Effects of livestock grazing on grizzly bear habitat along the east front of the Rocky Mountains, Montana
by Thomas Scott Stivers

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 on the effects of cattle grazing on grizzly bear habitat along the East Front of the Rocky Mountains, in Montana, was conducted from June 1985 to October 1986. Objectives were to determine impacts of cattle grazing on cover and forage preferred by grizzlies within aspen and willow plant communities, and to test the possibility of reestablishing preferred forage species within aspen and willow stands where they were lacking. Information collected on the phenology of bear foods growing in aspen and willow stands revealed that the more nutritious bear foods produced seeds late in the growing season. The utilization of bear foods by cattle in 5 study pastures showed that in 41-47 days all bear foods were 50% utilized. Paired contrast sites were selected in aspen and willow stands and stand structure and herbaceous bear foods were measured. Sites annually grazed after June generally produced more of the desirable bear foods (cow-parsnip, sharptooth angelica, and western sweet-cicely) than did sites grazed during June. The cumulative information suggests that June cattle grazing is adversely affecting the abundance of the 3 desirable bear foods. Sites protected from cattle grazing for 2 to 9 years had more aspen and willow suckers than did grazed sites, though both sites appeared to be recruiting enough suckers for stand survival. Ungrazed vs. grazed sites and sites grazed after June vs. sites grazed during June, produced more horizontal cover to potentially conceal a bear. Results from experimental plantings of seeds from 3 Umbelliferae bear foods showed that seed germination and seedling reestablishment was possible. Management guidelines and recommendations are presented.

EFFECTS OF LIVESTOCK GRAZING ON GRIZZLY BEAR HABITAT ALONG THE EAST FRONT OF THE ROCKY MOUNTAINS, MONTANA

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Thomas Scott Stivers

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Thomas Scott Stivers

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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ABSTRACT

A study on the effects of cattle grazing on grizzly bear habitat along the East Front of the Rocky Mountains, in Montana, was conducted from June 1985 to October 1986. Objectives were to determine impacts of cattle grazing on cover and forage preferred by grizzlies within aspen and willow plant communities, and to test the possibility of reestablishing preferred forage species within aspen and willow stands where they were lacking. Information collected on the phenology of bear foods growing in aspen and willow stands revealed that the more nutritious bear foods produced seeds late in the growing season. The utilization of bear foods by cattle in 5 study pastures showed that in 41-47 days all bear foods were 50% utilized. Paired contrast sites were selected in aspen and willow stands and stand structure and herbaceous bear foods were measured. Sites annually grazed after June generally produced more of the desirable bear foods (cow-parsnip, sharptooth angelica, and western sweet-cicely) than did sites grazed during June. The cumulative information suggests that June cattle grazing is adversely affecting the abundance of the 3 desirable bear foods. Sites protected from cattle grazing for 2 to 9 years had more aspen and willow suckers than did grazed sites, though both sites appeared to be recruiting enough suckers for stand survival. Ungrazed vs. grazed sites and sites grazed after June vs. sites grazed during June, produced more horizontal cover to potentially conceal a bear. Results from experimental plantings of seeds from 3 Umbelliferae bear foods showed that seed germination and seedling reestablishment was possible. Management guidelines and recommendations are presented.

INTRODUCTION

Studies on the East Front of the Rocky Mountains in the northwest chinook zone of Montana have provided a large data set on grizzly bear (Ursus arctos horribilis) habitat use, movements, and distribution (Schallenberger and Jonkel 1978, 1979, 1980; Aune and Stivers 1981, 1982,1983; Aune et al. 1984; Aune 1985; Aune et al. 1986; and Aune and Brannon 1987). Along the East Front, approximately 65 percent (%) of spring and early summer grizzly range is managed primarly for the production of livestock forage. Eighty nine % of livestock grazing is by cattle. During spring / early summer, cattle and grizzly bears show considerable overlap in diet and habitat use -- primarily due to their common use of riparian plant communities (Aune 1985).

Many researchers have suggested that livestock grazing may have negative impacts on grizzly bear habitat and distribution (Mealey et al. 1977, Schallenberger and Jonkel 1980, Knight et al. 1981, and Aune and Stivers 1982). Varying intensities and seasonality of livestock grazing could change vegetation composition, phenology, and/or the structure of riparian communities in favorable or unfavorable ways. This study, conducted from April 1985 through September 1986, was designed to provide some site

specific information needed for determining impacts of cattle grazing on grizzly bear habitat along the East Front of the Rocky Mountains. The specific objectives were:

1) to determine the impacts of cattle grazing on cover and forage preferred by grizzly bears within mesic plant communities.

2) to develop guidelines to mitigate negative influences and enhance positive influences of cattle grazing on bear habitat.

3) to identify sites suitable for long term studies on the influence of livestock on cover types and foods preferred by bears.

4) to test the possibility of establishing preferred bear foods at sites where they were lacking.

This study was supported by the U.S. Bureau of Land Management through a contract with the U.S. Fish and Wildlife Service.

STUDY AREA

The study area encompassed 600 square kilometers (km^2) in Teton and Pondera counties (Fig. 1). Land ownership was divided between the U.S. Forest Service, the Bureau of Land Management (BLM), Montana Department of Fish, Wildlife, and Parks (MDFWP), The Nature Conservancy, the Boone and Crockett Club's Theodore Roosevelt Memorial Ranch, and private individuals. The dominant land uses were ranching and recreation. The area had been subjected to extensive oil and gas exploration, but few wells were in production.

Elevations in the study area ranged from 1340 to 2070 meters (m). Precipitation averaged between 30 and 50 centimeters (cm) annually. Temperatures ranged from -40 to 32 C annually. The average growing season was 90 days. Strong westerly to southwesterly winds were common.

