Habitat use, distribution, movement, and associated behavior of elk, Little Belt Mountains, Montana
by Kenneth Joe Coop

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 during two summers and one fall on an area of 125,000 acres in the eastern Little Belt Mountains of central Montana to obtain data on use of habitat, distribution, movements, and associated behavior of elk prior to logging within this area. Three major habitat types; open park, broken park, and timber were delineated on the basis of tree crown densities of 0-15, 16-75, 76-100 percent, respectively.

The open park type was further separated into natural openings, burns, powerline strips, and clearcuts. Ground vegetation was determined for these types and subtypes from measurements within 2 x 5 dm plots spaced along linear transects. Habitat use in both the Douglas-fir and spruce-fir zones was determined by 5,720 observations of elk. During summer, use of open park types predominated over all others. Average size of 50 natural parks used by elk was 57 acres. Decreased use of these areas was noted in late summer through fall. The natural opening sub-type received the highest recorded use of all subtypes in both vegetation zones. Elk when disturbed in open parks ran an average distance of 374 feet to utilize escape timber. Escape cover timber stands were fully stocked with an average crown density of 85 percent. Use of timber types and zones varied in fall as related to hunting pressure and other factors. In summer 'elk distributed themselves across the heads of three major drainages from about 7,500-8,000 feet elevation, with distribution occurring at slightly lower elevations during fall.

Elk moved off the winter range through the transition range and onto summer range by the first week in July. This appeared to be correlated with green-up of vegetation and recession of snow. Movements of a radio-equipped cow indicated a summer home range of 3 square miles to be twice that of her late winter-early spring range. One radio-equipped male indicated more extensive movement by bulls than by cows.

A shift was noted in this animal's summer home range involving a movement of some 14 miles. Movements of up to 25 miles were noted for banded animals in one summer. Four yearlings banded on one winter range were observed to spend the next winter on a different range some 20 miles from the first. More than 36 percent of 84 elk banded in the winter of 1968-69 returned to the same winter range the following winter. One area was found to serve as summer range for elk wintering on two distinct and separate ranges, Clearcuts receiving greatest use were approximately 30 acres in size and 8-10 years of age. Observations of rutting behavior by bulls with harems indicated defense of a moving parameter type area around the harem instead of a fixed land area defense. Elk and cattle were observed to be generally compatible while elk were noted to avoid areas used currently or previously by sheep.

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Date May 28, 1971

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Approved:

Head, Major Department

Chairman, Examining Committee

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ABSTRACT

A study was conducted during two summers and one fall on an area of 125,000 acres in the eastern Little Belt Mountains of central Montana to obtain data on use of habitat, distribution, movements, and associated behavior of elk prior to logging within this area. Three major habitat types; open park, broken park, and timber were delineated on the basis of tree crown densities of 0-15, 16-75, 76-100 percent, respectively. The open park type was further separated into natural openings, burns, powerline strips, and clearcuts. Ground vegetation was determined for these types and subtypes from measurements within 2 x 5 dm plots spaced along linear transects. Habitat use in both the Douglas-fir and spruce-fir zones was determined by 5,720 observations of elk. During summer, use of open park types predominated over all others. Average size of 50 natural parks used by elk was 57 acres. Decreased use of these areas was noted in late summer through fall. The natural opening subtype received the highest recorded use of all subtypes in both vegetation zones. Elk when disturbed in open parks ran an average distance of 374 feet to utilize escape timber. Escape cover timber stands were fully stocked with an average crown density of 85 percent. Use of timber types and zones varied in fall as related to hunting pressure and other factors. In summer elk distributed themselves across the heads of three major drainages from about 7,500-8,000 feet elevation, with distribution occurring at slightly lower elevations during fall. Elk moved off the winter range through the transition range and onto summer range by the first week in July. This appeared to be correlated with green-up of vegetation and recession of snow. Movements of a radio-equipped cow indicated a summer home range of 3 square miles to be twice that of her late winter-early spring range. One radio-equipped male indicated more extensive movement by bulls than by cows. A shift was noted in this animal's summer home range involving a movement of some 14 miles. Movements of up to 25 miles were noted for banded animals in one summer. Four yearlings banded on one winter range were observed to spend the next winter on a different range some 20 miles from the first. More than 36 percent of 84 elk banded in the winter of 1968-69 returned to the same winter range the following winter. One area was found to serve as summer range for elk wintering on two distinct and separate ranges. Clearcuts receiving greatest use were approximately 30 acres in size and 8-10 years of age. Observations of rutting behavior by bulls with harems indicated defense of a moving parameter type area around the harem instead of a fixed land area defense. Elk and cattle were observed to be generally compatible while elk were noted to avoid areas used currently or previously by sheep.

INTRODUCTION

During recent years logging in Montana has increased greatly. This has caused concern among wildlife managers because of the possible effects on wildlife habitats and various wildlife species. The Little Belt Mountains of central Montana, where extensive block clearcut logging of lodgepole pine (*Pinus contorta*) has occurred at least since 1951 and is continuing, are representative of areas in which concern has focused on the possible effects of logging on the habitats of elk. There is a paucity of published data pertaining to this subject. Most studies, such as those of Kirsch (1962) and Harper (1966), have reported on responses of elk during and after logging. Quantitative data on elk and elk use of a specific area prior to, as well as during, and following logging are apparently lacking. Possible effects of logging and related activities on the welfare of elk remain conjectural.

Logging in the eastern Little Belts has been confined mainly to the South Fork of the Judith River, adjacent areas to the south and west, and drainages between U. S. Highway 89 and the main divide from King's Hill north to the Big Baldy region (Figure 1). The Middle and Lost Fork drainages of the Judith River have remained in a relatively undisturbed condition, but logging operations are planned for these areas.

The purpose of this study, conducted from June-September, 1969 and June-December, 1970, was to obtain data pertaining to elk movements, distribution, habitat use, and associated behavior in the Middle

and Lost Fork drainages prior to logging. These data should prove valuable for comparison with data secured after logging has occurred. Work was also done in adjacent areas including the Judith Game Range which serves as a wintering area for elk in this region.

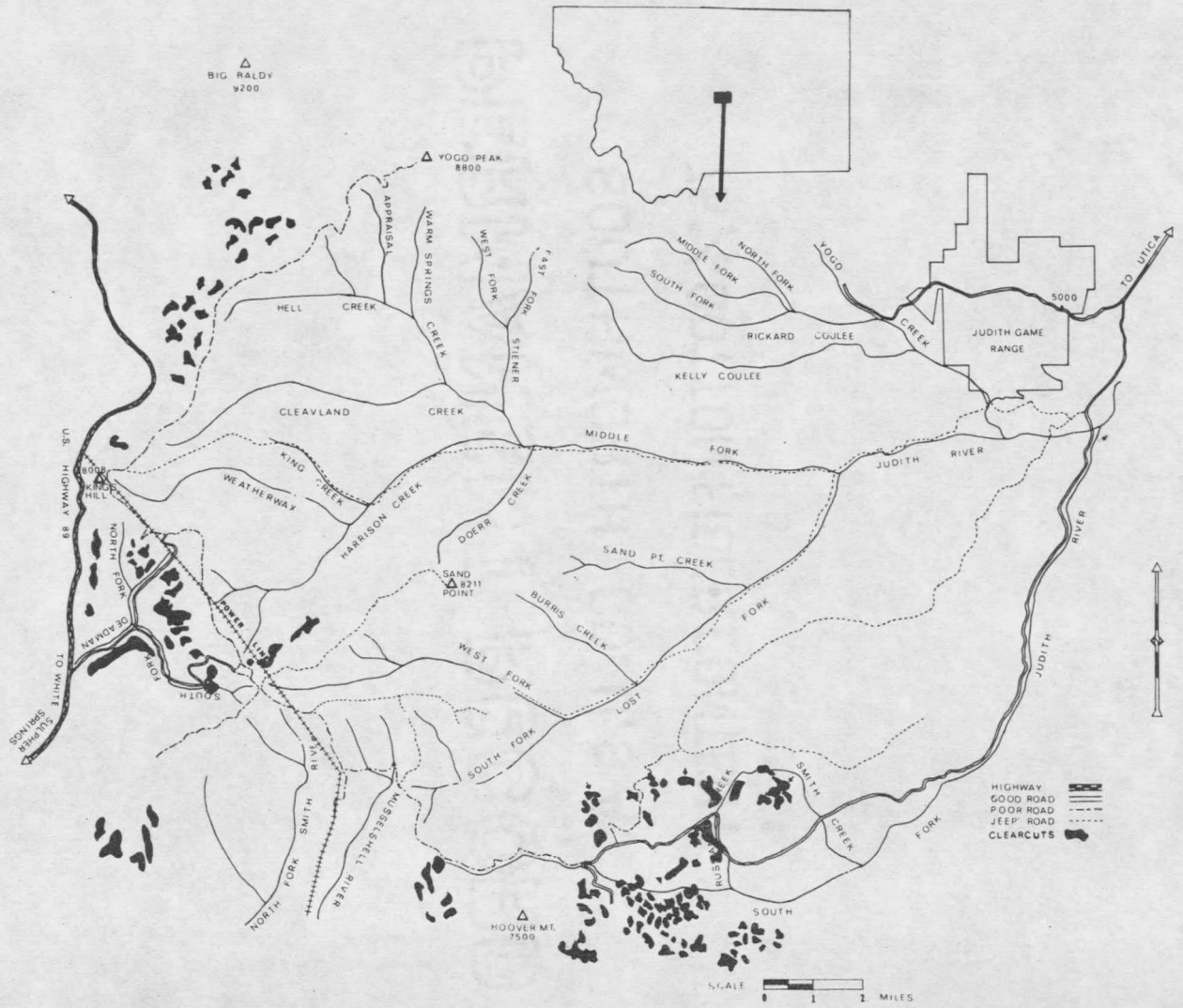


Figure 1. Map of study area and associated clearcuts. Arrows indicate three most used clearcuts within study area.

DESCRIPTION OF STUDY AREA

The study area (Figure 1), located in the eastern Little Belt Mountains of central Montana, encompasses approximately 125,000 acres and includes all of the headwaters of the Middle and Lost Forks of the Judith River, part of the headwaters of Yogo Creek, and about one-third of the head drainages of the South Fork of the Judith River. The area is bordered by ridges or divides along the north, west, and part of the south. The South Fork of the Judith served as a boundary for part of the southern and all of the eastern edges.

Four major vegetation zones (Figure 2): ponderosa pine-grassland (*Pinus ponderosa*), ponderosa pine, Douglas-fir (*Pseudotsuga menziesii*), and Engelmann spruce-subalpine fir (*Picea engelmannii-Abies lasiocarpa*) were described for this area by Kirsch (1962). Numerous seral lodgepole pine (*Pinus contorta*) stands are located throughout the Douglas-fir and spruce-fir zones. White bark (*Pinus albicaulis*) and limber pine (*Pinus flexilis*) are found along dry ridges and slopes. Big sagebrush (*Artemisia tridentata*) is the only large significant shrub occurring in the area with fairly extensive stands located on the slopes and bottoms adjacent to the Middle and Lost Forks in the Douglas-fir zone.

Of the 125,000 acres, a total of 108,000 were classified by personnel of the U. S. Forest Service according to timber types and classes. The remaining 17,000 acres were listed as forests of non-commercial value or were unclassified. Ponderosa pine, Douglas-fir, Engelmann spruce, subalpine fir, and lodgepole pine make up approxi-

mately 7.5, 40, 9, 1, and 26 percent, respectively of the classified timber types. Nonforested lands make up some 11.5 percent with less than 2 percent being listed as privately owned. White bark and limber pine were classified as making up some 3 percent of the timber but in addition to this, some of the non-commercial timber is also composed of these species.

Most of the parent material is limestone in nature with formation of drainages resulting in rounded and somewhat flattened ridge tops and divides. Several of the canyons have areas with steep, rugged, limestone outcroppings.

Approximately 800-1,200 elk which summer in the Judith River drainages at elevations up to 8,500 feet, winter primarily on the Judith Game Range and adjacent lands at about 5,000 feet elevation. Another 200-300 head winter in scattered groups along the foothills some 20 miles to the south and southwest of the Judith Game Range.

