Browse condition and trend on Montana ungulate ranges
by Scott Karl Thompson

A thesis submitted in partial fulfillment of the requirements for the degree of Master of Science in Animal and Range Sciences
Montana State University

Abstract:
Ungulate impacts on woody vegetation have been a concern in Montana for a half-century. Exclosures were built on many areas of concern to determine if ungulates were affecting browse species. Most exclosures were built many decades ago, thus allowing impacts of long-term browsing to be realized. My objective was to determine the condition and trend of a variety of browse species. This was achieved by comparing browse species growing inside exclosures to browse species on environmentally similar areas outside. Thirty-two exclosures restricting the access of all ungulates were evaluated across many different environmental types. Methods that evaluated short shrub species (< 2 m), tall shrub species (> 2 m) and trees, primarily aspen (Populus tremuloides Michx.), were used. Dominant browse species impacted included bearberry (Arctostaphylos uva-ursi [L] Spreng.), big sagebrush (Artemisia tridentata Nutt.), bitterbrush (Purshia tridentata (Pursh) DC.), curlleaf mountain mahogany (Cercocarpus ledifolius Nutt, ex Torr. & Gray), horizontal juniper (Juniperus horizontalis Moench), chokecherry (Prunus virginiana L.), serviceberry (Amelanchier alnifolia (Nutt.) Nutt.), willow (Salix L.), and aspen. Browsing was found to have had an impact on browse species at 22 sites. In addition, 5 sites were considered areas of caution because not all methods of evaluating browsing impacts agreed. These sites were likely coming out of a period of intense browsing or entering a period of intense browsing. No browsing impacts were found at 2 sites. At the remaining 3 sites, differences in browse species inside and outside exclosures were attributed to factors other than browsing such as natural successional changes. Sites with no browsing effects were not related geographically within Montana. Impacts were found at both the oldest exclosure (57 yrs) and most recent exclosure (10 yrs). My findings imply browsing levels have been and remain a deterrent to development of shrub and aspen communities throughout Montana.

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Scott Karl Thompson

This thesis has been read by each member of the thesis committee and has been found to be satisfactory regarding content, English usage, format, citations, bibliographic style, and consistency, and is ready for submission to the College of Graduate Studies.

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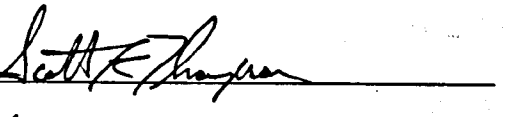
Signature 

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ABSTRACT

Ungulate impacts on woody vegetation have been a concern in Montana for a half-century. Exclosures were built on many areas of concern to determine if ungulates were affecting browse species. Most exclosures were built many decades ago, thus allowing impacts of long-term browsing to be realized. My objective was to determine the condition and trend of a variety of browse species. This was achieved by comparing browse species growing inside exclosures to browse species on environmentally similar areas outside. Thirty-two exclosures restricting the access of all ungulates were evaluated across many different environmental types. Methods that evaluated short shrub species (< 2 m), tall shrub species (> 2 m) and trees, primarily aspen (*Populus tremuloides* Michx.), were used. Dominant browse species impacted included bearberry (*Arctostaphylos uva-ursi* [L.] Spreng.), big sagebrush (*Artemisia tridentata* Nutt.), bitterbrush (*Purshia tridentata* (Pursh) DC.), curlleaf mountain mahogany (*Cercocarpus ledifolius* Nutt. ex Torr. & Gray), horizontal juniper (*Juniperus horizontalis* Moench), chokecherry (*Prunus virginiana* L.), serviceberry (*Amelanchier alnifolia* (Nutt.) Nutt.), willow (*Salix* L.), and aspen. Browsing was found to have had an impact on browse species at 22 sites. In addition, 5 sites were considered areas of caution because not all methods of evaluating browsing impacts agreed. These sites were likely coming out of a period of intense browsing or entering a period of intense browsing. No browsing impacts were found at 2 sites. At the remaining 3 sites, differences in browse species inside and outside exclosures were attributed to factors other than browsing such as natural successional changes. Sites with no browsing effects were not related geographically within Montana. Impacts were found at both the oldest exclosure (57 yrs) and most recent exclosure (10 yrs). My findings imply browsing levels have been and remain a deterrent to development of shrub and aspen communities throughout Montana.