The study area was in the transition zone between the Rocky Mountains (Sawtooth Range) and the Great Plains. The foothills and prairie were abundantly trellised with small streams. Along streams, dominant plant communities consisted of aspen (Populus tremuloides), cottonwood (P. trichocarpa), and willow (Salix spp.). The prairie and higher elevation grasslands were dominated by bluebunch wheatgrass / Idaho fescue (Agropyron spicatum / Festuca

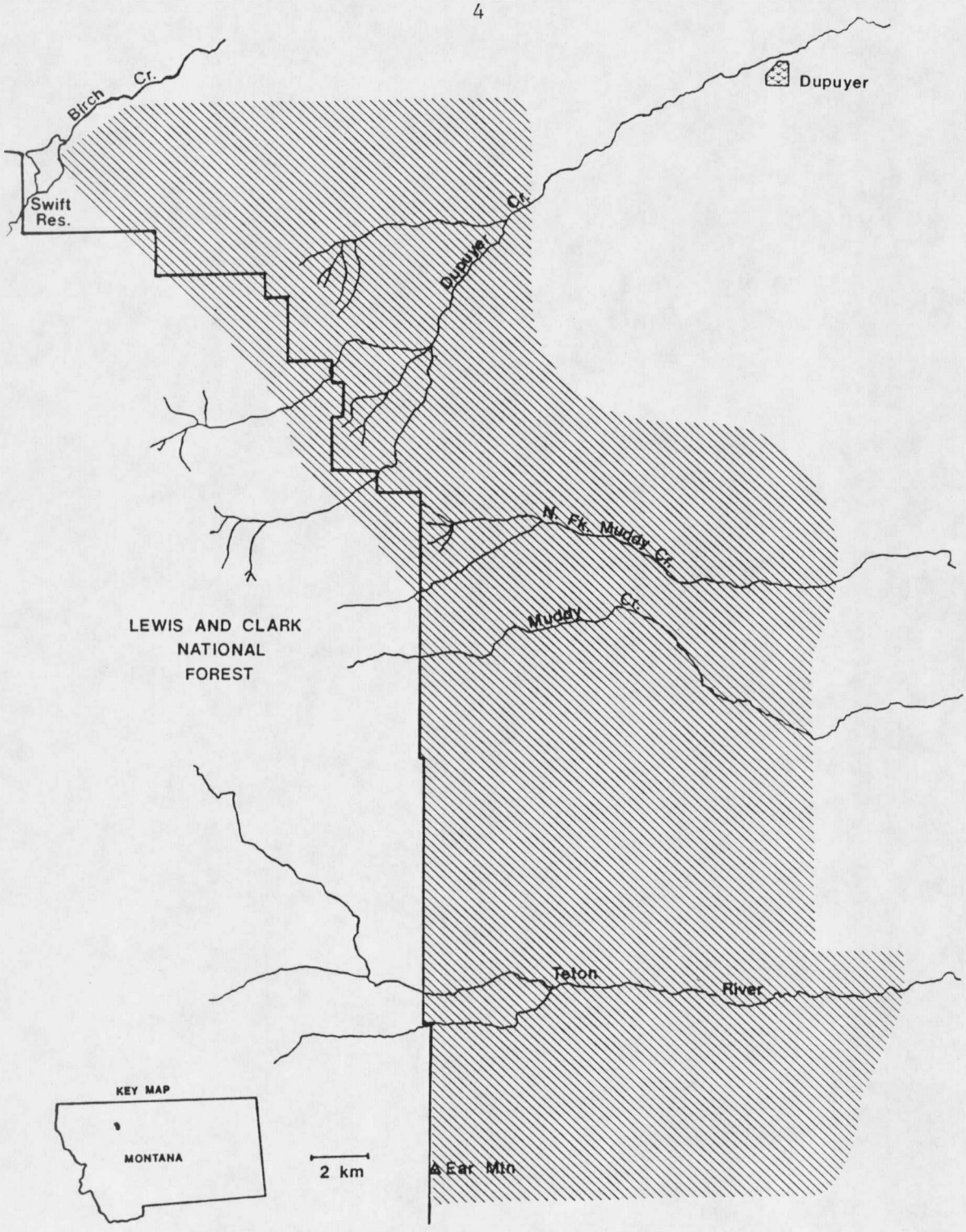

Figure 1. Map of the East Front study area showing major features.

idahoensis) and shrubby cinquefoil / rough fescue (Potentilla fruticosa / F. scabrella) habitat types. Stands of subalpine fir (Abies lasiocarpa), Douglas fir (Psuedotsuga menziesii), lodgepole pine (Pinus contorta), limber pine (P. flexilis), and Engelmann spruce (Picea engelmannii) were common at higher elevations and/or on wetter slopes of foothills. Detailed descriptions of the vegetation and habitat types are given by Harvey (1980), Kasworm (1981) and Lesica (1982).

In addition to grizzly bears, the other large mammals occupying the study area, at least seasonally, were: American black bear (U. americanus), mountain lion (Felis concolor), mule deer (Odocoileus hemionus), white-tailed deer (O. virginianus), Rocky Mountain elk (Cervus elaphus nelsoni), Rocky Mountain goat (Oreamos americanus), and Rocky Mountain bighorn sheep (Ovis canadensis canadensis).

METHODS

Paired Contrast Sites

Site Selection

Paired riparian sites were selected for intensive quantitative and qualitative vegetation measurement in 1985 and 1986. Sites within each pair were selected on the basis of similarity in vegetation communities, seral stages, slope, topography, aspect and elevation; and marked differences in grazing regimes. Both current and historic grazing regimes were considered when selecting sites.

Transect and Plot Establishment

Individual sites were mapped on USGS 1:24000 scale maps and gridded using a 10 x 10 grid adjusted to the area to be measured. Three random coordinates were selected from this grid, located on the ground, and permanently marked with a 1.25 x 100-cm steel pin. A 20-m transect was established at each pin. On a randomly chosen side of each transect, a 20 x 3-m rectangular plot was delineated using wooden stakes and a stringline. Deviations from random placement were made only to insure that plots did not overlap or fall on vegetation ecotones.

Transect Measurements:

Microplots. -- On the plot side of each transect, 40 50-cm^2 microplots were read at 0.5 m intervals along the transect. Measurements taken in each microplot included: percent ground coverage of leaf litter [dead plant parts and woody stems < 10 millimeters (mm) in diameter], wood, exposed soil, and moss.

Line intercept/concealment cover. -- To determine the the extent to which vegetation could conceal a grizzly bear from lateral view, a line intercept index was used. All vegetative materials, alive or dead, that intercepted the transect from 0.5 to 1.0 m above the ground, were recorded in millimeters by species. Values from the 3 transects per site were summed to give a lateral cover index value.