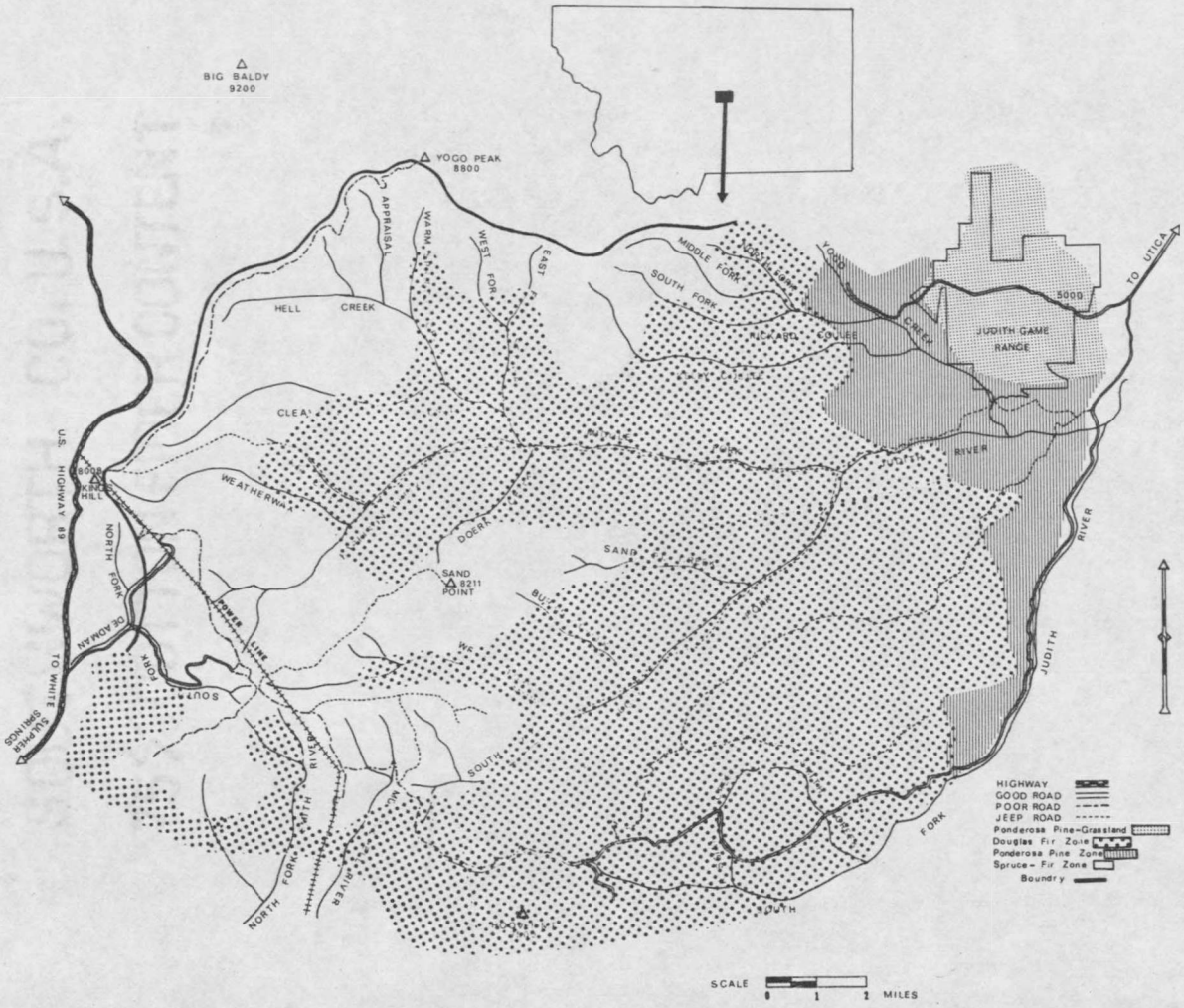


Figure 2. Map of study area and major vegetation zones.

METHODS

Vegetation

Scientific and common names of plants follow Booth (1950) and Booth and Wright (1959).

On the basis of tree crown density, Douglas-fir and spruce-fir zones were separated into three major habitat types; open park, broken park, and timber. Open park type was further separated into four subtypes. Fifty representative open parks were measured from aerial photographs with the aid of a planimeter and dot grid to determine approximate area. Crown density was determined from aerial photographs as described by the American Society of Photogrammetry (1960). Measurements taken from aerial photos were correlated with data collected in the field.

Composition and canopy coverage of low-growing vegetation in each of the three major habitat types were determined from a modification of the method described by Daubenmire (1959). Twenty, 2 x 5 dm plots were placed at 3-yard intervals in each of 15 representative sites for both open and broken park habitats and in five sites each for white bark-limber pine, Douglas-fir, lodgepole pine, and spruce-fir stands.

Each of 50 stands of timber which were used at least once by a group of elk for escape cover were evaluated according to the method of Cottam and Curtis (1956). Density, species composition, and size (dbh) of trees were secured by this method. The sample unit was a 200-foot line transect with center points established at 50-foot intervals.

Distances from the center of location of a group of elk in an open park to the edge of the closest timber and to the edge of the timber stand actually used for escape were measured in feet.

Marked Animals

During the winter of 1968-69 personnel of the Montana Fish and Game Department trapped and neck banded 84 individual elk on the Judith Game Range. In the winter of 1969-70 an additional 31 elk were trapped and neck banded on the Judith Game Range. Five elk wintering some 20 miles to the south of the game range were also trapped and neck banded. Four elk, three cows and one yearling male trapped on the game range, were each equipped with a radio transmitter. Transmitter units were similar to those described by Bayless (1967) while neck bands were similar to those described by Knight (1966).

Observations

Distribution, movements, and use of habitat types by marked and unmarked elk were determined by recording locations of animals observed. Ground observations were made by the author either from a vehicle or while on foot. A 150 Super Cub was used in making aerial observations and for locating elk with radios. A pair of 7 x 35 binoculars and a 15-60 x spotting scope were used to aid in making observations.

RESULTS

Vegetation

The three main habitat types were separated on the basis of timber crown density. Open park areas (Figures 3 and 4) were those having from 0-15 percent crown density, broken parks (Figures 3 and 5) 15-75 percent, and timber types (Figures 3 and 4) 75-100 percent. Measurements of ground vegetation for these three types is presented in Tables 1 and 2. Broken park and timber types in this study were similar to the areas designated by Knight (1967) and Picton (1960) as open and closed canopy conifer types, respectively. Open park types generally represented the kind of habitat described by Kirsch (1962) as open conifer-park type. Subtypes were designated only for the open park type, and combined, constituted less than 5 percent of the total habitat within the study area.

Open and Broken Park Type

The open park type was separated into natural openings (Figures 3 and 4), clearcuts (Figures 3 and 6), burn (Figure 7), and powerline (Figures 3 and 8) subtypes. Except for clearcuts, no significant differences in low-growing vegetation were indicated between subtypes. Therefore all subtypes except clearcuts were included in the open park data (Table 1). Kirsch (1962) quantitatively described the clearcut subtype. The powerline subtype was represented by cleared

100-foot-wide strips in which high voltage powerline systems had been installed. These strips run in straight line segments through the Douglas-fir and spruce-fir zones.

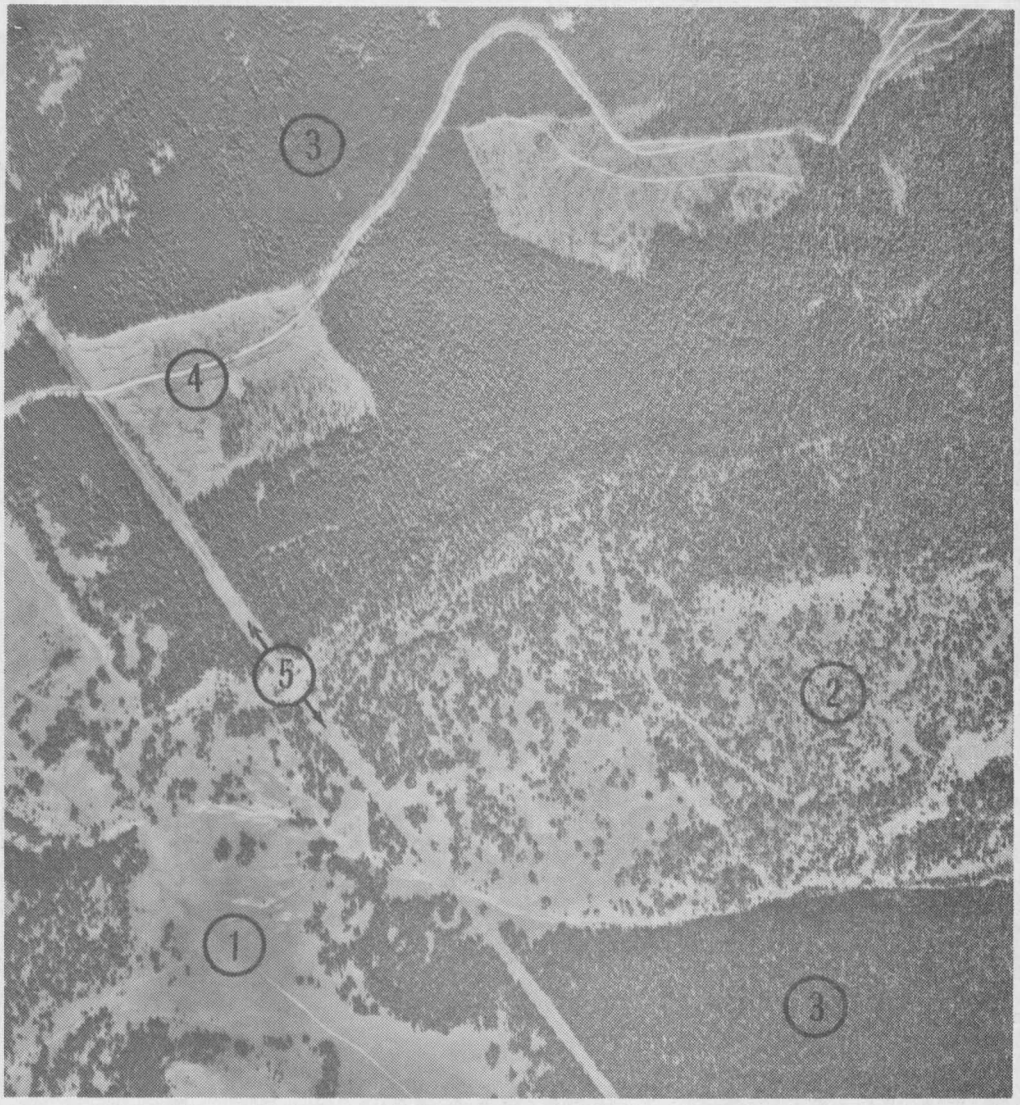
Data from the open and broken park habitats (Table 1) indicated no significant difference between the two on the basis of low-growing vegetation. A few species occurred in both types but were only recorded in the plots of one. Each of these constituted less than 1 percent of the cover and are included in Appendix, Table 10. All species which did not make up at least 1 percent of the ground cover in at least one type are recorded in this table. One species in each type was not observed to occur in the other. These were cudleaf sagewort (*Artemisia ludoviciana*) in the open type and rough fescue (*Festuca scabrella*) in the broken type. Of the five forbs making up the greatest percentage of canopy coverage in each type, four were the same for both types: cinquefoil (*Potentilla* spp.), daisy (*Erigeron* spp.), western yarrow (*Achillea millefolium*), and dandelion (*Taraxacum officinale*). In the open park lupine (*Lupinus argenteus*) and clover (*Trifolium* spp.) each ranked fifth in canopy coverage, while in the broken park ballhead sandwort (*Arenaria congesta*) occupied this position. Forbs predominated over grasses in both types. Four of the five most abundant grasses were the same for both types. These were wheatgrasses (*Agropyron* spp.), bromes (*Bromus* spp.), timber oatgrass (*Danthonia intermedia*), and Idaho fescue (*Festuca idahoensis*). Idaho fescue was found

to be the most predominant grass throughout all types in the study area. The species ranking fifth in coverage for open and broken park types were bluegrasses (*Poa* spp.) and green needle grass (*Stipa viridula*), respectively.

