Characteristics of elk calving sites along the West Fork of the Madison River, Montana
by Leslie Ronald Reichelt

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
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Abstract:
A study was conducted along the West Fork of the Madison River in southwestern Montana during the spring and summer of 1972, The objectives were to capture and mark elk calves and to determine the vegetational and physical characteristics of each calf site. The effect of sagebrush spraying on the location of calf sites was also considered. Thirteen calves, 4 males and 9 females, were handled.

The weights of seven calves ranged from 43 pounds for a 3-day-old to 59 pounds for an 8+S--day-old calf. Two of the marked calves were later found dead from undetermined causes, The use of colored ear ribbons was the best method for marking calves. Low-growing plant taxa were measured at fourteen calf sites; twelve were in the sagebrush-grassland type, one was in the aspen type, and one was in the forest type. Only one of the twelve found in the Sagebrush-grass-land type was on an area of recently sprayed sagebrush. The percent canopy coverage for shrubs among fourteen sites ranged from 0 to 26.4 percent with an average of 12.4 percent. Big sagebrush was the most commonly occurring shrub. The percent canopy coverage for forbs ranged from 15.5 to 47.1 percent with an average of 35.9 percent. Yarrow was the forb with the highest constancy value. The canopy-coverage for grasses ranged from 12.8 to 66.7 percent with an average of 34.0 percent. Wheatgrasses, bluegrasses, sedges, and bromes were the common grasses. The number of feet of sagebrush intercept along a two hundred foot line at each of 12 sites ranged from 7 to 63.2 feet with an average of 39.4 feet. The proportion of living to dead sagebrush was about three to one. Sagebrush with a height greater than 18 inches made up 76.1 percent of the live sagebrush. The effective cover height averaged 27.6 inches at 12 sites® Maximum and minimum altitudes for calf sites were 7680 and 6760 feet. Ten calves were found on slopes with a southerly exposure. Calves found in the open were from 0 to 823 feet with a mean of 233 feet from tree cover. The average d.b.h. for the trees in the nearest aspen stand was 6.0 inches and the average density was 734.6 trees per acre. The first elk seen migrating from the Wall Creek Game Range to the West Fork calving area was on April 11 and the first elk observed on the calving area was on April 27. The first calf found was estimated to have been born on May 17 and the first calves seen with a herd of adult elk was on June 14.

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ABSTRACT

A study was conducted along the West Fork of the Madison River in southwestern Montana during the spring and summer of 1972. The objectives were to capture and mark elk calves and to determine the vegetational and physical characteristics of each calf site. The effect of sagebrush spraying on the location of calf sites was also considered. Thirteen calves, 4 males and 9 females, were handled. The weights of seven calves ranged from 43 pounds for a 3-day-old to 59 pounds for an 8+-day-old calf. Two of the marked calves were later found dead from undetermined causes. The use of colored ear ribbons was the best method for marking calves. Low-growing plant taxa were measured at fourteen calf sites; twelve were in the sagebrush-grassland type, one was in the aspen type, and one was in the forest type. Only one of the twelve found in the sagebrush-grassland type was on an area of recently sprayed sagebrush. The percent canopy coverage for shrubs among fourteen sites ranged from 0 to 26.4 percent with an average of 12.4 percent. Big sagebrush was the most commonly occurring shrub. The percent canopy coverage for forbs ranged from 15.5 to 47.1 percent with an average of 35.9 percent. Yarrow was the forb with the highest constancy value. The canopy coverage for grasses ranged from 12.8 to 66.7 percent with an average of 34.0 percent. Wheatgrasses, bluegrasses, sedges, and bromes were the common grasses. The number of feet of sagebrush intercept along a two hundred foot line at each of 12 sites ranged from 7 to 63.2 feet with an average of 39.4 feet. The proportion of living to dead sagebrush was about three to one. Sagebrush with a height greater than 18 inches made up 76.1 percent of the live sagebrush. The effective cover height averaged 27.6 inches at 12 sites. Maximum and minimum altitudes for calf sites were 7680 and 6760 feet. Ten calves were found on slopes with a southerly exposure. Calves found in the open were from 0 to 823 feet with a mean of 233 feet from tree cover. The average d.b.h. for the trees in the nearest aspen stand was 6.0 inches and the average density was 734.6 trees per acre. The first elk seen migrating from the Wall Creek Game Range to the West Fork calving area was on April 11 and the first elk observed on the calving area was on April 27. The first calf found was estimated to have been born on May 17 and the first calves seen with a herd of adult elk was on June 14.

INTRODUCTION

The practice of sagebrush spraying in the West to increase the production of grasses has continued in recent years. Short and long range effects of this activity on wildlife habitats and wildlife species has caused concern among those interested in the welfare of wildlife. Studies have been conducted near Winnett, Montana to determine the effects of different methods of sagebrush control on both game and non-game species (Pyrah, 1972). The effects on elk (Cervus canadensis nelsoni) were not considered. During late spring and early summer, use of sagebrush areas by this animal for calving has been reported by Johnson (1951) for the Gallatin drainage in Montana and by Altmann (1952) in Wyoming. Altmann reported that slopes of dense sagebrush (Artemesia tridentata) were used as calving areas for a herd of elk in Yellowstone National Park. The sagebrush was used as protection for the young animals from climatic factors and from predators.

The West Fork of the Madison River drainage in Montana is used by elk for calving. Although not extensive some spraying of sagebrush has been done on the north side of the West Fork between Lobo Creek on the West and Soap Creek on the east as shown in Figure 1. The northern boundary for spraying was determined by the location of the forest edge but usually was no more than two miles from the West Fork.

This known elk calving area with both sprayed and unsprayed stands of sagebrush was selected to conduct a study from April-

