Survival and behavior of radio-collared mule deer fawns during summers, 1978-1980, in the Missouri River Breaks, Montana
by Shawn James Riley

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

Abstract:
A study to determine the causes and extent of mortality among mule deer fawns and to evaluate how behavior and habitat use affect early fawn survival was conducted in the Missouri River Breaks, north-central Montana, during the summers of 1978, 1979, and 1980. Forty-nine fawns were equipped with radio transmitters: 15 in 1978, 18 in 1979, and 16 in 1980. One-third of the total summer mortality (1 fawn each summer) was attributed to starvation due to abandonment. Known and/or suspected predation by coyotes resulted in fawn mortality rates of 16.7%, 11.8%, and 13.3% in 1978, 1979, and 1980, respectively. The low mortality occurred despite a stable to slightly increasing coyote population. Dense growth of yellow sweetclover during 1978 and 1979, an abundance of alternative prey for coyotes during all years, and changes in habitat use by fawns in 1980, apparently were important in reducing predation and increasing survival during the study period as compared with 1976 and 1977. Movements of fawns between relocations ranged from 0.00 to 3.85 kilometers, with an overall mean of 0.78 kilometers. Monitored fawns made greater movements in 1978 than in 1979 and 1980. Summer home ranges of fawns varied in size from 23 to 350 hectares and averaged 133 hectares through the study period. The average size decreased significantly from 211 hectares in 1978 to 100 hectares and 105 hectares in 1979 and 1980, respectively. Home ranges frequently overlapped, but complete overlap was observed only in 1980. The extent to which fawns utilized cover types differed significantly between early and late summer and between years. Decreased use of the open types occurred each year as summer progressed. Fawns utilized the Pinus-Juniperus and Psuedotsuga-Juniperus cover types earlier and to a greater extent in 1980 than in 1978 or 1979. Marked fawns selected bedsites that provided an average of 69% concealment cover from 3 sides. The amount of cover surrounding fawn bedsites did not differ significantly between years. Results indicated that predation patterns and rates within and between years were not a function of coyote numbers alone, but reflected complex interaction between coyotes, the availability and abundance of alternative prey, and environmental conditions that determine the vulnerability of fawns.

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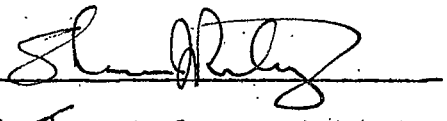
Signature 

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Approved:

Chairperson, Graduate Committee

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ABSTRACT

A study to determine the causes and extent of mortality among mule deer fawns and to evaluate how behavior and habitat use affect early fawn survival was conducted in the Missouri River Breaks, north-central Montana, during the summers of 1978, 1979, and 1980. Forty-nine fawns were equipped with radio transmitters: 15 in 1978, 18 in 1979, and 16 in 1980. One-third of the total summer mortality (1 fawn each summer) was attributed to starvation due to abandonment. Known and/or suspected predation by coyotes resulted in fawn mortality rates of 16.7%, 11.8%, and 13.3% in 1978, 1979, and 1980, respectively. The low mortality occurred despite a stable to slightly increasing coyote population. Dense growth of yellow sweetclover during 1978 and 1979, an abundance of alternative prey for coyotes during all years, and changes in habitat use by fawns in 1980, apparently were important in reducing predation and increasing survival during the study period as compared with 1976 and 1977. Movements of fawns between relocations ranged from 0.00 to 3.85 kilometers, with an overall mean of 0.78 kilometers. Monitored fawns made greater movements in 1978 than in 1979 and 1980. Summer home ranges of fawns varied in size from 23 to 350 hectares and averaged 133 hectares through the study period. The average size decreased significantly from 211 hectares in 1978 to 100 hectares and 105 hectares in 1979 and 1980, respectively. Home ranges frequently overlapped, but complete overlap was observed only in 1980. The extent to which fawns utilized cover types differed significantly between early and late summer and between years. Decreased use of the open types occurred each year as summer progressed. Fawns utilized the *Pinus-Juniperus* and *Psuedotsuga-Juniperus* cover types earlier and to a greater extent in 1980 than in 1978 or 1979. Marked fawns selected bedsites that provided an average of 69% concealment cover from 3 sides. The amount of cover surrounding fawn bedsites did not differ significantly between years. Results indicated that predation patterns and rates within and between years were not a function of coyote numbers alone, but reflected complex interaction between coyotes, the availability and abundance of alternative prey, and environmental conditions that determine the vulnerability of fawns.

