Range relationships of mule deer in the prairie habitat, northcentral Montana
by Gary Lynn Dusek

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

Abstract:
A study was conducted in the Cottonwood Creek area in the prairie habitat of northcentral Montana during summer and winter to obtain quantitative data on seasonal distribution, range use, food habits and interspecific relationships of mule deer and cattle. Vegetation of the area included three major types: Silver Sage, Big Sage, and Grassland. Canopy coverages and frequencies of occurrence were determined for low-growing taxa on representative sites in each of the types. Use of vegetation types by mule deer during both summer and winter was determined by recording the location of 1,812 and 1,086 observations of mule deer from the ground and air, respectively. The Big Sage and Grassland Types combined received 81 and 99 percent of the use for summer and winter, respectively. Sixty-four percent of the 2,332 observations of cattle for the period May 1 to November 1 occurred in the Silver Sage Type compared to 31 percent in the Grassland Type. Both mule deer and cattle used the Silver Sage Type during late summer. Food habits of mule deer were determined from the examination of 29 rumens and 79 feeding sites. Volume of browse averaged 43, 81, 60 and 59 percent of the rumen contents for summer, fall, winter and spring, respectively. Forbs constituted 54 percent of the rumen contents for samples taken in summer. Yellow sweetclover, snowberry, rubber rabbitbrush and creeping juniper were the most important items in the diet during summer, fall, winter and spring, respectively. Grass constituted 17 percent of the diet during spring but was insignificant during other seasons. Grass accounted for 67 and 85 percent respectively, of the summer and early fall diets of cattle as determined from the examination of 52 feeding sites. Forbs, including yellow sweetclover, were important in early summer. Greasewood, snowberry, and chokecherry were shrubs used by cattle. Hog-dressed weights averaged 70 percent of whole weights of 18 mule deer. Kidney fat indices for mule deer collected between January and June averaged 108, 36, 20 and 11 percent, respectively, for yearling females, older females, male fawns and yearling males.

An average ovulation incidence of 2.0 and a conception rate of 90 percent were determined for females collected from January to April. Fawn:female ratios for winter were 106:100 and 104:100 as determined by ground and aerial observations, respectively. There appeared to be some land use but no significant forage competition between mule deer and cattle.

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Date May 26, 1971

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

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ABSTRACT

A study was conducted in the Cottonwood Creek area in the prairie habitat of northcentral Montana during summer and winter to obtain quantitative data on seasonal distribution, range use, food habits and interspecific relationships of mule deer and cattle. Vegetation of the area included three major types: Silver Sage, Big Sage, and Grassland. Canopy coverages and frequencies of occurrence were determined for low-growing taxa on representative sites in each of the types. Use of vegetation types by mule deer during both summer and winter was determined by recording the location of 1,812 and 1,086 observations of mule deer from the ground and air, respectively. The Big Sage and Grassland Types combined received 81 and 99 percent of the use for summer and winter, respectively. Sixty-four percent of the 2,332 observations of cattle for the period May 1 to November 1 occurred in the Silver Sage Type compared to 31 percent in the Grassland Type. Both mule deer and cattle used the Silver Sage Type during late summer. Food habits of mule deer were determined from the examination of 29 rumens and 79 feeding sites. Volume of browse averaged 43, 81, 60 and 59 percent of the rumen contents for summer, fall, winter and spring, respectively. Forbs constituted 54 percent of the rumen contents for samples taken in summer. Yellow sweetclover, snowberry, rubber rabbitbrush and creeping juniper were the most important items in the diet during summer, fall, winter and spring, respectively. Grass constituted 17 percent of the diet during spring but was insignificant during other seasons. Grass accounted for 67 and 85 percent respectively, of the summer and early fall diets of cattle as determined from the examination of 52 feeding sites. Forbs, including yellow sweetclover, were important in early summer. Greasewood, snowberry, and chokecherry were shrubs used by cattle. Hog-dressed weights averaged 70 percent of whole weights of 18 mule deer. Kidney fat indices for mule deer collected between January and June averaged 108, 36, 20 and 11 percent, respectively, for yearling females, older females, male fawns and yearling males. An average ovulation incidence of 2.0 and a conception rate of 90 percent were determined for females collected from January to April. Fawn:female ratios for winter were 106:100 and 104:100 as determined by ground and aerial observations, respectively. There appeared to be some land use but no significant forage competition between mule deer and cattle.

INTRODUCTION

Range relationships of mule deer (*Odocoileus hemionus*) have been intensively studied in various localities of Montana. Included are the studies of Morris and Schwartz (1957), South (1957), Wilkins (1957), Lovaas (1958), Firebaugh (1969), Kamps (1969), Nellis and Ross (1969), and Mackie (1970). Habitat types represented by these studies have included at least some plant communities dominated by coniferous forests. Quantitative data are generally lacking for areas where the short-grass prairie is the dominant habitat type. This type predominates throughout much of the Milk River breaks in the northcentral part of the State. This area, administered largely by the Bureau of Land Management and used primarily for grazing by cattle, supports a significant population of mule deer. Dual use by cattle and deer has suggested the possibility of interspecific range competition particularly on heads of coulees and in drainage bottoms which receive heavy use by cattle. Overuse of range by mule deer has also been considered a likely possibility but quantitative data are lacking. Since both deer and cattle are given consideration in the 1969 management plan for the Cottonwood Creek Grazing Association, it was desirable to secure data on both classes of animals.

The main objectives of this study, conducted during the summers of 1969 and 1970 and the winter of 1971, were: to obtain quantitative data on seasonal distribution, range use and food habits of mule deer and cattle in the Cottonwood Creek area; to evaluate interspecific re-

lationships; and to utilize the information in developing criteria for proper management of mule deer on prairie habitat types.

DESCRIPTION OF THE STUDY AREA

The study area, with boundaries as shown in Figure 1, includes approximately 85,900 acres located about 7 miles north of Malta, Montana. Approximately 41,000 acres are used by members of the Cottonwood Creek Grazing Association (Appendix, Figure 10). Approximately 54 percent of the 41,000 acres is privately owned. Thirty-nine percent is Federal land administered by the Department of the Interior. The remaining 7 percent is owned by the State.

Major drainages, including Big Cottonwood, Little Cottonwood, Garland and Assiniboine Creeks, flow in a southeasterly direction emptying into the Milk River. These drainages form a dendritic pattern characterized by long side coulees, many of which extend more than a mile from the stream bottoms. Long side coulees appear to be more common on the north sides of the Cottonwood drainages than on the south sides. These drain relatively smooth, gently sloped glacial till plains. Elevations on the area range from 2,250 to 2,750 feet. Mesozoic sedimentary rock (Southard 1969) lies underneath the glacial till and is exposed in some areas.

Soils of the area are dominated by Brown and Solidized-Solonetz soils of the northern till plain (Southard 1969). Very shallow, light colored calcareous clay loam soils occur on steep and very steep edges of till plains. Deep dark colored soils with loamy surface layers and clay loam subsoils occur on nearly level to undulating glacial uplands (Soil Conservation Service 1969).

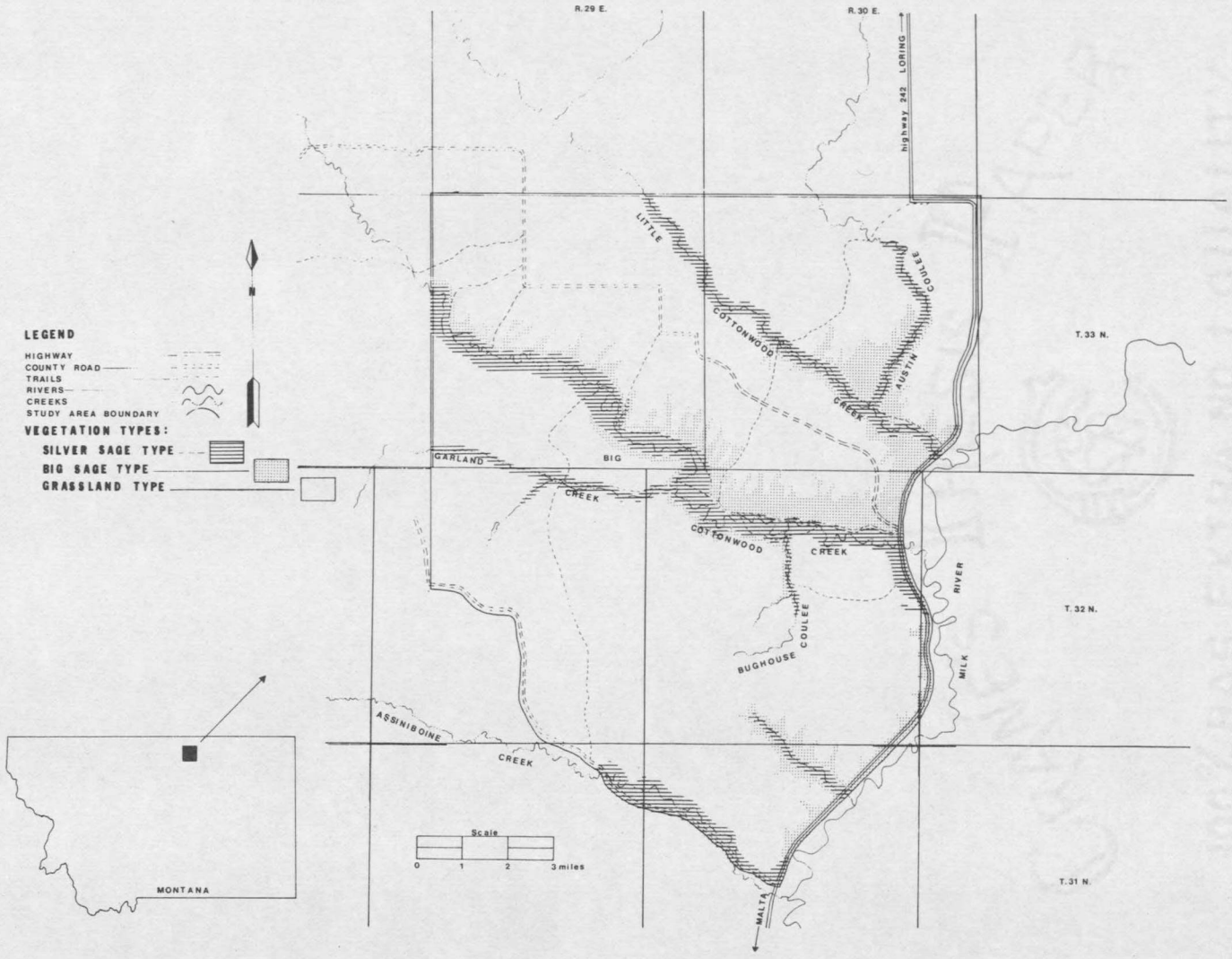

Figure 1. Map of the study area showing vegetation types.

Climatological data were taken from that recorded by the Bureau of Reclamation at Malta (Appendix, Table 16). Mean temperatures for June-September were 66.1° and 66.9° F for 1969 and 1970, respectively. These were a little above the normal of 65.3° F. The number of frost-free days was 117 and 122 in 1969 and 1970, respectively. The mean temperature for the period of December, 1970 through February, 1971 was 11.3° F. Mean temperatures for December and January were below normal. Average temperatures for February were not available for comparison.

Annual precipitation for 1969 and 1970 was 11.36 inches and 13.48 inches, respectively. Monthly variations can be found in Appendix, Table 16. Total precipitation for the period of December, 1970 through March, 1971 was 2.10 inches.

METHODS

Vegetation

The vegetation of the study area was grouped into three types based on major vegetation characteristics. Each of the types was further divided into subtypes based on minor differences. A reference collection of plants from the area was assembled to aid in the identification of various species comprising the vegetation types and subtypes. Common and scientific names were from Booth (1950) and Booth and Wright (1959). Plant composition of the subtypes characterized by low-growing vegetation was quantitatively sampled by a method similar to that described by Daubenmire (1959). Several sites were selected in each subtype, and the vegetation within each of twenty, 2x5 decimeter plots spaced at 10-foot intervals along four, 50-foot lines was analyzed. Canopy coverage and frequency for each low-growing taxon were estimated for each plot. A further measure of ground cover was provided by recording whether each leg of the 2x5 decimeter frame rested on bare ground, rock, litter or living vegetation.

On subtypes where deciduous shrubs were the dominant life form, canopy coverage was determined by crown intercept of the various shrubs measured along 100-foot transect lines. Heights of shrubs intercepted were determined also.

Distribution and Range Use

Most observations of mule deer were made while I was in a vehicle or on foot with the aid of a 7x35 binocular and a 15-60X spotting scope

during observation trips to areas where the animals were concentrated during a given season as determined by general surveys of the area. As opposed to systematic coverage of definitely established routes, this method is justified according to Russo (1964). Obviously most of the observer's time is in areas where opportunities for observations of deer are greatest. During winter inaccessibility limited ground observations in some areas. Distribution of deer was evaluated for the entire study area once a month as determined by observations from a fixed-wing airplane.

Deer observed were classified as to sex, whether adult or fawn, and activity such as feeding, bedding, etc. Both deer and cattle were recorded according to occurrence by vegetation type and subtype, and for deer, slope and exposure. The approximate location of each observation of deer and cattle was plotted on a grid map.

Food Habits

Year-long trends in food habits of mule deer were determined by the examination of rumen samples from deer which I collected, from hunter-killed animals, and from deer accidentally killed on roads. A quart rumen sample from each of 29 deer was analyzed using a technique similar to that used by Wilkins (1957) and others.

Summer and winter food habits of mule deer and summer food habits of cattle were determined by the use of feeding site examinations. Sites

were examined shortly after being vacated by feeding animals. When practicable, availability of various taxa on feeding sites was determined by the use of twenty, 2x5 decimeter frames as previously described. This provided a basis for determining preference when compared with the data on usage of various taxa. One bite on a plant constituted one instance of use. The aggregate percentage method (Martin *et al.* 1946) was used to tabulate by month, season, or vegetation type, the results of both feeding sites and rumen samples.