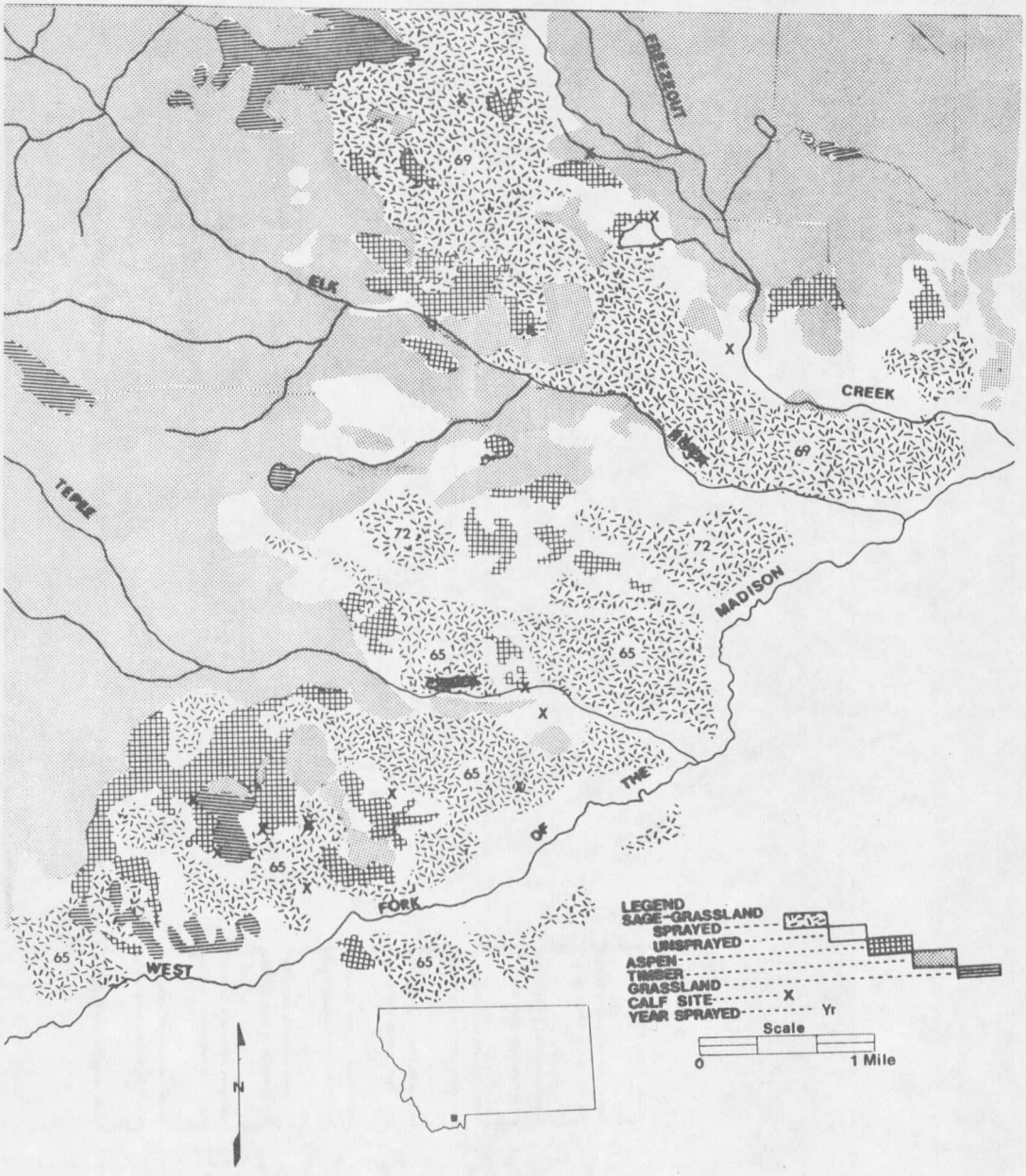


Figure 1. Map of the study area showing vegetation types, spray areas, and calf sites.

September, 1972, to evaluate vegetation and physical characteristics of sites used by elk for calving. This information may be of use in evaluating effects of sagebrush removal on the behavior of elk during this phase of their life history.

Movements of elk throughout the summer were also noted.

DESCRIPTION OF STUDY AREA

The Gravelly Mountain Range of Southwestern Montana is a north-south range approximately 32 miles long by 8-20 miles wide. These mountains, described by Rouse (1957), Knowlton (1960), Peek (1962), and Eustace (1967), are characterized by low, easily accessible slopes. Elevations are 5600 to 10,500 feet with areas over 9500 feet rare. The West Fork of the Madison River drains into the Madison River approximately 40 miles south of Ennis. Beginning at a point six miles from the mouth of the West Fork, the north side of this drainage is characterized by broad expanses of sagebrush, interspersed with stands of conifers and quaking aspen (Populus tremuloides) (Figure 2). These are the areas used by the elk during calving. The important drainages in this area are Freezeout Creek, Elk River, Tepee Creek, and Lobo Creek (Figure 1).

The vegetation in this area was described by Eustace (1967). He described 3 major zones: fescue-wheatgrass, Douglas fir, and Engelmann spruce-alpine fir. Three types were recognized in the fescue-wheatgrass zone: fescue-wheatgrass found between 5800 and 6600 feet, sagebrush-fescue between 6600 and 7000 feet, and aspen-willow found in drainage bottoms and other mesic sites. The Douglas fir zone, found at elevations between 7000 and 7800 feet, was also divided into three types: timber, sagebrush-fescue park, and aspen. Higher up is the Engelmann spruce-alpine fir zone, between 7800 and 9200 feet. This zone was divided into four types: fescue-wheatgrass park,



Figure 2. Photograph of West Fork area showing characteristic interspersion of sagebrush, aspen, and conifers. The location of calf sites 13 and 14 are indicated.

sagebrush-fescue park, drainage and disturbed sites, and timber. The vegetation types found on the West Fork study area are shown in Figure 1.

A program of sagebrush removal was begun in this area in 1959. That year 11,411 acres were sprayed with 2,4-D. Sagebrush spraying programs were also carried on in 1963, 1965, 1969, and 1972 covering areas of 1266, 2199, 1764, and 581 acres respectively. These areas sprayed from 1965 to present are shown in Figure 1.

The West Fork study area is utilized by cattle during the summer. The area from the Madison River to Landon Ridge has been divided into seven pastures by the Forest Service and a program of rest rotation grazing is being followed.

Approximately 500 elk winter on the Wall Creek Game Range which is located 13 miles north of the West Fork of the Madison. This herd divides into 3 different units during the summer (Shurr, 1973). Approximately 30 head migrate north of Wall Creek Game Range to the Cherry Creek drainage area. Nearly 250 elk move to the West Fork and 200 go to the summer range just west of Wall Creek Game Range and on the area around the headwaters of Wall Creek. These areas are shown in Figure 3.