Arboreal canopy coverage. -- To determine arboreal canopy coverage, a modified vertical viewing tube was used (Emlen 1967). The tube had a field of vision of approximately 1 m^2 at a distance of 3 m. Canopy coverage was measured as the percent of the viewed field covered by vegetation. Readings were taken from 1 m above the ground at all 4 plot corners and every 5 m along the transect. Site values were based on means of readings for all 3 transects within a site.

Plot Measurements:

Herbaceous bear foods. -- Initially, canopy coverages

of herbaceous species considered desirable bear foods were estimated as a percentage of each 60 m^2 plot. Stems of the larger forb species considered important bear foods were counted in each plot. The average heights and phenological stages of bear foods were also recorded in each plot. The phenological categories were: new leaves, flower bud, flowering, fruit/seed set, fruit/seed ripe (fully swollen), fruit/seed dry and shedding, fruit/seed shed, and plant dry and brown. In the second half of the 1985 field season, and throughout the 1986 field season, the plots were subdivided into 3 x 5 m quarters to increase sample size from 3 to 12 per site and to decrease the area over which estimates of canopy coverage and counts of stems were made. In each quarter plot the average heights of each bear food species were multiplied times their respective number of stems, or canopy coverage, to produce a weighted mean height. These values were summed and averaged for each site.

Low and medium height shrubs. -- Percent canopy coverage by height category was estimated for all low to medium height shrubs (<2.0 m). The height categories were 0-0.5, 0.5-1, and 1-2 meters.

Stand structure. -- The taller shrubs (potentially > 2.0 m) and all trees were counted and placed into height and diameter categories by species. The height categories were 0-1, 1-2, and >2 meters. For shrubs the diameter categories

were 0-5, 5-10, 10-20, and >20 cm. Shrub diameters were measured at 0.5 m above ground to accommodate species which sprout from prostrate stems. Trees had the same diameter categories, but were measured at breast height (1.37 m above ground). Plot measurements were summed and a mean value calculated per 60 m^2.

Vegetative Nomenclature

For descriptive purposes vegetation communities occupying study sites were classified into cover-types based on the plant species dominating the primary and secondary canopy strata. Plant identification followed Hitchcock and Cronquist (1973).

Statistical Tests

All site comparisons were tested with "t" tests (Zar 1984) unless stated otherwise. $P < 0.05$ was required for statistical significance.

Pasture Utilization by Cattle

To determine short term impacts of cattle grazing on bear foods in mesic plant communities, 5 pastures were chosen that differed in size, shape, relief, proportions of mesic communities, timing of livestock use, stocking density, and age classes of livestock. Two null hypotheses were tested using these pastures: 1) cattle utilization of

slight; and 2) relative to the gate cattle entered the pasture, they would use the closer mesic sites more than farther ones.

Sample points were chosen in mesic vegetation at 200-m intervals from the gate cattle entered the pasture. At each point, 20 x 3-m plots were established following the procedures described for paired contrast sites. The measurements taken at each plot were also the same, except that microplots and line intercepts were not employed. Vegetation measurements were made 1 week before cattle were put on the pasture and at 2 to 3 week intervals while cattle were on the pasture.

To determine the extent to which cattle utilized bear foods, 2 bear food biomass indices were calculated for each plot. The indices were calculated by multiplying the number of stems [of sharptooth angelica (Angelica arguta), cow-parsnip (Heraculem lanatum), mountain sweet-cicely (Osmorhiza chilensis), and western sweet-cicely (O. occidentalis)] and canopy coverages [of grasses/sedges, common dandelion (Taraxacum officinale), and clovers (primarily Trifolium longipes)] by the average height of each bear food per plot. Biomass values were summed by category (number of stems of members of the Umbelliferae family or percent canopy coverages of grasses/sedges, dandelions and clovers) for each plot measured through the

grazing period. Utilization was estimated by comparing the change in biomass values between measurements. This was accomplished by calculating the percentage of maximum biomass removed between measurements by consumption or trampling. Pasture utilization values were summed and averaged for all pastures in both years. Average pasture utilization over time was then determined. Biomass values and utilization calculations are presented in Appendix B.

In testing whether closer mesic sites were utilized more than distant ones, utilization plots were grouped into 0.5 kilometer (km) categories, based on plot distances from the gate cattle entered the pasture. The percentage of maximum biomass left at the end of the grazing period was then averaged for all pastures and compared by distance categories (Appendix B).

Bear Food Phenology

The phenological information collected at paired sites, utilization plots, and at sites selected specifically for monitoring phenology, was used to construct the chronology of bear food phenology. The range of dates for bear foods at the "seed ripe" phenological stage were assembled for both 1985 and 1986. Survival to this stage was deemed necessary for long term survival of plant species.

Bear Food Re-establishment

During the 1985 field season, many mesic stands lacked some of the larger and more nutritious (Sizemore 1980) spring bear foods such as cow-parsnip, sharptooth angelica, and western sweet-cicely. The absence of these Umbelliferae bear foods could have been due to lack of a seed source. To test this hypothesis, seeds from these 3 species were collected at various locations in the study area and planted in selected mesic communities to determine if establishment was possible.

Seeds were collected prior to shedding and allowed to air dry. During September and October of 1985 and 1986, seed beds were selected under aspen and willow stands that lacked these desirable bear foods. One hundred milliliters of seeds of each species were broadcast by hand over 1 m^2 plots from which the duff had been removed. The seeds were lightly covered with 2 to 4 cm of leaf litter. Each plot was marked with a wooden stake. In late May / early June, of the next year, seedling germination and establishment success were determined by estimating the percentage canopy coverage of the first foliage leaves (poor = 0-5 %, fair = 6-25 %, good = 26-75 %, and excellent = 76-100 %).

RESULTS

Paired Contrast Sites

Site Selection and Characteristics

Fifteen sites were established and measured in 1985 (Table 1). During 1986, the original 15 sites were remeasured and an additional 6 established and measured. From these 21 sites, 12 paired site comparisons (Appendix B, Fig. 7) were made to examine differences attributable to cattle grazing. Ten paired site comparisons were in contiguous stands of aspen or willow, and all comparisons were separated by fencelines. All aspen comparisons were made within the same clone.

