	--	22	--	--	24	--	--	Bridger Cr. to Ross Cr.
2/7/73	213	142	--	47	--	24	33	--	--	Estimated Middle Cottonwood Cr. to Miser Canyon
12/27/73	112	96	68	16	28	--	17	24	41	Middle Cottonwood Cr. to Ross Cr.
1/4/74	135	119	--	16	--	--	13	--	--	Middle Cottonwood to Jones Crs.
4/30/74	77	--	--	--	--	--	--	--	--	Middle Cottonwood to Jones Crs.
1/2/75	241	163	126	71	37	7	44	56	29	Middle Cottonwood Cr. to Truman Cr.
3/23/75	277	211	--	66	--	--	31	--	--	Middle Cottonwood Cr. to Miser Cay.
4/20/75	234	179	--	55	--	--	31	--	--	Middle Cottonwood Cr. to Spring-branch Cr.
5/13/75	202	166	--	35	--	--	21	--	--	Middle Cottonwood Cr. to Miser Cay.
1/2/76	215	176	143	39	33	--	22	27	23	Middle Cottonwood Cr. to Miser Cay.
3/15/76	214	188	--	26	--	--	14	--	--	Middle Cottonwood Cr. to Miser Cay.
1/5/77	199	147	112	50	35	2	34	45	31	Middle Cottonwood Cr. to Miser Cay.
3/10/77	202	162	--	40	--	--	25	--	--	Middle Cottonwood Cr. to Miser Cay.
12/19/77	200	143	116	57	27	--	40	49	23	Middle Cottonwood Cr. to Miser Cay.
4/10/78	76	53	--	18	--	5	34	--	--	Middle Cottonwood Cr. to Miser Cay.

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