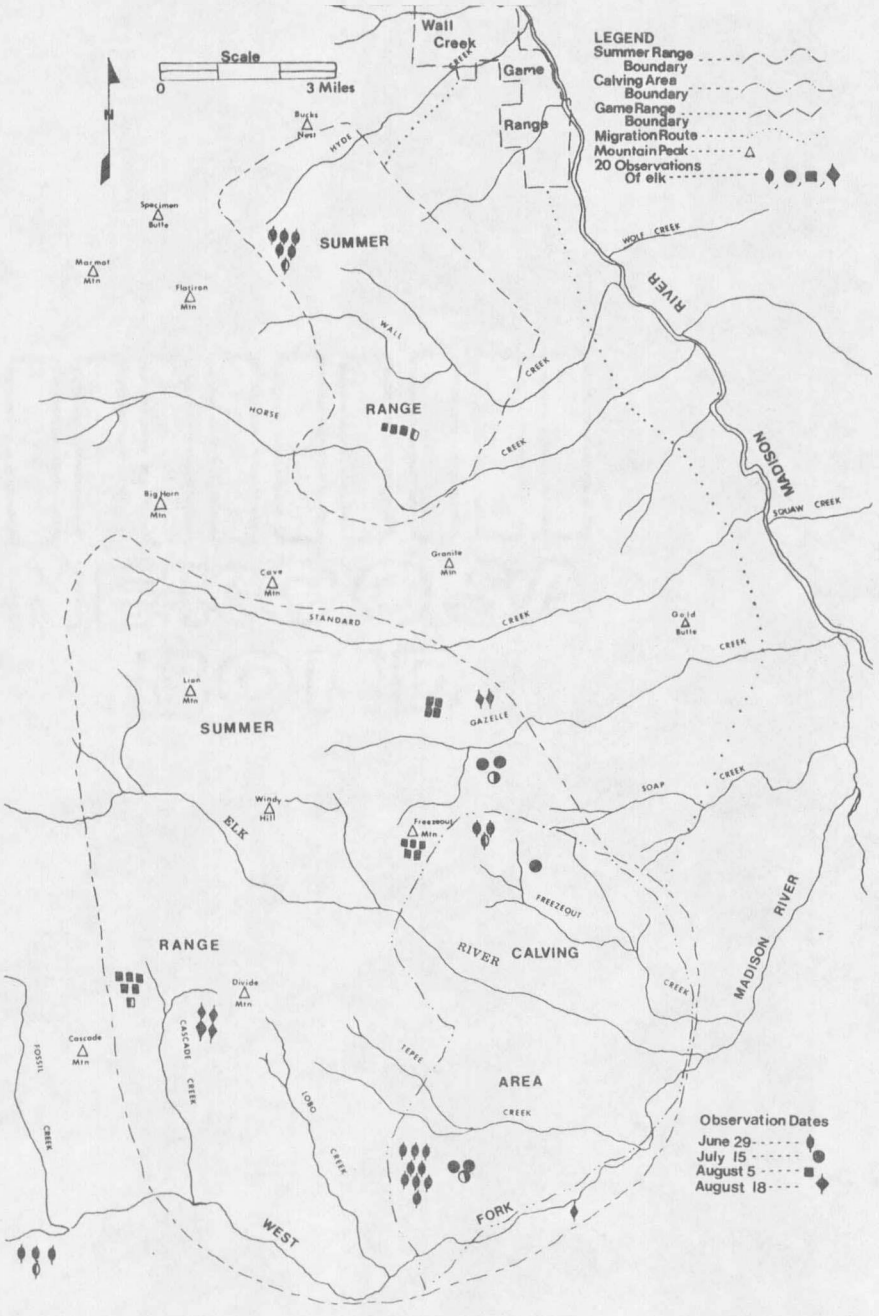


Figure 3. Map showing the summer and winter ranges of the elk that winter on the Wall Creek Game Range.

METHODS

The calves were located by the method described by Johnson (1951). Areas of sagebrush were covered by riders on horseback between May 15 and June 15, the period when most elk calves are born in this latitude (Johnson, 1951). Whenever a lone cow elk was sighted, the surrounding sagebrush was searched until a calf was found or the searchers were convinced there was no calf in the area. New born calves characteristically remain motionless while lying on the ground when disturbances occur in the immediate vicinity (Johnson, 1951). A nine-month old English pointer was also used to locate calves. The calves were caught by hand. Their legs were tied and their heads covered with a coat. This proved effective in quieting the animals. Seven calves were weighed and their sex noted. The age of all calves was estimated to the nearest day using the characteristics described by Johnson (1951). For each calf captured, a standard metal numbered ear tag was placed in each ear. To aid the recognition of individuals during subsequent observations from the air and ground the calves were marked as follows: Each of five calves was neck-banded with an individually recognizable plastic band, similar to those described by Knight (1966). Orange ribbons were attached to the ear tags of each of three calves (Rouse, 1957). Black sheep branding paint was used to paint the rumps and fluorescent orange paint was used to paint the sides of ten calves. Five of these ten were also marked by one or the other of the two preceding methods.

General notes of the phenology of the vegetation at calf locations were recorded. A marker was placed at the location of each calf site found. After the calving period, these sites were relocated for vegetational analyses and physical measurements.

Scientific and common names of plants used in vegetation analyses follow Booth (1950) and Booth and Wright (1959).

Composition and canopy coverage of low-growing vegetation at the site of each calf location were determined from a modification of the method described by Daubenmire (1959). A line 60 feet in length was placed along the axis of the slope with the location of the calf at the midpoint of this line. The vegetation within 2x5 dm plots located along the line at distances of 5 ft, 10 ft, 15 ft, 20 ft, and 30 ft in both directions from the calf site was analyzed. This procedure was repeated along a line run perpendicular to the first line so a total of 20 plots per site were examined.

Sagebrush density of these sites was determined using the line intercept method along two one-hundred feet lines at each site (Canfield, 1941). Individual sagebrush plants were separated into height classes. Class I was 0-6 in; class II, 6-12 in; class III, 12-18 in; class IV, 18-24 in; class V, 24-30 in; and class VI, greater than 30 inches. The sagebrush plants were also placed in living or dead categories.

Distances to the tree cover nearest each calf site was measured in feet. These tree stands were evaluated according to the method of Cottam and Curtis (1956). Density and size (dbh) of trees were acquired by this method. The sample unit was a 100 foot line transect with center points established at 10-foot intervals.

The height of the plants adjacent to the location of each individual calf was measured. Another measure was made by one observer locating himself approximately 100 feet from the calf site and then sighting across the tops of the sagebrush plants to the calf site. This line-of-sight height was measured at the calf site by a second observer and called the effective cover height. This provided a measure of the ability of a stand of sagebrush to furnish concealment for the elk calf.

At 13 calf locations, the slope was measured and the exposure determined. A topographical map was used to estimate the altitude of each site.

Aerial observations were made to determine the distribution and movements of elk throughout their spring and summer ranges. Observations by the author were also made from the ground with the aid of 8x40 binoculars.

RESULTS

Calving Dates and Characteristics of Elk Calves

The calving period, calculated from the birth dates of the captured calves, was from May 17 to June 4 (Table 1). No peak calving date as reported by Johnson (1951) was observed. The youngest calf handled was 2-days-old and three calves captured were classified as 8+-days-old. Weights were obtained from seven calves (Table 1). These weights were similar to the values obtained by Johnson (1951). A total of 4 male and 9 female calves (44♂:100♀) were handled. The ratio of males to females in my small sample is low compared to sex ratios in elk calves observed by Johnson (1951) and Angstmann and Gaab (1950) who observed sex ratios of 96♂:100♀ and 97♂:100♀ respectively.