CHAPTER 1

INTRODUCTION

Consideration of browse species is an integral part of natural resource management. Tree and shrub species providing forage from leaves, twigs, and young shoots are considered browse species (Webster 1996). Plant communities often include a number of browse species and their ecological processes may depend on browse species. Specifically, shrubs and trees are vital components of wildlife habitats by providing animals with necessary forage and cover (Urness 1989, Welch 1989). The sustainability of many wildlife species is dependent on the browse in their habitat.

During the twentieth century, primarily the mid decades, resource managers determined the need to study the impacts and extent of ungulate use of plant communities. Browse use was, and still is, of great concern on winter ranges where wild ungulates congregate. To evaluate the influence of ungulates on browse and other plants, ungulate proof exclosures were constructed on many winter ranges and other areas of concern across Montana. In some cases, 2 exclosure designs were built in the same area to distinguish the impact of wild ungulates versus domestic ungulates on plant communities. These exclosures offer insight to changes and differences in plant communities in the absence or presence of all ungulates or the presence of only wild ungulates.

Many of these exclosures remain functional, but are deteriorating and nearing the end of their useful life. Many have not been rigorously measured in 20 years or more and

maintenance of fences is lacking (Moynahan et al. 1999). The remaining functioning exclosures provided a unique opportunity to evaluate the long-term effect of ungulate use on browse species. Comparisons were possible across a variety of environmental types and management practices throughout Montana.

My objective was to determine the impact of long-term browsing by wild and domestic ungulates on tree and shrub species growing under a variety of environmental conditions and management scenarios. This objective was achieved by quantitatively and qualitatively comparing browse species inside exclosures to the same species outside exclosures. The goal of this research was to provide information to resource managers about the long-term impact and level of ungulate use on a variety of browse species throughout Montana. The data collected provide continuation of long-term studies started by construction of these exclosures.

CHAPTER 2

LITERATURE REVIEW

Browse Species on the Landscape

Ecosystem Function. Browse species play an integral role in ecosystem function. Shrubs cycle nutrients and provide protected and fertile sites for other plant species (Garcia-Moya and McKell 1970, West 1989). Riparian function is dependent on willows (*Salix* L.) to trap sediments and stabilize streambanks (Clary 1999, Shields et al. 1995). Upland shrubs reduce overland water flow and reduce soil erosion (West 1989). Infiltration and storage of soil moisture has been shown to be greater on shrub-dominated ranges (West 1989). Browse species increase plant diversity of communities that in turn increased community stability (McKell 1989).

Historical Management. Individual or agency objectives of an area dictate management of browse species. Herbivory, fire, herbicides and use of machinery are tools by which managers manipulate rangelands (Vallentine 1989). Fire is the most commonly used tool and has been extensively used in sagebrush (*Artemisia* L.) dominated ranges to improve livestock forage (McKell 1989, Vallentine 1989). Following a burn, livestock forages are not always improved and wildlife habitat can be destroyed (Fraas et al. 1992, Wambolt et al. 2001). Herbicide application and use of machinery are more intensive management practices used on smaller acreages and can be used to control unwanted shrubs (McKell 1989, Vallentine 1989).

Value of Browse to Wild Ungulates

Forage. Shrubs and trees, due to their growth habits and nutritive properties, provide valuable forage to wildlife. Browse is especially important to wild ungulates in the non-growing season (typically winter). Nutrient needs of wild ungulates drop to maintenance or gestation levels during winter (Welch 1989). Most range plants do not meet nutrient requirements at that time with the exception of browse species (Cook 1972). Shrubs, as a vegetative class, have higher values for crude protein, phosphorus, and carotene than most grasses or forbs during fall and winter and typically remain more digestible (Cook 1972). Browse species also typically grow taller and remain above or closer to the surface of the snow.

Kufeld et al. (1973) reported browse species averaged 74% of mule deer (*Odocoileus hemionus*) diets in winter. Fecal analyses show that mule deer consume the greatest quantities of browse during winter months (Kasworm et al. 1984), but also rely on browse during summer months (Hansen and Clark 1977, Ngugi et al. 1992). Mule deer and whitetailed deer (*Odocoileus virginianus*) rumen analyses have also shown dominant use of browse in winter (Lovass 1958, Martinka 1968, Wilkins, 1957). Pac et al. (1991) reported green herbaceous vegetation dominated mule deer diets during spring, summer and fall, but browse was dominant in winter.