Weights, Productivity and Population Characteristics

Sex, age, whole weights and hog-dressed weights were determined for deer collected in the field. The age of deer was estimated by tooth replacement or wear on the mandibular dentition (Robinette *et al.* 1957). Kidneys and kidney fat were weighed to evaluate physical condition (Ransom 1965). Reproductive tracts were taken from all females collected from January to April. Fetuses were sexed and measured. Corpora lutea in ovaries were counted using the gross technique described by Cheatum (1949) to determine ovulation incidence. Productivity and population characteristics were determined from observed fawn:doe, fawn:adult and male:female ratios.

RESULTS

Vegetation

The three vegetation types, Silver Sage, Big Sage, and Grassland, (Figure 1) are included in the Temperate Grassland Biome (Odum 1959). The Silver Sage and Grassland Types, in another section of the Milk River breaks, have been generally described by Martinka (1967). The species composition of types and subtypes for which quantitative measurements were taken are in Table 1 and Appendix, Table 17. Ground cover characteristics are in Table 2. Subtypes not quantitatively studied but described from general observations include the Abandoned Meadow and Deciduous Shrub Subtypes in the Silver Sage Type, the Deciduous Shrub and Juniperus Subtypes in the Big Sage Type, and the Cropland Subtype in the Grassland Type.

SILVER SAGE TYPE

This type occurs on the floodplains of major drainages. It extends into the bottoms of some side coulees for short distances. Included are four subtypes.

Silver Sage-Agropyron Subtype. - Silver sagebrush (*Artemisia cana*) and western wheatgrass (*Agropyron smithii*) represent the dominant shrub and grass, respectively (Table 1 and Figure 2). Other grasses and grasslike plants commonly occurring are Richardson needlegrass (*Stipa richardsonii*), crested wheatgrass (*Agropyron cristatum*), needle-and-thread (*Stipa comata*), junegrass (*Koeleria cristata*), and sedges (*Carex* spp.). Shrubs, occurring in trace amounts are rose (*Rosa* spp.) and

TABLE 1. CONSTANCY, PERCENT CANOPY COVERAGE AND FREQUENCY OF LOW-GROWING TAXA FOR VEGETATION TYPES AS DETERMINED BY EXAMINATION OF TWENTY 2X5 DECIMETER PLOTS ON EACH OF 44 SITES.

	SILVER SAGE TYPE		BIG SAGE TYPE			GRASSLAND TYPE	
Taxa[1]	Silver Sage-Agropyron Subtype 8 Sites	Cottonwood Subtype 5 Sites	Big Sage-Agropyron Subtype 10 Sites	Artemisia-Sarcobatus Subtype 5 Sites	Sarcobatus Subtype 3 Sites	Stipa Subtype 8 Sites	Juniperus Subtype 5 Sites
GRASS AND GRASS-LIKE PLANTS:							
Agropyron cristatum	13/ 5/11[2]	40/ 1/5	---	---	---	---	---
Agropyron smithii	100/18/74	60/ 8/38	70/11/58	100/15/67	33/ 1/8	25/ 1/14	40/ 1/12
Agropyron spp.	38/ 1/8	60/ 7/28	70/ 5/28	20/ 1/6	67/ 4/17	100/ 3/26	40/ 4/27
Agrostis scabra	---	20/ 1/5	---	---	---	---	---
Andropogon scoparius	---	---	10/ 1/4	---	---	---	20/tr/1
Bouteloua gracilis	25/ 1/9	20/ 1/3	40/ 3/17	20/tr/1	33/tr/2	75/ 4/31	20/tr/1
Bromus inermis	---	80/20/53	---	20/ 2/4	---	---	---
Calamovilfa longifolia	---	---	30/tr/5[3]	---	---	13/tr/1	80/ 2/10
Hordeum jubatum	---	20/ 5/13	---	---	33/ 1/5	---	---
Koeleria cristata	38/ 2/18	---	50/ 2/15	---	---	75/ 5/41	60/ 1/7
Muhlenbergia cuspidata	---	---	30/ 2/12	---	---	63/ 3/21	60/ 3/11
Poa secunda	63/ 1/8	20/tr/1	20/1/5	100/ 6/42	33/ 1/8	38/ 1/8	---
Stipa comata	50/ 4/28	---	70/ 2/14	20/tr/1	---	100/13/69	40/ 3/18
Stipa richardsonii	63/ 5/33	---	50/ 2/9	40/ 3/17	---	---	60/ 3/20
Unidentified Grass	13/tr/1	40/ 1/10	---	20/ 2/10	33/ 1/2	---	---
Carex spp.	25/ 2/14	20/ 1/10	70/ 2/15	20/tr/3	---	100/ 9/54	80/18/61
CYPERACEAE	---	20/ 3/17	---	---	---	---	---
Total Grasses and Grass-like	100/42/99	100/53/99	100/32/99	100/25/89	100/ 8/38	100/43/98	100/35/93
FORBS:							
Achillea millefolium	38/tr/4	10/tr/1	10/tr/1	---	---	---	40/ 1/5
Anemone patens	---	---	---	---	---	---	80/ 2/22
Artemisia frigida	88/ 4/26	---	60/ 2/14	60/ 1/8	38/tr/3	88/ 8/55	100/ 3/29
Artemisia ludoviciana	25/ 1/6	---	10/tr/1	20/tr/2	---	13/tr/33	---
Astragalus dasyglotis	25/tr/6	---	10/tr/1	---	---	---	20/tr/1
Astragalus spp.	---	---	20/tr/3	---	---	13/tr/1	40/ 1/3
Aster falcatus	---	---	---	---	---	---	40/tr/6
Atriplex argenta	---	---	10/tr/1	20/ 1/4	33/ 1/5	---	---
Chenopodium capitatum	---	---	---	---	100/10/73	---	---
Commandra umbellata	13/tr/1	---	40/tr/5	---	---	25/tr/3	20/tr/6
Erigeron caespitosa	---	---	---	---	---	13/tr/1	60/ 1/12
Glycyrrhiza lepidota	25/ 1/5	40/ 2/9	10/tr/1	---	---	---	---
Grindelia squarrosa	13/tr/1	---	10/tr/1	---	33/ 1/5	---	---
Gutirrezia sarothrae	---	---	10/tr/1	---	---	50/ 1/13	40/tr/2
Kochia scoparia	---	---	---	20/ 1/5	67/ 4/35	---	---
Lappula redowski	20/tr/3	20/ 2/12	20/tr/6	20/tr/3	---	---	---
Lactuca serriola	---	20/tr/1	10/tr/1	---	---	---	20/ 2/10
Lepidium densiflorum	---	---	20/tr/5	60/ 3/25	67/tr/5	---	---
Medicago sativa	---	20/ 3/9	---	---	---	---	---
Melilotus officinalis	38/ 3/24	60/ 1/9	20/ 5/9	---	---	---	---
Malva spp.	---	20/tr/5	---	---	---	---	---
Monolepis nuttalliana	---	---	---	60/ 4/20	33/tr/2	---	---
Opuntia polyacantha	50/tr/4	---	50/ 1/5	80/ 3/18	67/tr/3	13/tr/1	60/tr/3
Petalostemon purpureum	---	---	20/tr/1	---	---	38/ 1/6	80/ 1/9
Phlox hoodii	13/tr/3	---	60/ 1/15	---	---	100/ 4/3	60/tr/10
Psoralea argophylla	13/tr/1	---	50/tr/6	---	---	38/tr/5	---
Sphaeralcea coccinea	38/tr/7	---	50/ 1/8	60/ 1/9	---	38/ 1/6	---
Taraxicum officinale	---	40/tr/7	10/tr/2	---	---	---	---
Tragopogon dubius	50/ 1/8	20/ 1/2	30/tr/2	---	---	---	---
Vicia americana	25/ 1/7	40/ 1/6	60/ 1/11	20/tr/2	---	13/tr/2	20/tr/2
Yucca glauca	---	---	30/ 1/6	---	---	---	20/tr/1
Unidentified Forbs	100/ 1/19	60/ 1/14	70/ 1/20	40/ 1/6	100/ 5/50	100/ 1/29	100/ 2/27
Total Forbs:	100/12/79	80/ 9/50	100/14/75	100/13/79	100/18/93	100/16/93	100/14/80
SHRUBS:							
Artemisia cana	100/21/73	40/ 2/7	20/tr/2	60/ 6/20	---	38/ 1/4	20/tr/2
Artemisia tridentata	---	---	100/16/57	80/18/54	67/ 1/5	---	40/ 1/3
Juniperus communis	---	---	---	---	---	---	20/ 6/8
Juniperus horizontalis	---	20/ 1/1	10/tr/1	---	---	25/ 1/4	100/41/72
Rhus trilobata	---	---	10/tr/1	---	---	13/tr/1	20/ 1/4
Rosa spp.	13/tr/2	60/ 3/19	20/tr/13	---	---	13/tr/1	60/ 1/5
Sarcobatus vermiculatus	---	---	30/ 1/2	100/10/28	100/23/64	---	---
Symphoricarpos albus	13/tr/1	80/14/42	10/ 1/5	---	---	---	40/ 1/4
Symphoricarpos occidentalis	---	80/12/43	---	---	13/tr/2	---	40/ 2/11
Total Shrubs:	100/22/73	80/33/68	100/18/64	100/32/85	100/24/68	63/ 2/12	100/48/80
Mosses and Lichens	25/ 3/13	---	---	---	---	88/ 9/63	---
Bare Ground	100/28/96	100/12/72	100/42/99	100/39/100	100/60/100	100/34/100	100/18/95

[1]Includes those taxa with a canopy coverage of .5 percent or greater or a frequency of 5 percent or greater in at least one type or subtype. Others are listed in Appendix.

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

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

common snowberry (*Symphoricarpos albus*). Forbs include fringed sagewort (*Artemisia frigida*) and yellow sweetclover (*Melilotus officinalis*). Mosses and lichens provide additional vegetation cover.

TABLE 2. GROUND COVER CHARACTERISTICS OF THE SUBTYPES WITHIN THE THREE VEGETATION TYPES. DATA ARE FREQUENCIES OF OCCURRENCE OF BARE GROUND, ROCK, LITTER AND LIVING VEGETATION AMONG 3,280 POINTS.

Vegetation Type	Subtype	Number Points	Bare Ground	Rock	Litter	Living Vegetation
Silver Sage	Silver Sage-*Agropyron*	560	25[1]	--[1]	33[1]	42[1]
	Cottonwood	320	6	--	21	73
Big Sage	Big Sage-*Agropyron*	800	36	4	33	27
	Artemisia-Sarcobatus	400	44	--	32	24
	Sarcobatus	240	55	2	15	28
Grassland	*Stipa*	640	32	10	24	34
	Juniperus	400	10	1	37	52

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

Deciduous Shrub Subtype. - This subtype occurs mainly on mesic sites along eroded channels of side coulees where they dissect the floodplain. Shrubs commonly found include buffalo-berry (*Shepherdia argentea*), abundant stands of snowberry, rose and an occasional skunkbrush sumac (*Rhus trilobata*).

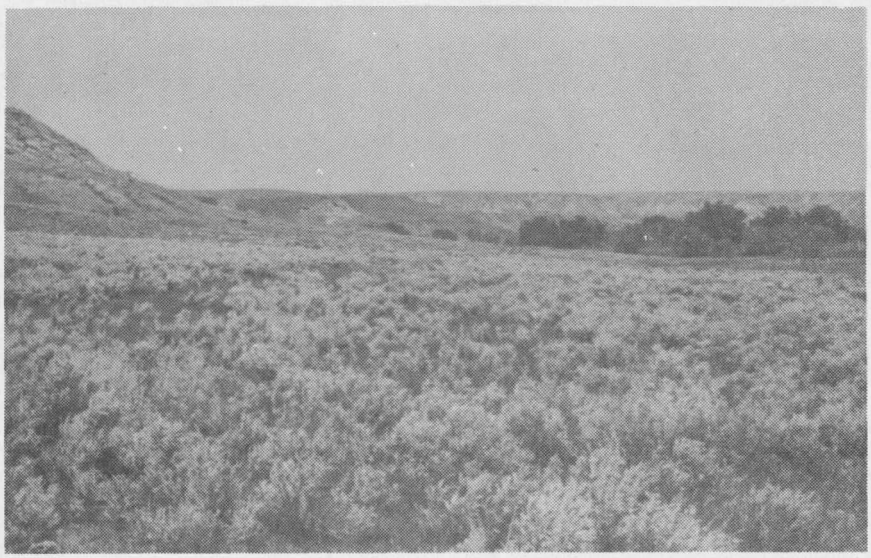

Figure 2. Silver Sage-*Agropyron* Subtype (in foreground) and Cottonwood Subtype (in background) of the Silver Sage Type.

Figure 3. Abandoned Meadow Subtype within the Silver Sage Type.

Cottonwood Subtype. - This subtype (Figure 2) occurs in continuous or broken stands adjacent to streams. Floral composition is influenced by seepage. The dominant overstory consists of plains cottonwood (*Populus deltoides*). An occasional stand of box elder (*Acer negundo*) is found particularly in the side drainages on the south side of Big Cottonwood Creek. Willows (*Salix* spp.) occur along the stream bank in the Big Cottonwood drainage. Canopy coverage of grasses is greater than that for any other type or subtype (Table 1). Most common in the understory are smooth brome (*Bromus inermis*), western wheatgrass and other wheatgrasses (*Agropyron* spp.). Forbs include alfalfa (*Medicago sativa*), wild licorice (*Glycyrrhiza lepidota*), western sticktight (*Lappula redowskii*) and yellow sweetclover. Common snowberry and western snowberry (*S. occidentalis*) are abundant shrubs with rose and silver sagebrush occurring in lesser amounts.