Two calves were located with the aid of the English pointer. Whether the dog used sight or scent to locate the calves is not known. Murie (1951) reported that the elk calves do have a scent that can be detected by dogs, however, Johnson (1951) believed that the calves were odorless or essentially so during the first few weeks of life. On both occasions the dog flushed the calves and pursued until the rider on horseback could control the dog. In one instance the barking of the dog and the squealing of the calf caused the cow to return with the intention of defending her calf. This was the only time a cow elk returned to defend her calf.

TABLE 1. AGE, SEX, WEIGHTS, AND BIRTH DATES OF THIRTEEN ELK CALVES.

Calf No.	Age	Weight	Birth Date	Sex
1	7 days	52 lb.	May 17, 1972	M
3	8+days	59 lb.	May 20, 1972	M
2	5 days	43 lb.	May 21, 1972	F
4	8+days	50 lb.	May 21, 1972	F
11	8+days	--	May 26, 1972	F
9	6 days	--	May 26, 1972	F
8	3 days	--	May 29, 1972	F
10	4 days	--	May 29, 1972	M
13	7 days	54 lb.	May 30, 1972	F
15	3 days	--	May 31, 1972	F
12	2 days	--	June 1, 1972	F
17	3 days	47 lb.	June 2, 1972	M
18	3 days	47 lb.	June 4, 1972	F

Calf Mortality

Thirteen elk calves were handled during this study; two were later found dead. Calf no. 1 was captured on May 24, ear-tagged, weighed, painted and then released. Two days later a lone cow elk was seen returning to a spot very near to the location where the calf was first found. On May 30, the same calf was "jumped" from the spot the cow had visited four days earlier. This same calf was found dead on June 5 approximately 300 feet from where it was last seen. The calf appeared to have been dead 2-3 days and there was no sign as to what may have caused death.

Calf no. 11 was captured on June 3, ear-tagged, painted, neck-banded, and released. Approximately one-half mile east of this location this calf was found dead on June 27. The calf was covered with mud in a small washout. There was no evidence as to what may have caused death. Stage of eruption of the upper canines suggested that the calf died only a short time after it had first been caught.

The failure to sight any marked calves after July 1 and the absence of neck-banded calves on the winter range suggested that calf mortality may have been more than the two calves found. Altmann(1952) stated that the cow elk seemed to recognize their calves by both smell and vision. Since ten of the calves marked by me were painted, this may have encouraged abandonment by the cow. McCullough (1969), while studying the tule elk, marked five calves and all five died;

most had been killed by coyotes. He found that many hours of searching from a vehicle and on foot resulted in cows leaving the vicinity of the hidden calves for much longer than normal and only a sixth as many calves per cow survived as survived in similar nearby herds. White, et.al. (1972) found that marked whitetail deer fawns had a higher mortality rate than fawns that were not captured and marked. These marked fawns that died appeared to have been abondoned by the doe. Johnson (1951) did not observe any increased mortality among the elk calves that he marked.

Effectiveness of Marking Technique

The most satisfactory method of marking elk calves was found to be the use of orange ear ribbons. Both types of paint, the black sheep branding paint and the fluorescent orange paint, seemed to lack in endurance and no calves were seen with any paint markings. The use of neckbands is questionable since the large neckband may be a burden to a young calf elk and the possibility of a neckband slipping off a calf exists. Ear ribbons do not appear to hinder the calves. The ear ribbons of one calf were easily observed from an airplane. The neckbands may be more permanent and better suited for distinguishing between individuals but for a study involving young calves, the use of colored ear ribbons is the better marking technique.

Vegetation at Calf Sites

Fifteen calves were located in the sagebrush-grassland type, two were located in a forest type of the Douglas fir zone, and one was located in the aspen type. Only one of the fifteen calves found in the sagebrush-grassland type was in an area of sprayed sagebrush (Figure 4) but one found in live sagebrush was only six feet from a sprayed area. The low-growing taxa were measured at 12 sites found in the sagebrush-grassland type, one site in the forest type, and at the site in the aspen type.

The percent canopy coverage for shrubs among 14 sites ranged from 0 to 26.4 percent with an average of 12.4 percent. The constancy value was highest for big sagebrush (Table 2 and Table 7, Appendix). The only other shrub of common occurence was the rose (Rosa spp.). The percent canopy coverages of forbs and grasses for 14 sites ranged from 15.5 to 47.1 (35.9) percent and 12.8 to 66.7 (34.0) percent respectively. The species of grasses with high constancy values were wheatgrasses (Agropyron spp.), bluegrasses (Poa spp.), sedges (Carex spp.), and bromes (Bromus spp.). Among forbs, highest values were recorded for yarrow (Achillea millefolium), lupines (Lupinus spp.), common dandelion (Taraxacum officinale), and sticky geranium (Geranium viscossissimum). The site with the highest value for forb canopy coverage (47.1 percent) was also the only site with an easterly exposure (Figure 5). The site found in the sprayed sagebrush area provided the highest canopy coverage value for grasses (66.7 percent).



Figure 4. Location of calf site no. 1 on the sprayed sagebrush area.



Figure 5. Location of calf site no. 17 showing an easterly exposure.

TABLE 2. CONSTANCIES, FREQUENCIES, AND AVERAGE PERCENT CANOPY COVERAGE FOR LOW-GROWING TAXA ON 14 CALF SITES. DATA ARE FROM TWENTY 2x5 DECIMETER PLOTS AT EACH SITE.

Taxa[1]		
GRASS AND GRASS-LIKE PLANTS		
Agropyron spp.	93/73[2]	11(0.0-22.6)[3]
Bromus spp.	64/31	5(0.0-15.5)
Carex spp.	71/18	2(0.0-5.4)
Festuca idahoensis	57/51	7(0.0-17.1)
Koeleria cristata	29/17	2(0.0-4.0)
Poa spp.	79/53	4(0.0-8.0)
Unidentified grass	36/27	4(0.0-7.0)
Total Grasses and Grass-like	100/99	34(12.8-66.7)
FORBS		
Achillea millefolium	100/63	4(0.6-9.9)
Antennaria spp.	71/30	3(0.0-11.4)
Aster spp.	36/15	1(0.0-2.5)
Cerastium arvense	29/13	1(0.0-2.7)
Collomia linearis	43/34	2(0.0-10.6)
COMPOSITAE	79/31	2(0.0-5.0)
Fragaria virginiana	64/48	7(0.0-11.5)
Galium boreale	36/38	3(0.0-6.6)
Geranium viscosissimum	86/29	3(0.0-6.9)
Lupinus spp.	93/60	6(0.0-12.2)
Taraxacum officinale	93/52	4(0.0-12.1)
Viola spp.	36/24	1(0.0-2.6)
Unidentified forbs	93/60	8(0.0-11.5)
Total Forbs	100/98	36(15.5-47.1)
SHRUBS		
Artemesia tridentata	71/54	14(0.0-24.6)
Berberis repens	43/22	2(0.0-6.0)
Rosa spp.	57/7	1(0.0-3.1)
Unidentified shrubs	57/11	1(0.0-3.9)
Total Shrubs	93/50	12(0.0-26.4)

[1]Includes only those taxa with a constancy value greater than 25 percent. Others are listed in the Appendix.