Kufeld (1973) summarized elk (*Cervus elaphus* nelsoni) food habit studies and reported varying results relative to the forage value of plants in an area. Browse dominated elk diets during winter in Montana, northern Idaho, northeastern Washington, New Mexico, Manitoba and Colorado (Blood 1966, Boyd 1970, DeNio 1938, Lang

1958, Trout and Leege 1971). Young and Robinette (1939) in Idaho and Blood (1966) in Manitoba found browse dominated elk diets in summer and fall. Other studies included in Kufeld (1973) found shrubs and trees in elk diets at lesser amounts, but browse still made up significant proportions of elk diets.

Antelope (*Antilocapra americana*) rely on browse species as a year round food source (Bayless 1969, Cole and Wilkins 1958). In Montana, browse made up 34% of rumen samples collected in summer, 80% in fall, and 70% in winter (Cole and Wilkins 1958). They reported silver sagebrush (*Artemisia cana* Pursh) and big sagebrush (*Artemisia tridentata* Nutt.) as the most important species. Mountain big sagebrush (*A. t.* ssp. *vaseyana* [Rydb.] Beetle) made up 76% of spring antelope diets and Wyoming big sagebrush (*A.t.* Nutt. ssp. *wyomingensis* Beetle & Young) made up 91% of spring antelope diets in south-central Wyoming (Ngugi et al. 1992). Ngugi et al. (1992) reported antelope bitterbrush (*Purshia tridentata* (Pursh) DC.) made up 90% of antelope diets in fall. Antelope in northeastern Montana heavily rely on big sagebrush communities in winter (Martinka 1967).

Bighorn sheep have been reported to use browse species for 25% of their summer diet and up to 43% of their winter diet (Erickson 1972, Schallenberger 1966). Kasworm et al. (1984) in northcentral Montana reported grasses were the most important part of sheep diets throughout the winter, but use of browse was 23% in early winter and 42% in late winter. Horizontal juniper (*Juniperus horizontalis* Moench), Douglas fir, big sagebrush and fringed sagewort were the browse species of greatest use.

Browse was reported as the most important forage class for moose (*Alces alces*) in Montana during all seasons (Schladweiler 1974). In southwest Montana, Dorn (1970) reported browse accounted for 98.3% and 99.8% of all forage used by moose in summer and winter, respectively. Moose were observed using willow dominated areas 84% of the time in summer and 93% of the time in winter (Dorn 1970). Rumen samples of moose in the Gallatin Mountains of Montana consisted of 88% browse in the fall, 99% in the winter, and 94% in the spring (Stevens 1970). Various shrubs were found in moose diets, but Douglas fir and aspen (*Populus tremuloides* Michx.) communities were considered key winter ranges. Reviews of several moose studies reported moose primarily rely on browse as forage year long and especially noted the importance of willow species (Hosley 1949, Peek 1974).

Cover. Browse species provide necessary thermal and security cover for wildlife according to growth habit and height of the tree or shrub (Urness 1989). Security (hiding) cover was defined as "vegetation capable of hiding 90% of a standing adult deer or elk from the view of a human at a distance equal to or less than 61 m (200 feet)" (Thomas et al. 1979). Topography may add to security cover when the angle of observation is elevated, but has not been demonstrated as an adequate substitute for vegetation (Thomas et al. 1979). Mule deer rely on big sagebrush communities for security cover year round (Carson and Peek 1987, Main and Coblentz 1996). Conversely, Van Dyke et al. (1983) found bighorn sheep (*Ovis canadensis*) avoided habitats with dense vegetation on gentle slopes. Bighorn sheep prefer habitats with greater sight distances.

Wild ungulates select certain topographic features and vegetation (thermal cover) that assist in maintaining a consistent body temperature. Deer and elk in the Blue Mountains of Oregon during winter benefit most from multistoried conifer stands with shrub understory for thermal cover (Thomas et al. 1979). Optimum thermal cover for mule deer in southeastern Oregon consists of evergreen or deciduous trees or shrubs at least 1.5 m tall and 75% crown closure (Leckenby et al. 1982).

Reproductive Success. The reproductive success of many wildlife species is dependent on the browse in their habitat (Urness 1989). Optimum mule deer and elk birthing habitat in the Blue Mountains of Oregon includes shrubs and trees 0.6 to 1.8 m tall and a tree overstory of 50% crown closure (Thomas et al. 1979). Elk prefer calving sites in open sagebrush or other shrub lands over adjacent conifer stands (Altman 1952, Johnson 1951, Thomas et al. 1979) and deer prefer even denser shrub cover for fawning (Fielder and McKay 1984).