Aspen dominated the upper canopy stratum at 16 sites and willow in 5 (Table 1). Sites ranged in elevation from 1381 to 1896 meters. Slopes were between 1 and 9 %, and most aspects were easterly (33 - 145°). Seven of the sites had not been grazed for 2 to 9 years prior to 1985. One site (8U) was on the MDFWP Ear Mountain Wildlife Management Area, 3 (1U, 2U, and 3U) were on the MDFWP Blackleaf Wildlife Management Area, 2 (6U and 7U) were within BLM cattle exclosures, and 1 (4U) had been rested by a private landowner.

Table 1. Characteristics of paired contrast sites.

Site/ status[a]	Cover Type[b]	Elevation (meters)	Aspect	Slope (%)	Pasture			
					Prior years rest	Stocking density[c] (A.U./ha)[d]	Aspen and willow[e] (%)	Grazing period[f]
1U	Potre/Syal	1576	90	7	5	0.3	10	June 1-Sept. 30
1G	Potre/Syal	1580	90	7	0	0.4	25	July 15-Sept. 15
2U	Potre/Syal	1567	70	3	5	0.3	10	June 1-Sept. 30
2G	Potre/Syal	1614	70	3	0	0.1	17	July 1-Sept. 1
3U	Potre/Salix	1494	35	2	5	1.5	6	Sept. 15-Oct. 31
3G	Potre/Salix	1497	35	2	0	0.5 or 1.1	1	June or Aug. 1-Oct. 15
4U	Salix/Hela	1402	120	1	2	2.2	10	Sept. 5-March 1
4EG	Salix/Hela	1408	120	1	0	1.3	19	Nov. and Feb. 15-May 15
4WG	Salix/Hela	1381	120	1	0	3.2	26	Jan. 1-March 31
6U	Potre/forb	1858	135	4	2	0.6	7	July,Aug., or Sept.1-20[g]
6G	Potre/forb	1858	135	4	1	0.6	5	July,Aug., or Sept.1-20[g]
7U	Potre/forb	1896	145	4	7	0.6	1	July,Aug., or Sept.1-20[g]
7G	Potre/forb	1892	145	3	0	0.6	0.5	July,Aug., or Sept.1-20[g]
8U	Potre/forb	1593	40	9	9	0.3	7	June 7-Sept. 1
8G	Potre/forb	1598	40	9	0	0.4	4	June 15-Aug. 15
9LG	Salix/forb	1512	85	3	0	0.4	25	July 15-Sept. 15
9EG	Salix/forb	1518	85	4	0	0.6	12	June 1-July 15
10LG	Potre/forb	1451	57	9	0	0.4	23	Aug. 15-Oct. 15
10EG	Potre/forb	1451	57	7	0	0.3	18	June 1-July 31
11LG	Potre/Salix	1498	33	6	0	0.5	26	July or Aug. or Sept.[h]
11EG	Potre/Salix	1495	33	6	0	0.3	18	June 1-July 31

[a] U = ungrazed, G = grazed, EG = early grazed, WG = winter grazed, and LG = late grazed.
[b] Abbreviations in Appendix A Table 9.
[c] Pasture area calculated minus steep slope closed timber areas, and animal units averaged since 1950.
[d] A cow with calf considered one Animal Unit (A.U.) until weaning.
[e] The proportion of pasture covered by aspen and willow.
[f] Averaged for 1950 through 1985, or up to date of rest.
[g] A 4 pasture rest-rotation system since 1974; prior grazing season was approximately July 1 - Sept. 15.
[h] A 3 pasture rotation system.

Cattle stocking densities ranged from 0.1 to 1.1 animal units per hectare (A.U./ha) on grazed pastures, and had been 0.3 to 2.2 A.U./ha on pastures protected from cattle grazing. Those sites in pastures with the highest stocking densities were in winter pastures where cattle were fed hay (4U, 4EG, and 4LG) or in pastures with a fall grazing period of short duration (3U and 3G) (Table 1).

The current, or historic, grazing periods of pastures containing study sites were: 8 pastures grazed during the month of June (1U, 2U, 3G, 8U, 8G, 9EG, 10EG, and 11EG), 8 pastures with summer grazing (1G, 2G, 6U, 6G, 7U, 7G, 9LG, 11LG), 4 pastures with fall / winter grazing (3U, 3G, 10LG, and 4U), 1 winter pasture (4WG), and 1 late winter / early spring pasture (4EG). The proportion of each pasture covered by aspen and willow communities ranged from 0.5 to 26 % (Table 1).

Transect Measurements:

Microplot ground cover. -- The 1985 and 1986 microplot measurements indicated that ungrazed and late grazed (fall - winter) sites generally had more ground covered by leaf litter and less exposed soil than grazed or early grazed sites (Table 2). Of 14 site comparisons that differed significantly in percent leaf litter and bare soil, 10 supported this trend. Only 2 paired sites differed significantly in the amount of wood laying on the ground,

Table 2. Values recorded for microplot, arboreal canopy coverage, and line intercept measurements for transects at paired contrast sites.

Site	Date	Microplot (mean percent)				Arboreal canopy coverage (%)	Line intercept (mm)
		Leaf litter	Wood litter	Exposed soil	Moss		
1U	4/28/85	98	2	tr[1]	0	7	435
1G	4/28/85	100*	0*	0	0	7	708
1U	7/26/86	94	4	1	0	56	10133
1G	7/22/86	88*	10*	1	0	49	7617
2U	5/8/85	94	5	0	0	4	831
2G	5/7/85	96	3	2*	0	4	819
2U	6/26/86	90	8	tr	0	53	7590
2G	6/19/86	98*	2*	tr	tr	62	3120
3U	5/14/85	93	5	0	0	20	3274
3G	5/15/85	86*	6	7*	0	14	1405
3U	6/24/86	81	7	7	3	56	12621
3G	6/22/86	80	7	9	2	56	3340
4U	5/17/85	82	4	12	0	17	2871
4EG	5/21/85	79	6	13	0	27	4161
4WG	5/25/85	89	3	6*,**	0	29**	5884
4U	7/10/86	78	5	14	tr	54	27947
4EG	7/9/86	76	4	17	tr	61	22430
4WG	7/11/86	92*,**	7	1*,**	tr	64	38873

Table 2. Continued.