INTRODUCTION

The mule deer (*Odocoileus hemionus hemionus* Rafinesque) population in the Missouri River Breaks of Montana declined sharply during 1971-1973, apparently as a result of extensive overwinter mortality in 1971-1972 and low fawn production or survival (Mackie 1976). The population remained low through 1977 as a result of low fawn production/survival that persisted despite average to above normal spring-summer precipitation and mild, open winters (Hamlin 1978). A similar sharp decline in mule deer numbers occurred in the Breaks during 1964-1965, but was followed by a population recovery within 1-2 years (Mackie 1976, Hamlin 1978).

Although predation by coyotes (*Canis latrans latrans* Say) was suspected as a possible cause of low fawn:doe ratios observed during early fall and winter population surveys in the area (Knowles 1976, Hamlin 1977), quantitative data were lacking. Thus, in 1976, an intensive study was initiated to determine the extent and causes of summer mortality as a factor in low fawn recruitment. Results of the first 2 years of the investigation were reported by Dood (1978). I continued the studies during the summers of 1978, 1979, and 1980 to further evaluate the extent and causes of summer mortality of fawns as environmental conditions changed and the mule deer population increased and, determine how behavior and habitat use affect early fawn survival.

STUDY AREA

The 30,000 hectare (ha) study area, previously described by Mackie (1970) and Dood (1978), was located approximately 40 kilometers (km) northeast of Roy, in Fergus County, Montana (Fig. 1). Boundaries were the Missouri River on the north, the Musselshell Trail on the south, the Skyline Trail on the east, and U.S. Highway 191 on the west.

The area was a 6-to-11 km wide, dissected plateau along the Missouri River, described locally as "breaks" (Fig. 2). The Breaks consist largely of steep, easily erodable, shale ridges separated by deep, saline coulee bottoms. The coulees blended gradually into rolling prairie along the south edge of the study area. Elevations ranged from 685 meters (m) along the Missouri River to 915 m on the south boundary.

Gieseker (1938) and Gieseker et al. (1953) described the soils in the breaks as primarily Lismas and Pierre clay loams derived from the underlying Bearpaw formation and associated shales of the Cretaceous age. These soils, commonly called "gumbo", are relatively impermeable to water. Runoff is high and flash-flooding is common during heavy rainstorms.

The climate is semi-arid with wide year-to-year fluctuations in both temperature and precipitation. Climatological data were obtained from a United States Department of Commerce weather station (Roy 8NE), located approximately 20 km southwest of the study area. Average