Exclosures

Exclosures have been widely used in range and big game management to evaluate the impact of wild and domestic animals on vegetation and soils (Anderson and Holte 1981, Brand and Goetz 1986, Green and Kauffman 1995, Jones 1965, Kay and Bartos 2000, McArthur et al. 1988, Rice and Westoby 1978, Schultz and Leininger 1990, Wambolt and Sherwood 1999, Young 1958). Daubenmire (1940) defines an exclosure as, "any experimental area, which is protected from the activities of a particular class of animal by a barrier such as a fence or screen." A 3-phase exclosure system was designed

to differentiate impacts of wild ungulates and domestic ungulates (Austin and Urness 1986, Young 1958). The 3-phase system includes an area enclosed by a 1.8 to 3 m tall fence that prevents access of wild and domestic ungulates (big game exclosure). An area enclosed by a 4-strand barbed wire fence, 1 m tall, restricts the access of domestic ungulates, but allows wild ungulates to enter the area (livestock exclosure). The area outside both of these exclosures receives use by both wild and domestic ungulates. Gross and Knight (2000) caution results from livestock exclosures smaller than 4 ha that are intended to allow access of elk.

Microclimate in Exclosures. Exclosures can produce different microclimates due to factors such as increased shading and litter accumulation (McInnes et al. 1992). Soil moisture can be higher inside exclosures (Lodge 1954, Smoliak et al. 1972). Lower soil temperatures, less wind movement, and less evaporation may occur inside exclosures (Whitman 1974). Differing microclimate and lack of some predators can favor higher rodent populations inside exclosures (personal observation).

Succession in Exclosures. Exclosures attempt to control ungulate herbivory while maintaining other disturbances constant. Exclosures are said to recreate climatic climax communities (Beetle 1974). Under traditional range ecology, excluding browsers enables secondary succession to occur and vegetation inside the exclosure should represent the climax state of the plant community (Clements 1916). Clementsian (1916) succession is the invasion by different plant communities until a climax community is established.

Brand and Goetz (1986) compared dominant growth forms inside exclosures to vegetation outside exclosures to identify secondary succession.

Classical theories of range succession were not useful in explaining vegetation in exclosures in semiarid shrublands of northern Utah due to inconsistencies in the observed plant community and the expected climax community (Rice and Westoby 1978). Smeins et al. (1976) also noted that exclosures may not lead to climax conditions and concluded that vegetation changes inside were adjustments in species dominance rather than species replacement. Woody species established following a disturbance (herbivory) tended to increase to a point of stabilization inside exclosures. These studies suggest that previous disturbance and vegetation established immediately after disturbance may determine community composition.

Anderson and Holte (1981) concluded that vegetation development without grazing on sagebrush rangelands fit Egler's (1977) stability/initial floristic model. The stability/initial floristic model states that the relative abundance of a species largely depends on the disturbance history and the vegetation composition at the time of disturbance (Egler 1977). Under this theory, any stable community might be considered climax.

Species richness and species diversity were reduced due to declines in disturbance (ungulate herbivory) inside exclosures on a riparian community (Green and Kauffman 1995). This would agree with Grime (1979) who presented competition models implying that species that adapted to habitats with moderate disturbance (herbivory) are displaced

by competitive species when disturbance decreases. Erecting an exclosure provides the decrease of disturbance.

Ungulate Impacts on Browse Species

Browsing and trampling can alter vegetation and have long-term effects on plant communities (Naiman 1988). Wild ungulate impacts on browse species as shown by exclosures have been documented on the Northern Yellowstone Winter Range (NYWR). Big sagebrush canopy cover on browsed and protected (unbrowsed) areas averaged 6.5% and 19.7%, respectively (Wambolt and Sherwood 1999). Production of winter forage and density of big sagebrush were significantly greater ($P \leq 0.0027$) on protected areas (Wambolt and Sherwood 1999). Kay (1995), also working on the NYWR, found significantly greater ($P \leq 0.05$) canopy cover, height, and volume of serviceberry (*Amelanchier alnifolia* (Nutt.) Nutt. ex M. Roemer), chokecherry (*Prunus virginiana* L.), buffaloberry (*Shepherdia canadensis* (L.) Nutt.) and bitterbrush inside big game exclosures than outside exclosures.

