



Relationship of mule deer to livestock on summer range in the Pryor Mountains, Montana
by John Edgar Firebaugh

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

Montana State University

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Abstract:

A study was conducted in the Pryor Mountains of south-central Montana during the summers of 1967 and 1968 to obtain quantitative data on distribution, food habits, and range relations of mule deer and cattle on the summer range. Physical condition and productivity of the deer were also studied. The previous history of livestock grazing on the area was reviewed. The physiography and vegetation of the study area were described. The vegetation was described as constituting three zones: the Fescue-Wheatgrass, Douglas-fir, and Spruce-Fir. Canopy coverages and frequencies of occurrence of various low-growing plant species were determined for most of the types and subtypes within each zone by quantitative measurements. Distribution of mule deer for both summers was determined by 1,152 observations during 129 observation trips. Eighty-one percent of the total deer observations were in the Douglas-fir Zone. The Fescue-Wheatgrass and Spruce-Fir Zones received light use by deer. Fifty-seven percent of the total cattle observations were on the Fescue-Wheatgrass Zone. The Douglas-fir Zone received the least amount of use by cattle. Deer food habits were determined by examination of 70 feeding sites during the summers of 1967 and 1968. Forbs composed 89 percent of the total summer diet while browse and grasses formed 10 and 1 percent, respectively. Use of forbs decreased from June to September while use of browse increased. Eighty-three percent of the mule deer feeding sites were located in the Douglas-fir Zone. Cattle food habits were evaluated by examination of 59 feeding sites. Grasses and grass-like plants constituted 71 percent of the diet. Forbs and browse composed 28 and 1 percent of the diet, respectively. Use on grasses and grass-like plants increased from 56 percent in July to 90 percent in September as forbs became desiccated. Utilization of forbs decreased from 42 to 9 percent during this same period. The majority of cattle feeding sites were located in the Fescue-Wheatgrass Zone. Forage utilization by cattle was determined by use of agronomy cages, exclosures, and grazed plant transects. Utilization was found to be heavy in several areas. Hog-dressed weights of hunter-killed mule deer were lower than those of certain other studies. Classification of 1,152 deer by age and sex revealed low fawn:doe ratios of 54 and 32 fawns per 100 does for the summers of 1967 and 1968, respectively. There was little overlap of range use and little direct competition for food between mule deer and cattle. *Taraxacum laevigatum* was the only plant species used substantially by both. Distribution and numbers of cattle appeared to limit the distribution of deer mainly to the Douglas-fir Zone.

This limitation of range use possibly accounted for the lower productivity of deer.

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by

JOHN EDGAR FIREBAUGH

131

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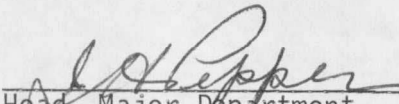
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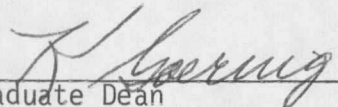
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ABSTRACT

A study was conducted in the Pryor Mountains of south-central Montana during the summers of 1967 and 1968 to obtain quantitative data on distribution, food habits, and range relations of mule deer and cattle on the summer range. Physical condition and productivity of the deer were also studied. The previous history of livestock grazing on the area was reviewed. The physiography and vegetation of the study area were described. The vegetation was described as constituting three zones: the Fescue-Wheatgrass, Douglas-fir, and Spruce-Fir. Canopy coverages and frequencies of occurrence of various low-growing plant species were determined for most of the types and subtypes within each zone by quantitative measurements. Distribution of mule deer for both summers was determined by 1,152 observations during 129 observation trips. Eighty-one percent of the total deer observations were in the Douglas-fir Zone. The Fescue-Wheatgrass and Spruce-Fir Zones received light use by deer. Fifty-seven percent of the total cattle observations were on the Fescue-Wheatgrass Zone. The Douglas-fir Zone received the least amount of use by cattle. Deer food habits were determined by examination of 70 feeding sites during the summers of 1967 and 1968. Forbs composed 89 percent of the total summer diet while browse and grasses formed 10 and 1 percent, respectively. Use of forbs decreased from June to September while use of browse increased. Eighty-three percent of the mule deer feeding sites were located in the Douglas-fir Zone. Cattle food habits were evaluated by examination of 59 feeding sites. Grasses and grass-like plants constituted 71 percent of the diet. Forbs and browse composed 28 and 1 percent of the diet, respectively. Use on grasses and grass-like plants increased from 56 percent in July to 90 percent in September as forbs became desiccated. Utilization of forbs decreased from 42 to 9 percent during this same period. The majority of cattle feeding sites were located in the Fescue-Wheatgrass Zone. Forage utilization by cattle was determined by use of agronomy cages, exclosures, and grazed plant transects. Utilization was found to be heavy in several areas. Hog-dressed weights of hunter-killed mule deer were lower than those of certain other studies. Classification of 1,152 deer by age and sex revealed low fawn:doe ratios of 54 and 32 fawns per 100 does for the summers of 1967 and 1968, respectively. There was little overlap of range use and little direct competition for food between mule deer and cattle. *Taraxacum laevigatum* was the only plant species used substantially by both. Distribution and numbers of cattle appeared to limit the distribution of deer mainly to the Douglas-fir Zone. This limitation of range use possibly accounted for the lower productivity of deer.