Timber Type

This type was represented by four timber type groups; Douglas-fir, lodgepole pine, Engelmann spruce-subalpine fir, and whitebark-limber pine. Ground vegetation was fairly sparse in these types except for the whitebark-limber pine. Litter cover averaged 85 percent for all four types. Whitebark-limber pine, spruce-fir, and Douglas-fir all had approximately the same number of species present in the low-growing vegetation (Table 2). Lodgepole was found to be somewhat lower in total species. Heartleaf arnica (*Arnica cordifolia*), clover, and sedges were the only plants recorded as occurring in all four types. Milkvetch (*Astragalus* spp.) was the most abundant forb in the Douglas-fir and whitebark-limber pine types. Heartleaf arnica was the most abundant for the spruce-fir and lodgepole pine types. Each of the grasses made up less than 1 percent of the canopy coverage in the four types except for Idaho fescue which made up 20 percent in the whitebark-limber pine type. More shrub species were recorded in the timber types than in the open and broken park types. Rose (*Rosa* spp.) was recorded in all timber types except whitebark-limber pine. Oregon

grape (*Berberis repens*) was recorded in all types except the spruce-fir although it probably occurred here also. Lodgepole pine was the only type where thinleaved huckleberry (*Vaccinium membranaceum*) and kinikinnick (*Arctostaphylos uva-ursi*) were recorded.



1. Open Park
2. Broken Park
3. Timber
4. Clearcut
5. Powerline

Figure 3. Aerial photo of three major habitat types and two subtypes in the spruce-fir zone.

Figure 4. Open park type (foreground) and timber type (background) in spruce-fir zone.

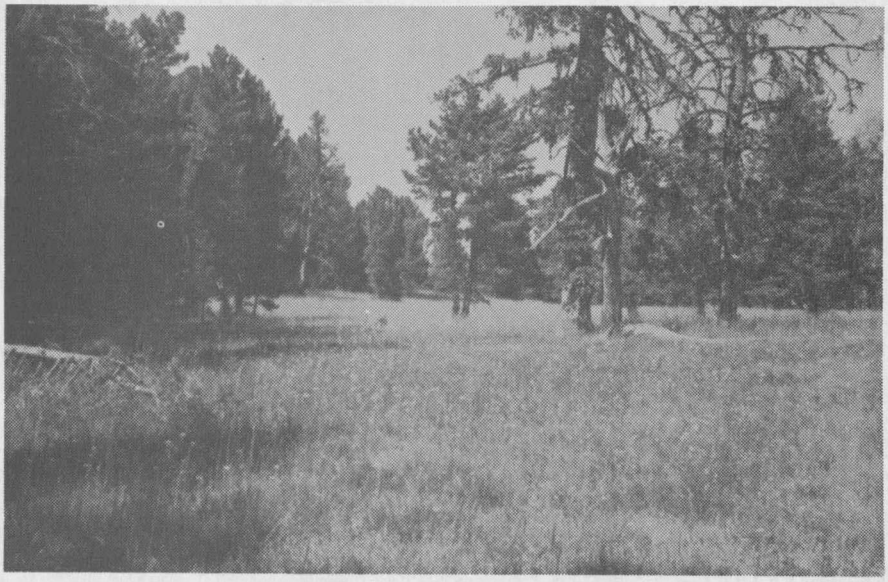


Figure 5. Broken park habitat type in Douglas-fir zone.

TABLE 1. CANOPY COVERAGE AND FREQUENCY OF TAXA FOR GRASSES, FORBS, AND SHRUBS OCCURRING IN THE OPEN AND BROKEN PARK HABITAT TYPES AS INDICATED BY MEASUREMENTS FROM 600, 2X5 DECIMETER PLOTS ON 30 DIFFERENT SITES.

Taxa[1]	Open Park Type 15 Sites 300 Plots	Broken Park Type 15 Sites 300 Plots
GRASS AND GRASS-LIKE PLANTS:	98/15/100[2]	97/21/100
Agrostis alba	3/.5/13	6/ 1/13
Agropyron spp.	52/80/73	42/ 6/80
Bromus marginatus	11/ 2/40	1/.1/7
Bromus spp.	16/ 3/47	14/ 3/73
Carex spp.	56/15/100	33/ 9/100
Danthonia intermedia	10/ 3/26	32/ 9/73
Festuca idahoensis	75/23/86	80/32/87
Koeleria cristata	14/ 2/47	12/ 2/47
Melica spectabilis	9/ 2/33	2/.4/27
Phleum alpinum	8/ 1/33	.6/.2/7
Phleum pratense	11/ 2/33	5/.7/20
Poa spp.	18/ 3/47	13/ 2/67
Stipa viridula	10/ 2/27	26/ 5/87
Trisetum spicatum	13/ 2/33	17/ 2/33
FORBS:	97/27/100	98/31/100
Achillea millefolium	67/10/93	73/13/100
Agoseris glauca	28/ 4/73	32/ 5/73
Anemone multifida	1/.1/7	13/ 2/60
Antennaria parvifolia	7/ 2/33	25/ 7/73
Antennaria rosea	1/.3/7	10/ 3/13
Arenaria congesta	17/ 2/40	46/ 8/100
Arnica cordifolia	9/.3/7	9/ 2/13
Aster spp.	7/ 1/20	3/.6/7
Campanula rotundifolia	6/.5/27	10/ 1/60
Cerastium arvense	27/ 3/73	16/ 2/73
Cirsium spp.	3/.8/20	4/ 1/33
Collomia linearis	5/.6/20	9/ 1/40
Delphinium bicolor	10/.9/20	13/ 2/60
Dodecatheon conjugens	12/ 2/47	14/.6/73
Erigeron spp.	45/ 8/60	72/15/100
Fragaria virginiana	7/ 1/33	7/ 1/47
Galium boreale	19/ 2/60	18/ 2/60
Geum triflorum	11/ 4/20	14/ 3/60
Geranium viscosisimum	17/ 2/33	28/ 5/73
Helianthus nuttallii	7/.1/7	6/ 1/20

TABLE 1. (continued)

Taxa	Open Park Type 15 Sites 300 Plots	Broken Park Type 15 Sites 300 Plots
Lupinus argenteus	27/ 7/53	9/ 2/27
Mertensia spp.	12/ 2/33	2/.3/27
Polygonum bistortoides	24/ 3/60	30/ 3/93
Potentilla spp.	59/18/86	40/ 9/100
Taraxacum officinale	45/ 9/80	44/13/87
Trifolium spp.	38/ 7/87	23/ 3/60
SHRUBS:	12/ 3/100	11/ 2/87
Vaccinium scoparium	1/.7/13	6/ 2/13

[1]All plant species which made up at least 1 percent canopy coverage in at least one type.
[2]Frequency of occurrence/mean canopy coverage/constancy.

TABLE 2. CANOPY COVERAGE AND FREQUENCY OF TAXA FOR GRASSES, FORBS, AND SHRUBS OCCURRING IN THE TIMBER HABITAT TYPES AS INDICATED BY MEASUREMENTS FROM 400, 2X5 DECIMETER PLOTS ON 20 DIFFERENT SITES.

Taxa	Douglas-fir 5 Sites 100 Plots	Lodgepole Pine 5 Sites 100 Plots	Spruce-fir 5 Sites 100 Plots	Whitebark-Limber Pine 5 Sites 100 Plots
GRASS AND GRASS-LIKE PLANTS:	18/ 5/100 [1]	--	2/.2/100	12/ 3/100
Agropyron spp.	--	--	--	1/.2/20
Bromus spp.	1/.9/25	--	--	--
Danthonia intermedia	1/.8/25	--	1/.2/20	--
Festuca idahoensis	1/.5/25	--	1/.1/20	3/20/60
Koeleria cristata	--	--	--	2/.5/40
Carex spp.	20/12/100	10/ 4/100	34/15/100	40/16/100
Stipa comata	3/.2/50	--	--	--
Stipa viridula	5/ 1/25	--	--	--
FORBS:	83/36/100	41/13/100	47/19/100	65/24/100
Achillea millefolium	1/.2/25	--	7/ 1/60	7/ 1/60
Agoseris glauca	3/.4/50	--	--	--
Allium textile	3/.2/25	--	--	--
Anemone multifida	1/.3/25	--	--	--
Antennaria racemosa	10/ 2/50	2/.2/20	3/.5/20	--
Arenaria congesta	--	--	14/ 5/40	8/ 3/20
Arnica cordifolia	31/ 6/75	22/ 6/80	34/ 8/60	14/ 5/40
Aster foliaceus	--	--	--	1/.2/20
Astragalus spp.	24/ 8/75	--	2/.2/20	19/ 7/40
Campanula rotundifolia	1/.2/25	--	1/.2/20	2/.3/40
Chimaphila umbellata	--	3/.7/40	--	--
Epilobium angustifolium	--	5/.3/60	--	4/.5/20
Epilobium spp.	--	--	4/.8/60	3/.3/40
Erigeron spp.	31/ 5/75	--	7/ 1/40	8/ 1/60
Eriogonum flavum	--	2/.5/40	--	--
Eriogonum ovalifolium	--	2/.5/100	--	--
Eriogonum spp.	--	--	--	4/.6/20

TABLE 2. (continued)

Taxa	Douglas-fir 5 Sites 100 Plots	Lodgepole Pine 5 Sites 100 Plots	Spruce-fir 5 Sites 100 Plots	Whitebark-Limber Pine 5 Sites 100 Plots
Erythronium grandiflorum	--	--	6/.7/40	2/.3/20
Fraseria speciosus	6/ 3/25	--	--	--
Fragaria virginiana	19/ 3/75	--	8/ 3/40	7/ 2/60
Galium boreale	23/ 4/75	--	1/.2/20	10/.8/20
Geranium viscosisimum	--	--	--	2/.3/20
Glycyrrhiza lepidota	2/.2/50	--	5/.6/60	--
Helianthus nuttallii	--	--	3/ 1/20	--
Linnaea borealis	10/ 5/75	5/ 1/20	--	--
Lupinnus argenteus	--	2/.5/20	--	7/ 2/40
Mertensia spp.	1/.2/25	--	2/.5/20	2/.3/20
Pedicularis spp.	--	--	3/.7/40	--
Polygonum bistortoides	--	--	1/.1/20	5/.8/60
Potentilla spp.	5/.1/25	--	5/.7/40	16/ 2/100
Pyrola spp.	11/ 2/75	4/.2/40	3/.1/40	--
Sedum stenopetalum	--	--	--	1/.2/20
Taraxacum officinale	8/ 1/25	--	1/.1/20	1/.1/20
Thalictrum spp.	13/ 4/75	--	22/ 7/60	--
Trifolium spp.	63/10/25	4/ 1/20	1/.2/20	1/.2/20
Valeriana dioica	--	--	4/ 1/20	--
Valeriana sitchensis	3/.37/50	--	5/.4/60	--
SHRUBS:	31/ 5/100	80/42/100	13/ 2/100	78/42/100
Arctostaphylos uva-ursi	--	1/.4/20	--	--
Berberis repens	14/ 2/75	1/.2/20	--	6/ 1/20
Rosa spp.	16/ 2/100	4/ 1/60	2/.6/20	--
Spiraea densiflora	1/.2/25	--	--	--
Spiraea spp.	6/.5/25	10/ 2/20	--	--
Vaccinium membranaceum	--	12/ 5/20	--	--
Vaccinium scoparium	--	15/ 5/60	14/ 2/60	66/38/80

[1]Frequency of occurrence/mean canopy coverage/constancy.

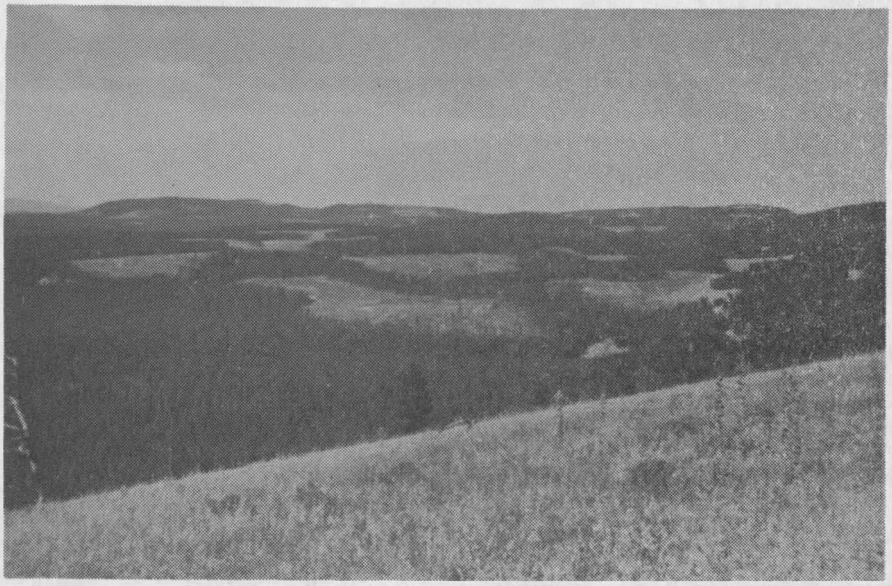


Figure 6. Clearcuts in lodgepole pine -- head of Smith Creek.