[2]Constancy (percent occurence among sites)/frequency (percent occurence among plots).

[3]Average and range of canopy coverages (percent of area covered).

The number of feet of sagebrush intercept along a two hundred foot line among 12 sites ranged from 7 to 63.2 feet with an average of 39.4 feet. The proportion of living to dead sagebrush was about three to one (Table 3). The most frequently occurring size class for living sagebrush was the 12-18 inches height category with its relative density being 11.7 percent (Table 4 and Table 8, Appendix). The living class IV had the highest dominance value. On the average, this size class made up 9.0 feet along the two one-hundred feet lines. Sagebrush with a height of 18 inches or more made up 76.1 percent of the live sagebrush. The effective cover height averaged 27.6 inches at 12 sites (Table 3). Only two sites had values less than 24 inches. Five sites were found on areas of common (10 to 25 percent ground cover) sagebrush density and five were found on areas of dense (25 percent and greater ground cover) sagebrush density. Only two sites were found on areas with scattered (1 to 10 percent ground cover) sagebrush density. The tall plants provided better protection than the shorter sagebrush. The average intercept of dead sagebrush along the two hundred foot line was only 8.8 feet. Two young calves were observed along with two elk cows on June 10 on a spray area. The exact bedding locations were not found since both calves ran with the cows. The cows along with their calves were probably drawn to the area by the abundant grass that is found on the spray areas. This forage class is prominant in the diet of elk during this month (Eustace, 1967).

TABLE 3. PERCENT SAGEBRUSH INTERCEPT ALONG TWO ONE-HUNDRED FOOT LINES AND THE EFFECTIVE COVER HEIGHT AT EACH OF TWELVE CALF SITES.

Site No.	% Sagebrush Intercept (live-dead)	Effective Cover Height Inches
1	7.6(0.3-7.3)	30
2	-	27
3	31.1(29.9-1.2)	17
4	26.3(11.7-14.6)	37
5	31.6(27.4-4.2)	30
7	25.5(24.4-1.1)	34
11	25.3(18.2-7.1)	30
12	12.0(10.5-1.5)	24
13	3.5(3.5-0.0)	25
14	15.6(15.2-0.4)	--
16	22.8(22.8-0.0)	14
17	15.3(8.7-6.6)	30
18	20.2(8.8-11.4)	33
Average	19.7(15.3-4.4)	27.6

TABLE 4. AVERAGE AND RANGES FOR DOMINANCE AND DENSITY VALUES OF EACH SAGEBRUSH HEIGHT CLASS AMONG 12 ELK CALF SITES. DATA ARE FROM MEASUREMENTS ALONG TWO ONE-HUNDRED FOOT TRANSECT LINES AT EACH SITE.

	Dominance[1]	Relative Density[2]
Class I(0-6")		
alive	0.1(0.0-0.7)[3]	0.9(0.0-3.8)
dead	0.1(0.0-0.7)	0.3(0.0-1.5)
Class II(6"-12")		
alive	0.7(0.0-2.6)	3.5(0.0-13.5)
dead	0.5(0.0-2.7)	1.6(0.0-6.3)
Class III(12"-18")		
alive	3.4(0.0-11.3)	11.7(0.0-27.8)
dead	0.5(0.0-3.2)	2.6(0.0-10.8)
Class IV(18"-24")		
alive	4.5(0.0-10.4)	9.6(0.0-17.8)
dead	1.7(0.0-6.5)	4.4(0.0-12.5)
Class V(24"-30")		
alive	3.3(0.0-9.8)	6.6(0.0-15.5)
dead	0.7(0.0-2.2)	1.9(0.0-6.9)
Class VI(30+")		
alive	3.8(0.0-11.8)	3.1(0.0-12.6)
dead	0.9(0.0-4.2)	2.6(0.0-18.7)

[1]Dominance= $\frac{\text{total intercept length for a height class}}{\text{total transect length}}$ X 100.

[2]Relative Density= $\frac{\text{total individuals of a height class}}{\text{total individuals of all classes}}$ X 100.

[3]Average(Minimum-Maximum).

The vegetation at the calf sites at the time of calving was in an early stage of development. Grasses and forbs were beginning to "green-up" but most were not blooming. Common dandelion was in bloom.

The sites occupied by the calves when found were mostly in sagebrush but their location at this time did not necessarily indicate their place of birth. Seventy-seven percent of all calves found by Johnson (1951) were in open sagebrush areas but this value decreased to 42 percent for newborn calves. Possibly some cows utilize the greater protection afforded by timber during parturition but move the calves to the edges of adjoining sagebrush slopes when the calves are physically capable. Johnson (1951) reported most newborn calves were unable to walk and some were unable to stand. He felt the calves did little moving until the third or fourth day following birth. All but one of the calves in this study were three or more days old when found.

Physical Characteristics of the Elk Calf Site

Johnson (1951) reported that the bulk of the calves he found were between approximatley 7000 and 7400 feet. This was similar to calving elevations observed during this study. Maximum and minimum calving elevations were 7680 and 6760 feet (Table 5). The slope and exposure of calf sites are listed in Table 5. Ten calves were found on south facing slopes and most of the calves were found on gradual slopes

ranging between 0 percent (Figure 6) and 22 percent (Figure 7). The use of south facing slopes is probably due to the greater warmth and earlier plant developement on this exposure.

Possible Effects of Sagebrush Spraying on Elk Productivity

This and previous studies have shown that big sagebrush is an important component of calving habitat. This study found that elk calves are usually found in areas of tall, live sagebrush on south facing slopes. Perhaps this exposure with its greater warmth is more important than the presence of live sagebrush which is characteristically present. One calf was found on a south facing slope in an area of dead sagebrush. Dead sagebrush skeletons and some of the taller grass species provide the only cover on these areas. Live sagebrush plants furnish better protection for the elk calf from inclement weather and predators. Past sagebrush spraying programs in this area have not been extensive enough to affect a large percent of elk calving habitat. If sagebrush spraying is to be continued in this area, south facing slopes should be excluded.

Characteristics of Tree Cover Nearest Each Calf Site

The calving areas were predominantly sagebrush slopes interspersed with stands of quaking aspen. Calves found in the open were from 0 (edge) to 823 feet from tree cover with a mean of 233 feet (Table 5). A mean of 221 feet was recorded by Johnson (1951). The



Figure 6. Location of calf site no. 11 illustrating the use of a flat sagebrush plain.