INTRODUCTION

Observations of mule deer (*Odocoileus hemionus*) and of summer ranges in the Pryor Mountains of south-central Montana by members of the Montana Fish and Game Department prior to 1967 suggested that both the deer population and the range were in below average condition. Low observed fawn: doe ratios suggested poor reproductive performance. Weights obtained at hunter checking stations and field observations indicated below normal weights. Certain personnel of the Fish and Game Department believed that these unfavorable conditions were partially a result of competition from livestock which heavily grazed the summer range.

Heavy grazing by sheep and cattle in the past resulted in loss of topsoil in certain areas and deterioration of this summer range. The magnitude of this deterioration is attested by recent range renovation practices such as contour furrowing by the U. S. Forest Service. Forest Service records show that the study area and adjacent lands were heavily grazed by numerous bands of sheep in the early 1900's. The Forest Service has controlled grazing in the Crooked Creek Allotment since 1926 when grazing permits were first issued. The other Federal agency involved in the administration of these lands is the Bureau of Land Management. Their records indicate that from 1936-1945, between 400 and 1,400 sheep grazed on the Mystic Allotment for 2 to 6 months of the year (Bibles 1968). The sheep were replaced by cattle in 1946. Cattle numbers have since varied from 100 to 200 for 3 to 5 months during the year.

This study was conducted in the Pryor Mountains during the summers of 1967 and 1968. Part time work was carried out in the fall of 1968. The objectives were to obtain quantitative data on distribution, food habits, and range relations of deer and livestock on the summer range. Mule deer reproduction and body condition were also studied.

DESCRIPTION OF THE STUDY AREA

The Pryor Mountain Range, located about 40 miles south of Billings, extends generally in an east-west direction. The range is approximately 21 miles long and 10 to 18 miles wide. The southern and western slopes gradually rise in elevation from the 4,500-5,000-foot surrounding plains to the highest point in the range, 8,786 feet on Big Pryor Mountain. The more abrupt northern and eastern slopes rise from 1,000-3,000 feet above the plains. Many deep, timbered canyons have been cut by drainages through the soft, underlying limestone formations.

The study area (Figure 1) comprises approximately 36 square miles of the eastern one-third of the Pryor Mountains. It is characterized by ridges which are open on top and timbered on the sides, large expanses of open grassland, and steep, timbered canyons. The heads of Sage Creek, Dry Head Creek, and the Dry Head Overlook Cliffs bounded the study area on the north while the east was bounded by the sheer cliffs which slope down to the Big Horn River canyon. The southern border was an indefinite line about 2 miles north of the Custer National Forest boundary, and the Big Pryor Mountain ridgeline bordered the area on the west.

Climatological data were taken at the Sage Creek Ranger Station located 7 miles west of the study area at an elevation of 5,675 feet. The mean monthly temperature and precipitation for June through September of 1967 and 1968 were 60.1°F. and 2.68 inches, respectively (USDA, Forest Service, 1967-1968). The month of June received the heaviest amount of moisture with an average of 6.27 inches for the two summers.