Site	Date	Microplot (mean percent) Leaf litter	Wood litter	Exposed soil	Moss	Arboreal canopy coverage (%)	Line intercept (mm)
6U	6/15/85	94	5	0	0	31	1466
6G	6/12/85	94	5	0	0	23*	616
6U	7/30/86	93	6	0	0	58	3396
6G	7/28/86	92	7	0	0	45*	925
7U	6/19/85	92	4	4	0	25	1404
7G	6/19/85	82*	3	13*	0	28	1709
7U	8/1/86	89	5	5	tr[1]	50	3170
7G	7/31/86	80*	5	14*	tr	55	3778
8U	8/21/85	84	9	6	0	42	4880
8G	8/19/85	70*	4	26*	0	46	4112
8U	6/16/86	93	4	2	0	45	6282
8G	6/17/86	79*	7	14*	0	43	3283
9LG	5/25/86	84	7	10	tr	15	2617
9EG	5/26/86	69*	7	23*	1	20	3476
10LG	6/11/86	91	7	2	0	25	16497
10EG	6/2/86	80*	6	14*	0	17	462
11LG	6/10/86	90	4	4	1	48	2082
11EG	6/9/86	84	9	3	2	36*	1355

*Significantly different at 5% level from the site above.
**Significantly different at 5% level from 2 sites above.
[1]tr = trace, a value less than 0.5%.

and no paired sites had significant differences in the amount of moss present.

Arboreal canopy coverage. -- No trends were noticed when sites were compared for arboreal canopy coverage. Only 4 ungrazed sites differed significantly from their paired comparisons. In 1985, sites 4U and 6U had arboreal canopy coverages significantly less than the grazed sites with which they were paired, while in 1986 sites 6U and 11LG had significantly more than their respective paired sites (Table 2).

Line intercept/concealment cover. -- Since no statistical proceedure was found adequate for comparing differences in the amount of total concealment cover between sites, all sites were categorized as ungrazed and late grazed vs. grazed and early grazed and tested with a paired "t" test (Zar 1984). Table 2 shows that the majority of ungrazed vs. grazed and late grazed vs. earlier grazed sites had more cover to potentially conceal a bear. In 1985, when the majority of sites were measured before the woody species had fully leaved out or herbaceous plants had reached maximum growth, ungrazed vs. grazed and late grazed vs. earlier grazed sites did not differ significantly in concealment cover ($t = 1.10$, $P > 0.30$). The 1986 paired sites (usually measured later in the growing season, 1 to 4 weeks before cattle were turned on to the grazed

sites/pastures) had significantly more cover on the ungrazed vs. grazed and late grazed vs. earlier grazed sites ($t = 2.921$, $P < 0.02$).

Plot Measurements:

Stand structure. -- Aspen and willow were the dominant woody plants at all sites (Table 3). Douglas fir, lodgepole pine, Engelmann spruce, and limber pine were present at 6 sites but made up < 2 % of the total stem count. Water birch (Betula occidentalis), red-osier dogwood (Cornus stolonifera), and common chokecherry (Prunus virginiana) were present in small amounts and varying combinations at sites 3U/G, and 4U/EG/WG.

Sites protected from cattle grazing usually had more aspen, willow, and total stems in the 0-5 cm diameter and 0-1 and 1-2 m height categories than did grazed sites (Table 3). Exceptions to this trend were site pairs 3U/G (1986), 9LG/EG, 10LG/EG, and 11LG/EG. In the latter 3, stems 0-5 cm in diameter and < 2 m in height were slightly more abundant (not significantly) in the early grazed plots. At site 4, the winter grazed site (4WG) had fewer small willow and total stems than did the ungrazed (4U) or early spring grazed (4EG) sites. Although ungrazed sites generally had more stems available for stand recruitment than did grazed sites, virtually all sites had at least twice as many stems in the 0-5 diameter category as in the 10-20 or >20

Table 3. Mean number of stems per 60 m^2 by diameter and height categories for aspen, willow, and total trees and tall shrubs (potentially > 2.0 m) at paired contrast sites.

Site	Date	Potre[a]							Salix spp.							Total[b]						
		Diameter (cm)				Height (m)			Diameter (cm)				Height (m)			Diameter (cm)				Height (m)		
		0-5	5-10	10-20	>20	0-1	1-2	>2	0-5	5-10	10-20	>20	0-1	1-2	>2	0-5	5-10	10-20	>20	0-1	1-2	>2
1U	4/28/85	74	15	10	tr[1]	6	33	64								74	15	10	tr	6	33	64
1G	4/28/85	29	11	4	1	tr*	7*	38								29	11	4	1	tr*	7*	38
1U	7/26/86	72	12	10	0	7	26	61								72	12	10	0	7	26	61
1G	7/22/86	31*	10	5*	1	4*	7*	36*								31*	10	5*	1	4	7*	36*
2U	5/8/85	170	14	5	0	77	101	59								170	14	5	0	77	101	59
2G	5/7/85	54*	17	7	0	23*	24	31*								54*	17	7	0	24*	24	31*
2U	6/26/86	140	12	5	0	43	59	56								140	12	5	0	43	59	56
2G	6/19/86	55*	14	9*	0	26*	19*	33*								55*	14	9*	0	26*	19*	33*
3U	5/14/85	14	tr	3	2	10	1	7	17	4	6	2	4	7	17	87	5	9	4	59	17	28
3G	5/15/85	3	2	6	0	2	1	8	5	10	7	3	1	2	23	24*	12	13	3	16	5*	31
3U	6/24/86	11	tr	5	0	8	3	5	31	2	6	0	5	14	20	42	2	11	0	13	17	25
3G	6/22/86	11	1	6	0	10	tr	7	44	9*	7	3	21	22	20	55	10*	13	3	31	22	28
4U	5/17/85								38	16	3	1	18	12	29	101	21	3	1	68	22	37
4EG	5/21/85								16	25	18*	1	11	5	44*	17	25	18*	1	12	5	45*
4WG	5/25/85								1	7*	6*	5*	0	0	19*	7	7*	6*	5*	2	4	20*
4U	7/10/86								49	13	4	2	17	20	31	57	14	4	2	19	24	35
4EG	7/9/86								42	14	21*	1	18	22	41	42	14	21*	1	18	22	41
4WG	7/11/86								2*	4*	3*	5*	tr***	1	13*	2***	4*	3*	5*	tr***	1	13***

Table 3. Continued.