Figure 7. Burn subtype.

Figure 8. Powerline subtype in the spruce-fir zone.

Population Characteristics of Elk

A total of 5,720 observations of elk from the air and ground, were classified according to categories as listed in Table 3. July of both 1969 and 1970 was the month of highest observations. The cow:calf ratio for July of both years combined was 100:57. Because of the increased activity of the calves and the high number of observations made in open areas during July the cow:calf ratios for this period were felt to best represent this segment of the population during summer. Winter cow: calf ratios for elk wintering on the Judith Game Range and adjacent areas were 100:55 in the winter of 1960 (Picton 1960) and 100:58 in the winter of 1966 (Schallenberger 1967). Average group size generally decreased from June until September and increased from October through December. The smallest average group size was recorded during September of both years. Knight (1970) reported the same. Observations of yearling males dropped by one-half or more from July and August, 1970 to September and mid-October while observations of older bulls with six or more antler points doubled from August and early September to late September and mid-October (Table 3). These changes occurred during the breeding season.

TABLE 3. CLASSIFICATION OF 5,720 OBSERVATIONS OF ELK BY SEX, AGE, AVERAGE GROUP SIZE, AND AVERAGE ELEVATION BY MONTH FOR THE SUMMERS OF 1969-70 AND FALL OF 1970.

	Average Elevation	Cows	Calves	Yrlg. Males	2-Year-Old Males	Older Males	Uncl.	Total	Number Groups	Average Group Size
1969:										
June 20-30	7,250	40	18	3	1	-	43	105	9	11.5
July 1-31	7,400	158	93	39	11	-	141	442	56	7.9
August 1-31	7,363	128	78	36	14	5	135	392	62	6.3
September 1-14	7,266	40	25	5	5	1	33	109	22	4.5
1970:										
June 20-30	7,513	20	15	-	-	-	24	59	6	9.8
July 1-31	7,550	680	386	87	32	2	518	1,705	163	10.5
August 1-31	7,334	519	283	57	10	6	178	1,053	128	8.2
September 1-14	7,055	129	54	28	6	5	52	274	60	7.5
September 15-31	7,166	208	90	26	22	10	91	447	43	6.3
October 1-17	7,150	280	86	24	23	14	258	685	78	8.7
October 18-31	7,355	56	21	8	4	1	5	95	9	10.5
November 1-30	7,356	121	36	17	8	1	66	249	27	9.2
December 1-5	6,187	25	10	2	-	-	68	105	4	26.2

Use of Habitat Types

For the periods of June 20-September 14, 1969-70 and September 15-December 5, 1970 a total of 6,881 associations of elk with the three main habitat types were recorded from the ground and air (Table 4). All habitat types used by each of 5,720 elk while under observation were recorded.

One observation flight was made each month during July, August, and September, 1969. During 1970, 35 flights were made from July through December; the monthly average was seven except for December when only one flight was made. Ground observations were made throughout the study. Aerial observations were superior to ground observations in determining relative use of broken park and timber type habitats as compared to open areas (Table 4).

SUMMER

The percentage of total summer observations for the Douglas-fir zone for late June, July, August and early September for both years were 1, 12, 16, and 6. For the spruce-fir zone the percentages were 2, 38, 21, and 4. This indicates that use of the two zones was quite similar for June and September with more use occurring in the spruce-fir zone during July and August.

The trend of use for the three habitat types was the same for July and September in the Douglas-fir zone and for July and August in the spruce-fir zone (Figures 9 and 10). Open parks received the

greatest use for all months in both zones except for early September when usage of broken parks slightly exceeded that of open parks in the spruce-fir zone. August showed a reduction in the usage of open and broken park types in the Douglas-fir zone and an increase in the use of timber types for both zones (Figures 9 and 10).

TABLE 4. PERCENTAGES BY MONTH AND HABITAT TYPE FOR 6,881 SIGHTINGS OF ELK FROM THE AIR AND GROUND FOR THE PERIODS JUNE 20 THROUGH SEPTEMBER 14, 1969-70 AND SEPTEMBER 15 THROUGH DECEMBER 5, 1970.

	AIR			GROUND		
	Open Park	Broken Park	Timber	Open Park	Broken Park	Timber
1969-70:						
June 20-30	-	-	-	162/98[1]	-	3/2
July 1-31	574/53	451/42	54/5	782/67	364/31	25/2
August 1-31	443/52	189/22	226/26	531/80	105/16	26/4
September 1-14	165/37	98/31	53/17	69/66	24/23	11/11
1970:						
Sept. 15-31	345/49	260/37	93/13	78/66	30/25	11/9
October 1-17	381/43	204/23	303/34	58/56	32/30	14/13
October 18-31	43/50	3/3	40/47	49/36	49/36	37/7
November 1-30	126/38	115/35	90/27	17/50	-	17/50
December 1-5	68/51	64/49	-			

[1]Number of observations/percentage of observations for month.

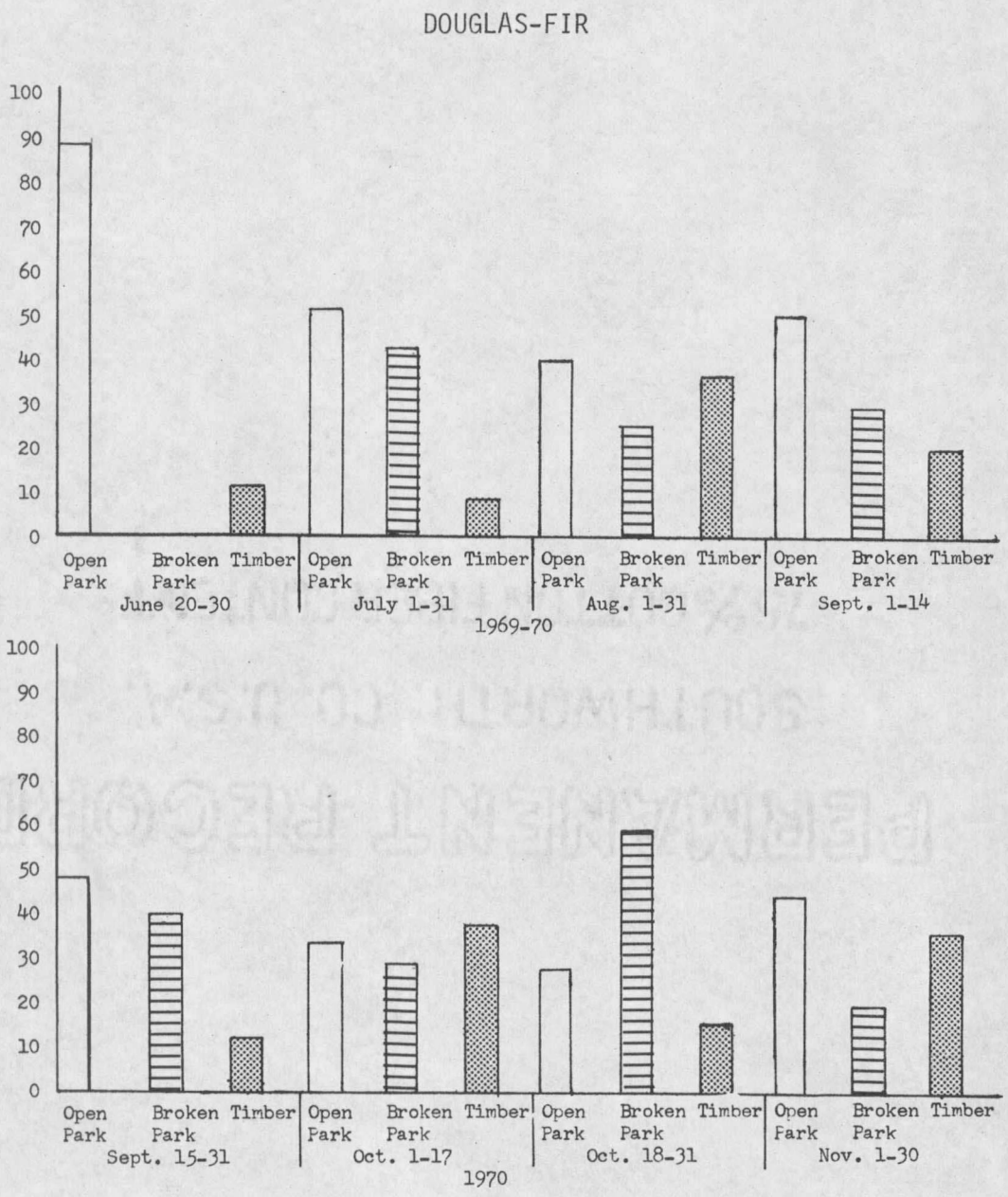


Figure 9. Percentage of use for the three main habitat types by month for summer, June 20-September 14 and Fall, September 15-November 30 in the Douglas-fir zone.

SPRUCE-FIR

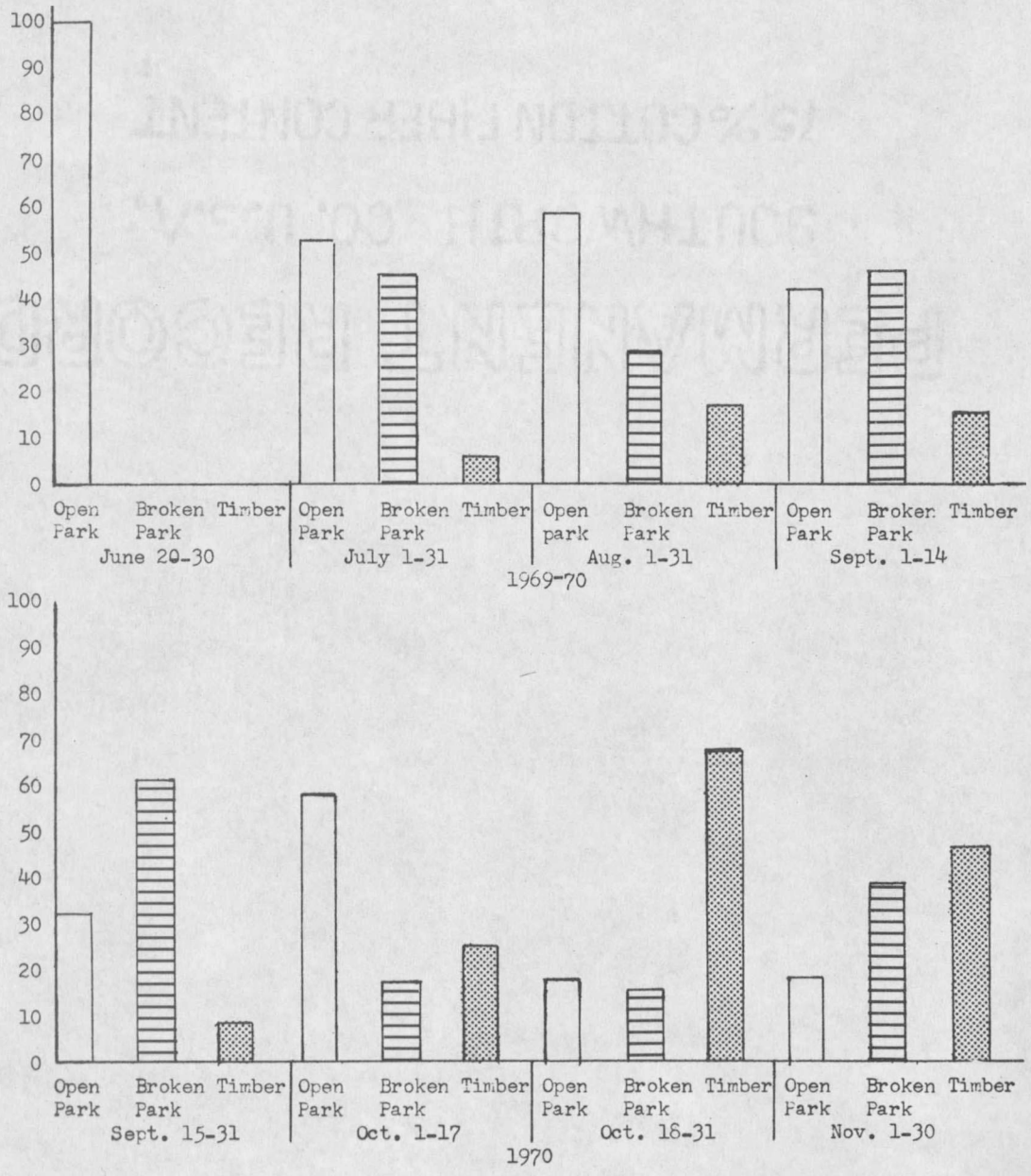


Figure 10. Percentage of use for the three main habitat types by month for summer, June 20-September 14, and fall, September 15-November 30 in the spruce-fir zone.