Figure 7. Location of calf site no. 12 showing the interspersion of types at the calf sites.

TABLE 5. DISTANCE TO TREE COVER, DENSITY OF TREES, AVERAGE D.B.H. OF TREES, SLOPE, EXPOSURE, AND ALTITUDE OF CALF SITES.

Site No.	Distance to cover	Density of cover[1]	D.B.H.	Slope	Exposure	Altitude
1	300 ft.	--	-	13%	S	7120 ft.
2	--	1000.0	7.1 in.	-	-	7040 ft.
3	823 ft.	--	-	20%	S	6760 ft.
4	180 ft.	--	-	12%	S-SW	6800 ft.
5	106 ft.	581.2	6.0 in.	10%	S-SW	6880 ft.
6	--	931.1	5.7 in.	-	-	6920 ft.
7	24 ft.	340.2	7.2 in.	14%	S-SW	6800 ft.
9	150 ft.	--	-	-	-	--
11	624 ft.	546.6	6.1 in.	0%	-	7000 ft.
12	144 ft.	1143.9	3.8 in.	22%	S-SW	7320 ft.
13	0 ft.	1122.0	4.7 in.	10%	S	7040 ft.
16	75 ft.	516.5	6.6 in.	13%	S-SW	7000 ft.
17	270 ft.	810.9	5.1 in.	5%	E	6840 ft.
18	300 ft.	995.9	7.0 in.	17%	S	7680 ft.
19	--	355.4	6.7 in.	0%	-	7320 ft.
20	--	471.7	6.0 in.	0%	-	7360 ft.
Average	233 ft.	734.6	6.0 in.	11%	-	7037 ft

[1] Trees/Acre

average d.b.h. (diameter at breast height) for the trees of aspen stands was 6.0 inches and the average density was 734.6 trees per acre (Table 5). Coop (1971) reported an average d.b.h. of 8.46 inches and an average density of 448.1 trees per acre for timber stands used as escape cover by elk. The average basal area per acre for the aspen stands measured during this study was 144.16 square feet as compared to 174.82 square feet reported by Coop (1971).

The aspen stands are probably used as resting areas for the cow elk during the time she is near her calf. On each of two occasions a lone cow elk was spotted within an aspen stand near a hidden calf. One of these stands was not the stand nearest the calf. Other cow elk may have used aspen stands for cover but were not sighted until they were disturbed and running in the open.

MOVEMENTS

Elk

During the winter months (December-April), the elk are concentrated on the Wall Creek Game Range and adjacent areas. Here the elk utilize the fescue-wheatgrass zone as reported for the Ruby Valley by Rouse (1957). The migration to summer range usually begins in April but the exact date is regulated by the amount of snow on the migration route. During the spring of 1972, the first observation of migrating elk was made on April 11. These elk were sighted along Standard Creek which intersects the route taken by elk moving from the Wall Creek Game Range to the summer range north of the West Fork of the Madison (Figure 3).

Elk were first observed on the West Fork calving area on April 27 (Figure 8). Altmann (1952) reported that cow elk interrupted their migration approximately three weeks to drop their calves. The first calf found during this study was estimated to have been born on May 17, 1972, and the first calves seen with a herd of adult elk was on June 14, 1972. This is a span of four weeks and is similar to Altmann's observations. Picton (1960) reported that the majority of elk on the Sun River Game Range calve at the upper regions of the winter range. In contrast to this, the elk calving observed during this study was at the lower limits of the summer range.

The only observation of a marked calf was on June 29, 1972. This was a calf with orange ear ribbons, sighted between Elk River and

Freezeout Creek. Most elk are on their summer ranges by the end of June (Figure 3).

Cattle

Approximately 1600 head of cattle (excluding calves) were brought onto the study area on June 16, 1972. The area is divided into seven pastures (Figure 9) and each year two or three of these are rested. The cattle are rotated among the remaining pastures during the summer (Table 6). Each summer the cattle are brought onto the area after the elk have calved. The effect of current year grazing on the location of elk calving the following year was not evaluated.

TABLE 6. GRAZING SCHEDULE FOR THE PASTURES ALONG THE WEST FORK OF THE MADISON RIVER.

	1970	1971	1972
Shakelford Pasture	6/21-6/28	7/26-8/25	Rest
Lobo Pasture	Rest	8/26-9/15	7/21-8/15
Freezeout Pasture	6/29-7/25	Rest	6/16-7/20
Elk River Pasture	6/29-8/15	6/16-7/25	Rest
Landon Pasture	8/16-9/25	9/16-10/20	8/16-9/20
Patchtop Pasture	9/25-10/18	Rest	9/21-10/20
Paradox Pasture	Rest	6/16-7/25	Rest



Figure 8. Physiography of typical calving area along the West Fork of the Madison.

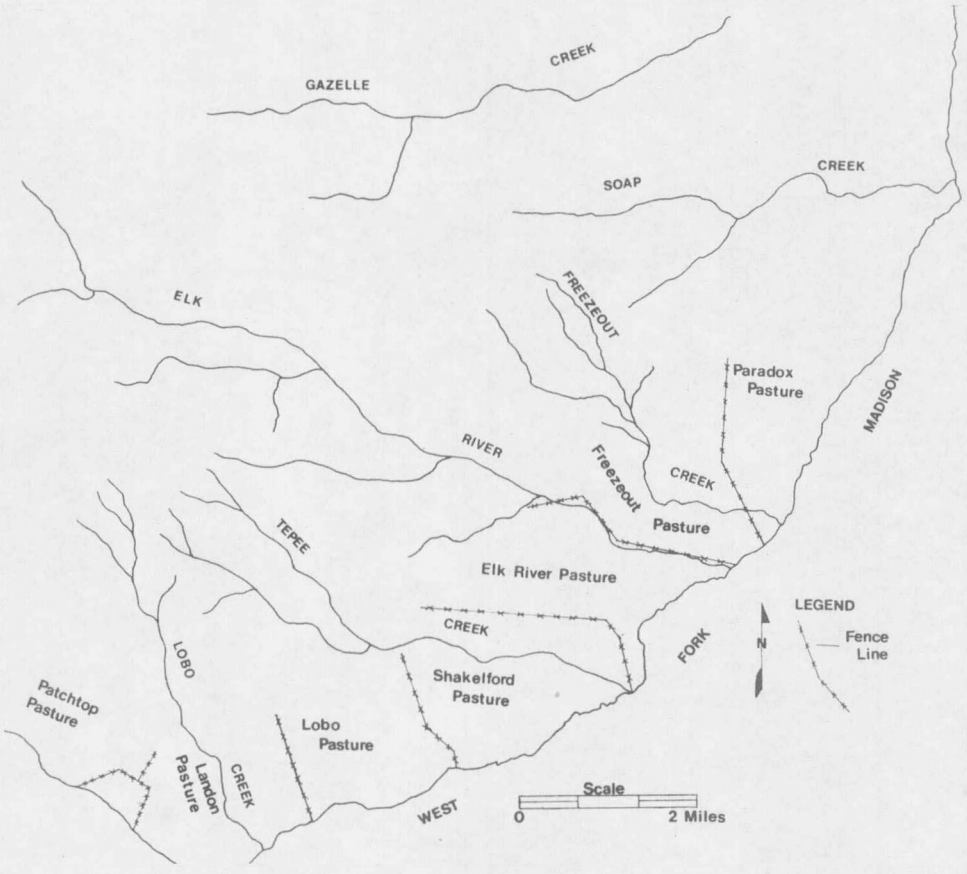


Figure 9. Location of the pastures in the grazing district along the West Fork of the Madison River.