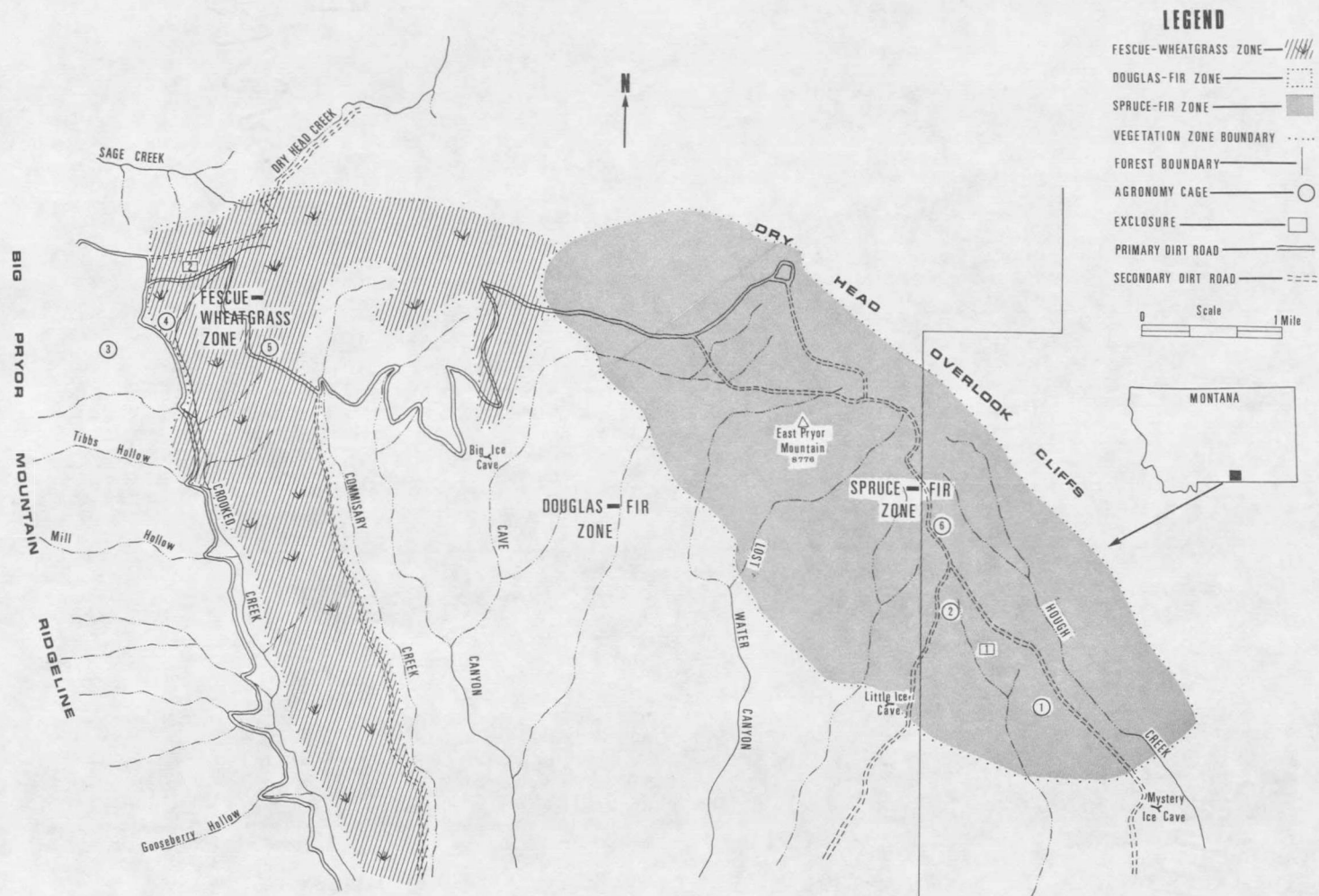


Figure 1. Map of the study area.

METHODS

Vegetation

Plants were collected from the study area and classified to aid in identification of the various species comprising the vegetation types. Scientific and common names of the plants are from Booth (1950) and Booth and Wright (1959).

Classification of vegetation into zones, types and subtypes was influenced by Daubenmire (1946). The vegetation in at least twenty 2 x 5 decimeter plots with ten paces between were evaluated on each type and subtype to determine canopy coverages and frequencies of the various low-growing species, following the method of Daubenmire (1959).

Animal Distribution

Deer and cattle were observed along each of three routes through the study area from a 4-wheel drive vehicle or on foot. A 7 x 35 binocular and a 25 X spotting scope aided in observations. Inaccessibility limited observations in certain areas. Animals were recorded as to vegetation zone, type, and subtype, as well as by location on a grid map of the study area.

Food Habits

Mule deer and cattle food habits were determined by examination of feeding sites as soon after the animals had vacated the area as practicable. All recent instances of plant use were recorded by species at each feeding site. One bite was considered one instance of use as de-

scribed by Knowlton (1960) and others. The number of instances of use for each species was computed as a percentage of the total for each feeding site. The aggregate percentage method (Martin *et al.* 1946) was then used to tabulate the data by vegetation zones and months.

Vegetation within ten 2 x 5 decimeter frames was evaluated on each feeding site to determine canopy coverage and frequency of each species present. The abundance of these plants in the community as measured by canopy coverage was compared to the percent of each species in the diet to determine food preferences.

Forage Utilization

Forage utilization was evaluated through the use of agronomy cages, exclosures, and the grazed plant method. Agronomy cages were placed in specific locations on the summer range prior to cattle use to protect the vegetation from grazing. Two previously constructed "permanent" exclosures were also located on the study area. After cattle were removed in the fall, the vegetation was clipped from five .96 square feet circular plots located inside and from five located outside each cage and exclosure. This vegetation was then air dried, separated to grasses and forbs, and weighed to the nearest gram. Weights for vegetation from protected and unprotected plots were compared. These samples were converted to pounds per acre to determine percent utilization by cattle on the range.

Percent utilization was also determined for most of these same

areas by use of the grazed plant method. One hundred bunchgrass plants on a paced transect were examined to determine if they were grazed. The only bunchgrass species occurring in abundance was Idaho fescue (*Festuca idahoensis*). A conversion chart (Cole 1963) was used to express the percent of grazed plants as the percent utilization.