Abandoned Meadow Subtype. - Some areas occupying parts of the floodplain were once under cultivation or were hay meadows (Figure 3). Many of the meadows consist of a mixture of alfalfa and smooth brome. Others are dominated by stands of crested wheatgrass or wild rye (*Elymus junceus*). Yellow sweetclover occurs in the wild rye meadows.

BIG SAGE TYPE

This type occurs on gentle to steep slopes adjacent to the floodplains of major drainages and in the lower half of some side coulees. Cover of living vegetation is less here than on any of the types studied

(Table 2). Differences in vegetation composition appear to be due to variation in moisture content of the soil and perhaps minor differences in soil type. Included are five subtypes.

Big Sage-Agropyron Subtype. - Various degrees of association and dominance occur between big sagebrush (*Artemisia tridentata*), grasses and forbs. Western wheatgrass, other wheatgrasses and blue grama (*Bouteloua gracilis*) are grasses commonly found. This subtype (Figure 4) exhibits the widest variety of forbs of all types and subtypes studied. Included are yellow sweetclover, fringed sagewort, Hood's phlox (*Phlox hoodii*), american vetch (*Vicia americana*), plains prickly-pear (*Opuntia polycantha*) among many others (Table 1 and Appendix, Table 17). Shrubs occurring in addition to big sagebrush include common and western snowberry.

Artemisia-Sarcobatus Subtype. - This subtype (Figure 5) lies adjacent to the Silver Sage Type and appears to be an ecotone between the two types. Shrubs represent the most abundant class of vegetation and include big sagebrush, greasewood (*Sarcobatus vermiculatus*) and silver sagebrush. Western wheatgrass and Sandberg bluegrass (*Poa secunda*) are common in this subtype. Predominating forbs include Nuttall monolepis (*Monolepis nuttalliana*), plains pricklypear, and prairie pepperweed (*Lepidium densiflorum*).

Sarcobatus Subtype. - This subtype occurs in small scattered patches near bottoms and mouths of side coulees. Greasewood is the most

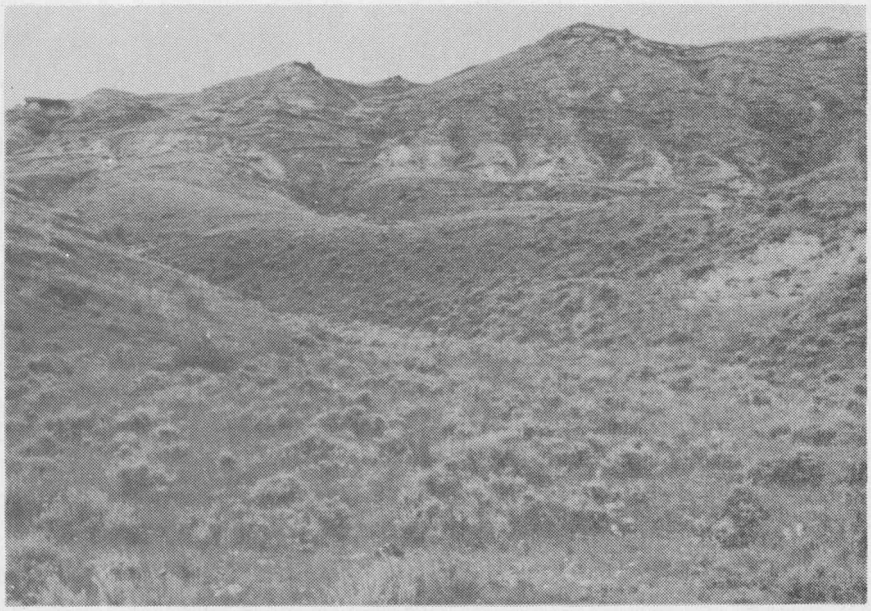

Figure 4. Big Sage-*Agropyron* Subtype within the Big Sage Type.

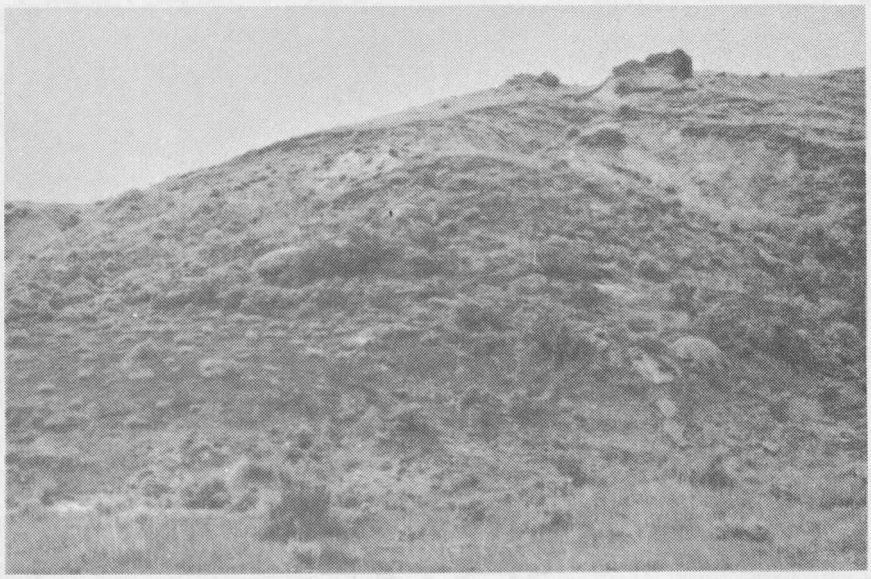

Figure 5. *Artemisia-Sarcobatus* Subtype within the Big Sage Type.

abundant taxon. Other shrubs occurring are big sagebrush and western snowberry. Strawberry blight goosefoot (*Chenopodium capitatum*) and summer cypress (*Kochia scoparia*) are the predominant forbs. Grasses are scarce. Wheatgrasses make up the bulk.

Deciduous Shrub Subtype. - This subtype occurs in or near the bottom of side coulees. Shrubs occurring here include chokecherry (*Prunus virginiana*), buffalo-berry, red dogwood (*Cornus stolonifera*), skunkbrush sumac, snowberry and big sagebrush.

Juniperus Subtype. - This is a subtype which occurs on very steep slopes, the bottoms of side coulees, and below rock ledges. Characteristic vegetation consists of shrubs which include creeping juniper (*Juniperus horizontalis*), common juniper (*Juniperus communis*), Rocky Mountain juniper (*Juniperus scopulorum*) and big sagebrush.

GRASSLAND TYPE

This type (Figure 6) occurs on tablelands above major drainages and in side coulees. Floral composition appears to be influenced by differences in moisture content of the soil due to differences in slope. Included in this type are four subtypes. Quaking aspen (*Populus tremuloides*) occurs in depressions in side coulees and in heads of some side coulees but not to the extent of constituting a subtype.

Stipa Subtype. - This subtype represents various degrees of association and dominance among grasses. Most predominant are needle-and-

thread, junegrass, blue grama and plains muhly (*Muhlenbergia cuspidata*). Sedges occur here as well as mosses and lichens. Among forbs are fringed sagewort and Hood's phlox. Shrubs are minor in abundance and include silver sage and creeping juniper.

Cropland Subtype. - This occurs on tablelands and represents an agricultural disturbance. Cereal grains including wheat (*Triticum* spp.), barley (*Hordeum* spp.), and oats (*Avena* spp.) are grown.

Deciduous Shrub Subtype. - This subtype (Figure 7) occurs on mesic sites such as heads of coulees and depressions in sides of coulees. Common and western snowberry are the most abundant shrubs present (Table 3). Other shrubs commonly found are rose, skunkbrush sumac, buffalo-berry, chokecherry and golden currant (*Ribes aureum*). Sometimes an understory of creeping juniper is present.

Juniperus Subtype. - This subtype is found on gentle to steep sloping sides of coulees. Creeping juniper is the most abundant taxon. An occasional common juniper is found. Predominant grasses and grass-like plants are plains muhly, Richardson needlegrass, needle-and-thread, wheatgrasses and sedges. Fringed sagewort, pasque flower (*Anemone patens*) and wild lettuce (*Lactuca serriola*) are forbs commonly found. Common and western snowberry and rose are deciduous shrubs occurring on this subtype.

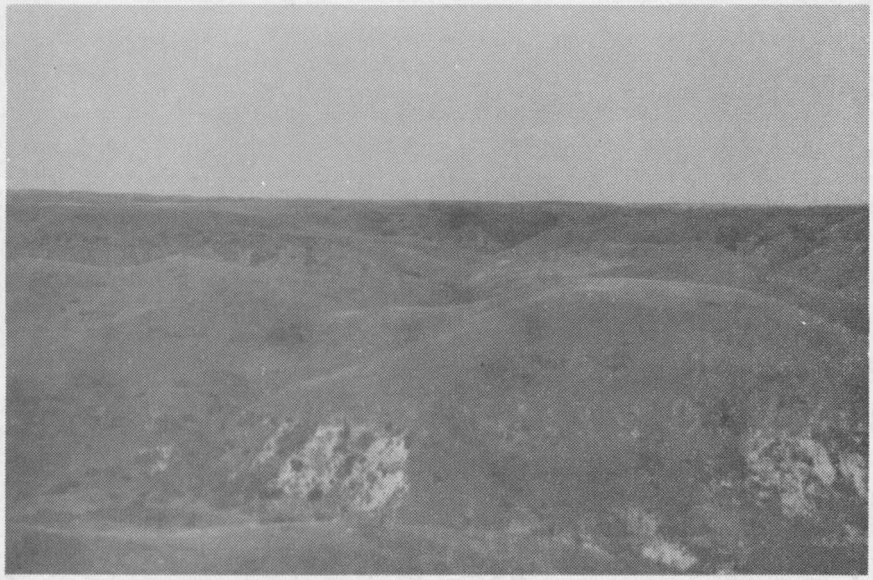

Figure 6. Grassland Type.

Figure 7. Deciduous Shrub Subtype within the Grassland Type.

TABLE 3. ANALYSIS OF THE VARIOUS PARAMETERS TAKEN FROM FIVE, 100-FOOT TRANSECTS ON THE DECIDUOUS SHRUB SUBTYPE IN THE GRASSLAND TYPE.

Taxa[1]	Percent Frequency[2]	Percent Intercept (Canopy Coverage)	Number Plants Per 100 Feet	Average Height	AGE CLASS[3]		
					Mature	Decadent	Seedling
Amelanchier alnifolia	20	tr	<1	3.0'	--	100	--
Cornus stolonifera	40	1	<1	3.8'	100	--	--
Prunus virginiana	40	10	14	3.1'	71	27	2
Rhus trilobata	100	12	6	1.9'	61	19	20
Ribes aureum	80	8	10	2.9'	82	16	2
Ribes setosum	40	1	1	1.5'	100	--	--
Rosa spp.	100	15	30	1.7'	81	5	14
Shepherdia argentea	60	11	5	5.3'	25	75	--
Symphoricarpos albus	100	19	52	1.4'	81	8	11
Symphoricarpos occidentalis	100	13	48	1.4'	88	tr	12

[1] Includes all species of deciduous shrubs intercepted along five, 100-foot transect lines.
[2] Percent occurrence among transect lines.
[3] Mature (0-25 percent dead); Decadent (25 percent and greater dead); Seedling (entire plant current season's growth).

Distribution and Range Use

MULE DEER

Areas occupied by mule deer during the summer of 1970 and the winter of 1970-71 are shown in Figure 8. Average group sizes for the period June-September of 1969 and 1970 were 1.9 and 1.7, respectively. An average group size of 6.0 for the period December,1970 to March, 1971 represented an increase of 231 percent from summer to winter.

Use of Vegetation Types. - During the study 1,812 observations of mule deer from the ground and 1,086 from the air were classified as to occurrence on vegetation types and/or subtypes. Data for the summer of 1970 and the winter of 1970-71 are in Table 4. Data for the summer of 1969 were for subtypes only. These are in Appendix, Table 18.