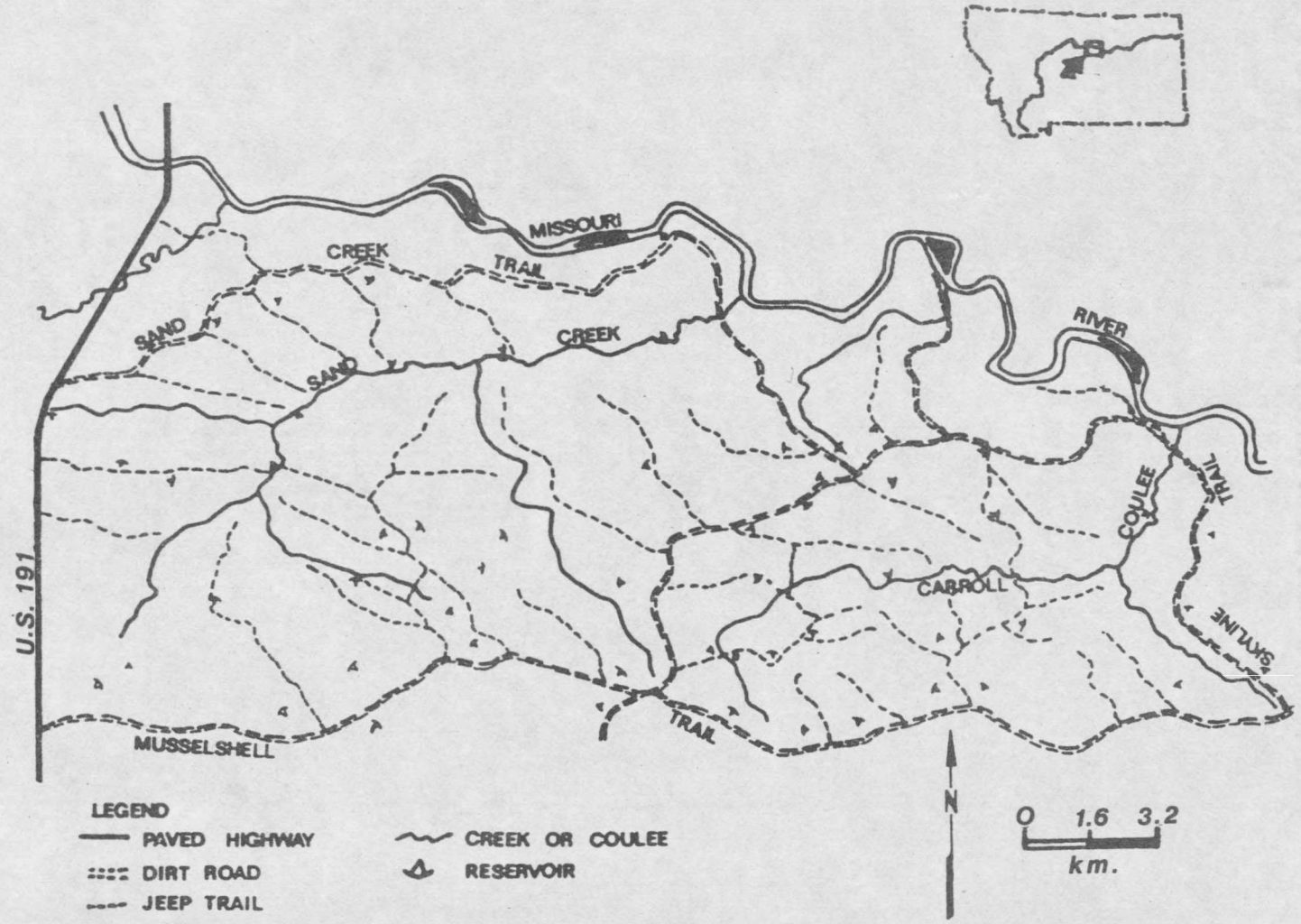

Figure 1. Map of the Missouri River Breaks Study Area.