Mule Deer Physical Condition and Productivity

Hunter checking stations were operated during the regular and late deer seasons each fall to determine the sex and to obtain weights and lower jaws of deer killed. Direct observations on the study area were also an indication of the physical condition of these deer. Productivity was determined by classification of deer to age and sex to obtain sex ratios and fawn:doe ratios. The reproductive tracts of six hunter-killed females were collected for examination.

RESULTS

Vegetation

The vegetation within the study area was divided into three major zones. These zones were the Fescue (*Festuca idahoensis*)-Wheatgrass (*Agropyron* spp.) Zone, the Douglas-fir (*Pseudotsuga menziesii*) Zone, and the Engelmann spruce (*Picea engelmanni*)-Subalpine fir (*Abies lasiocarpa*) Zone (Figure 1). The species composition of low-growing vegetation of the major types and subtypes within each of these zones as determined by quantitative measurements is shown in Table I. General observations were used to evaluate the vegetation in the following types and subtypes: Aspen Type, Douglas-fir Type, Lodgepole pine Type, Logged Clear-Cut Type, Sagebrush-Bluegrass Subtype, Sagebrush-Juniper Subtype, and the Spruce-Fir Type.

FESCUE-WHEATGRASS ZONE

This was the only grassland zone represented in the study area. It was found at elevations of 6,200 to 8,000 feet and was divided into three types.

Fescue-Wheatgrass Type: This type (Figure 2) was dominated by Idaho fescue (*Festuca idahoensis*) and thickspike wheatgrass (*Agropyron dasystachyum*). Other locally important grasses present were bluebunch wheatgrass (*Agropyron spicatum*), Junegrass (*Koeleria cristata*), and bluegrass (*Poa* spp.). Common forbs were field chickweed (*Cerastium arvense*), yarrow (*Achillea millefolium*), and bedstraw (*Galium* spp.). Although not sampled on the specific sites, sticky geranium (*Geranium*

TABLE I. PERCENT CANOPY COVERAGE AND FREQUENCY OF LOW-GROWING TAXA FOR VEGETATION TYPES AS DETERMINED BY EXAMINATION OF TWENTY 2 X 5 DECIMETER PLOTS ON EACH OF 27 SITES.

Taxa ^{1/}	Fescue-Wheatgrass Zone			Douglas-fir Zone		Spruce-Fir Zone		
	Sagebrush Type			Sagebrush Park Type		Fescue-Sedge 6 sites	Sagebrush-Fescue 3 sites	Open Sedge Grassland 2 sites
	Fescue-Wheatgrass 5 sites	Sagebrush-Fescue 2 sites	Sprayed ^{2/} Sagebrush-Fescue 3 sites	Sagebrush-Fescue 4 sites	Sprayed ^{2/} Sagebrush-Fescue 2 sites			
GRASS AND GRASS-LIKE PLANTS								
<i>Agropyron dasystachyum</i>	10/44 ^{3/}	2/15	5/33	-	13/78	-	-	-
<i>Agropyron smithii</i>	2/13	-	-	-	2/23	-	-	-
<i>Agropyron spicatum</i>	5/33	1/5	-	-	-	-	-	-
<i>Agropyron spp.</i>	-	-	1/12	1/20	-	1/5	2/22	1/8
<i>Bromus marginatus</i>	-	-	1/17	1/15	1/5	-	-	-
<i>Carex eleocharis</i>	-	-	-	-	-	4/29	-	19/95
<i>Carex spp.</i>	1/8	1/5	1/22	4/39	1/20	7/50	3/35	1/3
<i>Danthonia intermedia</i>	-	-	-	1/18	-	2/23	1/3	-
<i>Festuca idahoensis</i>	21/84	24/87	13/63	16/80	17/90	17/80	19/97	-
<i>Hesperochloa kingii</i>	-	-	1/8	-	2/23	-	-	-
<i>Koeleria cristata</i>	4/48	-	-	-	-	1/14	-	2/30
<i>Melica spectabilis</i>	-	-	1/13	-	-	-	2/27	-
<i>Phleum alpinum</i>	-	-	-	-	-	1/4	-	-
<i>Poa spp.</i>	4/45	1/3	5/37	1/23	2/35	1/18	1/12	-
<i>Stipa spp.</i>	-	-	-	-	4/53	-	1/10	-
FORBS								
<i>Achillea millefolium</i>	4/25	5/50	6/48	8/46	6/65	11/72	11/65	-
<i>Agoseris glauca</i>	1/5	1/5	1/17	3/19	-	2/10	9/60	2/18
<i>Anemone patens</i>	3/24	1/5	2/8	-	6/33	1/11	-	2/20
<i>Antennaria parvifolia</i>	-	1/8	-	-	-	-	-	-
<i>Antennaria rosea</i>	-	-	1/3	2/9	-	1/8	1/7	1/25
<i>Arnica cordifolia</i>	-	-	-	2/11	-	-	-	-
<i>Arnica sororia</i>	-	-	-	1/5	-	3/18	-	-
<i>Astragalus miser</i>	3/34	1/25	1/12	-	-	1/9	1/3	1/15
<i>Astragalus spp.</i>	3/24	1/5	-	1/4	1/10	1/12	1/7	2/38

TABLE I. (CONTINUED).