Use of the natural opening and burn subtypes within the open park types was recorded for each zone (Table 5).

TABLE 5. PERCENT OF ELK OBSERVATIONS IN SUMMER AND FALL FOR SUBTYPES OF THE OPEN PARK TYPE BY ZONE, 1969-70.

	Natural Opening	Clearcut	Burn	Powerline
Douglas-fir Zone	56/87[1]	31/13	12/-	tr/-
Spruce-fir Zone	91/95	-/-	3/-	5/5

[1]Summer percentages/fall percentages.

Of the other two subtypes use of clearcuts predominated in the Douglas-fir zone while use of powerline habitat predominated in the spruce-fir. This was due to the fact that most of the clearcut habitat occurred in the Douglas-fir zone while almost all of the powerline habitat occurred within the spruce-fir zone. Natural openings received the greatest use of all subtypes in both zones.

Use of the various timber species within the broken park and timber types is presented in Table 6.

Because of interfingering and disturbances, ponderosa pine, Douglas-fir, Engelmann spruce, and subalpine fir occurred in ecotones of the Douglas-fir or spruce-fir zones. Use of timber species varied between the two zones. Douglas-fir and whitebark-limber pine received more use than any other species in the Douglas-fir and spruce-fir zones, respectively. Whitebark-limber pine was second in usage

in the Douglas-fir area followed by lodgepole, spruce-fir, and ponderosa pine. In the spruce-fir zone Engelmann spruce-subalpine fir was second followed by Douglas-fir and lodgepole pine.

TABLE 6. PERCENT OF ELK OBSERVATIONS IN SUMMER AND FALL FOR TIMBER SPECIES OF THE BROKEN PARK AND TIMBER TYPES BY ZONE, 1969-70.

Zone	Whitebark-Limber Pine	Spruce Fir	Lodgepole	Douglas-fir	Ponderosa Pine
Douglas-fir	21/21[1]	12/12	16/6	50/45	1/17
Spruce-fir	48/37	32/28	3/11	17/24	-/-

[1]Summer percentages/fall percentages.

FALL

The percentages of total fall observations in the Douglas-fir zone for late September, October 1-17, October 18-31, November,and December 1-5 for 1970 were 15, 32, 7, 6, and 5, respectively. For the spruce-fir zone these percentages were 8, 8, 7, 13, and 0, respectively. Recorded use of the Douglas-fir zone for the last half of September and first half of October, prior to the hunting season, exceeded that of the spruce-fir by two to four times. During the last part of October, use became almost equal between zones and use of the spruce-fir zone increased in November to twice that recorded for the Douglas-fir. This may have been related to the hunting of elk during the season of October 18-November 28.

Use of the three habitat types during fall indicated several

varied patterns in each zone (Figures 9 and 10). Each exhibited the same trend of use for the last half of September as indicated for the first half. In early October, broken park habitat received the lowest usage in both zones while use of timber was first in the Douglas-fir zone and second in the spruce-fir. During the last part of October, patterns of use were quite different between the two zones (Figures 9 and 10). Use of open and broken park habitat in the spruce-fir area was about equal but use of timber approached 70 percent of the total usage. Timber received the lowest use in the Douglas-fir zone while broken parks received almost 60 percent of the total usage. Use of the habitat types in the spruce-fir zone for November was a reversal of that indicated for the summer months of July and August (Figure 10). The pattern of use for the Douglas-fir zone in November was the same as that for the summer month of August where open park and timber types received more usage than did broken parks.

The natural opening subtypes of the open park type again received the greatest utilization in both zones (Table 5). No observations were recorded in the clearcut or burn subtypes of the spruce-fir zone while powerline habitat received the same amount of use in the fall as it did in summer. No observations were recorded in the Douglas-fir zone for the burn and powerline subtypes while clearcuts received some 13 percent of the use for fall.

The highest to lowest recorded use of timber species for the

spruce-fir zone was whitebark-limber pine, spruce-fir, Douglas-fir, and lodgepole pine. For the Douglas-fir zone these were Douglas-fir, whitebark-limber pine, ponderosa pine, spruce-fir, and lodgepole. Use of lodgepole in the spruce-fir zone and use of ponderosa pine in the Douglas-fir zone increased significantly over that recorded for the summer period.

Characteristics of Natural Openings Used by Elk

Use of natural openings in the open park habitat type was highest during early and mid-summer with a decrease in late summer for those which were associated with ridgetops or higher exposed slopes (Table 7). These areas were relatively large and became xeric as the season progressed, with use shifting to smaller open and broken parks associated with timbered types. Knight (1970), Kirsch (1962), and Stevens (1966) also noted decreased use of exposed areas in late summer and attributed it in part to desiccation of forage. Cole (1963) felt that movements in late August to timbered types was related to but not necessarily determined by quality of forage in these types at that time. As indicated in Table 7, all elk did not stop using ridgetop areas and/or move to lower elevations.

The average size of 50 natural parks used by elk was 57 acres (3-320). Seventy-four percent were of irregular shape and had irregular edges. Kowalsky (1964) reported an average of 59.7 acres for six mountain meadows used by elk. Reynolds (1966, 1962) indicated

that in Arizona elk used natural openings of approximately 20 acres in spruce-fir areas and 45 in ponderosa pine regions. Seventy percent of the parks used were classified as dry, 24 percent as wet:dry, and 6 percent wet. Jeffery (1963) indicated that wet areas were avoided by elk. Wet areas used during this study were characterized by forbs while wet areas with sedges received little use by elk.

TABLE 7. PERCENT OF ELK OBSERVATIONS ASSOCIATED WITH RIDGE TOPS AND ELEVATIONS ABOVE 7,500 FEET FOR JULY AND AUGUST OF 1969-70 COMBINED.

	Ridgetops	Elevation of 7,500 feet (or more)
July 1-31	358/17[1]	1,345/63
August 1-31	139/10	709/49

[1]Number of observations/percent of observations.

Sixty percent of the parks were either ridgetops or southeast facing with an average slope of 10 degrees. Forty-five percent had at least some slope of 30 degrees or greater. Jeffery (1963) reported the highest elk usage on slopes of 17 degrees or less. Thirty percent of the parks had frequently used roads or trails, 24 percent had infrequently used roads or trails, and 44 percent had no vehicle roads or trails. Kowalsky (1964) indicated a very low use of mountain meadows by elk which were not secluded from man.

Elk, when disturbed in open parks, usually responded by seeking out escape timber. Timber characteristics of 50 timbered areas used

for escape cover are presented in Table 8. In 22 observations representing 258 animals, elk ran an average distance of 374 feet to utilize escape timber while the average distance to the closest timber was only 224 feet. Regardless of the manner and direction from which the observer approached, 58 percent of the elk returned to the same general stand of timber from which they had emerged. Elk did not always run away from the source of disturbance as was indicated in four instances when elk could not be prevented from reaching a particular stand of escape timber. Altmann (1952) reported that elk will often cut through a driving force.

TABLE 8. RELATIVE FREQUENCY, DENSITY AND SIZE OF TREE SPECIES FOR 50 TIMBERED AREAS ADJACENT TO OPENINGS AND USED BY ELK FOR ESCAPE COVER. DATA ON TREES FROM ONE, 200-FOOT TRANSECT IN EACH AREA.

Relative Frequency of Tree Species: Percent of all transects in which the following species made up 50 percent or more of the trees recorded.	
Spruce-fir	43.5
Lodgepole pine	21.8
Whitebark-Limber pine	19.5
Douglas-fir	10.6
No Predominance	4.5
Density, dbh, Crown Density:	
Distance between trees	9.86 feet
Trees/acre	448.1
Average dbh/tree	8.46 inches
Basal area/tree	56.18 square inches
Basal area/acre	174.82 square feet
Average crown density	85 percent
Estimated average height	40-50 feet

For the 50 stands of escape timber, an average of 450 trees per acre with an average crown density of 85 percent was recorded (Table 8). This represents a spacing of approximately 9 feet between trees. Relative frequency of tree species in the timber stands is presented in Table 8. The relatively low value for Douglas-fir was influenced by fewer samples in the Douglas-fir zone as compared to the spruce-fir zone. Three combinations of tree species made up 20-22 percent of the total timber located within a belt of 210 feet surrounding the 50 parks. These were whitebark-limberpine-Engelmann spruce-subalpine fir, whitebark-limber pine-Douglas-fir, and whitebark-limber pine-Engelmann spruce-subalpine fir-lodgepole pine (Figures 11-14). Lodgepole by itself made up 8 percent while all other species and species combinations made up 6 percent each or less.

Characteristics of Clearcuts as Related to Use by Elk

The Russian Creek sale area had a significant grouping of clearcuts in which elk use was recorded (Figure 1). Physical characteristics of these clearcuts is recorded in Table 9. Average age of clearcuts was from 8 to 10 years. Kirsch (1962) found that 57 percent of total use for clearcuts occurred in cuts 7 to 8 years old. Harper (1966) found that peak usage occurred from 5 to 7 years after logging. The average size of the three clearcuts which received 88 percent of all use of clearcuts did not differ from the others (Table 9, Figure 1). Kirsch

Figure 11. Representative whitebark-limber pine timber type escape cover.

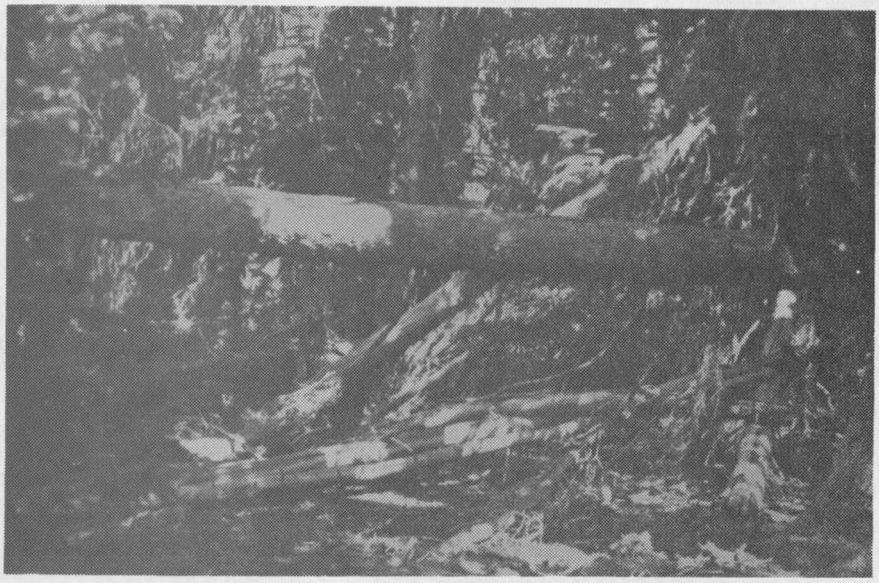


Figure 12. Representative spruce-fir timber type escape cover.

Figure 13. Representative Douglas-fir timber type escape cover.

Figure 14. Representative lodgepole pine timber type escape cover.

(1962) reported 74 percent of elk use was in clearcuts ranging from 15.2-25.12 acres while those of 25.3 to 35.3 acres, which compare with sizes in my study, were second with 15 percent use.

Four hundred and seventy acres of clearcuts were located in the head of Harrison Creek. Only three instances of use representing 20 animals were recorded for these. Some of these cuts were 5 to 6 years old but none had been cleared of slash or burned before late fall of 1970. This could have effected usage by elk (Harper 1966).

TABLE 9. PHYSICAL CHARACTERISTICS OF 20 CLEARCUTS RELATED TO ELK USE FOR THE SUMMERS OF 1969-70 AND THE FALL OF 1970.