Summer. - As determined from ground observations the Grassland and Big Sage Types, which constituted 62 and 19 percent of the study area, accounted for 43 and 38 percent, respectively, of summer observations. Kamps (1969) also found a greater usage by mule deer of the grassland type as compared to other types during this season in the Snowy Mountains. The Silver Sage Type accounted for only 19 percent of the seasonal observations, but the percent of observations for this type as compared to all types doubled from early to late summer (Table 4). This corresponded with a decrease in the percent of observations in the Big Sage Type which appeared to be correlated with desiccation of forbs on the slopes. Mackie (1970) observed a shift to river bottoms

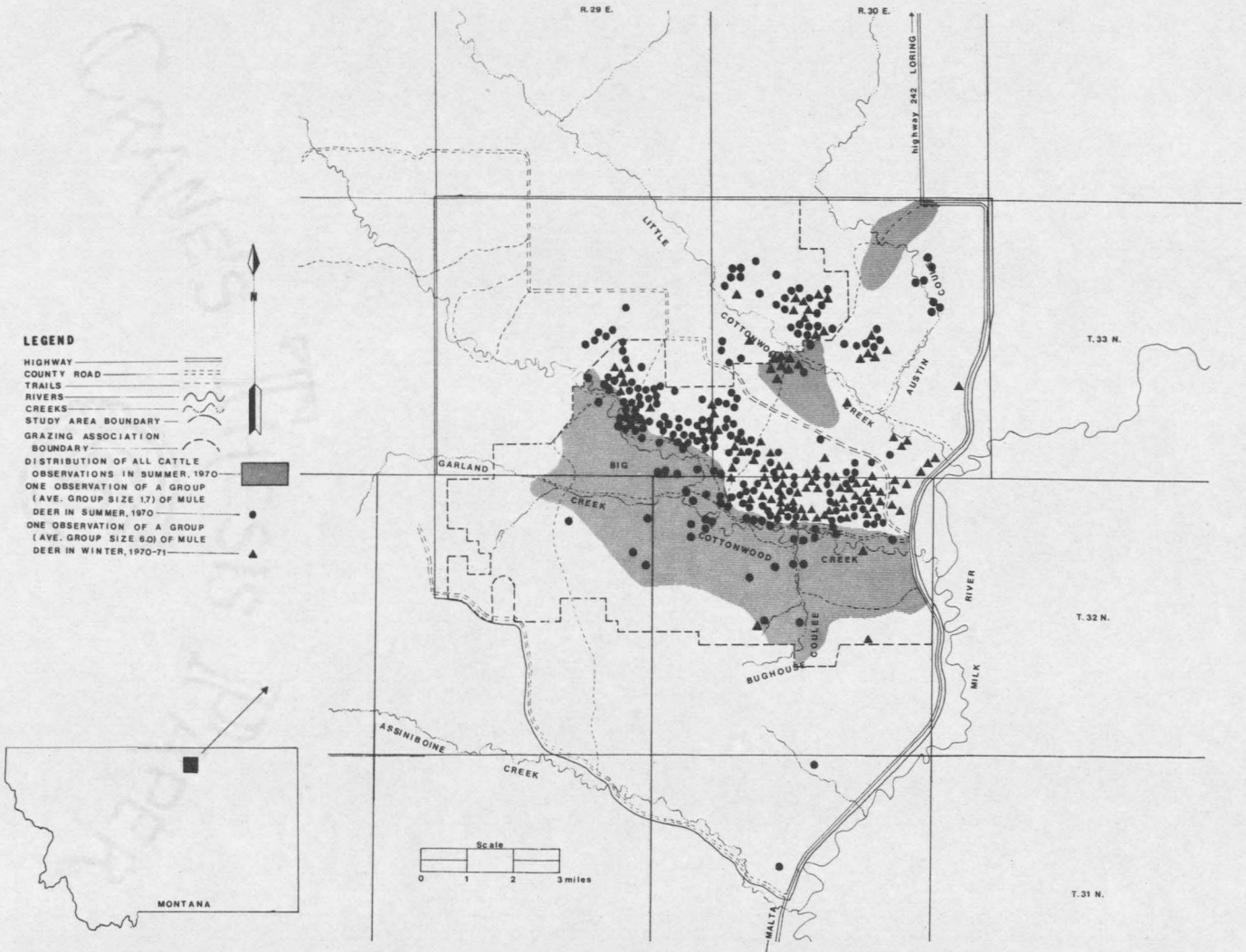

Figure 8. Map of study area showing distribution of cattle during summer and mule deer during summer and winter.

TABLE 4. PERCENT OF GROUND AND AERIAL OBSERVATIONS OF MULE DEER ON VARIOUS VEGETATION TYPES AND SUBTYPES BY MONTH AND SEASON FOR THE SUMMER OF 1970 AND THE WINTER OF 1970-71.

Vegetation Type	June 82/52[1]	July 139/74	August 144/97	September 89/91	June - September 454/314	December 74[3]	January 306/184	February 403/199	March 237/131	December - March 1,020/514
Silver Sage Type:										
Silver Sage-Agropyron Subtype	11/10[2]	6/—	15/7	2/—	9/4			--/1		1/—
Deciduous Shrub Subtype	1/13	1/—	3/2	—/6	2/4		2/3			—/1
Cottonwood Subtype		4/—	3/—	6/—	3/—					
Abandoned Meadow Subtype		1/—	4/11	16/4	5/5					
Total	12/23	12/—	25/20	24/10	19/13		2/3	--/1		1/1
Big Sage Type:										
Big Sage-Agropyron Subtype	22/10	37/21	16/11	32/14	26/14	28	41/19	44/42	63/30	45/31
Artemisia-Sarcobatus Subtype	6/—	4/—	3/—		4/—		4/—		6/—	3/—
Sarcobatus Subtype										
Deciduous Shrub Subtype	4/9	4/20	2/25	3/6	4/9	13	4/—			2/—
Juniperus Subtype	10/8	7/—	1/—	1/—	4/1		4/—			1/—
Total	42/27	52/41	22/36	36/20	38/24	41	53/19	44/42	69/30	51/31
Grassland Type:										
Stipa Subtype	20/46	21/25	25/29	20/37	21/32	59	44/54	52/49	22/45	43/50
Cropland Subtype			3/5	3/—	2/2					
Deciduous Shrub Subtype	8/2	10/33	18/21	9/33	12/28		1/21	tr/6	—/4	1/11
Juniperus Subtype	18/2	5/1	7/1	8/—	8/1		—/3	4/2	9/21	4/7
Total	46/50	36/59	53/66	40/70	43/63	59	45/78	56/57	31/70	48/68

[1] Sample sizes: ground/aerial.
[2] Percent of monthly observations: ground/aerial.
[3] Ground observations only.

during summer and fall in the Missouri River breaks due to desiccation of forage in adjacent uplands. A minor increase in use for late summer was observed in the Grassland Type during the present study. Martinka (1968) observed decreasing use in the bunchgrass types with increasing use of bottomland types. Although the percentage of mule deer using the Grassland Type did not change appreciably, percent use of the Deciduous Shrub Subtype increased as that on the Juniperus Subtype decreased (Table 4).

Although monthly and seasonal trends in the use of vegetation types as determined from ground and aerial observations were similar (Table 4 and Appendix, Table 18), a greater percentage of deer observed from the air were using the Grassland Type as compared to ground observations particularly in the Deciduous Shrub Subtype. This appeared to be due to greater coverage by aerial observations of the Grassland Type (Figure 1). Mule deer appeared to be more easily observed in the Deciduous Shrub Subtype from the air than from the ground.

Winter. - Mule deer appeared to be concentrated on fewer types and subtypes during winter than during summer. Observations from the ground revealed 51 percent of the use in the Big Sage Type and 48 percent in the Grassland Type. Lovaas (1958) found the prairie type to be the major winter range in the Little Belt Mountains. Use of the Big Sage-Agropyron and Stipa Subtypes in the Big Sage and Grassland Types, respectively, accounted for 88 percent of the seasonal use (Table 4).

Percent of observations on the Juniperus Subtype in the Grassland Type increased throughout the winter. Use of this subtype possibly was underestimated because of the difficulty in distinguishing this subtype from the Stipa Subtype when snow covered the ground. Mule deer were rarely observed in the Silver Sage Type during this season. Those observed were in the bottoms of side coulees.

As in summer, data from aerial observations showed a greater percentage of mule deer using the Grassland Type than did data from ground observations (Table 4). Most areas on the south side of Big Cottonwood Creek were dominated by the Grassland Type. These areas were inaccessible by vehicle in winter.

Use of Slope and Exposure. - Distinct changes in occurrence of mule deer on slopes and exposures were apparent from summer to winter (Tables 5 and 6). Sides of coulees received the greatest use during both seasons. Use on this slope increased from 39 percent in summer to 66 percent in winter. Percent use also increased from summer to winter on plateaus between side coulees. Of all deer observed feeding in summer and winter, 2 and 20 percent, respectively, were observed on this type of slope (Table 5). The use of bottoms and heads of coulees declined sharply from summer to winter. This appeared to be a result of snow accumulating in these areas. Loveless (1967) and Gilbert *et al.* (1970) concluded that snow depths of 20-24 inches and 18 inches, respectively preclude the use of an area by deer. From general observations, snow depths on these two types of slopes were equal to or greater

than depths mentioned by these two studies.

During summer, there appeared to be little preference between east, west and southeast exposures which together accounted for 55 percent of animals classified as to occurrence on exposure (Table 6). During winter a greater percent of deer were observed on southeast exposures than on any other.

TABLE 5. THE RELATIONSHIP BETWEEN ACTIVITY OF MULE DEER AND SLOPE OCCUPANCY DURING THE SUMMERS OF 1969 AND 1970 AND THE WINTER OF 1971, BASED ON A SAMPLE OF 1,901 OBSERVATIONS.

		SLOPE				
Activity	Number of Observations	Side of Coulee	Bottom of Coulee	Head of Coulee	Plateau	Plateau Between Coulees
		Percent	Percent	Percent	Percent	Percent
Feeding:						
Summer[1]	92	34	27	34	3	2
Winter	267	69	9	2	-	20
Bedding:						
Summer	68	28	25	43	1	3
Winter	172	79	14	-	-	7
Moving:						
Summer	376	38	33	11	11	6
Winter	282	64	7	1	10	18
Standing:						
Summer	353	44	31	13	10	3
Winter	291	57	15	3	12	13
TOTAL:						
Summer	889	39	31	17	9	4
Winter	1,012	66	11	1	6	16

[1] Data from both summers have been combined.

TABLE 6. PERCENT OF OBSERVATIONS OF MULE DEER OCCURRING ON EACH OF EIGHT EXPOSURES FOR THE COMBINED SUMMERS OF 1969 AND 1970 AND THE WINTER OF 1970-71.

Season	Number Observations	EXPOSURE							
		North	East	South	West	NE	NW	SE	SW
Summer	642	8	19	13	18	12	6	18	9
Winter	806	3	5	14	15	12	11	27	13

Activity. - During summer, 82 percent of the mule deer observed were moving or standing. In many instances these activities were probably provoked by the author disturbing feeding or bedding animals. During winter, observations were distributed evenly among feeding, moving, or standing animals. Bedding deer were more difficult to observe.

Periods of activity during both summer and winter appeared to be related to feeding as shown in Table 7. During summer, 74 percent of the observations were made from 4:00 to 8:00 a.m., 20 percent after 4:00 p.m., and the remaining 6 percent between 8:00 a.m. and 4:00 p.m. Winter, with decreased hours of daylight, was not characterized by peaks of activity in early morning and evening. Seventy-seven percent of the observations were made between 10:00 a.m. and 4:00 p.m. Periods of feeding followed a similar trend (Table 7). Loveless (1967) found that deer seek out direct sunlight during cold weather and ex-

hibit a negative response to direct sunlight during warm weather.

TABLE 7. PERCENTAGE DISTRIBUTION BY 2-HOUR INTERVALS FOR OBSERVATIONS OF MULE DEER IN RELATION TO ALL ACTIVITIES AND FOR FEEDING ONLY DURING THE SUMMERS OF 1969 AND 1970 AND THE WINTER OF 1970-71

Season	Total Obs.	Time Interval[1] A.M. 4-6	6-8	8-10	10-12	P.M. 12-2	2-4	2-6	6-
All Activities:									
Summer	906	43	31	4	tr[2]	1	1	6	14
Winter	973	--	1	20	28	19	30	2	--
Feeding Only:									
Summer	96	46	29	4	--	--	1	9	11
Winter	266	--	--	16	24	18	39	3	--

[1] Time during summers has been corrected to Mountain Standard Time.
[2] tr -- Trace represents less than .5 percent of the observations for a given period.

CATTLE

A three-pasture deferred rotation grazing system was administered by the Bureau of Land Management to three grazing units of the Cottonwood Creek Grazing Association (Table 8). Two additional units, Upper Little Cottonwood and Bughouse, were grazed but not according to grazing systems. Cattle were pastured on the association units from May 1 to November 1 during 1969 and 1970. Areas occupied by cattle during the summer of 1970 are shown in Figure 8.

During the summer of 1970, 2,332 observations of cattle were recorded as to occurrence on vegetation types and subtypes. Results are

in Table 9. Each of the three vegetation types occurred in all three grazing units of the Association, but the Big Sage Type was not represented in either Pasture 25 or 27 within the West Garland Unit (Table 8).

TABLE 8. GRAZING PLAN FOR THE THREE GRAZING UNITS UNDER A DEFERRED GRAZING SCHEDULE FOR THE SUMMERS OF 1969 AND 1970.

Grazing Unit	1969	1970	Animal Unit Months
East Garland Unit:			
Pasture 17	May 1-June 5	May 1-June 5	500
Pasture 15-16	June 5-July 10	Oct. 1-Nov. 1	619
Pasture 26	Sept. 1-Nov. 1	June 5-July 10	549
Pasture 30	Sept. 25-Nov. 1	July 10-Sept. 1	692
Pasture 31	July 10-Sept. 1	Sept. 1-Oct. 1	538
West Garland Unit:			
Pasture 14	May 1-July 25	Aug. 10-Oct. 1	878
Pasture 25	July 25-Sept. 15	June 15-Aug. 10	605
Pasture 27	Sept. 15-Nov. 1	May 1-July 1	533
Lower Little Cottonwood Unit:			
Pasture 11	Sept. 10-Nov. 1	July 1-Aug. 15	432
Pasture 12	July 15-Sept. 10	May 1-July 1	840
Pasture 13-24[1]	May 1-July 15	Aug. 15-Nov. 1	1,277

[1] Pastures 13&24 are not included in the study area.

Sixty-four percent of the total seasonal observations occurred in the Silver Sage Type. Most were in the Silver Sage-Agropyron Subtype. The Cottonwood Subtype was used largely for resting. Following heavy use in the major drainage bottoms, the cattle moved to the Grassland Type on adjacent tablelands. Firebaugh (1969) found cattle concen-

trated in drainage bottoms when first placed on an allotment. The Grassland Type received 31 percent of the seasonal use, most of which occurred on the Stipa Subtype. The Big Sage Type received only 5 percent of the seasonal use which occurred mostly in June and July (Table 9). Most cattle observed on this type were on gentle slopes. Use by cattle in this type was probably influenced by an abundance of succulent forbs early in the summer in the Big Sage-Agropyron Subtype. Cattle were observed feeding on greasewood in the Artemisia-Sarcobatus Subtype early in June.

The Bughouse unit, particularly Bughouse Coulee (Figure 1), appeared heavily grazed where cattle remained in the same areas during most of the summer of 1970. Deciduous Shrub Subtypes received heavy use here in late summer as did other areas of heavy concentrations of cattle. Chokecherry plants appeared severely hedged in these areas.

Cattle typically fed during early morning and evening hours. They rested during the middle of the day. Concentrations were often near watering areas during the heat of the day.