Site	Date	Potre[a] Diameter (cm) 0–5	5–10	10–20	>20	Potre[a] Height (m) 0–1	1–2	>2	Salix spp. Diameter (cm) 0–5	5–10	10–20	>20	Salix spp. Height (m) 0–1	1–2	>2	Total[b] Diameter (cm) 0–5	5–10	10–20	>20	Total[b] Height (m) 0–1	1–2	>2
6U	6/15/85	107	tr[1]	10	1	77	19	23								108	tr	10	1	77	19	23
6G	6/12/85	35*	1	10	tr	32	3	11								39*	1	10	tr	34	4	12
6U	7/30/86	129	0	9	2	104	17	18								130	0	9	2	105	17	18
6G	7/28/86	102	2	10	0	99	3*	13								105	2	10	0	101	3*	14
7U	6/19/85	91	9	11	0	90	tr	20								96	9	11	0	95	1	20
7G	6/19/85	23	10	15	tr	14	2	33								29	10	15	tr	20	2	33
7U	8/1/86	112	7	11	0	111	1	18								118	7	11	0	116	1	18
7G	7/31/86	88	10	14	0	80	1	31								92	10	14	0	84	2	31
8U	8/21/85	44	0	10	tr	25	16	13								44	0	10	tr	25	16	13
8G	8/19/85	27*	0	10	0	17	9	11								27*	0	10	0	17	9	11
8U	6/16/86	39	0	10	0	19	17	13								39	0	10	0	19	17	13
8G	6/17/86	34	0	10	0	24	9	11								34	0	10	0	24	9	11
9LG	5/25/86								48	12	6	1	3	31	34	48	12	6	1	3	31	34
9EG	5/26/86								68	18	6	2	7	31	52	68	18	6	2	7	31	52
10LG	6/11/86	9	3	5	1	4	2	12								9	3	5	1	4	2	12
10EG	6/2/86	15	1	5	0	11*	1	10								15	1	5	0	11*	1	10
11LG	6/10/86	37	6	13	0	29	5	22	25	3	1	tr	10	5	14	62	9	14	tr	38	11	36
11EG	6/9/86	56	10	11	0	49	2	26	9	tr	1	0	5	1	4	64	10	13	0	54	3*	30

[a]Abbreviations in Appendix A Table 9.
[b]Includes all tree and tall shrub species sampled per site. Additional species per site were: 6U, 7U and 7G'85 and '86 = Psme and Pien; and 6G'85 and '86 = Psme, Pien and Pico.
[1]tr = trace, a value less than 0.5%.
*Significantly different at 5% level from the site above.
***Significantly different at 5% level from both sites above.

categories (Table 3).

Low and medium height shrubs. -- Fifteen different low to medium height shrub species were identified in plots during the study. The 4 shrubs most often encountered were currant (Ribes spp.), rose (Rosa woodsii), red raspberry (Rubus idaeus), and common snowberry (Symphoricarpos albus) (Table 4).

Snowberry, the most abundant shrub, showed no significant differences between grazed and ungrazed sites. Rose canopy coverages were significantly greater in the 0-0.5 m height category in 1 grazed vs. ungrazed site (1G/U) and 2 early grazed vs. late grazed sites (10EG/LG and 11EG/LG). Currant canopy coverages were significantly more abundant at 2 late grazed vs. early grazed sites (9LG/EG and 11LG/EG), and red raspberry was significantly greater in the ungrazed plots at site 8. Total shrub canopy coverages were generally greater at ungrazed vs. grazed and early grazed vs. late grazed sites (Table 4).

Herbaceous bear foods. -- Grasses/sedges [primarily Kentucky bluegrass (Poa pratensis), timothy (Phleum pratensis) and smooth brome (Bromus inermis)] and common dandelion had the greatest canopy coverages. Ungrazed plots at 4 sites differed significantly from their corresponding grazed sites in grass canopy coverage. Two had more (4U vs. 4WG and 8U vs. 8G) and 2 had less (1U vs. 1G and 2U vs. 2G).

Table 4. Mean canopy coverage by height categories for the 4 most common, and total, low and medium height shrubs at paired contrast sites.

Site	Date	Ribes[a] spp. Height (m) 0-.5	.5-1	1-2	Rowo Height (m) 0-.5	.5-1	1-2	Ruid Height (m) 0-.5	.5-1	1-2	Syal Height (m) 0-.5	.5-1	1-2	Total[b] Height (m) 0-.5	.5-1	1-2
1U	4/28/85	1	tr[1]	0	tr	tr	0	3	1	0	10	1	0	15	3	0
1G	4/28/85	1	tr	0	tr	tr	0	0	0	0	3	tr	0	4*	tr*	0
1U	7/26/86	tr	tr	0	tr	tr	0	8	4	tr	37	5	0	48	11	1
1G	7/22/86	tr	tr	0	3*	1	tr	tr	tr	0	18	2	0	22*	3*	tr
2U	5/8/85	tr	0	0	1	tr	0				5	tr	0	7	tr	0
2G	5/7/85	tr	0	0	tr	tr	0				4	tr	0	5	tr	0
2U	6/26/86	tr	0	0	8	4	0				24	1	0	32	5	0
2G	6/19/86	0	0	0	8	2	0				28	1	0	36	4	0
3U	5/14/85	tr	tr	0	tr	tr	0				tr	tr	0	1	tr	tr
3G	5/15/85	tr	tr	0	tr	tr	0				tr	tr	0	1	tr	tr
3U	6/24/86	tr	tr	tr	1	1	1	0	0	0	2	tr	0	9	7	2
3G	6/22/86	1	1	0	3	1	0	1	tr	0	13	tr	0	8	1*	tr
4U	5/17/85	tr	tr	0	tr	tr	0							1	tr	tr
4EG	5/21/86	tr	tr	0	0	0	0							tr	tr	0
4WG	5/25/85	tr	tr	0	tr	tr	0							tr	tr	0
4U	7/10/86	tr	tr	tr	1	1	0				tr	0	0	7	4	1
4EG	7/9/86	tr	tr	tr	0	0	0				0	0	0	tr*	tr	tr
4WG	7/11/86	1	1	tr	tr	tr	0				tr	0	0	1	2	1

Table 4. Continued.