Number:	20
Total Acreage	632
Average Acreage	32 (6-88)
Average Age in Years	8-10
Number Used by Elk Two or More Times:	9
Average Age in Years	8-10
Average Size of Three Most Used Cuts	30.66 Acres
Percent of 307 Elk Observations in Three Mose Used Cuts	88

Special Activity Areas

RUTTING

Each of five areas used for rutting activities, from the third week in August to mid-September, 1969-70 and from mid-September through the first week in October, 1970 were dominated by different timber types. These were Douglas-fir, spruce-fir, lodgepole pine, spruce-fir-whitebark-limber pine or Douglas-fir-whitebark-limber pine. All areas were closely associated with a water source. Each included all of the three major types of habitat, with broken park and timber types predominating. Three were associated with canyons while two were located in rolling hill type topography in and between drainages. Only one had an adjacent large, open ridgetop park (Figure 15). Three each had small open park areas in the heads and along the slopes of associated canyons (Figure 16). For one group clearcuts served as the major open areas (Figure 6). All rutting areas were within the summer range.

As many as three bulls with harems used the same canyons or drainages but did not use the same areas simultaneously. Two bulls with harems that occupied the same canyons and drainages were observed repeatedly. The two bulls could often see each other but no bugling or antagonistic response was noted. They did respond to the presence of a "strange" bull or to the imitated bugling by the author. Two banded cows were both seen in the harem of each of the two bulls indicating movement by cows from area to area or from bull to bull. One

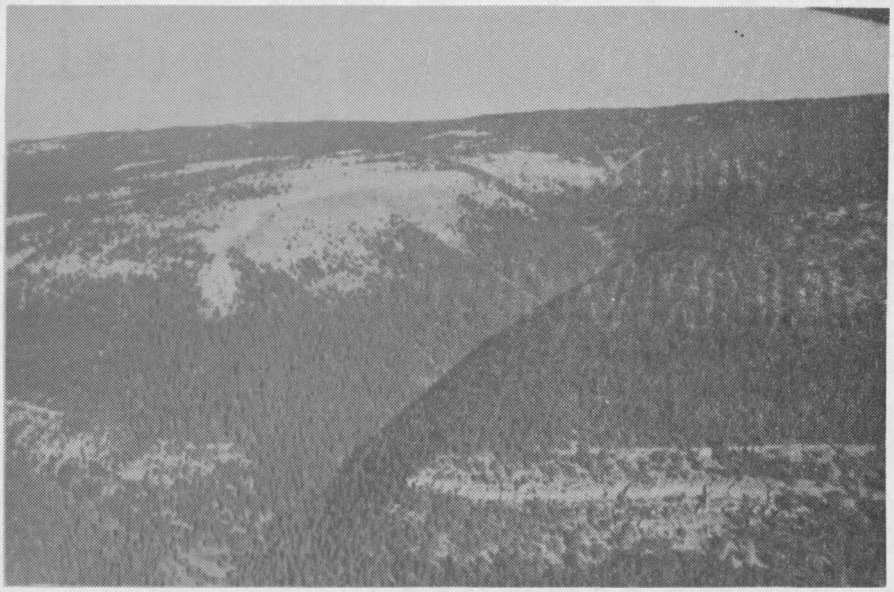


Figure 15. Canyon with adjacent open ridgetop park used by elk during rut.

Figure 16. Canyon with associated open parks used by elk during rut.

bull with his harem would occasionally move out of one canyon around the end of a ridge and into the adjacent canyon. Twice the other bull and his harem moved into the area vacated. Each bull defended an area against a 2-year-old bull when he approached them with their harems. In both instances the concerned bulls bugled and advanced toward the intruding bull which then retreated. On two occasions, I attracted one or the other of these bulls to my immediate vicinity by imitation bugling. The concerned bull responded with bugling until shortly after I stopped penetrating the area between the bull and myself. After responding for a while to my bugling, from a stationary position the bull stopped bugling and slowly worked his way back into the harem and commenced feeding. After this when I bugled the bull would raise his head but did not reply nor advance in my direction. These bulls did not seem to defend a specific geographic area but instead, defended a parameter around the harem (Struhsaker 1967). This is similar to the concept of plastic territory described by Dzubin (1955) for some species of waterfowl. This concept is not necessarily in disagreement with the reports by some authors of a bull with a harem being located within a certain area for the duration of the rut and apparently defending a specific geographic area. For if the bull and his harem did not move out of the area during the rut, one could not distinguish between a defended parameter around the harem and a geographic defense. Knight (1970) mentions that when two solitary bulls met they would de-

fend a land area even when no harems were in evidence. It seems possible that solitary bulls not in possession of harems, but very actively involved in the rutting activities may not in fact, be defending a specific land area but instead may be responding to the presence of each other.

Spikes were observed to mount cows during the rut and were sometimes seen running with a single cow or a cow and calf. Two-year-old bulls were observed in charge of harems as were six- and seven-point bulls. Some bulls in charge of harems did not drive off yearling males while approximately 50 percent did. This is indicated somewhat by reduction in observations of yearling males during the breeding seasons (Table 3). Older bulls, not readily observed during the summer became more noticeable from mid-September to mid-October (Table 3).

CALVING

Robert Varner, Manager of the Judith Game Range, pointed out the major known calving areas. These are located in association with stands of big sagebrush in the bottoms and along the slopes of the of the Middle and Lost Forks (Figures 17 and 18) within the Douglas-fir zone at elevations of 5,500-6,000 feet. Johnson (1950) and others have reported use of sagebrush areas for calving. Idaho fescue and bluebunch wheatgrass (*Agropyron spicatum*) were the predominant grasses.

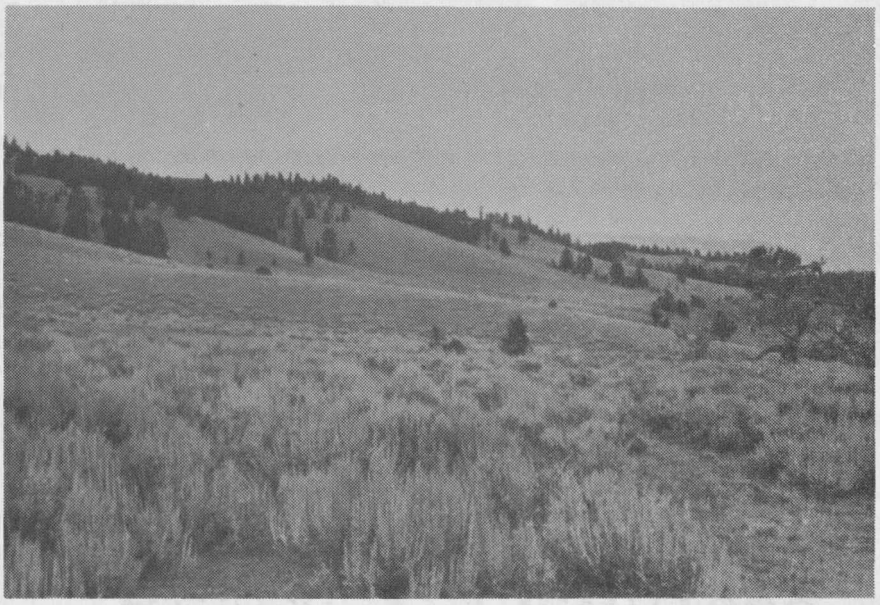


Figure 17. Calving area bottom of Lost Fork with south-facing slopes in background.

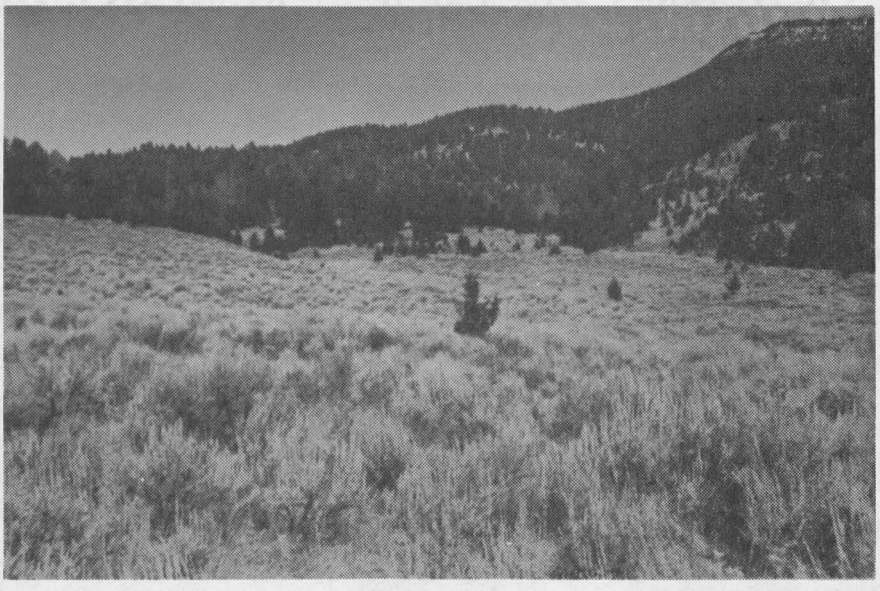


Figure 18. Calving area in Middle Fork of Judith River.

Ballhead sandwort and mouse-eared chickweed (*Cerastium arvense*) were abundant forbs with western gromwell (*Lithospermum ruderale*), goldenrod (*Solidago* spp.), and fringed sagewort (*Artemisia frigida*) also being noted. All other forbs observed also occurred in the open and broken park types previously described.

Although a few elk may winter in these regions, these calving areas fall somewhat above the major wintering range or on transition range. Johnson (1950) and others have indicated that most calving occurred on the upper limits of the winter range while Stevens (1966) indicated that elk moved through the various types from winter to summer range with no special delay for calving in any one area. Varner (1969), reported that during some years with late springs, elk have calved in the ponderosa pine-grassland zone on the game range.

One known calving area fell on summer range, just under 7,000 feet and was not in association with big sagebrush stands. Calving in this area occurred either in a burned-over, reforested Douglas-fir stand (Figure 19) or in the open and broken park types adjacent to this stand.

Distribution of Elk

Distribution of elk in summer and fall generally followed the heads of drainages for the Lost, Middle, and South Forks of the Judith (Figure 20). There was a general overlap between areas used in summer

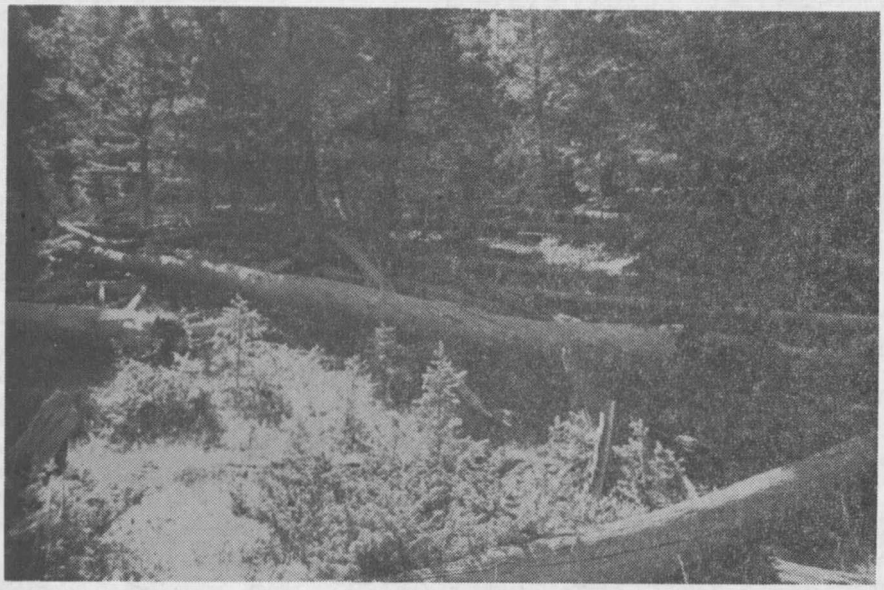


Figure 19. Calving area in Douglas-fir timber type.

and fall but fall usage was associated somewhat more with the lower slopes and ridges of the summer and upper parts of the transition range. All observations of elk in the bottoms of the Lost and Middle Forks were made prior to and after hunting season opened.