TABLE 9. PERCENT OF MONTHLY AND SEASONAL OBSERVATIONS OF CATTLE FOR THE SUMMER OF 1970 FOR EACH VEGETATION TYPE AND SUBTYPE.

Vegetation Type and Subtype	June 310[1]	July 655	August 735	September 632	June-Sept. 2,332
Silver Sage Type:					
Silver Sage-Agropyron	29	44	49	36	41
Deciduous Shrub	--	--	2	2	1
Cottonwood	4	2	14	8	8
Abandoned Meadow	10	11	11	23	14
Total	43	57	76	69	64
Big Sage Type:					
Big Sage-Agropyron	--	12	--	2	4
Artemisia-Sarcobatus	10	--	--	--	1
Sarcobatus	--	--	--	--	--
Deciduous Shrub	--	--	--	--	--
Juniperus	--	tr[2]	--	--	tr
Total	10	12	--	2	5
Grassland Type:					
Stipa	45	31	24	29	30
Cropland	--	--	--	--	--
Deciduous Shrub	2	--	--	--	1
Juniperus	--	--	--	--	--
Total	47	31	24	29	31

[1] Number of observations.
[2] tr = Trace -- less than .5 percent of the total animals occurring in a type or subtype during a month or season.

Food Habits

MULE DEER

Monthly and seasonal trends in food habits were determined by the examination of 29 rumens representing every month except November. Data obtained from 79 feeding sites for the combined summers of 1969

and 1970 and the winter of 1970-71 included 18,360 instances of use. Results from both methods are shown in Tables 10, 11, and 12.

Summer. - Forbs constituted 54 percent of the contents of nine rumen samples from deer collected in summer. Yellow sweetclover, which accounted for 27 percent of the contents of rumen samples, was the leading item. Greatest usage was in July (Table 10). Precipitation during July, 1969, when samples for this month were collected, was above normal. This probably increased availability. Mackie (1970) found yellow sweetclover to be the most important item in the diet during summer in the Missouri River breaks. Other forbs commonly found in rumens during this season were wild lettuce, alfalfa, and soap-weed (*Yucca glauca*). Flower buds of the latter were the plant parts eaten. Alfalfa decreased in the diet from June to July but increased to the greatest seasonal amount in August as use of the bottomland subtypes by deer increased (Table 4). Browse, which accounted for 43 percent of the summer diet, was represented by a wide variety of deciduous shrubs. Of these, buffalo-berry was the most important, constituting 15 percent of the seasonal diet. Others included snowberry, rose and skunkbrush (Table 10). Willow occurred in August samples which corresponded with an increased use by mule deer of the bottomland subtypes. Use of deciduous shrubs in the diet increased from July to August when browse became the leading forage class in the diet. Use of grass was negligible during summer.

TABLE 10. FOOD HABITS OF MULE DEER BY SEASON AND MONTH AS DETERMINED FROM THE EXAMINATION OF 29 RUMEN SAMPLES.

	SUMMER			FALL		WINTER			SPRING		
Taxa[1]	June	July	August	September	October	December	January	February	March	April	May
	4[2]	3	2	2	7	2	2	2	3	1	1
GRASSES:	2/100[3]	1/100	tr/100[4]	1/100	6/100	tr/50	tr/100	--	tr/33	4[5]	48
FORBS:											
Artemisia dracunculus	--	--	--	--	--	--	tr/50	1/100	5/33	--	--
Artemisia frigida	--	--	--	--	--	2/100	--	--	--	--	--
Atriplex nuttalli	1/75	--	tr/50	--	--	--	3/100	--	--	--	--
Aster falcatus	--	--	--	1/100	tr/29	--	1/100	1/100	--	tr	--
Astragalus gilviflorus	tr/25	--	1/50	--	1/71	--	--	--	--	--	--
CHENOPODIACEAE	--	--	--	1/50	--	--	--	--	--	--	--
Chrysopsis villosa	--	--	--	--	--	--	--	--	2/33	--	--
COMPOSITAE	tr/50	--	tr/50	tr/100	--	--	1/100	--	1/67	--	--
Conringa orientalis	2/50	--	--	--	--	--	--	--	--	--	--
Eriogonum multiceps	--	--	--	--	--	--	3/100	9/100	tr/33	--	--
Glycyrrhiza lepidota	1/50	--	--	--	4/86	tr/100	--	--	--	--	--
Haplopappus spinulosa	--	--	--	1/50	--	--	--	--	--	--	--
Lactuca serriola	tr/100	14/33	--	--	--	--	--	--	--	--	--
LEGUMINOSAE	1/25	tr/33	--	tr/50	1/29	--	2/50	--	--	--	--
Lomatium spp.	--	--	--	--	--	--	--	--	--	--	35
Medicago sativa	4/25	1/33	11/100	tr/50	tr/57	--	--	--	--	--	--
Melilotus officinalis	12/50	52/100	16/100	--	--	--	1/100	--	--	--	--
Oxytropis sericea	7/75	--	--	--	--	--	--	--	--	--	--
Oxytropis spp.	--	1/33	--	--	tr/29	3/50	5/100	tr/50	1/100	--	--
Petalostemon purpureum	tr/25	--	1/50	--	--	--	--	--	--	--	--
Phlox hoodii	--	--	--	--	--	--	1/100	--	tr/33	--	--
Ratibida columnifera	--	--	1/50	--	--	--	--	--	--	--	--
Tragopogon dubius	1/75	2/67	tr/50	--	--	--	--	--	--	--	--
Vicia americana	1/50	--	--	--	tr/14	--	--	--	--	--	--
Yucca glauca	8/25	1/33	--	--	--	7/50	8/100	46/100	21/100	--	1
Unidentified Forbs	21/100	1/100	9/100	11/100	7/100	6/100	17/100	3/100	3/100	3	1
Total Forbs	59/100	72/100	39/100	14/100	13/100	18/100	42/100	60/100	33/100	3	37
SHRUBS:											
Artemisia cana	--	--	--	--	15/43	4/100	--	tr/100	5/67	--	13
Artemisia tridentata	--	--	--	--	--	7/100	14/100	1/100	4/100	1	--
Chrysothamnus nauseosus	--	--	1/100	9/100	19/86	59/100	32/100	7/100	7/100	--	--
Cornus stolonifera	tr/25	2/67	--	1/50	--	--	--	--	--	--	--
Eleaeagnus commutata	--	--	--	--	4/29	--	--	--	--	--	--
Juniperus communis	--	--	--	--	tr/29	3/100	tr/50	6/100	tr/33	16	1
Juniperus spp.	--	--	--	tr/50	tr/29	5/100	tr/50	24/100	47/100	74	1
Prunus virginiana	tr/25	1/33	1/100	10/50	tr/29	--	--	--	--	--	--
Rhus trilobata	2/100	2/100	6/100	26/100	4/71	tr/50	--	tr/50	--	--	--
Ribes aureum	2/75	tr/33	--	--	tr/14	--	--	--	--	--	--
Rosa spp.	9/75	10/100	8/100	8/50	6/100	--	--	1/50	--	--	--
Salix spp.	--	--	5/100	--	--	--	--	--	--	--	--
Sherpherdia argentea	11/100	9/100	26/100	2/100	2/100	--	--	--	--	--	--
Symphoricarpos spp.	14/100	3/100	10/100	25/100	30/100	3/50	--	--	--	--	--
Unidentified Shrubs	1/100	1/67	3/100	4/50	1/43	1/100	14/100	1/100	3/100	3	1
Total Shrubs	39/100	28/100	60/100	85/100	80/100	82/100	60/100	40/100	66/100	94	16

[1]Includes taxa occurring at a level of at least .5 percent in at least one month or season. Plants occurring at a level of less than .5 percent include the following forbs: *Artemisia longifolia*, *Artemisia ludoviciana*, unidentified mustard species, *Psoralea esculenta*, and *Salsola kali*.
[2]Sample size.
[3]Percent of monthly or seasonal diet/frequency (percent occurrence among rumen samples).
[4]tr = percent of monthly or seasonal diet is less than .5 percent.
[5]Percent of diet only.

TABLE 11. SUMMER AND WINTER FOOD HABITS OF MULE DEER BY SEASON AND MONTH AS DETERMINED FROM THE EXAMINATION OF 79 FEEDING SITES DURING THE SUMMERS OF 1969 AND 1970 AND THE WINTER OF 1970-71.

	SUMMER					WINTER				
Taxa[1]	June 3 Sites 116[2]	July 10 Sites 403	August 13 Sites 782	Seasonal Average 1,301	September 5 Sites 227	December 2 Sites 230	January 25 Sites 7,870	February 16 Sites 8,075	Seasonal Average 16,175	March 5 Sites 657
GRASSES:	--	--	tr/15[3]	tr/5	1/20[4]	--	tr/16	1/6	tr/7	--
FORBS:										
Artemisia biennis	--	--	--	--	--	--	tr/4	1/19	tr/8	--
Artemisia dracunculus	--	tr/10	1/8	tr/6	--	4/100	1/24	2/75	2/66	tr/20
Artemisia longifolia	--	--	--	--	--	--	1/8	--	tr/3	--
Aster falcatus	--	--	1/8	tr/3	--	--	tr/8	--	tr/3	2/40
Astragalus drummondii	--	--	--	--	--	--	1/16	tr/6	tr/7	--
Astragalus pectinatus	--	--	--	--	--	6/50	--	--	2/17	--
Astragalus spp.	--	1/20	3/8	5/9	2/20	--	tr/4	--	tr/1	--
COMPOSITAE	--	--	--	--	--	--	1/28	tr/13	tr/14	--
Eriogonum multiceps	--	--	--	--	--	--	1/12	1/31	1/14	--
Glycyrrhiza lepidota	13/33	4/30	4/15	7/23	--	--	1/12	tr/6	tr/6	1/20
Helianthus spp.	--	--	--	--	--	--	1/8	--	tr/3	--
Lactuca serriola	20/67	--	tr/8	7/25	--	--	tr/4	--	tr/1	--
LEGUMINOSAE	--	--	1/8	tr/3	--	--	tr/4	tr/6	tr/3	--
Medicago sativa	30/33	3/10	--	11/14	--	--	--	--	--	--
Melilotus officinalis	--	9/10	3/8	4/6	--	--	1/8	--	tr/3	tr/20
Oxytropis lambertii	15/33	--	--	5/11	--	--	--	--	--	--
Oxytropsis spp.	--	--	--	--	--	--	1/16	tr/25	tr/14	2/20
Solidago missouriensis	--	--	--	--	1/20	--	--	--	--	--
Tragopogon dubius	--	--	--	--	--	1/50	--	--	tr/17	--
Yucca glauca	--	7/10	--	2/3	--	--	2/24	4/50	2/25	--
Unidentified Forbs	--	--	--	--	1/20	5/50	2/28	1/44	3/41	--
Total Forbs	78/100	34/50	13/46	41/65	4/20	16/100	13/88	9/88	10/92	5/100
SHRUBS:										
Amelanchier alnifolia	--	--	--	--	5/20	--	--	--	--	--
Artemisia cana	--	--	--	--	--	9/50	9/52	10/75	9/59	18/80
Artemisia tridentata	--	--	--	--	--	--	7/44	22/75	10/40	44/80
Chrysothamnus nauseosus	--	--	11/15	4/5	--	75/100	40/80	30/75	48/85	--
Cornus stolonifera	5/33	24/30	1/8	10/24	--	--	--	--	--	--
Eleagnus commutata	--	10/10	--	3/3	--	--	tr/8	--	tr/3	--
Juniperus communis	--	--	--	--	--	--	2/16	5/31	2/16	2/20
Juniperus horizontalis	--	--	--	--	--	--	18/52	18/63	12/38	22/40
Juniperus scopulorum	--	--	--	--	--	--	--	2/13	1/4	--
Populus tremuloides	--	1/10	--	tr/3	--	--	--	--	--	--
Prunus virginiana	13/33	1/10	9/23	8/22	--	--	6/24	--	2/8	tr/20
Rhus trilobata	--	7/40	28/84	12/41	22/80	--	1/24	1/31	1/18	3/40
Ribes aureum	--	1/20	8/31	3/17	tr/20	--	--	--	--	--
Ribes setosum	--	--	1/8	tr/3	--	--	--	--	--	--
Rosa spp.	1/33	3/30	14/31	6/31	25/80	--	1/20	--	tr/7	--
Sarcobatus vermiculatus	--	--	--	--	--	--	tr/4	1/13	tr/6	4/20
Shepherdia argentea	--	6/20	6/15	4/12	20/60	--	tr/12	tr/6	tr/6	tr/20
Symphoricarpos albus	--	10/40	7/46	6/29	14/40	--	1/12	tr/6	tr/6	tr/20
Symphoricarpos occidentalis	3/33	3/30	1/31	2/31	6/40	--	1/16	--	tr/5	--
Total Shrubs	22/100	66/90	86/100	58/97	92/100	84/100	86/100	89/100	85/100	93/100

[1] Includes taxa occurring at a level of at least .5 percent in at least one month or season. Plants occurring at levels of less than .5 percent in all months and seasons include the following forbs: *Atriplex nuttalli, Chrysopsis villosa, Erigeron caespitosa, Eurotia lanata, Phlox hoodii,* and *Solidago* spp.

[2] The number of instances of use.

[3] tr = percent of monthly or seasonal diet is less than .5 percent.

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

TABLE 12. SUMMER AND WINTER FOOD HABITS OF MULE DEER BY VEGETATION TYPE AS DETERMINED FROM THE EXAMINATION OF 79 FEEDING SITES DURING THE PERIOD OF JUNE-SEPTEMBER OF 1969 AND 1970 AND DECEMBER-MARCH OF 1970-71.