APPENDIX

TABLE 7. FREQUENCY AND CANOPY COVERAGE OF THE LOW-GROWING TAXA AT EACH CALF SITE.

Vegetation type	Sagebrush sprayed	Sagebrush unsprayed	Sagebrush unsprayed
Taxa	Site 1	Site 3	Site 4
GRASS AND GRASS-LIKE PLANTS			
Agropyron spp.	13/75[1]	15/95	23/85
Bromus spp.	4/10	-	7/55
Carex spp.	5/35	-	5/45
Elymus spp.	27/45	16/45	-
Festuca idahoensis	2/15	4/40	-
Poa spp.	3/25	5/60	6/70
Unidentified grass	-	-	tr/5[2]
Total Grasses & Grass-like	67/100	41/100	39/100
FORBS			
Achillea millifolium	9/55	10/75	4/70
Antennaria spp.	-	2/25	2/20
Aster spp.	-	-	1/15
COMPOSITAE	-	tr/10	3/40
CRUCIFERAE	-	-	tr/5
Fragaria virginiana	2/15	-	12/70
Geranium viscossissimum	3/25	1/15	2/15
Lupinus spp.	5/45	7/65	2/40
Perideridia gairdneria	-	-	2/40
Phacelia glandulosa	-	-	2/30
Taraxacum officinale	1/5	3/55	5/50
Viola spp.	-	1/10	-
Unidentified forbs	7/60	1/20	3/45
Total Forbs	25/85	23/100	41/100
SHRUBS			
Artemesia tridentata	-	25/95	9/60
Rosa spp.	tr/5	2/15	1/5
Unidentified shrubs	-	1/5	-
Total Shrubs	tr/5	26/95	9/60

TABLE 7. (CONTINUED).

Vegetation type	Sagebrush unsprayed	Sagebrush unsprayed	Sagebrush unsprayed
Taxa	Site 5	Site 7	Site 11
GRASS AND GRASS-LIKE PLANTS			
Agropyron spp.	2/70	5/65	14/75
Bromus spp.	tr/15	1/10	-
Carex spp.	-	2/5	2/10
Festuca idahoensis	17/100	3/40	-
Koeleria cristata	tr/5	-	-
Poa spp.	6/70	2/75	4/30
Stipa spp.	-	-	9/40
Unidentified grass	-	-	7/35
Total Grasses & Grass-like	32/100	13/95	57/100
FORBS			
Achillea millifolium	3/90	5/80	4/65
Allium spp.	-	1/25	-
Antennaria spp.	5/50	1/5	-
Aster spp.	-	-	1/5
Cerastium arvense	tr/5	-	1/5
Cirsium arvense	-	tr/5	-
Collomia linearis	1/45	1/40	-
Comandra umbellata	-	-	1/25
COMPOSITAE	-	tr/15	4/55
CRUCIFERAE	-	-	tr/15
Fragaria virginiana	8/50	11/45	-
Geranium viscosissimum	5/55	3/15	-
Geum triflorum	1/20	-	-
LEGUMINOSAE	3/80	4/65	1/5
Linum perenne	-	tr/10	-
Lupinus spp.	9/80	12/90	1/20
Penstemon spp.	-	1/15	-
Taraxacum officinale	4/75	3/60	6/80
Trifolium longpipes	-	-	2/50
Viola spp.	1/30	-	-
Unidentified forbs	tr/10	3/55	5/45
Total Forbs	37/100	41/100	30/100
SHRUBS			
Artemesia tridentata	10/55	23/80	15/45
Berberis repens	tr/5	-	-
Rosa spp.	-	tr/5	-
Unidentified shrubs	2/5	-	-
Total Shrubs	12/65	23/80	15/45

TABLE 7. (CONTINUED).

Vegetation type	Sagebrush unsprayed	Sagebrush unsprayed	Sagebrush unsprayed
Taxa	Site 12	Site 13	Site 14
GRASS AND GRASS-LIKE PLANTS			
Agropyron spp.	4/70	4/25	11/65
Bromus spp.	tr/10	13/35	2/20
Carex spp.	tr/10	tr/10	1/15
Elymus spp.	-	14/50	-
Poa spp.	7/75	1/15	8/90
Total Grasses & Grass-like	26/100	37/100	23/100
FORBS			
Achillea millifolium	3/50	6/80	5/85
Antennaria spp.	3/30	-	2/20
Aster spp.	-	3/25	1/20
Balsamorhiza sagittata	2/15	-	-
COMPOSITAE	1/30	1/5	tr/15
CRUCIFERAE	-	tr/5	tr/5
Fragaria virginiana	4/35	10/75	8/60
Galium boreale	-	4/40	1/10
Geranium viscosissimum	2/15	7/50	2/20
Linum perenne	-	1/20	tr/5
Lupinus spp.	10/90	4/40	9/80
Perideridia gairdneri	-	1/30	tr/15
Taraxacum officinale	5/65	4/40	6/70
Unidentified forbs	6/75	2/25	1/20
Total Forbs	41/100	39/100	43/100
SHRUBS			
Artemesia cana	-	2/15	-
Artemesia tridentata	7/30	-	15/35
Berberis repens	1/15	tr/5	3/30
Juniperus communis	3/5	1/5	-
Rosa spp.	2/15	tr/5	tr/5
Unidentified shrubs	2/15	1/10	tr/10
Total Shrubs	13/55	3/30	16/50

TABLE 7. (CONTINUED).