Aspen regeneration in Utah failed or was significantly lower ($P \leq 0.08$) where cattle (*Bos taurus*), elk, and mule deer browsed as compared to excluded areas (Kay and Bartos 2000). Maschinski (2001) reported significantly reduced ($P \leq 0.005$) plant height and total branch length of Arizona willow (*Salix arizonica* Dorn) outside exclosures as compared to protected plants. McArthur et al. (1988) reported mountain big sagebrush browsed and unbrowsed (protected) by mule deer had an average dead crown of 64% and 17%, respectively, and dead sagebrush plants were 11 times more common where mule

deer browsed. An exclosure in central Washington revealed excessive use of snowbrush ceanothus (*Ceanothus velutinus* Dougl. ex Hook.) and chokecherry by mule deer and elk (Tiedemann and Berndt 1972). Snowbrush ceanothus canopy cover inside and outside the exclosure was 14.1% and 0.1%, respectively, and chokecherry canopy cover was 4.6% and 0, respectively. Shrub species richness was significantly greater ($P \leq 0.04$) inside exclosures than outside exclosures in Oregon (Moser and Witmer 2000). Moose (*Alces alces*) browsing in Michigan opened the tree canopy outside exclosures, which increased the amount of shrubs and herbs in the understory (Brandner et al. 1990, McInnes et al. 1992). Excluded areas had significantly greater ($P \leq 0.05$) tree biomass and less shrub and herb biomass (McInnes et al. 1992).

Mackie (1973) evaluated browsing impacts on antelope bitterbrush, western serviceberry, curlleaf mountain mahogany (*Cercocarpus ledifolius* Nutt. ex Torr. & Gray), and skunkbush sumac (*Rhus trilobata* Nutt.) by comparing shrub parameters inside exclosures to parameters outside at 12 exclosures in western Montana. Percent canopy cover of browse species was greater inside exclosures at 10 of the 12 sites. Browsing did not suppress density of plants and twig production was typically greater on shrubs that were browsed. Mackie (1973) cautioned against any generalizations concerning influences of browsing due to variations in species, location, time, site or other environmental conditions affecting browse species productivity.