	SILVER SAGE TYPE		BIG SAGE TYPE		GRASSLAND TYPE	
	Summer	Winter	Summer	Winter	Summer	Winter
	6 Sites	0 Sites	10 Sites	27 Sites	15 Sites	21 Sites
Taxa[1]	346[2]		378	9,410	804	7,456
GRASSES:	1/50[3]	--	--	tr/15[4]	--	tr/10
FORBS:						
Artemisia biennis	--	--	--	1/11	--	tr/5
Artemisia dracunculus	--	--	1/20	1/37	--	1/52
Artemisia longifolia	--	--	--	tr/4	--	1/5
Aster falcatus	1/17	--	--	tr/7	--	tr/10
Astragalus drummondii	--	--	--	tr/11	--	1/10
Astragalus pectinatus	--	--	--	--	--	1/5
Astragalus spp.	--	--	3/20	tr/4	9/13	--
COMPOSITAE	--	--	--	1/22	--	tr/14
Eriogonum multiceps	--	--	1/10	1/19	--	tr/14
Glycyrrhiza lepidota	8/33	--	6/30	tr/7	1/7	1/14
Helianthus spp.	--	--	--	--	--	1/10
Lactuca serriola	--	--	1/10	--	4/13	tr/5
LEGUMINOSAE	--	--	--	tr/7	1/7	--
Medicago sativa	--	--	3/10	--	6/7	--
Melilotus officinalis	16/17	--	--	--	3/7	1/14
Oxytropis lambertii	--	--	--	--	3/7	--
Oxytropis spp.	--	--	--	tr/11	--	1/29
Yucca glauca	--	--	7/10	2/26	--	3/33
Unidentified Forbs	--	--	tr/10	1/22	--	2/43
Total Forbs	25/50	--	22/50	7/89	27/47	13/86

TABLE 12. (CONTINUED).

Taxa	SILVER SAGE TYPE Summer 6 Sites 346	SILVER SAGE TYPE Winter 0 Sites	BIG SAGE TYPE Summer 10 Sites 378	BIG SAGE TYPE Winter 27 Sites 9,410	GRASSLAND TYPE Summer 15 Sites 804	GRASSLAND TYPE Winter 21 Sites 7,456
SHRUBS:						
Amelanchier alnifolia	--	--	2/10	--	--	--
Artemisia cana	--	--	--	13/70	--	8/52
Artemisia tridentata	--	--	--	26/85	--	2/19
Chrysothamnus nauseosus	--	--	8/10	34/78	4/7	35/62
Eleagnus commutata	--	--	--	tr/4	7/7	tr/5
Cornus stolonifera	--	--	2/10	--	17/27	--
Juniperus communis	--	--	--	4/30	--	2/10
Juniperus horizontalis	--	--	--	10/41	--	28/67
Juniperus scopulorum	--	--	--	1/7	--	--
Prunus virginiana	--	--	4/10	tr/7	8/27	7/24
Populus tremuloides	--	--	--	--	1/7	--
Rhus trilobata	37/67	--	28/70	1/19	4/33	1/38
Ribes aureum	13/17	--	2/10	--	3/33	--
Ribes setosum	--	--	--	--	1/7	--
Rosa spp.	8/17	--	14/40	tr/7	10/47	1/14
Sarcobatus vermiculatus	--	--	--	1/15	--	--
Shepherdia argentea	--	--	14/40	tr/7	6/27	tr/14
Symphoricarpos albus	14/67	--	4/10	tr/11	7/47	1/10
Symphoricarpos occidentalis	2/23	--	tr/10	--	5/47	2/24
Total Shrubs	74/100	--	78/100	90/100	73/93	86/100

[1] Includes taxa occurring at a level of at least .5 percent in at least one season in one type. Plants occurring at less than this level on all types include the following forbs: *Atriplex nutalli*, *Chrysopsis villosa*, *Erigeron caespitosa*, *Eurotia lanata*, *Phlox hoodii*, *Solidago missouriensis*, *Solidago* spp., and *Tragopogon dubius*.

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

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

[4] tr = Percent of diet is less than .5 percent.

Data from 26 feeding sites showed a greater percentage of shrubs than forbs in the summer diet which was in contrast to that from rumens. There was a decrease in the percent of forbs and an increase in the percent of deciduous shrubs as the summer progressed (Table 11). Yellow sweetclover appeared to be a preferred species because its occurrence in the diet exceeded its abundance in vegetation types where its use was recorded (Tables 1 and 12). The percent of alfalfa in the diet decreased from June to July (Table 11). Use of this species was recorded in the Big Sage and Grassland Types during these two months. As determined from feeding sites, use of red dogwood exceeded its abundance in the Deciduous Shrub Subtype in the Grassland Type (Tables 3 and 12). Summer food habits by forage class as determined by the examination of feeding sites are shown in Figure 9.

Fall. - Browse, forbs and grasses constituted 81, 16, and 3 percent, respectively of the contents of nine rumens. Most important items in the diet were snowberry, skunkbrush sumac and rubber rabbitbrush (*Chrysothamnus nauseosus*) accounting for 27, 15 and 14 percent of the diet, respectively. During this season evergreen shrubs, including rubber rabbitbrush and silver sagebrush, became an important part of the diet. The percent of rubber rabbitbrush in the diet doubled from September to October while percentages for all deciduous shrubs except snowberry and silverberry (*Elaeagnus commutata*) decreased (Table 10). Wild licorice was the most important forb accounting for

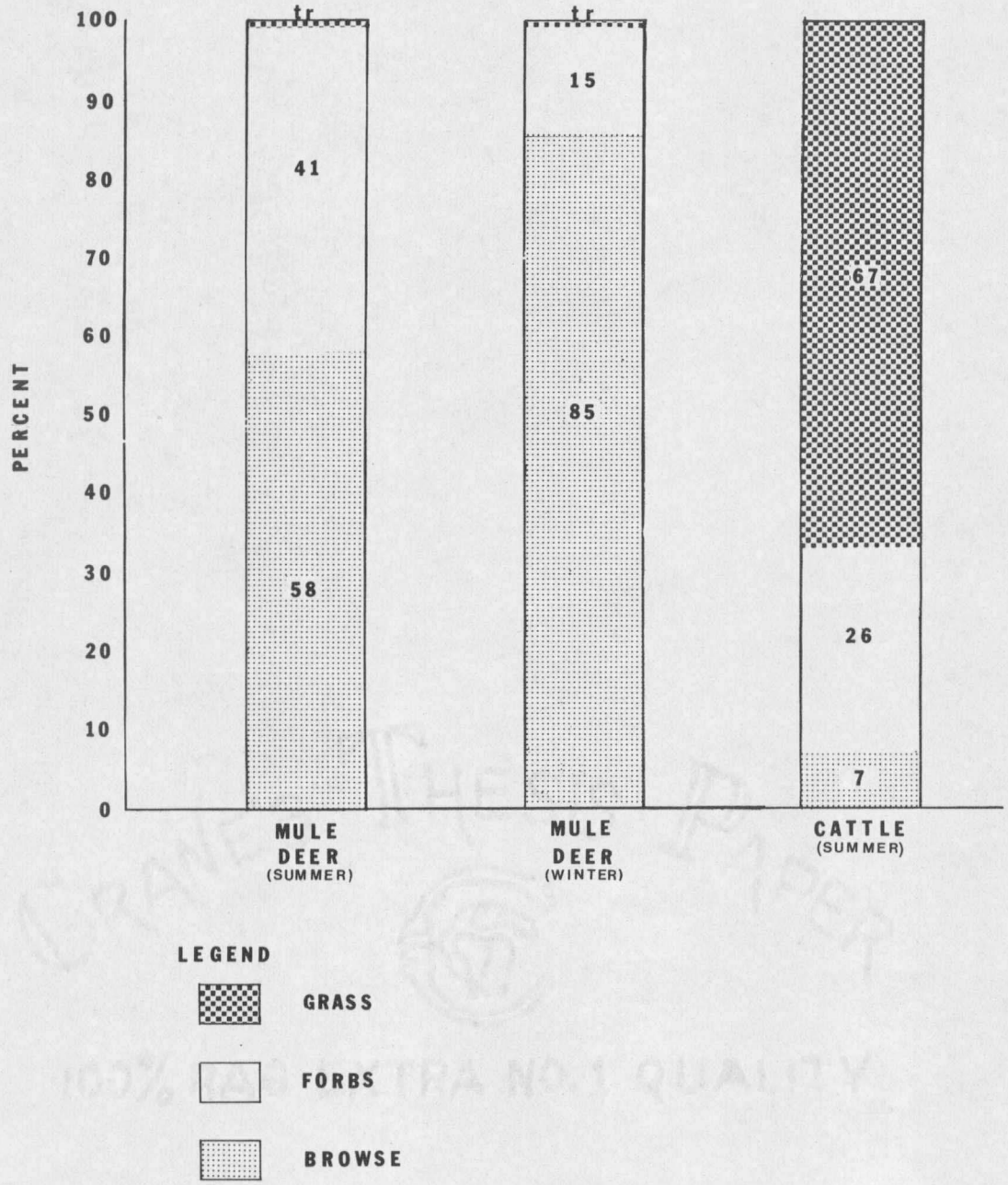

Figure 9. Percent Grasses, Forbs, and Browse occurring in the summer and winter diets of mule deer and the summer diet of cattle as determined from the examination of feeding sites.

2 percent of the seasonal diet. Use of barley was largely responsible for the increased use of the grass forage class during this period. Data obtained from five feeding sites in September agreed closely with that obtained from rumen samples for this month. Food habits for this season were similar to those observed by Mackie (1970).

Winter. - Browse and forbs accounted for 60 and 40 percent, respectively, of the diet as determined from six rumens. The percent of forbs in the diet increased while the percent of browse decreased as the winter progressed (Table 10). Rubber rabbitbrush was the most important item in the diet accounting for 33 percent. The percent of this taxon in the diet decreased throughout the winter from a high of 59 percent in December (Table 10). Rocky Mountain and creeping juniper were indistinguishable in rumen samples. Together they made up 10 percent of the diet. Big sagebrush and silver sagebrush also occurred in the diet. Soap-weed, the most important forb, accounted for 20 percent of the seasonal diet. Use of this forb, which remained green throughout the winter, increased as the winter progressed (Table 10). *Eriogonum* was another forb that commonly occurred in rumen samples. Use of grasses was negligible.

The results from 43 feeding sites closely agreed with the results from rumen samples so far as major items were concerned but did not show any change in the relative percentages of shrubs and forbs as the winter progressed. This may have been influenced by greater difficulty in de-

tecting use of forbs as compared to browse in late winter when forbs became more available because of receding snow cover. Rubber rabbitbrush, the most important item, was fed upon in the Big Sage and Grassland Types (Table 12). The canopy coverage for this species was less than .5 percent on both types on which it was found (Appendix, Table 17). Creeping juniper was second in importance. Use of Rocky Mountain juniper was minor. Chokecherry was commonly used on feeding sites on the south side of Big Cottonwood Creek which was dominated by the Grassland Type. Use of forbs in the Grassland Type was greater than that on the Big Sage Type. Winter food habits by forage class are shown in Figure 9. Seasonal food habits as shown in Table 11 did not add up to 100 percent. This is attributed to a large number of forbs occurring in the diet at a level of less than .5 percent of the total diet. The difference is accounted for in Figure 9.

Spring. - As determined from five rumen samples, the percent of browse in the diet for spring, 59 percent, did not change appreciably from that recorded during winter. Juniper was the most important item accounting for 41 percent of the spring diet. This may indicate that rubber rabbitbrush, the favored taxon for winter, was preferred to creeping and common juniper. Use of junipers increased from March to April but dropped off sharply in May when browse occurred at its lowest level in the year-long diet (Table 10). Forbs and grasses made up 24 and 17 percent of the season diet, respectively. Lomatium (*Lomatium*

spp.) was the most important forb. It accounted for 35 percent of the sample collected in May (Table 10). Grasses were more abundant in the diet during this season than during any other. This was influenced by the sample collected in May of which 48 percent was newly sprouted grass. The examination of five feeding sites in March indicated big sagebrush constituted 44 percent of the diet this month. Its importance in the diet was twice that of creeping juniper (Table 11). Spring food habits found during this study closely parallel those observed by Mackie (1970).

CATTLE

Summer and early fall food habits of cattle were determined by the examination of 52 feeding sites and the recording of 4,723 instances of use. Results are in Table 13, Appendix, Table 19, and Figure 9. Data for the summers of 1969 and 1970 were combined.

Grasses, forbs and shrubs accounted for 67, 26 and 7 percent of the summer diet, respectively. Western wheatgrass, the most important species, accounted for 24 percent of the diet from June to August. Other grasses commonly used by cattle were smooth brome, needle-and-thread, prairie sand reedgrass (*Calamovilfa longifolia*), blue grama and plains muhly. Use of these grasses in the various vegetation types is shown in Table 13. Forbs common in the summer diet included alfalfa, yellow sweetclover, flixweed tansymustard (*Descurainia sophia*), and common salsify (*Tragopogon dubius*). Greasewood accounted for all the use

on shrubs in June. Chokecherry and common snowberry were important shrubs used in August. Food habits of cattle during summer for this study were similar to those found by Mackie (1970) in the Missouri River breaks.

In September the percentage of grass in the diet increased to 85 percent as compared to 67 percent for summer. Needle-and-thread was the most important grass during this month accounting for 49 percent of the diet. Western wheatgrass and blue grama were second and third in importance, respectively. Forbs represented 6 percent of the diet. Shrubs accounted for 11 percent. Western snowberry was the most important.

During the period of June to September the percent of western wheatgrass in the diet exceeded its abundance in all three vegetation types indicating that cattle selectively fed on this species (Tables 1 and 13). Yellow sweet clover accounted for 39 percent of the diet on the Big Sage Type. It occurred only on the Big Sage-Agropyron Subtype with a canopy coverage of 5 percent. All utilization of shrubs by cattle was in the Silver Sage or Grassland Types. Snowberry was important in the Silver Sage Type. Chokecherry was important in the Grassland Type.