Taxa	Fescue-Wheatgrass Zone			Douglas-fir Zone		Spruce-Fir Zone		
	Fescue- Wheatgrass 5 sites	Sagebrush Type		Sagebrush Park Type		Fescue- Sedge 6 sites	Sagebrush- Fescue 3 sites	Open Sedge Grassland 2 sites
		Sagebrush- Fescue 2 sites	Sprayed Sagebrush-Fescue 3 sites	Sagebrush- Fescue 4 sites	Sprayed Sagebrush-Fescue 2 sites			
FORBS (continued)								
<i>Balsamorhiza incana</i>	2/9	1/5	1/10	1/9	-	-	-	-
<i>Balsamorhiza sagittata</i>	-	-	-	2/9	-	-	-	-
<i>Campanula rotundifolia</i>	1/6	3/17	-	1/6	-	-	1/7	-
<i>Castilleja lutescens</i>	-	1/3	-	-	-	-	-	1/15
<i>Cerastium arvense</i>	5/40	5/48	4/53	2/28	2/43	5/42	4/33	2/23
<i>Cirsium undulatum</i>	-	-	-	-	-	-	1/8	-
<i>Clematis hirsutissima</i>	-	-	1/3	-	-	-	-	-
<i>Delphinium bicolor</i>	-	-	-	3/36	1/8	1/9	-	-
<i>Dodecatheon conjugens</i>	-	-	-	1/6	-	1/12	-	-
<i>Eriogonum speciosus</i>	1/5	4/25	1/3	-	3/20	1/6	2/18	-
<i>Eriogonum umbellatum</i>	-	2/17	1/5	2/6	-	1/4	3/15	-
<i>Fragaria virginiana</i>	-	-	-	-	3/10	-	-	-
<i>Galium</i> spp.	4/20	3/17	6/38	4/28	10/53	-	3/22	-
<i>Geranium viscosissimum</i>	-	1/7	5/28	1/4	4/12	-	2/12	-
<i>Geum triflorum</i>	-	4/15	-	-	-	11/61	3/20	-
<i>Lithophragma parviflora</i>	-	-	-	2/18	-	-	-	-
<i>Lomatium montanum</i>	1/9	-	-	1/16	-	-	-	-
<i>Lupinus polyphyllus</i>	1/2	8/32	2/13	6/34	1/5	1/5	5/35	1/8
<i>Myosotis sylvatica</i>	-	-	-	-	-	1/19	-	-
<i>Oxytropis sericea</i>	-	-	-	-	-	-	-	1/5
<i>Perideridia gairdneri</i>	-	-	4/43	4/41	1/20	-	-	-
<i>Phlox</i> spp.	2/21	13/53	1/13	2/26	-	7/41	5/27	17/87
<i>Polygonum bistortoides</i>	-	-	-	-	-	5/64	-	1/20
<i>Potentilla gracilis</i>	-	-	-	-	-	2/23	1/13	-
<i>Senecio</i> spp.	-	-	-	-	-	-	-	3/20
<i>Taraxacum laevigatum</i>	-	-	2/30	1/6	1/12	-	1/8	-
<i>Townsendia parryi</i>	-	-	-	-	-	3/22	-	-
<i>Valeriana dioica</i>	-	-	-	-	-	-	1/5	-
<i>Viola praemorsa</i>	-	-	1/13	1/10	-	-	3/22	-
<i>Zygadenus elegans</i>	-	-	-	-	-	-	-	6/55

TABLE I. (CONTINUED).

Taxa	Fescue-Wheatgrass Zone			Douglas-fir Zone		Spruce-Fir Zone		
	Fescue- Wheatgrass 5 sites	Sagebrush Type		Sagebrush Park Type		Fescue- Sedge 6 sites	Sagebrush- Fescue 3 sites	Open Sedge Grassland 2 sites
		Sagebrush- Fescue 2 sites	Sprayed Sagebrush-Fescue 3 sites	Sagebrush- Fescue 4 sites	Sprayed Sagebrush-Fescue 2 sites			
SHRUBS								
<i>Artemisia tridentata</i> (live)	-	23/72	4/53	18/58	1/5	-	27/72	-
<i>Artemisia tridentata</i> (dead)	-	-	13/17	-	10/55	-	-	-
<i>Juniperus horizontalis</i>	1/3	-	-	-	-	-	-	-
<i>Potentilla fruticosa</i>	1/2	-	-	-	-	-	-	4/18
<i>Rosa</i> spp.	-	-	-	-	1/5	-	-	-
<i>Symphoricarpos albus</i>	-	-	2/15	5/21	-	-	-	-
BARE GROUND	11/77	9/60	6/48	13/73	8/63	9/73	7/45	13/93
ROCK	3/33	1/15	-	1/13	-	-	1/10	14/88

1/ Includes only those taxa with mean canopy coverage values of 1 percent or more for at least one vegetation type. Others are listed in Appendix Table X.