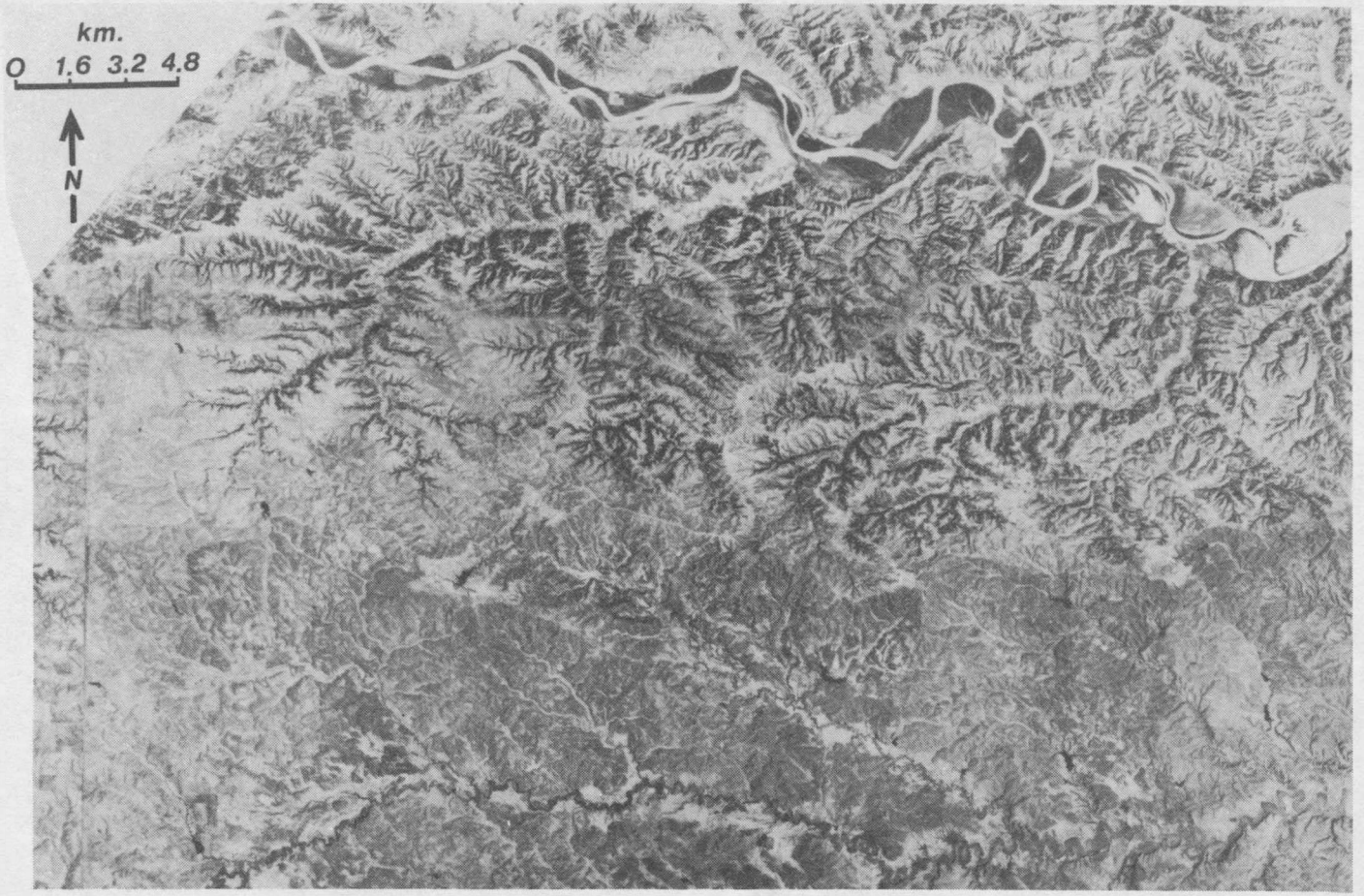

Figure 2. Aerial Mosaic of the Missouri Breaks Study Area.

monthly temperature and precipitation for the study period are compared with the 20-year (1960-1980) monthly means in Table 1.

Domestic livestock grazing was the principal commercial land use. Frequent droughts and heavy clay soils have greatly restricted successful agricultural cropping operations. Most previously cultivated tracts have reverted to grasslands. Nearly 45% of the study area was in the C. M. Russell Wildlife Refuge, while another 23% of the land was administered by other federal, state, and county agencies (Mackie 1970). Recreational uses of these lands included hunting, fishing, and camping.

In addition to mule deer, other wild ungulates on the study area included white-tailed deer (*Odocoileus virgininanus dacotensis* Goldman and Kellogg), elk (*Cervus elaphus nelsoni* Bailey), and pronghorn antelope (*Antilocapra americana americana* Ord). Possible predators of big game on the study area were coyotes, bobcats (*Lynx rufus floridanus* Rafinesque), and golden eagles (*Aquila chrysaetos canadensis* L.), but only coyotes existed in large numbers.

Vegetation cover types were varied and highly interspersed on the study area. Mackie (1970) provided a detailed description of the upland vegetation, while Allen (1968) described vegetation on the adjacent Missouri River bottom. Six general types were recognized as being important to mule deer fawns during this study.

Table 1. Monthly average temperature (°C) and monthly total precipitation (millimeters) during the study period compared to 20-year means for the Roy 8NE, Montana weather station (Climatological Data, 1977-1980).