TABLE 13. FOOD HABITS OF CATTLE BY SEASON, MONTH AND VEGETATION TYPE AS DETERMINED BY EXAMINATION OF 52 FEEDING SITES DURING THE SUMMERS AND EARLY FALL OF 1969 AND 1970.

	SUMMER				FALL	TYPE[5]		
	June	July	August	Seasonal	September	Silver Sage	Big Sage	Grassland
	8 Sites	14 Sites	20 Sites	Average	10 Sites	32 Sites	2 Sites	18 Sites
Taxa[1]	677[2]	1,135	1,832	3,644	1,029	2,796	203	1,724
GRASS AND GRASS-LIKE PLANTS:								
Agropyron cristatum	2/25[3]	2/14	2/15	2/18	tr/10[4]	3/25	--	--
Agropyron smithii	18/63	31/79	26/65	24/69	21/80	27/72	23/100	21/67
Agropyron spp.	--	--	5/25	2/8	3/13	3/13	--	2/17
Bouteloua gracilis	tr/13	5/50	8/40	4/31	7/80	4/22	3/50	11/89
Bromus inermis	12/25	14/36	4/30	10/30	--	11/41	--	--
Calamovilfa longifolia	3/13	3/14	tr/5	6/11	--	2/9	--	tr/6
Koeleria cristata	1/13	tr/7	1/20	1/13	1/40	tr/6	--	2/44
Muhlenbergia cuspidata	9/13	2/29	2/15	4/19	1/10	3/13	1/50	3/22
Poa secunda	--	--	3/20	1/7	1/30	2/13	--	tr/17
Stipa comata	1/25	10/21	12/35	7/27	49/90	1/13	25/50	43/89
Stipa richardsoni	--	8/50	1/25	3/25	--	3/28	2/50	1/11
Unidentified Grasses	tr/13	1/14	1/10	1/12	1/20	tr/9	--	1/22
Carex spp.	4/13	1/29	1/15	2/19	1/40	tr/9	1/50	4/50
CYPERACEAE	--	--	1/5	tr/2	--	1/3	--	--
Total Grass and Grass-like	50/88	77/100	67/95	67/94	85/100	60/94	55/100	88/94
FORBS:								
Artemisia dracunculus	--	--	--	--	2/10	--	--	1/6
Aster falcatus	--	--	1/10	tr/3	--	1/6	--	--
Convolvulus arvensis	--	--	1/5	tr/2	--	tr/3	--	--
CRUCIFERAE	2/25	--	--	1/8	--	tr/6	--	--
Descurainia sophia	8/25	tr/7	--	3/11	--	2/9	--	--
Equisetum spp.	--	1/14	--	tr/5	--	tr/6	--	--
Eurotia lanata	--	1/7	1/5	1/2	tr/10	--	5/50	1/11
Gailardia aristata	--	--	1/10	tr/3	--	--	--	1/11
Geum triflorum	--	--	1/10	tr/3	1/10	tr/3	--	tr/11
Glycyrrhiza lepidota	--	1/7	2/15	1/7	1/10	2/16	--	--
Kochia scoparious	--	--	2/10	1/3	--	1/6	--	--
Liatris punctata	--	--	1/5	tr/2	--	tr/3	--	--
Medicago satvia	18/38	7/29	4/15	8/27	--	10/31	--	--
Melilotus officinalis	5/38	10/50	6/20	7/36	--	7/28	39/100	--
Opuntia polycantha	tr/13	--	--	tr/4	--	tr/3	--	--
Salsola kali	--	--	tr/10	1/2	1/10	2/6	--	--
Solidago missouriensis	--	1/7	--	tr/2	tr/30	tr/3	--	--
Tragopogon dubius	3/13	2/36	1/25	2/25	--	2/28	--	tr/11
Unidentified Forbs	2/25	tr/14	1/15	1/18	1/20	4/3	1/50	1/39
Total Forbs	38/88	23/100	24/80	26/89	6/80	31/94	45/100	4/83
SHRUBS:								
Acer negundo	--	--	1/5	tr/2	--	1/3	--	--
Amelanchier alnifolia	--	--	--	--	1/10	tr/3	--	--
Prunus virginiana	--	--	5/5	2/2	1/10	tr/3	--	6/6
Sarcobatus vermiculatus	12/13	--	--	4/4	--	3/3	--	--
Symphoricarpos albus	--	--	2/10	1/3	1/10	2/9	--	--
Symphoricarpos occidentalis	--	--	1/10	tr/3	8/15	3/9	--	--
Total Shrubs	12/13	tr/7	9/25	7/15	11/20	9/22	--	6/6

[1] Includes only those taxa occurring at a level of at least .5 percent in at least one month, season or vegetation type.
[2] Number of instances of use.
[3] Percent of instances of use/frequency (percent occurrence among feeding sites).
[4] Indicates less than .5 percent (tr).
[5] June-September.

Weights, Productivity and Population Characteristics of Mule Deer

WEIGHTS AND KIDNEY FAT INDICES

Whole weights were recorded for 22 mule deer. Hog-dressed weights were obtained for 18 of these (Table 14). Hog-dressed weights averaged 70 percent of whole weights. There was no observed seasonal change in this percentage. Hog-dressed weights averaged 73 percent in the Snowy Mountains (Kamps 1969). Average whole weights generally decreased from the period of July-December to January-June for adults two and one-half years and older but increased for fawns and yearlings.

The kidney fat index was calculated for each of 12 mule deer examined from January to June (Table 14). Three male fawns taken between February and April had an average index of 20 percent. Two yearling males collected in June, which were fawns the previous winter, had an average index of 11 percent. Ransom (1965) concluded that an index of less than 30 percent does not accurately reflect body condition. Two yearling females collected in January and February exhibited an average kidney fat index of 108 percent as compared to 36 percent for five adult females two and one-half years and older. These were much higher values than those found by Lovaas (1958) in the Little Belt Mountains.

PRODUCTIVITY AND POPULATION CHARACTERISTICS

Sex and age ratios are in Table 15 and Appendix, Table 20. Fawn: female ratios obtained from ground observations were highest for sum-

TABLE 14. SEX, AGE, WEIGHTS AND KIDNEY FAT INDICES FOR 22 MULE DEER.

Date of Collection[1]	Sex	Assigned Age	Whole Weight	Hog-Dressed Weight	Dressing Index[2]	Kidney Fat Index[3]
1/20/71	Female	1½	120	82	.683	0.787
1/20/71	Female	3½	138	95	.688	0.330
2/ 9/71	Male	½	80	60	.750	0.363
2/22/71	Female	1½	128	86	.672	1.365
3/ 2/71	Male	½	85	60	.706	0.133
3/16/71	Female	2½	108	70	.648	0.836
3/16/71	Female	6½-7½	126	76	.603	0.303
4/11/70	Female	4½	126	100	.794	0.156
5/ 2/70	Male	½	100	70	.700	0.098
6/ 9/70	Male	1½	90	70	.777	0.095
6/16/70	Male	1½	116	90	.776	0.126
6/18/69	Female	2½	140	--	--	--
6/23/70	Female	4½	140	90	.643	0.149
7/ 3/69	Female	2½	115	--	--	--
7/10/69	Male	3½	185	--	--	--
7/28/69	Female	3½	145	--	--	--
8/ 7/69	Male	1½	115	80	.696	--
8/21/69	Female	2½	125	90	.720	--
9/ 1/69	Female	1½	100	73	.730	--
9/15/69	Female	7½	155	102	.658	--
12/23/70	Male	1½	130	90	.692	--
12/23/70	Male	½	75	55	.733	--

[1] Collections are arranged by month and day from January-December, regardless of year.

[2] Determined by dividing the hog-dressed weight by the whole weight.

[3] Determined by dividing the weight of the kidney fat and capsule by the weight of the kidney, plus the weight of the kidney fat and capsule.

mer during the period of August 16 to September 18. Ratios for this period were 65 and 71 fawns per 100 females for 1969 and 1970, respectively. These figures were similar to those found by Kamps (1969) and considerably lower than those reported by Nellis (1968) for the National Bison Range. It is the writer's opinion that ratios obtained during winter were more reliable than those obtained in summer because all fawns were active and more easily observed during this period. A ratio of 104 fawns per 100 females was obtained from ground observations during the period of December 22, 1970 to February 15, 1971 (Table 15). A ratio of 106 fawns per 100 females was obtained from aerial observations for January and February, 1971 (Appendix, Table 20). Fawn:female ratios were not calculated after the middle of February because sex of adults was not readily determined. From aerial observations made by personnel of the Montana Fish and Game Department in December of 1967 and in January, 1969, ratios of 96 and 91 fawns per 100 females, respectively were reported. Fawn:female ratios were more than twice as great as those reported by Lovaas (1958) for the Little Belt Mountains. This might indicate that physical condition of the animal and its reproductive performance are directly related. Fawn: adult ratios are in Table 15 and Appendix, Table 20. Data from aerial observations were found to be quite variable during summer months but closely agreed with data from ground observations during winter.

All six females collected from January to April were pregnant.

Three each carried a single fetus, two each bore twins, and one had triplets. For the two yearlings in the sample, the number of fetuses was one and two, respectively. The female carrying triplets was estimated to be six and one-half to seven and one-half years old. Three corpora lutea were found in ovaries of the female collected in April, 1970 with only one fetus present in the uterus. Ten corpora lutea were found in ovaries of the five animals collected in 1971 representing an ovulation incidence of 2.0 for these animals. This is higher than that found by Nellis (1968) on the National Bison Range. Nine fetuses present in the five females represented a fertilization rate of 90 percent. From measuring each fetus to determine the age (Hudson and Browman 1959), dates on which conception occurred could be estimated. The dates of conception for the two yearling females were estimated to occur between December 2 and 9, 1970 and for two of the older females, November 24 and 25, respectively. The female collected in April of 1970, which was estimated to be four and one-half years old, was believed to have conceived on or near November 22, 1969.

Of the 22 deer taken from the study area, 15 were two and one-half years old or younger (Table 14). Two were six and one-half or older. This might suggest that the population was composed largely of younger animals.

As determined from ground observations the number of males observed per 100 females, from June to September, doubled from 1969 to 1970 (Table 15). Aerial observations did not show this because deer

were difficult to observe from a plane in areas where males were prevalent. Nineteen males per 100 females were observed from the ground during the winter of 1970-71 as compared to 87 during the previous summer (Table 15). This may have been influenced by selection of males over females by hunters during the previous hunting season.

TABLE 15. SEX AND AGE CLASSES OF MULE DEER AS DETERMINED BY GROUND OBSERVATIONS FOR THE SUMMERS OF 1969 AND 1970 AND THE WINTER OF 1970-71.

Time Period	Total Observed	ADULTS			Fawns	Uncl. Sex & Age	RATIOS		
		Male	Female	Uncl.			Males: 100 Females	Fawns: 100 Females	Fawns: 100 Adults
June 9-July 15:									
1969	52	15	25	8	3	1	60	12	6
1970	173	65	81	22	5	-	80	6	3
July 16-August 15:									
1969	189	42	93	11	43	-	47	46	29
1970	138	53	61	4	20	-	87	33	17
August 16-September 18:									
1969	194	31	94	8	61	-	33	65	46
1970	160	57	59	2	42	-	97	71	36
Total June 9-September 15:									
1969	435	88	212	27	107	1	42	50	33
1970	471	175	201	28	67	-	87	33	14
December 22-January 15:									
1970-71	156	14	58	2	57	25	24	98	77
January 16-February 15:									
1971	484	36	201	2	213	32	18	106	88
Total December 22-February 15:									
1971	640	50	259	4	270	57	19	104	86
February 16-March 15:									
1971	379	12	61	125	135	46	--	--	68

DISCUSSION

Smith and Julander (1953) have listed conditions necessary for range competition between deer and livestock. Land use competition occurs where animals use the same areas and the same forage species. Forage competition results if forage species used by both reach or surpass a point of utilization that is considered "proper."

Most observations of mule deer occurred in areas where numbers of cattle were few or absent during the summer of 1970 (Figure 8). This was mainly due to differences in the types of slopes used by deer and by cattle. The only time and area of significant dual usage of slopes was in late summer when both used bottoms of major drainages occupied by the Silver Sage Type (Tables 4 and 9). Although this type received most of the seasonal use by cattle as compared to all types, specific areas on this type used by deer were currently occupied by few if any cattle. This might indicate an avoidance by deer of areas occupied by large concentrations of cattle as suggested by Firebaugh (1969). The Grassland and Big Sage Types together received 81 percent of the seasonal use by mule deer and 36 percent of the seasonal use by cattle (Tables 4 and 9). Use of these two types by both classes of animals was seldom concurrent in the same parts of the study area. Most pastures on the north side of Big Cottonwood Creek were not grazed by cattle during the period of study in the summer of 1970. This may have influenced use of this area by mule deer. During the summer of 1970, few observations of mule deer were obtained south of Big Cottonwood

Creek in Bughouse Coulee (Figure 8) within the Bughouse Unit where cattle occurred during the period of July through September. During the same period in 1969, many observations of deer were made there when cattle were absent.

Grasses and grasslike plants, the most abundant forage class in the diet of cattle during summer and early fall, were insignificant in the diet of mule deer during this period (Tables 10, 11, 13, and Figure 9). Forbs were important in the diets of both classes of animals during early summer. Yellow sweetclover, the most important item in the diet of mule deer during July (Table 10), was the most important forb in the diet of cattle during this month. The availability of this forb, which was preferred among forbs by both mule deer and cattle where dual use was recorded, was enhanced by above normal precipitation in early summer of both years (Appendix, Table 16). Below normal precipitation, resulting in a decreased availability, would probably result in a greater use of deciduous shrubs by deer and a greater percentage of grass in the diet of cattle. In areas where a systematic grazing program is not employed, an overgrazed range may cause cattle to use more deciduous shrubs which are the most important item in the diet of mule deer during late summer and early fall (Table 10). This could be detrimental to mule deer. Common use by both classes of animals of snowberry and chokecherry in the Deciduous Shrub Subtype in the Grassland Type also indicated that land use competition did occur.