Concentrations of elk were observed in the heads of the South and West Forks of the Lost Fork and in the South Fork of the Judith. A fairly even distribution of elk was noted across the heads of the contributing drainages to the Middle,Fork with the exception of Weather-wax. This may have been related to the construction of a logging road in 1968-69. Warm Springs, Appraisal, Cleveland, and the East Fork of

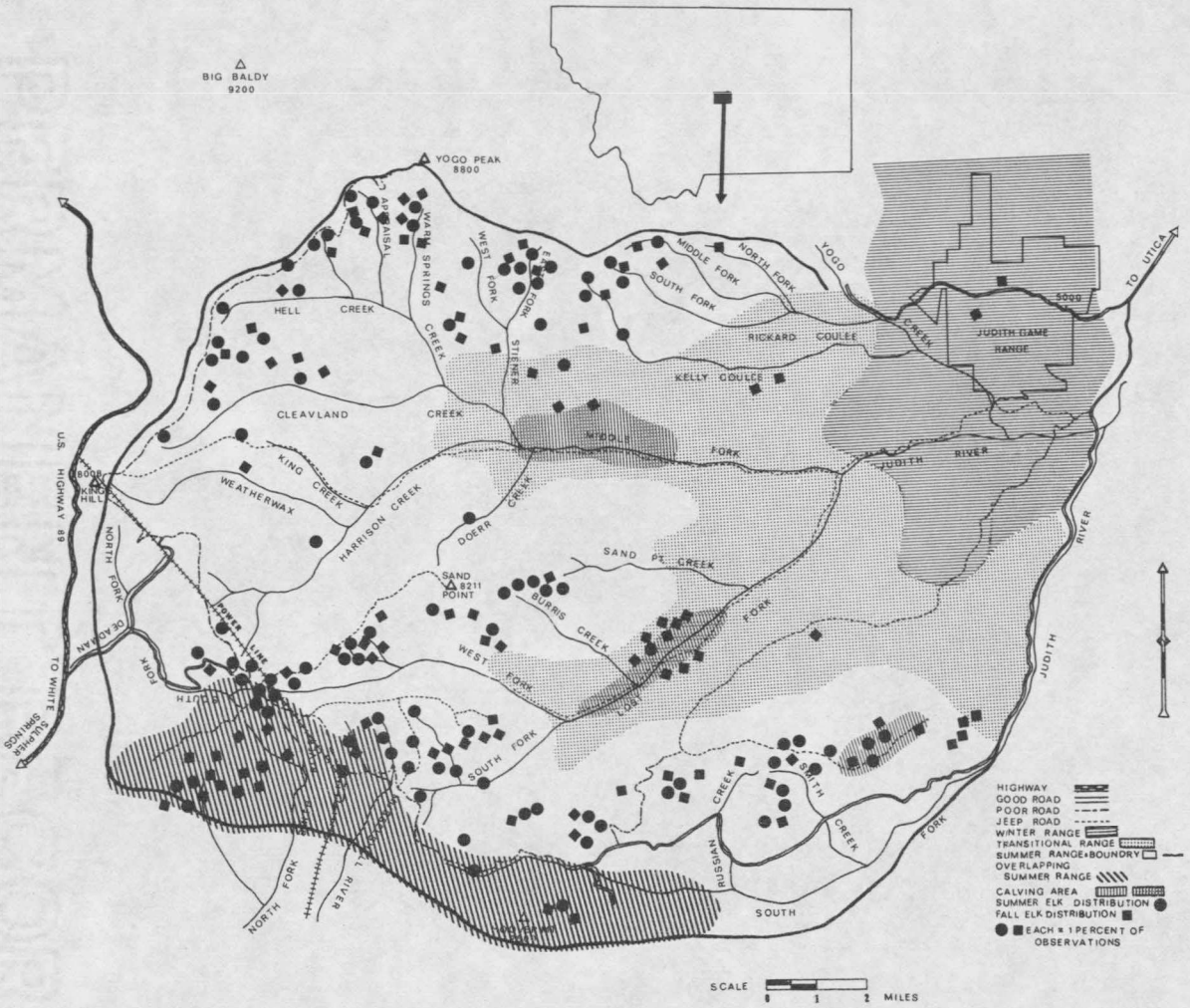


Figure 20. Map of study area with ranges and distribution of elk for summer, 1969-70 and fall, 1970 indicated.

Stiener all received significant use. Observations associated with Warm Springs during fall increased 5 percent over summer. The main distribution of elk during hunting seemed to fall in belts just above the hunting pressure from below and just below the hunting pressure from above. High ridges and bottoms of main drainages were easily accessible to hunters. One area at the heads of the North Fork of the Smith and Mussehlshell Rivers received significant use during the summer with elk remaining in these areas during hunting season. These areas had 4-5 inches of snow on the level with drifts from mid-November on, which prevented vehicle travel except for snowmobiles.

Use of Season Ranges

The area was separated into winter, summer, and transition ranges (Figure 20). Use of the winter range was greatest from December to May. Most elk moved into the transition range by the end of May. Movement through the transition to summer range occurred mainly during June. Picton (1960), Knight (1970) and others have reported similar findings. Most elk were observed on the summer range by the second week of July in 1970. Evidence of tracks in snowbanks and fields during the last week of June at higher elevations indicated that elk had been in the area but no elk were observed. Green-up of vegetation had not been initiated to any great degree except for a few early forbs: yellowbell (*Fritillaria pudica*), western springbeauty (*Claytonia lanceolata*), buttercups, and dogtooth lily. Elk were ob-

served in Deadman drainages at elevations of around 7,300 feet. These animals had possibly arrived on the higher summer range before green-up and melting of snow and then crossed the main divide into Deadman at lower elevations. Anderson (1958) reported elk crossing unbroken snow to reach summer range. In 1969 elk were found on the summer range at 8,000 feet in the last week of June. Green-up of vegetation was already initiated and no snow cover or banks were present.

Transition range was important in late spring, early summer and late fall. The Lost and Middle Forks seem to serve as main corridors from winter to summer range in the spring and vice versa during fall and winter. No single paths or trails were observed to function as the main migration routes with elk spreading out and moving through areas as generally dictated by topography and vegetation. Anderson (1958) noted similar findings. During the rut and prior to hunting season most elk remained on summer range but some elk groups were observed in the bottoms and slopes of the Middle and Lost Forks (Figure 20). These shifts to transition range might have been "natural" for this time of the year or could have been influenced by periodic snowfall during September and early October, resulting in some 2 to 3-foot drifts where wind action was prevelant. Two to three inches of light snow had accumulated in some areas down to 7,000 feet. A 3-day snow storm occurred from the 10th to 13th of September. One group of approximately eight elk went onto the game

range on the 14th of September and another group was seen in the Ettien ridge area at around 6,300 feet. No elk were seen in the bottoms of the Lost and Middle Forks at about 6,000 feet on this date.

After the opening of hunting season some groups of elk moved from lower transition ranges to the lower edges of the summer range or higher edges of the transition range. Knight (1970) reported a similar type movement.

One section of the study area served as an overlapping summer range for elk which wintered on the Judith Game Range and for those that wintered some 20 miles south and southwest of this range (Figure 20). This was determined primarily from observations of marked animals. The true extensiveness of this area is probably not indicated from these data.

Movements of Elk

Of 118 marked elk, 95 were observed at least once by others and myself. I had a total of 175 observations on summer and transition range representing 55 individually marked elk. Relocation of marked animals indicated that elk banded on the Judith Game Range in winter moved as much as 20-25 miles to summer range but the majority moved 12-16 miles. Kirsch (1962) recorded movements of up to 20 miles for this area. Thirty-six percent of 84 animals banded during the winter of 1968-69 were individually recognized on the game range during the winter of 1969-70. The rate of return was actually much higher be-

cause many banded animals which could not be individually identified spent the winter on the range. Three yearling elk, one male and two females, banded on the game range in the winter of 1968-69, wintered some 20 miles to the south the following winter. One, two-and-one-half year old female and one yearling male banded in the winter of 1969-70 were observed wintering in this same area during the winter of 1970-71. Martinka (1969) reported yearlings as having extensive movements during certain periods of the year.

Two radio-equipped animals, an adult cow and a 2-year-old male, provided data on year-long movements (Figure 21).

The cow was monitored from March 21, 1970 through February of 1971. Winter, transition, summer, and fall ranges were determined. Size of late winter-early spring home range was approximately 860 acres or 1.5 square miles. This cow was relocated in a calving area during the first week of June. After this she moved around somewhat before becoming associated on July 20 with what was indicated as her summer range of approximately 1,930 acres or 3 square miles. Martinka (1969) reported an average summer home range of 4.8 square miles for adult cows. Harper (1966) reported that 92 percent of the observations on marked cows fell within a 4-mile grid. Fall movements were those just prior to, during, and after hunting season from October 14 to December 5. She returned to the game range 5 days after hunting season closed on November 28. The last relocation before this was up

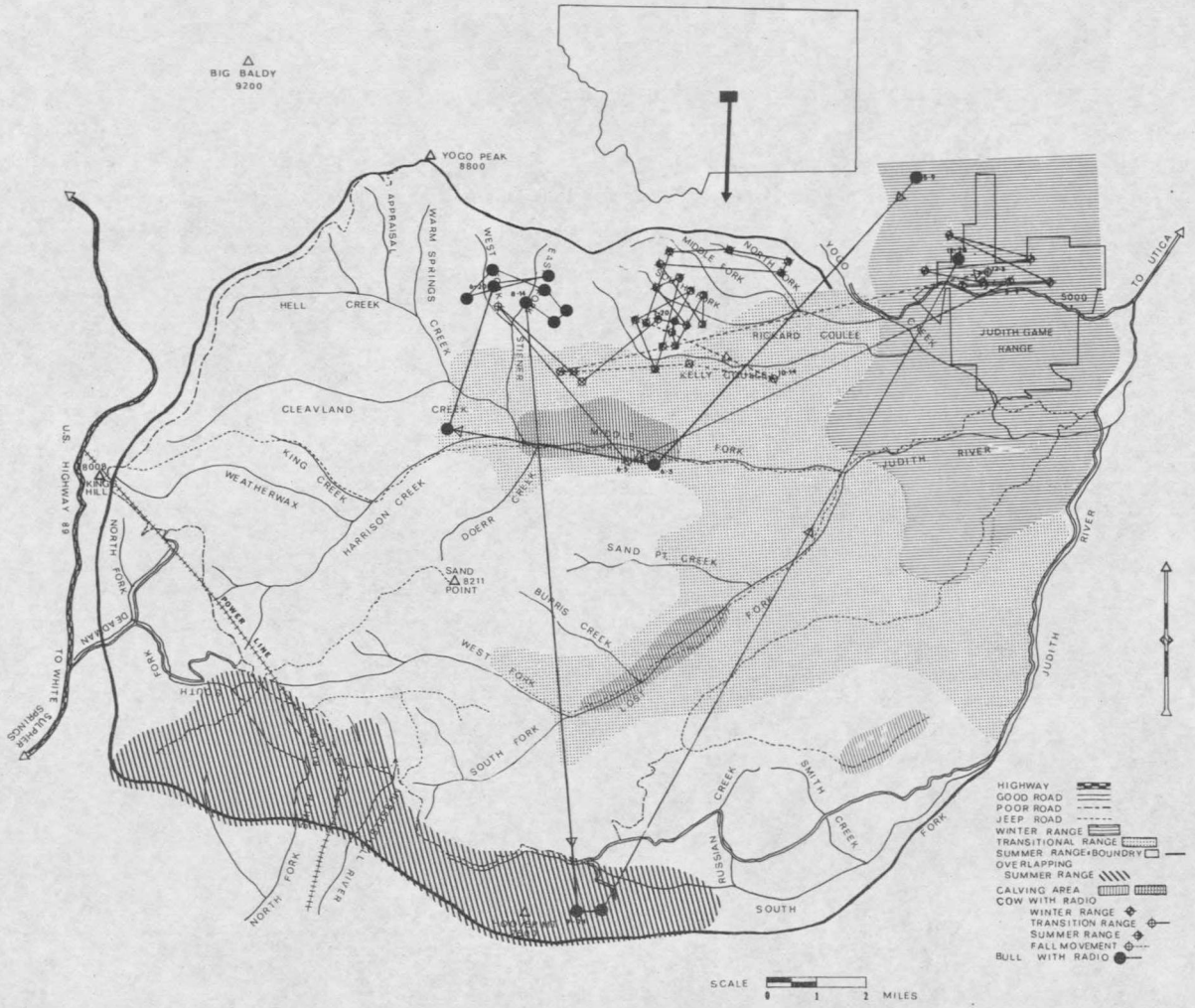


Figure 21. Map of study area and range with recorded movements of two radio-equipped elk during 1970.

high on the slopes of the Middle Fork the last week of hunting. No hunters were observed in the bottom or along the sides of this drainage at this time. River crossings and ice may have discouraged travel in the bottoms.