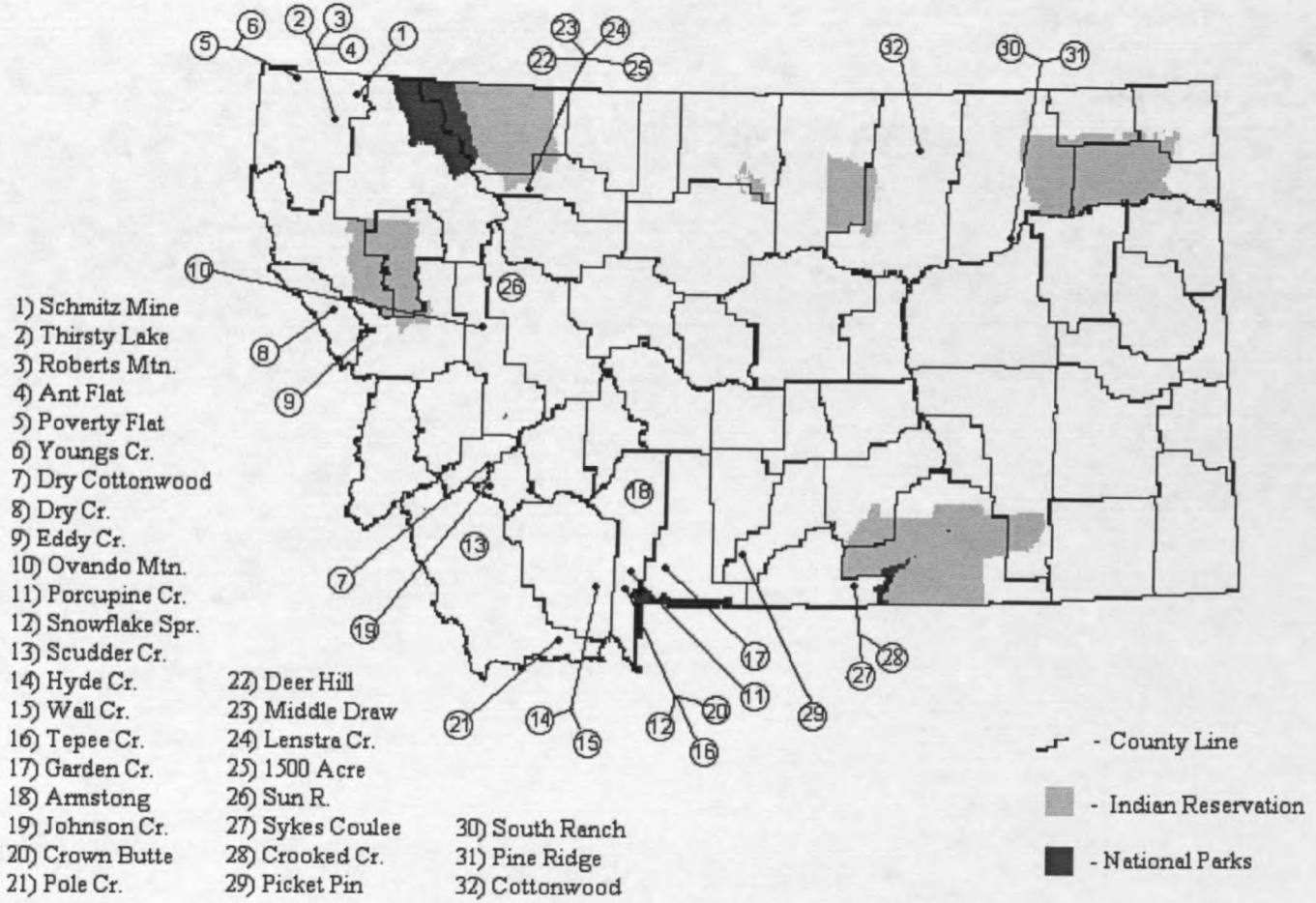

Figure 1. Location of study areas in Montana.

Table 1. Locations of the study areas.

No.	Name	Region	Legal Description			UTM Coordinates		
			Section	Township	Range	Zone	mE	MN
1	Schmitz Mine	1	7	35N	25W	11	0655965	5408356
2	Thirsty Lake	1	34	36N	27W	11	0641675	5412134
3	Roberts Mtn.	1	35	35N	26W	11	0652368	5402026
4	Ant Flat	1	7	34N	25W	11	0656385	5399170
5	Poverty Flat	1	3	36N	28W	11	0631362	5420052
6	Young Cr.	1	12	37N	28W	11	0632179	5428066
7	Dry Cottonwood	2	6	5N	8W	12	0372209	5119110
8	Dry Cr.	2	27	17N	27W	12	0650250	5229614
9	Eddy Cr.	2	31	15N	22W	11	0695736	5209421
10	Ovando Mtn.	2	1	15N	12W	12	0343081	5215972
11	Porcupine Cr.	3	16	7S	4E	12	0481400	5008190
12	Snowflake Spring	3	12	9S	4E	12	0486744	4989828
13	Scudder Cr.	3	17	6S	12W	12	0336004	5018941
14	Hyde Cr.	3	27	9S	1W	12	0443528	4985059
15	Wall Cr.	3	14	10S	1W	12	0446320	4978773
16	Tepee Cr.	3	7	9S	5E	12	0487024	4990773
17	Garden Cr.	3	18	7S	7E	12	0512791	5009718
18	Armstrong	3	25	2N	5E	12	0495331	5083614
19	Johnson Cr.	3	18	1N	1E	12	0342898	5077768
20	Crown Butte	3	8	9S	5E	12	0488378	4990122
21	Pole Cr.	3	11	7S	7E	12	0418630	4955822
22	Deer Hill	4	18	27N	8W	12	0375033	5329034
23	Middle Draw	4	12	27N	9W	12	0375033	5329034
24	Lenstra Cr.	4	1	27N	9W	12	0372937	5329591
25	1500 Acre	4	23	27N	9W	12	0371600	5326967
26	Sun R.	4	5	21N	8W	12	0374413	5274219
27	Sykes Coulee	5	33	9S	28E	12	0713122	4988356
28	Crooked Cr.	5	34	8S	27E	12	0703443	4996600
29	Picket Pin	5	6	5S	15E	12	0583219	5031976
30	South Ranch	6	14	24N	27E	13	0355054	5300371
31	Pine Ridge	6	4	23N	38E	13	0360540	5293948
32	Cottonwood	6	2	31N	30E	13	0294254	5373024

Table 2. Characteristics of the study areas.