Month	Monthly average temp.	Deviation from the mean	Monthly total precipitation	Deviation from the mean
8/77	16.7	-3.2	61	28
9/77	13.3	-0.5	54	25
10/77	8.8	0.4	16	- 3
11/77	- 1.9	-2.1	18	5
12/77	- 8.7	-3.7	49	39
1/78	-14.6	-6.3	33	21
2/78	-10.5	-6.1	23	13
3/78	- 0.6	0.8	13	1
4/78	6.7	0.4	35	8
5/78	11.6	-0.2	124	60
6/78	16.9	0.9	101	17
7/78	18.8	-2.1	97	58
8/78	18.4	-1.5	23	-10
9/78	14.6	0.8	132	103
10/78	8.5	0.1	8	11
11/78	- 4.9	-4.9	26	13
12/78	- 9.7	-4.7	24	15
1/79	-16.3	-8.0	19	7
2/79	-11.3	-6.6	20	10
3/79	0.1	1.5	16	2
4/79	3.8	-2.4	44	17
5/79	10.3	-1.6	38	-26
6/79	17.1	1.1	11	-74
7/79	20.9	0.1	22	-17
8/79	20.2	0.3	16	-17
9/79	16.9	3.2	4	-26
10/79	10.2	1.7	5	-14
11/79	- 0.3	-0.5	2	-10
12/79	- 0.4	4.5	2	- 7
1/80	- 9.3	-2.1	5	- 6
2/80	- 3.6	1.2	5	- 5
3/80	- 0.8	0.6	31	18
4/80	10.1	3.8	18	- 9

Table 1. Continued.

Month	Monthly average temp.	Deviation from the mean	Monthly total precipitation	Deviation from the mean
5/80	14.1	2.3	53	-11
6/80	17.7	1.8	39	-45
7/80	21.7	0.9	6	-33
8/80	17.4	-2.4	55	23
9/80	14.8	1.0	13	17

Artemisia-Agropyron cover type

This cover type occurred extensively along ridge tops and moderately sloped side ridges. It also occurred on steeper slopes with southerly exposure, and occupied nearly 31% of the study area. Big sagebrush (*Artemisia tridentata* Nutt.) was the dominant shrub species in this cover type. It was found in association with bluebunch wheatgrass (*Agropyron spicatum* (Pursh) Scribn. and Smith) where soils were well developed and runoff was low (Fig. 3); these areas generally had northerly or easterly exposures. Big sagebrush was also found in association with western wheatgrass (*Agropyron smithii* Rydb.) on major ridge tops or similar dry, level sites (Fig. 4). Depending on local topoedaphic conditions, other prominent shrubs commonly found in this cover type were greasewood (*Sarcobatus vermiculatus* Hook.) and Rocky Mountain juniper (*Juniperus scopulorum* Sarg.).

Figure 3. *Artemisia tridentata-Agropyron spicatum* cover type.

Figure 4. *Artemisia tridentata-Agropyron smithii* cover type.

Artemisia longifolia cover type

This cover type occurred on loose shale slopes with southerly or westerly exposures (Fig. 5). Longleaf sage (*Artemisia longifolia* Nutt.) was the dominant plant. Grasses and forbs were generally sparse, however, yellow sweetclover (*Melilotus officinalis* (L.) Lam.) formed dense stands during some years.

Pinus-Juniperus cover type

A *Pinus-Juniperus* complex occurred on slopes and coulee heads, covering nearly 45% of the study area. It was most often found on steep south- and west-facing slopes, but also occurred to some degree on more gentle north- and east-facing aspects. Ponderosa pine (*Pinus ponderosa* Dougl.) was the dominant tree on all sites. The understory present depended largely on the degree and aspect of slope.

Dense stands of Rocky Mountain juniper grew on mesic sites (Fig. 6). These stands graded to more scattered pine and fewer juniper as the aspect became southerly or as the degree of slope decreased. A savannah, formed from an interspersion of ponderosa pine and big sagebrush-wheatgrass types occurred on slight southerly or westerly slopes, or as an ecotone between dense stands of *Pinus Juniperus* or *Psuedotsuga-Juniperus* and the *Artemesia-Agropyron* types (Fig. 7). On some steep shale slopes, ponderosa pine stands had little or no vegetative understory, and were denoted as a pine-shale type. Other shrubs found in association with the *Pinus-Juniperus* type

Figure 5. *Artemisia longifolia* cover type.

depending on local site conditions, included big sagebrush, skunkbrush sumac (*Rhus trilobata* Nutt.), western snowberry (*Symphoricarpos occidentalis* Hook.), rose (*Rosa* spp.), green rabbitbrush (*Chrysothamnus viscidiflorus* (Hook.) Nutt.) and rubber rabbitbrush (*Chrysothamnus nauseosus* (Pall.) Britt.).