The 2-year-old male was originally trapped and banded as a calf in the winter of 1968-69. He returned to the winter range as a yearling in 1969-70 when he was immobilized by use of a tranquilizer gun from a helicopter and subsequently equipped with a radio transmitter. This animal was last located, on winter range, on the 26th of May, 1970. The next location was on June 5 on transition range in the same general area as the radio-equipped cow (Figure 21). He moved onto summer range during the last week of June and remained on his first summer range of approximately 960 acres or 1.5 square miles until August 14. Martinka (1969) reported the summer home range of adult bulls as averaging 4.8 square miles. Harper (1966) reported 80 percent of marked bulls being relocated within a 4-mile grid. This animal was located again for the first time some 6 weeks later approximately 14 air miles to the south of the previous location (Figure 21). On this date, September 24, he was in charge of a harem in a clearcut area. He was located one more time on summer range on October 1. Harper (1966) reported movements of adult bulls ranging from 4 to 25 linear miles over a period of 5 to 10 days. He noted that in most instances they would remain in the vicinity of their new location.

During the last week of December, 1970 this bull was relocated on the winter range, thus making it the third consecutive winter for this animal on this range.

Associated Use of Areas by Elk and Livestock

Cattle allotments are allowed in the Middle, Lost, and South Forks of the Judith generally from mid-June through October. Usage by cattle is confined almost entirely to the slopes and bottoms of these three drainages. In the study area this appeared to be primarily determined by water source, vegetation pattern, and topography in unfenced areas. In the Middle and Lost Forks elk range use usually preceded that of cattle in the spring and followed it in the fall. In early October, some joint use of these areas was noted prior to hunting.

In the South Fork some areas around Smith, Russian, and Big Hill Creeks were used by cattle and elk during the same periods of time. In one clearcut during the elk rutting season, elk were observed to feed and bed down within 30 yards of cattle. Distribution of cattle was recorded by Martin in 1969 in the Middle and Lost Forks (Figure 22) during three observation flights in summer. Distribution of cattle followed the same general pattern during 1969-70 except that in October of 1970 some cattle groups were observed in the bottoms at the heads of the East and West Forks of Stiener (Figure 22).

On the ridgetops and divides of the higher elevations, sheep

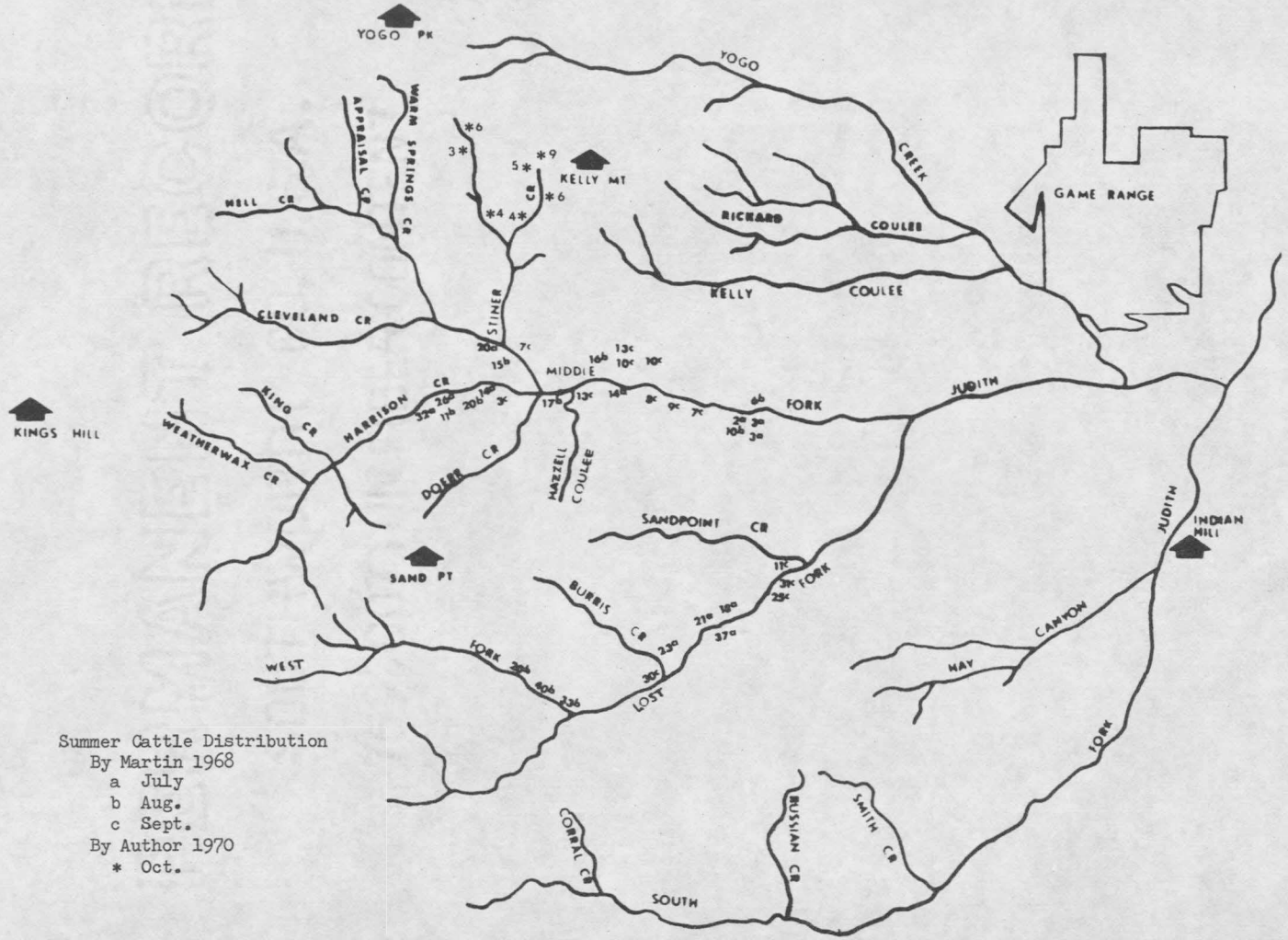


Figure 22. Pattern of summer cattle distribution for 1968-69-70 as determined by Martin for 1968 and the author for 1969-70.

allotments are allowed on a 2-year use-rest plan. Distribution and range use of elk was effected in those areas which elk were using prior to the presence of sheep. In 1969, sheep utilized the ridgetop areas from the head of the South Fork of Hell Creek to the head of Warm Springs and Appraisal from mid-July to September. Although elk did not leave a particular drainage when sheep came on the area they did move to lower elevations, utilizing areas directly below those used by the sheep. Hancock (1955) and Stevens (1966) reported similar behavior. This pattern was noted in all drainages used by both classes of animals. After the sheep were moved from areas formerly used by elk there was no significant return by elk. This was probably in part related to the range use habits of elk at this time of year. A few animals were observed to move back into these areas and utilize the artificial salt licks both during and after use by sheep.

Elk Hunting Data

During the hunting season of 1970, a total of 560 groups of hunters were checked at weekend checking stations. These groups represented 1,450 hunters for an average of 2.6 hunters per group. Besides checking for kills, information was obtained on whether or not elk had been seen and if the hunters had hunted from a road, in the field, or a combination of the two. Approximately 22 percent of all hunter groups were recorded as having seen elk, while only 4.3 percent were

successful in making a kill. Ninety-four percent of the groups which saw elk spent at least some time in the field. More elk were seen by hunter groups that hunted in the field exclusively than the other two groups combined. Of 29 elk killed and checked through the stations, 72 percent were taken by hunters hunting in the field either on foot or horseback. Harper (1966) reported very similar data. Distribution of the kill by period of hunting indicated that in the first 7 days of the season, 59 percent of the kill was made and in the first 14 days, 62 percent. Thirty-eight percent of the kill came the last 8 days of the season. Nine kills were checked in the field. Of these, 77 percent were made by hunters while on foot.

Hunting was not observed to force animals into a mass downward movement, but instead in some instances caused or contributed to elk moving up or remaining on higher summer range. In the areas at the heads of the North Fork of the Smith River, eight elk were killed during the first 4 or 5 days of the season. This area was hunted until the third week in November when elk were still in the area in which the early kills were made. This contrasted somewhat with elk found in the bottoms and slopes of the Middle and Lost Forks (Figures 17 and 18) early in the season and on the game range where elk moved off of or out of these areas after the first few days of hunting. For the duration of the hunting season some elk continued to go onto the game range at night but moved off prior to daylight. The nature

or pattern of the habitat may have contributed to elk staying within one area during hunting while leaving another. The area at the heads of the North Fork of the Smith River while having open park areas, also has extensive areas of broken and timber types in association with canyons. The predominance of open and broken timber types on the game range and on the slopes and bottoms of the Lost and Middle Forks seemed to make it necessary for elk to leave these areas while hunters were present.

DISCUSSION

Results of this study indicated a definite relationship between the patterns and interspersion of habitat types in the area and the degree of use received by elk. Although open, broken, and timber types all received use throughout the study, degrees of use for each type varied according to time of year. Types, and patterns of use changed in relation to the needs of elk during various phases of the elk's life history such as feeding, calving, and rutting; changes in habitat types related to phenology; and in response to activities by man such as hunting, logging activities, and use by livestock. The true use of timber as areas of feeding, bedding, movements, and other activities was masked by observational bias. Only 10 percent of the elk population was recorded from the air during any one flight of the study area. This indicated that some 80 to 90 percent of the elk were in timber types or areas of low visibility. Natural, open parks received the highest use of the open park types but artificial openings were also used. In general the use of open parks appeared to be related to location and juxtaposition with reference to other habitat types rather than to whether openings were natural or artificial. Use of timber stands also appeared to be more closely related to this than to the species of trees making up the stands.

The presence of frequently traveled roads through some parts of the study area did not appear to discourage use of open park types by elk but did perhaps influence time of use, with highest use by

elk during periods of lowest use of roads by man. Harassment or pursuing of elk from different types of motor vehicles did effect use of areas by elk.

Year-around elk use of concerned habitat types and ranges is a complex, interrelated system and should be considered as one integrated unit. The overall importance of vegetation and topography patterns and related interspersion of habitat types to the year-long ecology of the elk must be considered as one of the primary factors in future plans concerning alteration of established elk habitat.

APPENDIX

TABLE 10. CANOPY COVERAGE AND FREQUENCY OF TAXA FOR GRASSES, FORBS, AND SHRUBS OCCURRING IN THE OPEN AND BROKEN PARK HABITAT TYPES AS INDICATED BY MEASUREMENTS FROM 600, 2X5 DECIMETER PLOTS ON 30 DIFFERENT SITES.

Taxa[1]	Open Park Type 15 Sites 300 Plots	Broken Park Type 15 Sites 300 Plots
GRASS AND GRASS-LIKE PLANTS:		
Agropyron subsecundum	4/.8/13[2]	4/.6/7
Phleum alpinum	8/ 1/33	.7/.2/7
Poa pratensis	2/.3/13	.3/ 0/7
FORBS:		
Allium textile	.3/ 0/7	.3/ 0/7
Anaphalis margaritacea	6/.7/40	2/.2/13
Besseya wyomingensis	4/.4/20	3/.3/26
Eriogonum flavum	7/.1/13	.3/.5/7
Fraseria speciosus	.7/.1/13	4/.7/33
Hedysarum sulphurescens	1/.1/7	1/.2/7
Silene parryi	.7/.1/7	.7/.1/7
Pedicularis spp.	5/.6/27	5/.6/47
Penstemon spp.	4/.3/26	2/.1/27
Polygonum spp.	3/.5/13	.7/.3/13
Senecio canus	4/.7/20	.7/.1/7
Senecio spp.	3/.3/7	3/.4/20
Thlaspi arvense	.3/.1/7	3/.4/13
Viola adunca	7/.3/33	5/.4/7
SHRUBS:		
Potentilla fruticosa	2/.6/13	4/.9/33

[1]All plants which made up less than 1 percent canopy coverage in both types.

[2]Frequency/cover/constancy.

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