Site	Date	Ribes[a] spp. Height (m) 0-.5	.5-1	1-2	Rowo Height (m) 0-.5	.5-1	1-2	Ruid Height (m) 0-.5	.5-1	1-2	Syal Height (m) 0-.5	.5-1	1-2	Total[b] Height (m) 0-.5	.5-1	1-2
6U	6/15/85	tr[1]	tr	0	tr	tr	0				tr	0	0	tr	tr	0
6G	6/12/85	tr	0	0	tr	tr	0				0	0	0	2*	tr	0
6U	7/30/86	1	tr	0	tr	0	0				tr	0	0	1	tr	0
6G	7/28/86	tr	tr	0	1	tr	0				0	0	0	2	tr	0
7U	6/19/86	tr	0	0				1	0	0	0	0	0	1	0	0
7G	6/19/85	1	0	0				0	0	0	tr	0	0	1	0	0
7U	8/1/86	1	tr	0	tr	0	0	7	2	0	0	0	0	9	2	0
7G	7/31/86	2	0	0	0	0	0	0	0	0	tr	0	0	2	0	0
8U	8/21/85	tr	0	0	4	tr	0	1	0	0	1	tr	0	7	tr	0
8G	8/19/85	2	tr	0	2	tr	0	8	0	0	6	tr	0	18	tr*	0
8U	6/16/86	1	1	0	5	2	0	1	tr	0	2	tr	0	9	3	0
8G	6/17/86	2	tr	0	2	tr	0	9*	3	0	5	1	0	19*	4	tr
9LG	5/26/86	13	2	0	tr	tr	0							13	3	0
9EG	5/26/86	6*	1	0	tr	tr*	0							6*	1	0
10LG	6/11/86	0	0	0	tr	tr	0				9	tr	0	9	1	0
10EG	6/2/86	2	tr	0	3*	2*	0				22	tr	0	28*	3*	0
11LG	6/10/86	4	tr	0	2	tr	0				14	1	0	20	2	tr
11EG	6/9/86	tr*	tr*	0	6*	1	0				16	tr	0	23	2	0

[a]Abbreviations in Appendix A Table 9.
[b]Includes all low to medium height shrubs sampled per site. Additional shrubs species per site are: 6G´85 and ´86 = Aruv, Juco and Pofr; 6U´86 and 7U´85 and ´86 = Pofr; 7G´85 and ´86, and 9EG´86, = Juco and Pofr; 8U´85 and ´86 = Spbe; 8G´85 and ´86 = Acgl, Sara and Spbe; 9LG´86 = Juco; 10LG´86 = Amal and Prvi; 10EG´86 = Amal; and 11LG and 11EG´86 = Amal, Pofr and Shca.
[1]tr = trace, a value less than 0.5%.
*Significantly different at 5% level from the site above.

Of the 3 late grazed vs. early grazed sites, 2 late grazed sites had significantly more grass (9LG/EG and 10LG/EG). Common dandelion canopy coverage was greater on 2 grazed (1G/U and 6G/U) and 2 early grazed (10EG/LG and 11EG/LG) sites. Clover (primarily Trifolium longipes) was never very abundant, but seemed to be more common on grazed sites, significantly so at site 6G. Strawberry was another uncommon bear food. At the 3 paired sites with significant differences, 2 ungrazed sites (7U and 8U) and 1 early grazed vs. late grazed site (11EG/LG) had greater canopy coverages (Table 5).

The number of stems were counted for 5 herbaceous plant species -- sharptooth angelica, cow-parsnip, mountain and western sweet-cicely, and glacier lily (Erythronium grandiflorum). The least common of these was glacier lily. This species was more abundant at 4 grazed vs. ungrazed sites, but not significantly.

The most common bear food counted was mountain sweet-cicely. Six paired site comparisons differed significantly. In 4 of these, the ungrazed plots had fewer stems (3U/G, 4U/EG/WG). One comparison of early and late grazed plots (10LG/EG) had significantly fewer stems in the late grazed plots. The only comparison in which an ungrazed treatment had significantly more was at site 1 (ungrazed vs. summer grazed). The "Osmo spp." category (which generally

Table 5. Mean numbers or canopy coverage, and mean heights of herbaceous bear foods in 60 m2 plots at paired contrast sites. Heights were not measured in some plots in 1985.

Site	Date	Anar[a] #/Ht.	Hela #/Ht.	Osmo spp.[b] #/Ht.	Osch #/Ht.	Osoc #/Ht.	Ergr #/Ht.	Frvi %/Ht.	Grass[c] %/Ht.	Taof %/Ht.	Trlo %/Ht.
1U	4/28/85		0	71/5				[1]tr/5	tr/8	tr/5	0
1G	4/28/85		*16/6	132/5				tr/4*	5/8	5/6	tr/4
1U	7/26/86	0	0		9/42	195/66		tr/11	4/65	tr/8	0
1G	7/22/86	9/48	*69/55		7/36	*443/60		1/11	*23/66	*8/13*	tr/11
2U	5/8/85			8/			0	tr/	tr/	tr/	
2G	5/7/85			34/			98/	tr/	tr/	tr/	
2U	6/26/86				75/24	20/69	0	1/15	tr/43	tr/24	
2G	6/19/86				82/14*	*253/40*	14/5	4/14	*3/51*	1/18*	
3U	5/14/85	188/13	13/20	50/			0	tr/5	5/12	3/9	tr/
3G	5/15/85	*2/8	0	267/5			65/	tr/3	1/7	3/9	tr/3
3U	6/24/85	306/59	30/78		201/21			tr/10	10/60	2/24	tr/7
3G	6/22/86	*6/50	0		*450/30*			tr/9	7/57	3/12*	2/5
4U	5/17/85	0	328/25	15/7				tr/3	11/12	tr/5	tr/2
4EG	5/21/85	tr/7	731/10	145/				tr/3	3/7*	1/7	0
4WG	5/25/85	0	487/	*155/5				tr/5	1/5	tr/15*	0
4U	7/10/86		490/88		10/12			0	18/72	tr/20	tr/9
4EG	7/9/86		594/62*		*30/45*			1/14	11/58*	2/19	tr/15
4WG	7/11/86		726/130**		**160/21*			tr/12	**3/80*	tr/25**	0

Table 5. Continued.