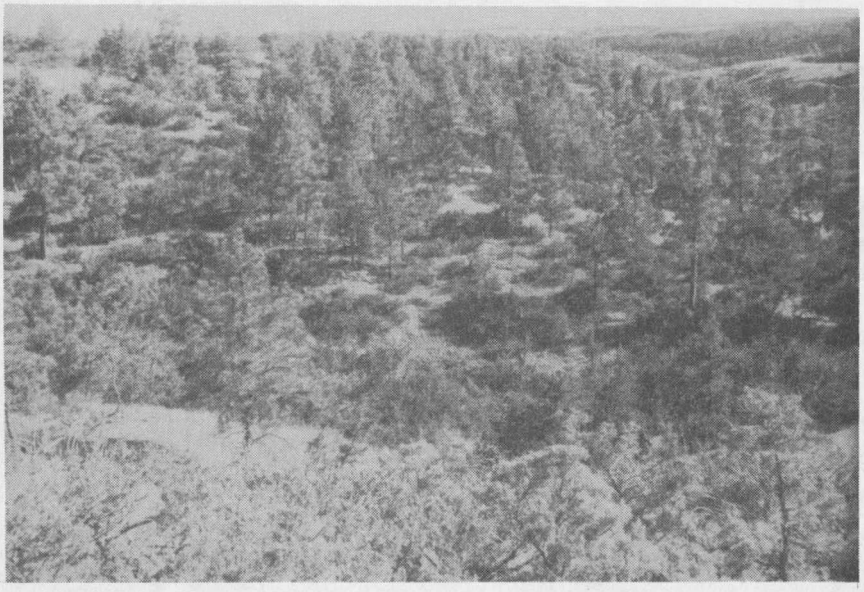

Figure 6. *Pinus-Juniperus* cover type with a dense understory of Rocky Mountain juniper.

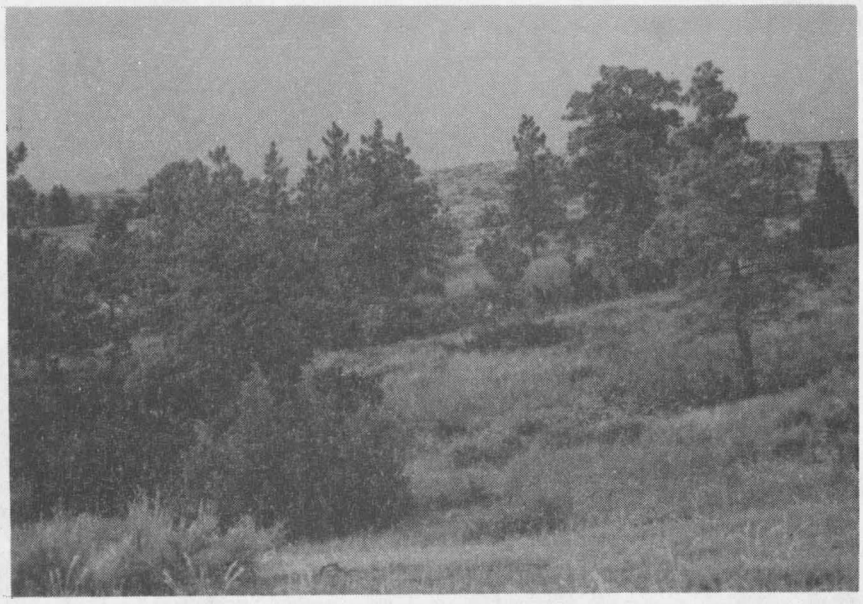

Figure 7. *Pinus-Juniperus* cover type, a pine savannah.