2/ Sprayed with 2, 4-D in 1960 for the control of sagebrush.

3/ Canopy coverage (percent of area covered by vegetation)/average frequency (percent occurrence among plots).

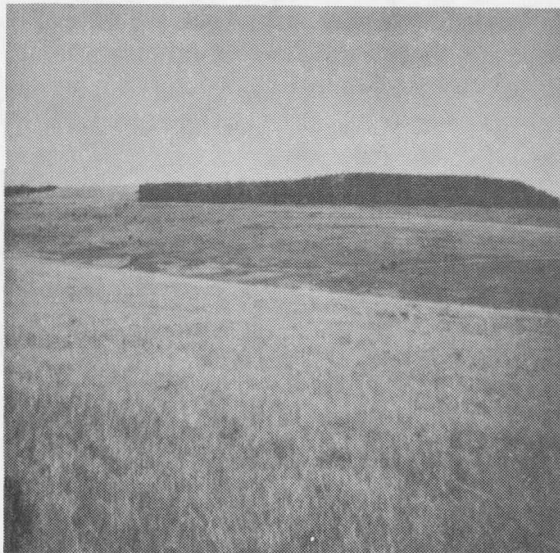


Figure 2. Fescue-Wheatgrass Type in the Fescue-Wheatgrass Zone.

viscosissimum) and yampa (*Perideridia gairdneri*) were prevalent in more mesic areas.

Sagebrush Type: A majority of the sagebrush type in the Fescue-Wheatgrass Zone was sprayed with 2, 4-D in 1960 by the Forest Service to control big sagebrush (*Artemisia tridentata*). Some live sagebrush remained near stands of Douglas-fir and lodgepole pine (*Pinus contorta*) in the ecotone between the Fescue-Wheatgrass Zone and the Douglas-fir Zone. This type was divided into two subtypes: the Sagebrush-Fescue Subtype (Figure 3) and the Sprayed Sagebrush-Fescue Subtype (Figure 4). The Sagebrush-Fescue Subtype was dominated by big sagebrush and Idaho fescue. Major forbs included phlox (*Phlox* spp.), Washington lupine (*Lupinus polyphyllus*), yarrow, field chickweed, Oregon fleabane (*Erigeron speciosus*), and prairiesmoke (*Geum triflorum*). The Sprayed Sagebrush-Fescue Subtype was also dominated by big sagebrush, although a majority of the plants were dead. Common snowberry (*Symphoricarpos albus*) was another shrub present. Idaho fescue, thickspike wheatgrass, and bluegrass were important grasses. Prevalent forbs were yarrow, bedstraw, sticky geranium, field chickweed, and yampa.

Aspen Type: This type (Figure 5) occurred in dense stands but was limited to a few mesic slopes of some drainages. Quaking aspen (*Populus tremuloides*) was the dominant overstory. Rose (*Rosa* spp.), bluegrass, sedge (*Carex* spp.), and smooth dandelion (*Taraxacum laevigatum*) were important understory plants.



Figure 3. Sagebrush Type (Sagebrush-Fescue Subtype) in the Fescue-Wheatgrass Zone.

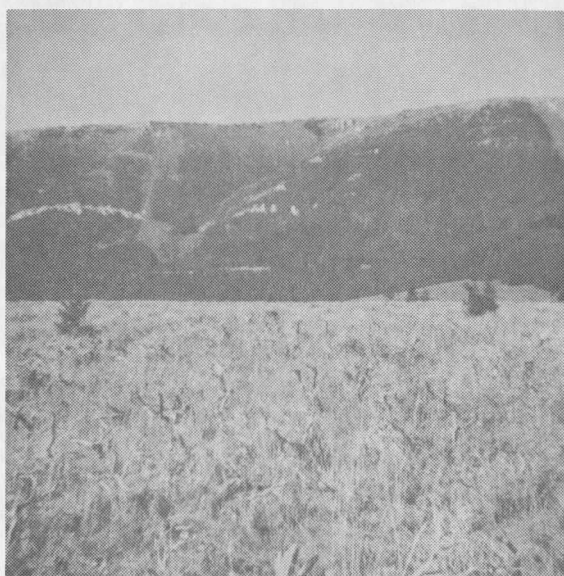


Figure 4. Sagebrush Type (Sprayed Sagebrush-Fescue Subtype) in the Fescue-Wheatgrass Zone.