Site No.	Aspect	Degrees of slope	Elevation (m)	Sampling Date	Exclosure Age at Sampling (years)
1	SW	1	1023	June 2001	39
2	S	10	918	June 2001	39
3	NE	3	992	June 2001	39
4	SW	10	945	June 2001	39
5	E	2	838	July 2001	43
6	W	2	812	July 2001	43
7	S	17	1728	June 2001	40
8	W	34	1026	June 2001	41
9	SW	3	1055	June 2001	42
10	SW	32	1616	August 2002	45
11	W-SW	4	2113	May, June 2001	56
12	N	1	2046	May 2001	53
13	SE	13	2041	July 2001	48
14	E	8	1972	August 2001	39
15	E	9	1997	August 2001	10
16	S	16	2143	May 2002	46
17	W	5	1712	May 2002	12
18	S	41	1786	June 2002	47
19	S	10	1880	June 2002	35
20	S	30	2218	July 2002	57
21	E	2	2163	August 2002	11
22	NW	10	1477	July 2001	13
23	NE	4	1489	July 2001	13
24	N	2	1416	July 2001	13
25	W	4	1527	July 2001	13
26	SW	12	1363	July 2001	34
27	SE	2	1501	June 2002	38
28	E	8	1930	June 2002	40
29	SW	24	1870	July 2002	40
30	N	21	905	July 2002	15
31	SE	5	740	July 2002	32
32	SE	3	704	August 2002	35

Montana Fish, Wildlife & Parks Region 1

1. Schmitz Mine. The Schmitz Mine site contains a single big game exclosure in Lincoln County, 16.1 km (10 miles) east of Fortine on the Flathead National Forest Land. The exclosure is approximately 0.2 ha in size. Douglas fir (*Pseudotsuga menziesii*

[Mirb.] Franco) dominates the overstory with serviceberry (*Amelanchier alnifolia* [Nutt.] ex M. Roemer), bearberry (*Arctostaphylos uva-ursi* [L.] Spreng.), snowberry (*Symphoricarpus albus* [L.] Blake), spiraea (*Spiraea douglasii* Hook.), Oregon grape (*Berberis repens* Lindl.), rose (*Rosa woodsii* Lindl.), and russet buffaloberry (*Shepherdia canadensis* [L.] Nutt.) in the understory. Cattle were found grazing the site and evidence of elk (*Cervus elaphus* nelsoni), mule deer (*Odocoileus hemionus*) and whitetailed deer (*Odocoileus virginianus*) was found.

2. Thirsty Lake. The Thirsty Lake exclosure is in Lincoln County, approximately 16.1 km (10 miles) southwest of Eureka on the Kootenai National Forest. A single big game exclosure approximately 0.2 ha in size exists at the site. Ponderosa pine (*Pinus ponderosa* P. & C. Lawson) and Douglas fir dominate the overstory. Antelope bitterbrush (*Purshia tridentata* [Pursh] DC.), Oregon grape, bearberry, snowberry, and rose are the dominant understory browse species. Deer and elk sign was found but elk presence was most noticeable.

3. Roberts Mountain. The Roberts Mountain exclosure is in Lincoln County, approximately 24.2 km (15 miles) southeast of Eureka on the Kootenai National Forest. A 0.2 ha big game exclosure exists at the site. Douglas fir and ponderosa pine dominate the overstory. The primary browse species are bearberry, Oregon grape, serviceberry, and russet buffaloberry. Evidence of deer (presumably whitetailed deer) was found.

4. Ant Flat. The Ant Flat exclosure is in Lincoln County, about 8.1 km (5 miles) west of Trego on the Kootenai National Forest. A big game exclosure with an adjacent

livestock exclosure exists just east and uphill from the Ant Flat Forest Service Station. Each are about 0.4 ha. The dominant overstory is Douglas fir and ponderosa pine. Understory browse species are dominated by serviceberry, with russet buffaloberry, bearberry, Oregon grape, snowberry, and rose present. A Forest Service prescribed fire consumed portions of both the livestock and big game exclosures in 1998. Burned areas are characterized by a dense thicket of serviceberry shoots. Presence of deer, presumably mule deer and whitetailed, was found. Minimal evidence of cattle was found.