Important taxa in the diet of mule deer in winter, except for chokecherry, were not used by cattle during the summers of this study. Forage competition was not apparent.

Julander *et al.* (1961) concluded that a good summer range, capable of carrying deer into the breeding season in good physical condition, is necessary to approach an ovulation rate of 1.95 per female. The ovulation rate of 2.0 determined from females collected during this study would indicate that the summer range in the Cottonwood Creek area was in good condition at the time of the study. An increased number of fawns observed per 100 females from 1967 and 1969 to 1971 may be related to an increase in hunting pressure in 1968 on areas occupied by the Cottonwood Grazing Association soon after it was organized. The fact that this area was also used by livestock did not appear to be detrimental to the reproduction of mule deer. That most of the area was systematically grazed may have been a contributing factor. Thilenius and Hungerford (1967) indicated that dual use of the range was a more efficient use providing that forage species heavily used by one class of animal were not heavily used by the other. In this study I felt that dual use of the range by cattle and mule deer, even when both were utilizing the same forage species, was efficient land use because the combined use was not excessive. Evaluation of the condition of browse plants in this area in 1967, 1968, and 1969 (Bayless 1971) indicated excessive use only on rubber rabbitbrush. This plant was the

most important item in the diet of mule deer during winter but no usage by cattle was recorded on this taxon during my study.

APPENDIX

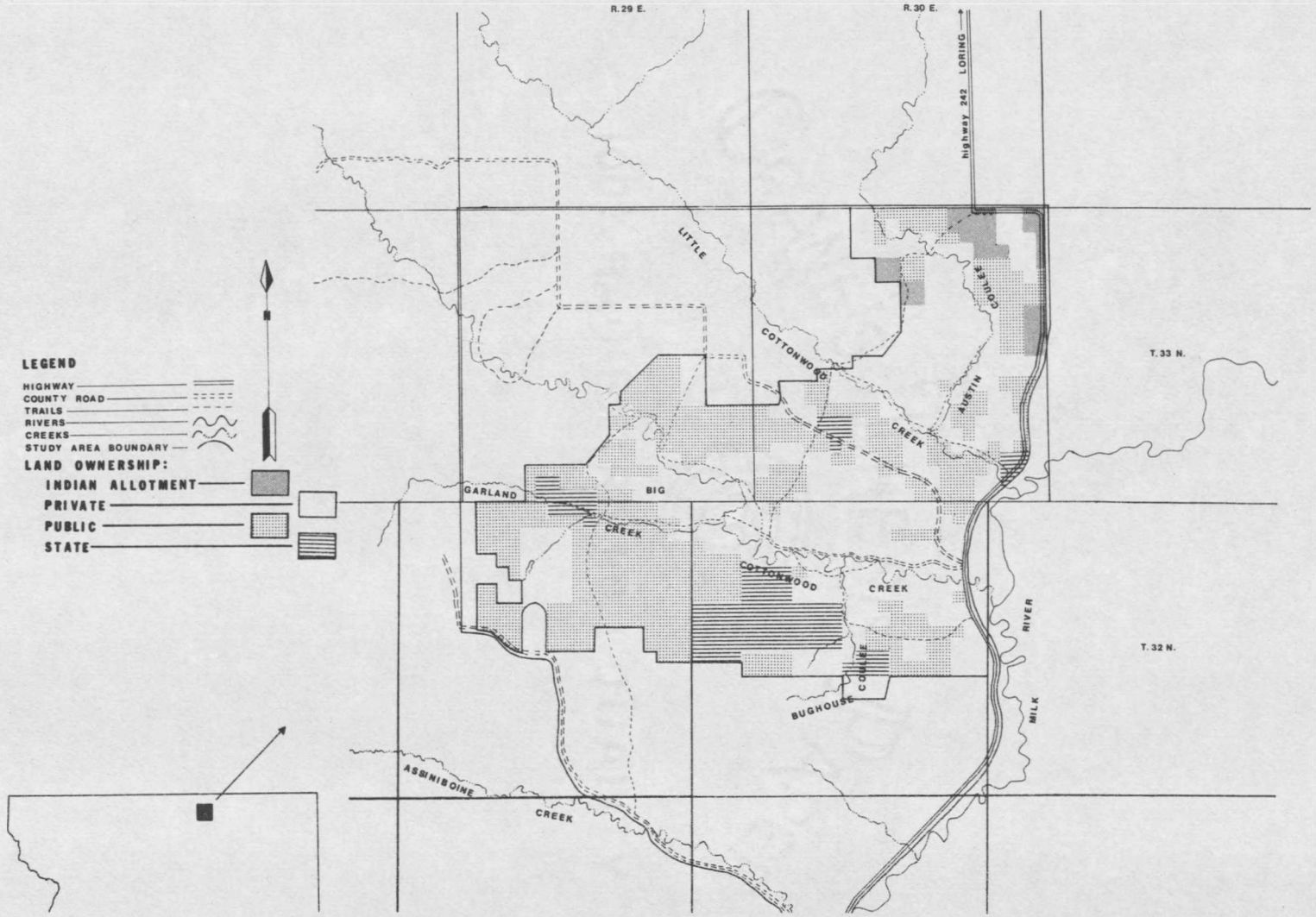

Figure 10. Map of Study Area showing ownership of land on the Cottonwood Creek Grazing Association.

TABLE 16. CLIMATOLOGICAL DATA GATHERED BY THE BUREAU OF RECLAMATION IN MALTA, MONTANA COVERING THE PERIOD OF JUNE-SEPTEMBER, 1969 AND 1970 AND THE PERIOD OF DECEMBER, 1970 THROUGH MARCH, 1971.

Period Covered	TEMPERATURE (degrees F) Avg. Max.	Avg. Min.	Average	Departure From Normal	High	Low	PRECIPITATION (inches) Total	Departure From Normal	Greatest Daily
June:									
1969	74.8	46.9	60.9	-2.3	93	35	2.86	-.05	.88
1970	83.2	54.0	68.6	5.4	94	44	4.52	1.61	1.49
July:									
1969	83.4	54.3	68.9	-2.6	93	46	1.65	.32	.52
1970	86.6	56.8	71.7	.2	98	47	1.70	.37	1.00
August:									
1969	91.4	54.0	72.7	4.1	103	42	.04	-1.22	.02
1970	90.0	53.1	71.6	3.0	100	42	.11	-1.15	.11
September:									
1969	78.5	45.0	61.8	3.9	95	32	.52	-.47	.39
1970	71.3	40.1	55.7	-2.2	92	21	.76	-.23	.29
December:									
1970	22.2	-1.4	10.4	-9.0	44	-30	.19	-.21	.10
January:									
1971	16.2	-4.0	6.1	-5.9	45	-26	1.73	1.30	.30
February:									
1971	28.1	6.6	17.4	--	50	-40	.09	--	--
March:									
1971	--	--	--	--	62	-1	.09	--	--

TABLE 17. TAXA WITH CANOPY COVERAGE OF LESS THAN .5 PERCENT AND/OR FREQUENCIES OF LESS THAN 5 PERCENT (See Table 1 of text for explanation).

	SILVER SAGE TYPE		BIG SAGE TYPE			GRASSLAND TYPE	
Taxa	Silver Sage-Agropyron Subtype 8 Sites	Cottonwood Subtype 5 Sites	Big Sage-Agropyron Subtype 10 Sites	Artemisia-Sarcobatus Subtype 5 Sites	Sarcobatus Subtype 3 Sites	Stipa Subtype 8 Sites	Juniperus Subtype 5 Sites
FORBS:							
Allium textile	X	-	X	X	-	-	-
Antennaria rosea	-	-	X	-	-	-	X
Arennaria spp.	-	-	-	-	-	X	X
Artemisia biennis	-	-	-	-	-	X	-
Artemisia dracunculus	-	-	-	-	-	X	X
Astragalus gilviflorus	-	-	X	-	-	X	-
Campanula rotundifolia	-	-	-	-	-	-	X
Chrysopsis villosa	X	-	-	-	-	-	X
Cirsium undulatum	X	-	-	-	-	-	-
Conringa orientalis	-	-	X	-	-	-	-
CRUCIFERAE	-	X	-	X	-	-	X
Descurainia sophia	-	X	X	X	-	-	-
Erigeron pumilus	X	-	X	-	-	-	X
Eriogonum flavum	-	-	-	-	-	X	X
Eriogonum multiceps	-	-	X	-	-	-	-
Eurotia lanata	-	-	X	-	-	X	-
Gaura coccinea	X	-	-	-	-	-	-
Geum triflorum	-	-	-	-	-	-	X
Helianthus petiolaris	-	-	X	-	-	-	-
Linum rigidum	-	-	X	-	-	X	X
Lomatium cous	-	-	X	-	-	-	-
Lygodesmia juncea	X	-	-	-	-	-	-

TABLE 17. (CONTINUED)

Taxa	SILVER SAGE TYPE		BIG SAGE TYPE			GRASSLAND TYPE	
	Silver Sage-Agropyron Subtype 8 Sites	Cottonwood Subtype 5 Sites	Big Sage-Agropyron Subtype 10 Sites	Artemisia-Sarcobatus Subtype 5 Sites	Sarcobatus Subtype 3 Sites	Stipa Subtype 8 Sites	Juniperus Subtype 5 Sites
Oxytropis lambertii	-	-	-	-	-	X	-
Penstemon albidus	X	-	-	-	-	-	-
Petalostemon candidum	-	-	X	-	-	-	-
Plantago purshii	X	-	X	-	X	X	-
Psoralea esculenta	-	-	X	-	-	-	X
Ratibida columnifera	-	-	X	-	-	X	X
Senecio canus	-	-	-	-	-	-	X
Smilicina stellata	-	X	-	-	-	-	-
Sonchus spp.	-	X	-	-	-	-	-
Thermopsis rhombifolia	X	-	X	-	-	-	-
Thlaspi arvense	-	X	-	-	-	-	-
UMBELLIFERAE	-	-	-	X	-	-	-
SHRUBS:							
Chrysothamnus nauseosus	-	-	X	-	-	X	-
Ribes setosum	-	X	-	-	-	-	-

TABLE 18. PERCENT OF GROUND AND AERIAL OBSERVATIONS OF MULE DEER OCCURRING ON SUBTYPES BY MONTH AND SEASON FOR THE SUMMER OF 1969.

Vegetation Subtype	June 9/[1]	July 122/46	August 180/127	September 101/85	June-Sept. 341/258
Silver Sage-Agropyron	11/-[2]	12/-	6/-	23/-	14/-
Cottonwood	-/-	6/-	2/6	7/-	5/3
Abandoned Meadow	11/-	2/-	3/-	7/-	4/-
Big Sage-Agropyron	11/-	25/39	37/13	24/13	27/18
Artemisia-Sarcobatus	11/-	8/-	2/-	-/-	5/-
Sarcobatus	-/-	-/-	-/-	-/-	-/-
Stipa	45/-	29/33	29/30	13/35	20/32
Cropland	-/-	-/-	-/-	-/-	-/-
Deciduous Shrub	-/-	16/28	18/48	7/49	13/45
Juniperus	11/-	1/-	3/tr	19/3	8/1

[1] Sample size: ground/aerial
[2] Percent of monthly or seasonal sample: ground/aerial.

TABLE 19. TAXA OCCURRING AT LEVELS OF LESS THAN .5 PERCENT IN THE SUMMER AND EARLY FALL DIET OF CATTLE.

	MONTH				TYPE		
	June	July	Aug.	Sept.	Silver Sage	Big Sage	Grassland
	8 Sites	14 Sites	20 Sites	10 Sites	32 Sites	2 Sites	18 Sites
Taxa	677	1,135	1,832	1,029	2,796	203	1,724
GRASSES:							
Hordeum jubatum	-	-	X	-	X	-	-
Poa pratensis	-	X	-	-	X	-	-
FORBS:							
Atriplex argenta	-	-	X	-	X	-	-
Helianthus petiolaris	-	-	X	-	X	-	-
Lactuca serriola	X	-	X	-	X	-	-
Lappula redowski	X	-	-	-	X	-	-
LEGUMINOSAE	-	X	-	-	X	-	-
Opuntia polycantha	X	-	-	-	X	-	-
Petalostemon candidum	-	X	-	-	X	-	-
Petalostemon purpureum	-	-	X	-	-	-	X
Sonchus spp.	-	-	X	-	X	-	-
Spaeralcea coccinea	-	-	X	-	-	-	X
Taraxicum officinale	-	X	-	-	X	-	-
Vicia americana	-	X	X	-	X	-	X
SHRUBS:							
Rosa spp.	-	X	-	-	X	-	-

TABLE 20. SEX AND AGE CLASSES OF MULE DEER AS DETERMINED BY AERIAL OBSERVATIONS FOR THE SUMMERS OF 1969 AND 1970 AND THE WINTER OF 1971.

Time Period	Total Observed	ADULTS			Fawns	Uncl. Sex & Age	RATIOS		
		Male	Female	Uncl.			Males: 100 Females	Fawns: 100 Females	Fawns: 100 Adults
June:									
1969	31	6	22	1	2	--	27	9	7
1970	52	4	33	15	--	--	12	--	--
July:									
1969	50	13	23	--	14	--	57	61	39
1970	74	20	42	--	12	--	48	28	19
August:									
1969	131	35	56	1	39	--	63	70	42
1970	96	8	49	--	39	--	16	92	71
September:									
1969	85	19	29	1	36	--	66	124	73
1970	89	13	48	--	33	--	30	73	59
Total June-September:									
1969	297	73	130	3	91	--	56	70	44
1970	309	45	167	15	85	--	27	51	38
January:									
1971	184	18	28	--	27	111	64	96	57
February:									
1971	199	14	60	1	66	58	23	110	88
March:									
1971	131	1	4	17	22	87	--	--	100
Total January-February:									
1971	383	32	88	1	93	169	36	106	77

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