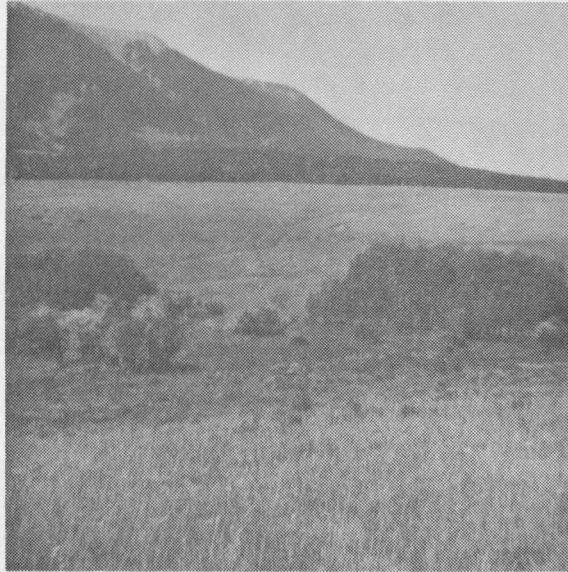


Figure 5. Aspen Type in the Fescue-Wheatgrass Zone.



Figure 6. Logged Clear-Cut Type of the Douglas-fir Zone with the Douglas-fir Type in the background.

DOUGLAS-FIR ZONE

This was the major timber zone in the study area. It was dominant from 6,000 to 7,800 feet. The vegetation was described as constituting four types and four subtypes.

Douglas-fir Type: This type (Figure 6) dominated the Douglas-fir Zone. Scattered among the Douglas-fir were Engelmann spruce and in the upper limits of the zone an occasional limber pine (*Pinus flexilis*). In areas where trees were not dense the understory was dominated by common juniper (*Juniperus communis*), sticky geranium, purple onion grass (*Melica spectabilis*), bluegrass, and sedge. Arrowleaf balsamroot (*Balsamorhiza sagittata*) was prevalent in the drier, more open areas. The common understory in the denser stands included elk sedge (*Carex geyeri*), heart-leaf arnica (*Arnica cordifolia*), and Virginia strawberry (*Fragaria virginiana*). Important shrubs present were white spiraea (*Spiraea betulifolia*) and common snowberry.

Lodgepole Pine Type: This was a minor type in the Douglas-fir Zone and appeared to be a seral stage which grew in burns originally occupied by Douglas-fir. Elk sedge and heartleaf arnica were the common grass-like plant and forb understory species, respectively. Dominant shrubs included low red huckleberry (*Vaccinium scoparium*); white spiraea, and Oregon grape (*Berberis repens*).

Logged Clear-Cut Type: These clearings (Figure 6) which were among dense stands of Douglas-fir, were logged during the summers of 1965 and 1966. Since then a variety of plant species have become established.

Common grass and grass-like plants included mountain brome (*Bromus marginatus*) and elk sedge. Heartleaf arnica, smooth dandelion, yarrow, bedstraw, and mint (*Mentha* spp.) were dominant forbs. Important shrubs present were common snowberry and white spiraea.

Sagebrush Park Type: The majority of parks in the Douglas-fir Zone were of a sagebrush type. They were classified into four subtypes. The Sagebrush-Fescue Subtype (Figure 7) was found in most of the smaller parks which did not receive the spray. Big sagebrush was the dominant shrub and common snowberry was also prevalent. Idaho fescue and sedge were the dominant grass and grass-like plants, respectively. Important forbs included yarrow, Washington lupine, bedstraw, and yampa. The Sprayed Sagebrush-Fescue Subtype (Figure 8) occurred in most of the larger parks in the Douglas-fir Zone which received the spray in 1960. The dominant shrub was big sagebrush, most of which was dead. Important grasses included Idaho fescue, thickspike wheatgrass, and needlegrass (*Stipa* spp.). Bedstraw, yarrow, pasque flower (*Anemone patens*), and sticky geranium were the major forbs present. In the more mesic parks of the zone occurred the Sagebrush-Bluegrass Subtype. Some of the sagebrush had been sprayed. Big sagebrush was the dominant shrub while bluegrass was the important grass. Common forbs were sticky geranium and yampa. The Sagebrush-Juniper Subtype occurred on the drier, south slopes in the southern portions of the study area. Big sagebrush and Rocky Mountain juniper (*Juniperus scopulorum*) were the