5. Poverty Flat. The Poverty Flat exclosure is approximately 24.2 km (15 miles) west of Eureka on the west shore of Lake Koocanusa in Lincoln County. The exclosure is on the Kootenai National Forest. A big game exclosure and a livestock exclosure exist, each about 0.4 ha in size. Browse species at the site include serviceberry, russet buffaloberry, antelope bitterbrush, Oregon grape, and bearberry. Limited evidence of cattle was found. Whitetailed deer predominately use the area with minimal elk use in winter.

6. Young Creek. The Young Creek exclosure is in Lincoln County approximately 24.2 km (15 miles) northwest of Eureka on the west shore of Lake Koocanusa on the Kootenai National Forest. A 0.04 ha big game exclosure and a 0.2 ha livestock exclosure are located at the site but on different environment types. Ponderosa pine dominates the overstory at each exclosure. Antelope bitterbrush dominates the livestock exclosure and surrounding area while antelope bitterbrush, serviceberry, bearberry, snowberry and rose are found at the big game exclosure site. The area has had limited use by livestock. The

area serves as important whitetail winter range with a few elk using the area (T. Their, Mont. Fish, Wild. and Parks, unpubl. Data, 7/25/01).

Montana Fish, Wildlife & Parks Region 2

7. Dry Cottonwood. The Dry Cottonwood Creek exclosure is located in Deerlodge County, 32.2 km (20 miles) Southeast of Deerlodge, MT on the Deer Lodge National Forest Land (Appendix G, Fig. 36). There are 2 big game exclosures and 1 nonfunctioning livestock exclosure, each approximately 0.4 ha in size. Dominant browse species include Douglas fir, Rocky Mountain juniper (*Juniperus scopulorum* Sarg.), antelope bitterbrush, and chokecherry (*Prunus virginiana* L.) as well as various understory shrubs. The Forest Service prescribed burned portions of both inside and outside the big game exclosure in 1998. Measurements were taken in both unburned and burned areas. The site is in a Forest Service rest-rotation grazing allotment during the summer and serves primarily as an elk and mule deer winter range.

8. Dry Creek. The Dry Creek exclosure is in Mineral County about 16.1 km (10 miles) west of Superior on the Lolo National Forest. A single functioning big game exclosure 0.4 ha in size is located on the hill slope above the West Fork of Dry creek. Douglas fir is the dominant tree and serviceberry is the dominant shrub. Other browse species include chokecherry, snowbrush ceanothus (*Ceanothus velutinus* Dougl. ex Hook.), and mallow ninebark (*Physocarpus malvaceus* [Greene] Kuntze). Evidence of elk, mule deer and whitetailed deer was found at the site.

9. Eddy Creek. The Eddy Creek exclosure is in Missoula County, located 8.1 km (5 miles) east of Alberton on the Lolo National Forest. A single 0.4 ha big game exclosure exists. The browse community includes a ponderosa pine overstory with serviceberry, bearberry, snowbrush ceanothus, spiraea, and common snowberry in the understory. Past use of elk, mule deer, and whitetailed deer was found at the site.

10. Ovando Mountain. The Ovando Mountain exclosure is located in Powell County, approximately 24.2 km (15 miles) north of Ovando. A 0.4 ha big game exclosure is located on State of Montana land. Browse species include: Rocky Mountain maple (*Acer glabrum* Torr.), serviceberry, chokecherry, snowbrush ceanothus, mountain ash (*Sorbus sp.* L.) and pin cherry (*Prunus pensylvanica* L.F.). The area has historically been a very important elk and mule deer winter range (B. Henderson, Mont. Fish, Wildl. and Parks, unpubl. data 8/6/02). In more recent years, the area has provided moderate winter range for elk, mule deer, and whitetailed deer.

Montana Fish, Wildlife & Parks Region 3

11. Porcupine Creek. The Porcupine Creek exclosure is located in Gallatin County approximately 16.1 km (10 miles) east of Big Sky, MT. It is a single exclosure approximately 0.8 ha in size that excludes big game (Fig. 2). Plant communities at the site support the following dominant browse species: Douglas fir, lodgepole pine (*Pinus contorta* Dougl. ex Loud.), mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana* [Rydb.] Beetle), Geyer's willow (*Salix geyeriana* Anderss.), and aspen (*Populus tremuloides* Michx.). The area serves primarily as an elk winter range for migrating