Vegetation type	Sagebrush unsprayed	Sagebrush unsprayed	Sagebrush unsprayed
Taxa	Site 16	Site 17	Site 18
GRASS AND GRASS-LIKE PLANTS			
Agropyron spp.	10/95	8/80	-
Bromus spp.	-	2/25	15/95
Carex spp.	tr/10	1/30	3/15
Festuca idahoensis	-	-	3/30
Koeleria cristata	4/35	-	tr/10
Poa spp.	-	8/70	5/35
Stipa spp.	-	5/35	-
Unidentified grasses	-	-	tr/5
Total Grasses & Grass-like	16/100	29/100	22/100
FORBS			
Achillea millifolium	2/40	5/80	2/40
Allium spp.	1/20	-	-
Antennaria spp.	11/80	3/30	1/15
Aster spp.	-	1/10	-
Cerastium arvense	-	3/35	tr/5
Chrysothamnus spp.	1/5	1/5	-
Collomia linearis	-	-	11/100
Comandra umbellata	1/10	tr/15	-
COMPOSITAE	5/80	4/30	1/50
Fragaria virginiana	-	2/15	-
Galium boreale	-	4/40	7/65
Geranium viscosissimum	-	2/15	6/55
Lithospermum ruderale	-	3/10	2/5
Lupinus spp.	9/80	4/70	1/30
Perederidia gairdneri	-	-	2/45
Potentilla fruticosa	-	1/15	tr/5
Taraxacum officinale	1/20	7/40	-
Viola spp.	tr/5	-	-
Unidentified forbs	-	3/10	5/50
Total Forbs	16/100	47/100	35/100
SHRUBS			
Artemesia tridentata	20/75	8/45	3/15
Berberis repens	-	6/65	-
Rosa spp.	-	3/5	-
Unidentified shrubs	1/5	4/30	tr/5
Total Shrubs	22/80	16/60	3/15

TABLE 7. (CONTINUED).

Vegetation type	Aspen	Forest
Taxa	Site 19	Site 20
GRASS AND GRASS-LIKE PLANTS		
Calamagrostis spp.	9/65	6/60
Festuca idahoensis	18/100	16/100
Poa spp.	3/30	3/30
Unidentified grasses	12/70	9/55
Total Grasses & Grass-like	42/100	32/100
FORBS		
Achillea millifolium	1/25	1/40
Antennaria spp.	-	1/25
Arnica cordifolia	-	6/20
Collomia linearis	tr/5	1/10
CRUCIFERAE	tr/5	-
COMPOSITAE	-	tr/10
Fragaria virginiana	-	8/70
Galium boreale	-	1/35
Geranium viscossissimum	3/20	3/45
LEGUMINOSAE	-	4/40
Lupinus spp.	-	5/50
Myosotis spp.	3/20	-
Taraxacum officinale	12/75	1/40
Thalictrum venulosum	-	2/45
Trifolium longpipes	-	1/25
Urtica dioica	7/45	-
Viola spp.	tr/5	1/20
Unidentified forbs	12/35	1/5
Total Forbs	45/95	40/100
SHRUBS		
Artemesia cana	2/5	-
Berberis repens	-	1/10
Total Shrubs	2/5	1/10

[1] Percent canopy coverage/frequency.

[2] tr=trace; a value less than 1.0.

TABLE 8. THE DOMINANCE AND RELATIVE DENSITY VALUES FOR THE DIFFERENT SAGEBRUSH HEIGHT CLASSES AT EACH OF TWELVE CALF SITES.

	Site 1	Site 3	Site 4	Site 5	Site 7	Site 11
Class I (0-6")						
alive	0.0/0.0[1]	0.3/2.2	0.3/1.5	0.3/2.4	0.1/0.8	0.0/0.0
dead	0.0/0.0	0.0/0.0	0.2/1.5	0.0/0.0	0.0/0.0	0.7/1.5
Class II (6"-12")						
alive	0.0/0.0	1.3/4.3	1.5/4.6	1.4/5.6	1.3/6.0	0.5/2.9
dead	0.3/6.3	0.0/0.0	0.3/1.5	1.9/2.4	0.0/0.0	2.7/4.4
Class III (12"-18")						
alive	0.3/3.1	8.0/18.7	3.4/6.9	1.9/5.6	7.5/18.8	3.8/13.2
dead	0.6/6.3	0.1/0.7	3.2/10.8	0.3/0.8	0.7/1.7	0.1/1.5
Class IV (18"-24")						
alive	0.0/0.0	10.4/15.8	3.2/3.8	7.2/15.3	6.0/9.4	3.7/7.4
dead	2.0/12.5	1.0/1.4	6.5/10.0	1.7/2.4	0.0/0.0	0.5/4.4
Class V (24"-30")						
alive	0.0/0.0	9.8/9.3	1.5/2.3	4.8/8.1	4.9/7.7	3.4/4.4
dead	0.7/3.1	0.0/0.0	2.2/3.1	0.3/0.8	0.3/0.8	1.2/2.9
Class VI (30+")						
alive	0.0/0.0	0.0/0.0	1.9/2.3	11.8/8.9	4.6/6.8	6.8/8.8
dead	3.6/18.7	0.0/0.0	2.2/3.1	0.0/0.0	0.0/0.0	1.8/1.5

TABLE 8. (CONTINUED).

	Site 12	Site 13	Site 14	Site 16	Site 17	Site 18
Class I (0-6")						
alive	0.0/0.0	0.0/0.0	0.0/0.0	0.7/3.8	0.0/0.0	0.0/0.0
dead	0.0/0.0	0.0/0.0	0.0/0.0	0.0/0.0	0.0/0.0	0.0/0.0
Class II (6"-12")						
alive	0.0/0.0	0.0/0.0	0.7/4.4	2.6/13.5	0.0/0.0	0.2/1.1
dead	0.0/0.0	0.0/0.0	0.0/0.0	0.0/0.0	0.0/0.0	1.3/4.6
Class III (12"-18")						
alive	1.5/11.9	1.6/27.8	0.7/6.7	11.3/23.1	1.4/5.0	0.0/0.0
dead	0.0/0.0	0.0/0.0	0.0/0.0	0.0/0.0	0.7/5.0	0.7/4.6
Class IV (18"-24")						
alive	4.0/19.0	0.3/5.5	5.0/17.8	2.5/3.8	3.4/11.6	1.5/5.7
dead	1.5/2.4	0.0/0.0	0.5/2.2	0.0/0.0	3.5/10.0	3.9/6.9
Class V (24"-30")						
alive	1.8/7.1	0.7/5.5	5.3/15.5	3.0/2.9	3.9/13.3	0.7/3.4
dead	0.0/0.0	0.0/0.0	0.0/0.0	0.0/0.0	1.7/5.0	1.3/6.9
Class VI (30+")						
alive	3.1/7.1	0.9/5.6	3.5/6.7	2.6/2.9	0.0/0.0	6.5/12.6
dead	0.0/0.0	0.0/0.0	0.0/0.0	0.0/0.0	0.2/1.7	4.2/5.7

[1]Dominance/relative density

$$\text{Dominance} = \frac{\text{total intercept length for a height class}}{\text{total transect length}} \times 100.$$

$$\text{Relative density} = \frac{\text{total individuals of a height class}}{\text{total individuals of all classes}} \times 100.$$

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