Psuedotsuga-Juniperus cover type

This cover type occurred almost exclusively on mesic, steep, north- and east-facing slopes or benches (Fig. 8). The dominant tree species was Douglas fir (*Psuedotsuga menziesii* (Mirbel) Franco), but ponderosa pine frequently occurred as a seral species. Shrubs commonly found included Rocky Mountain juniper, chokecherry (*Prunus virginiana* L.), skunkbrush sumac, western snowberry, rose, big sagebrush, and rabbitbrush. Deadfall from trees and shrubs was also densely concentrated at some sites. The *Psuedotsuga-Juniperus* type covered approximately 13% of the study area.

Sarcobatus-Agropyron cover type

This cover type was found primarily on saline slopes, benches, and bottoms along the Missouri River and major coulees (Fig. 9). Greasewood was the dominant shrub, but big sagebrush often shared dominance where soils were better developed and had a lower salt content. Western wheatgrass was the most common species in the typically sparse herbaceous layer.

Symphoricarpos-Agropyron cover type

This cover type (Fig. 10) was of limited occurrence, occupying sites along water courses where silty soils existed. Western snowberry was the dominant shrub and often formed dense patches. Western wheatgrass was the most abundant grass species, but also occurred with

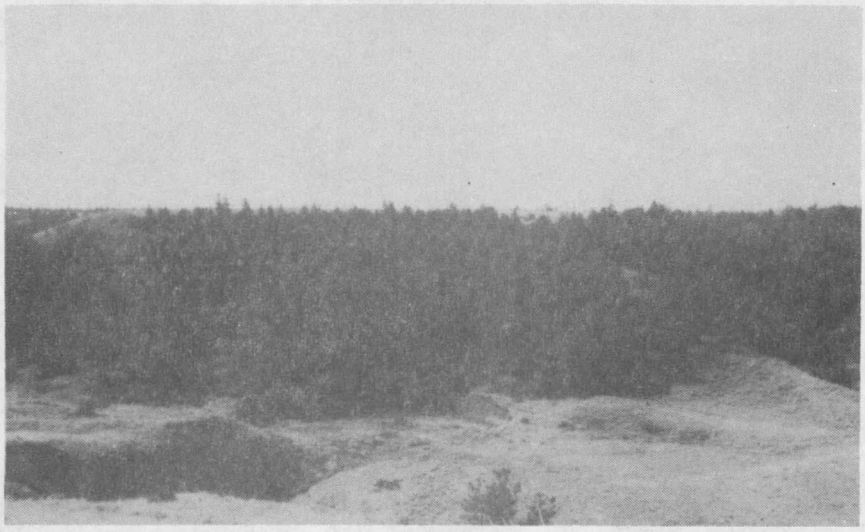

Figure 8. *Psuedotsuga-Juniperus* cover type.

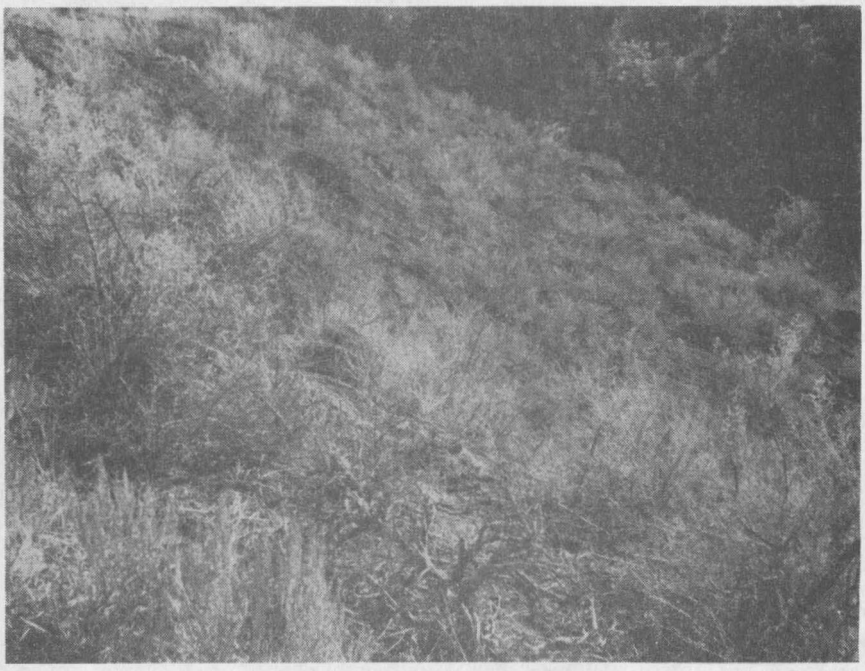

Figure 9. *Sarcobatus-Agropyron* cover type.