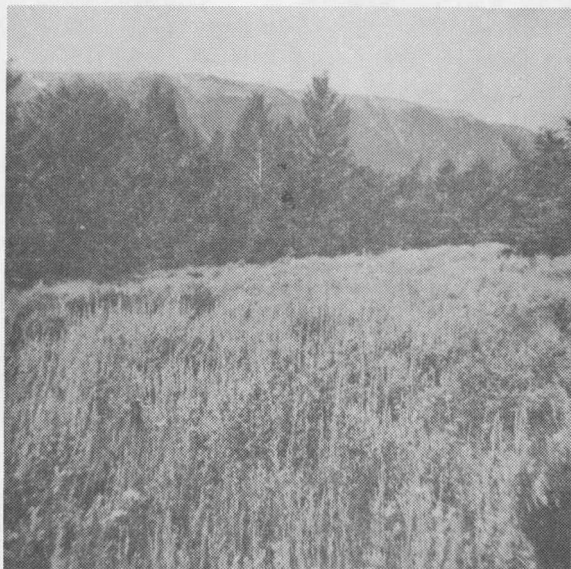


Figure 7. Sagebrush Park Type (Sagebrush-Fescue Subtype) in the Douglas-fir Zone.

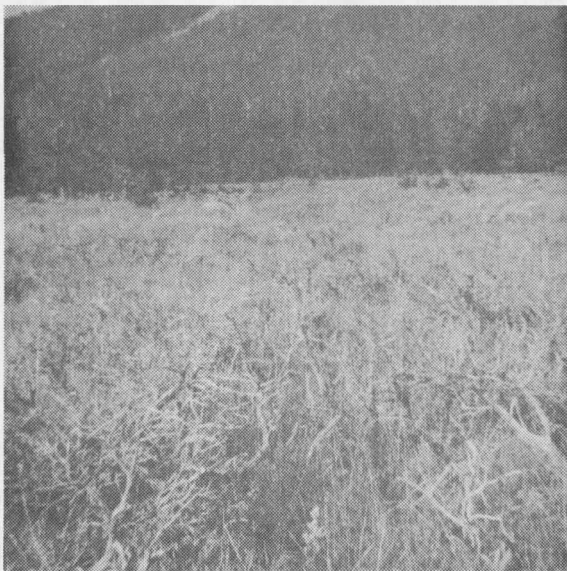


Figure 8. Sagebrush Park Type (Sprayed Sagebrush-Fescue Subtype) in the Douglas-fir Zone.

dominant shrubs. Common grasses included Idaho fescue and bluebunch wheatgrass. Lupine was the important forb.

ENGELMANN SPRUCE-SUBALPINE FIR ZONE

This zone occurred from approximately 8,000 feet to the highest elevation on the study area, 8,776 feet. Four main types were described.

Spruce-Fir Type: This timber type (Figure 9) was composed of Engelmann spruce and subalpine fir growing together in small dense stands separated by open fescue-sedge parks. Dominant understory included sedge, heartleaf arnica, yarrow, and gooseberry (*Ribes* spp.).

Fescue-Sedge Park Type: This was the dominant park type (Figure 9) in the Spruce-Fir Zone. Important grass and grass-like plants included Idaho fescue, needleleaf sedge (*Carex eleocharis*), and other sedges. Major forbs were yarrow, prairiesmoke, phlox, field chickweed, and western bistort (*Polygonum bistortoides*).

Sagebrush-Fescue Park Type: This type (Figure 10) occurred on some southern slopes at the heads of drainages. Big sagebrush was the dominant shrub and Idaho fescue the major grass. Yarrow, pale agoseris (*Agoseris glauca*), Washington lupine, phlox, and field chickweed were common forbs.

Open Sedge Grassland Type: This type (Figure 11) occurred as large open expanses of grassland on shallow, rocky soils. Sedges were the dominant species present with needleleaf sedge the most common.

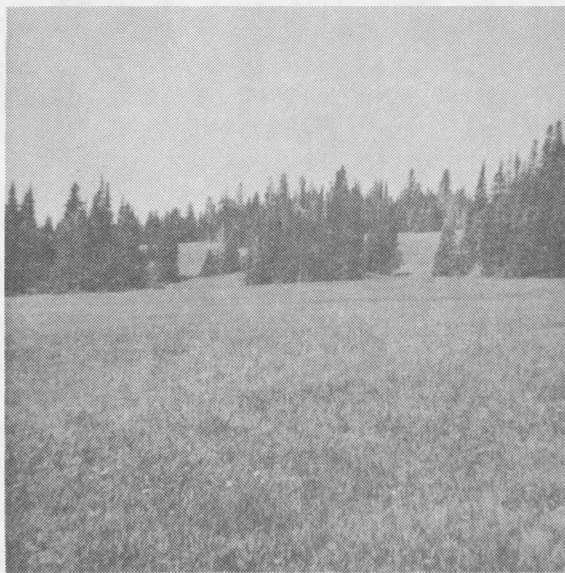


Figure 9. Fescue-Sedge Park Type in the Spruce-Fir Zone with the Spruce-Fir Type in the background.



Figure 10. Sagebrush-Fescue Park Type in the Spruce-Fir Zone.