Figure 10. *Symphoricarpus-Agropyron* cover type.

bluegrasses (*Poa* spp.) or desert saltgrass (*Distichlis stricta* (Torr.) Rydb.) at some sites.

METHODS

Field studies were conducted from mid-June to mid-September in 1978, 1979, and 1980. Mule deer fawns, 1 day to 3-weeks of age, were captured during mid-June. Capture was effected by ground crews using long handled hoop nets. An observer, flying in a Piper Super Cub aircraft, located fawns and coordinated the capture operation with ground crews using 2-way transceivers.

Captured fawns were processed quickly and carefully to avoid the possible negative effects of handling (White et al. 1972). Each was sexed, weighed, examined for wounds or other irregularities, and the overall condition of the animal was noted. They were then fitted with a radio-transmitter collar and numbered metal ear-tags. The approximate age and birth date of each fawn was calculated later following Robinette and Jensen (1950).

Transmitters (Wildlife Materials Inc.) were in the 150-152 Megahertz range, and powered two 1,200-milliamp lithium batteries. Each had a decimeter (dm) external whip antenna and a motion sensitive switch. Transmitter and batteries were sealed in dental acrylic and attached to an expandable, elastic neckband. All neckbands had 5-6, 8 centimeter (cm) break-away flaps sewed with cotton thread. When the thread rotted or was stressed, the flaps broke open allowing expansion with growth of the fawn. The entire radio package weighed 80 grams.

Fawns were relocated from the ground using an LA12 portable receiver (AVM Instrument Co.) and a hand held Yagi antenna. Ground

observations were supplemented with aerial observations during periods when roads were impassable. An attempt was made to visually locate each fawn at regular 2-3 day intervals from the time of capture until death or 15 September. Data recorded for each relocation included activity, cover type, aspect, degree of slope, and position on slope. The distance from the doe and the general overall condition of the fawn was also recorded. All relocations were plotted on an airphoto grid of the study area. Home ranges were determined using the modified minimum area method (Harvey and Barbour 1965). During this study, classification of vegetation cover types followed Mackie (1970).

Concealment cover surrounding fawn bedsites was measured using a 3 X 6 dm cover profile board (Nudds 1977). The board was divided from top to bottom into 1 dm bands of alternating red and yellow colors. Measurements were taken from a distance of 6 m, and from 3 directions at 120° intervals. The apex of a triangle formed from the 3 directions was always pointed to the north. Because the visual environment of a coyote is different from that of a human, readings were taken from a kneeling position (50 cm). The amount of cover was estimated to the nearest 5%.

When remains of a dead fawn were located, the surrounding area was extensively searched for evidence of the cause of death. Criteria used for determining the cause of death followed those described by White (1973), Dood (1978), and O'Gara (1978).

RESULTS

Forty-nine fawns were equipped with radio transmitters: 15 in 1978, 18 in 1979, and 16 in 1980 (Table 2). Two in the 1978 sample were not monitored due to transmitter failure. Two additional fawns were captured and marked only with ear streamers in 1980, but neither was subsequently reobserved. One fawn handled in 1978 and another caught in 1980 had been severely wounded by predators prior to capture. None of these were included in samples used to calculate mortality patterns and rates (Table 3).

Mortality

Total mortality rates were similar (X^2, $P>.05$) for the 3 summers (Table 3). The causes of death also were the same each year (Table 4). All mortality was attributed to either starvation following abandonment or predation. A complete description of each case of fawn mortality observed during the study is presented in Appendix Table 13.

One-third of the total mortality (1 fawn each summer) could be attributed to abandonment, though the proximal cause of death in each case was starvation. The rumens of 2 of those fawns (#12 and #23, Table 2) were empty. The rumen of the other (#41) was completely full of vegetation (primarily browse, Fig. 11) that retained a herbal fragrance indicating that digestion probably was not occurring. The bodies of all were emaciated, and none had been scavenged. Fawns 23 and 41 were offspring of the same marked doe, and each was a member