Site	Date	Anar[a] #/Ht.	Hela #/Ht.	Osmo spp.[b] #/Ht.	Osch #/Ht.	Osoc #/Ht.	Ergr #/Ht.	Frvi %/Ht.	Grass[c] %/Ht.	Taof %/Ht.	Trlo %/Ht.
6U	6/15/85				558/9	6/22	97/10	1/8	11/25	11/16	8/7
6G	6/12/85				*58/6*	12/20	347/9	6/6	10/13*	*16/11*	*24/7
6U	7/30/86				179/20	22/24		5/8	24/60	12/11	3/9
6G	7/28/86				*65/11*	5/25		*2/7	17/30*	*20/10	*11/7*
7U	6/19/85		0		1247/7		293/11	7/7	6/15	10/14	
7G	6/19/85		1/15		1025/8		317/12	*1/7	7/13*	13/11*	
7U	8/1/86		0		483/23			4/8	18/34	9/12	
7G	7/31/86		tr/22		401/29*			*tr/6*	20/29*	8/7*	
8U	8/21/85				77/7			tr/13	24/32	2/12	
8G	8/19/85				124/5*			tr/	*13/9*	5/9*	
8U	6/16/86				151/13			1/11	24/43	6/21	
8G	6/17/86				*339/13			tr/7*	16/51*	7/15*	
9LG	5/25/86	143/15	0		94/4			tr/3	17/17	9/9	tr/3
9EG	5/26/86	*0	*58/6		86/4			tr/3	*8/14*	8/7*	tr/3
10LG	6/11/86		243/54		25/	1198/65		tr/7	23/53	1/27	
10EG	6/2/86		*11/15*		*70/12	*549/27*		tr/6*	*7/29*	*15/17*	
11LG	6/10/86	95/43	38/46		186/24	126/47		tr/7	20/44	16/20	1/7
11EG	6/9/86	*0	*1/25		353/23	34/25*		*3/10*	12/41	*11/18	1/5*

[a]Abbreviations in Appendix A Table 9.
[b]Osmorhiza plants not keyed to species.
[c]Includes all grasses and sedges. Sedges never exceeded a trace in any plot.
[1]tr = trace, a value less than 0.5%.
*Significantly different at 5% level from the site above.
**Significantly different at 5% level from 2 sites above.

contained more mountain than western sweet-cicely) also tended toward lower counts in the ungrazed plots, although differences were significant at only 1 site (4U compared to 4WG) (Table 5).

Sharptooth angelica, cow-parsip, and western sweet-cicely were the most desirable spring bear foods encountered in plots. Of these, cow-parsnip was the most common -- occurring at 11 sites. Two late grazed sites had significantly more cow-parsnip stems than did early grazed sites (10LG/EG and 11LG/EG), and 1 summer grazed site (1G) had significantly more than its paired ungrazed site. Paired site 9EG/LG had more stems at the early grazed site than at the late grazed site. Sharptooth angelica had significantly more stems at an ungrazed vs. early or late grazed site (3U/G), and 2 late grazed vs. early grazed sites (9LG/EG and 11LG/EG). Western sweet-cicely was significantly more abundant at 2 grazed vs. ungrazed sites (1G/U and 2G/U) and 1 late grazed vs. early grazed site (10LG/EG) (Table 5).

Since plot data on phenology were too incomplete for statistical analyses, weighted mean heights were used as an index to phenology. These data (Table 5) show that among paired sites more ungrazed vs. grazed and late grazed vs. early grazed sites had significantly taller bear foods.

Effects of historical grazing on bear foods. -- In the

above analyses of herbaceous bear foods, it was apparent that the current grazing regimes (particularly no grazing from 2 to 9 years) were inadequate predictors of bear food abundances. Consequently, historical information on grazing period, stocking density, and the proportion of each pasture covered by mesic plant communities were used as criteria to compare sites that differed significantly in amount of bear foods (Table 6). In 1986 (the year all sites were measured), there were significantly more desirable bear foods (sharptooth angelica, cow-parsnip, and western sweet-cicely) in pastures that were historically grazed after the month of June (sites 1G, 2G, 3U, 9LG, 10LG, and 11LG). Four of the 6 sites/pastures had more animal units per area, and all 6 had proportionately more aspen and willow than their paired pastures that were grazed during June.

The historical information did not adequately explain why mountain sweet-cicely, the most common Umbelliferae measured, was more abundant at certain sites than others. Of the paired site comparisons, it was more abundant in 4 early grazed sites (3G, 10EG, 4EG, and 4WG) regardless of grazing intensity or proportions of aspen and willow in the pastures. It was also more abundant at 2 sites (6U and 8G) that, compared to their paired sites, had similar grazing periods, very similar stocking densities, and similar proportions of riparian vegetation (Table 6).

Table 6. Relationships between pasture characteristics and abundance of specific herbaceous bear foods. Pluses indicate significantly greater ($p<0.05$) abundance (number or canopy coverage) than the other site in the pair.

	Bear foods								Historic pasture characteristics[b]		
Site	Anar[a] #	Hela #	Osch #	Osoc #	Frvi %	Grass %	Taof %	Trlo %	Months cattle grazed	Stocking density[c] (A.U./ha)[d]	Aspen and willow[e] (%)
1U									June-Sept.	0.3	10
1G		+		+		+	+		July-Sept.	0.4	25
2U									June-Sept.	0.3	10
2G				+		+			July-Sept.	0.1	17
3G			+						June/Aug.-Oct.[f]	0.5/1.1	1
3U	+								Sept.-Oct.	1.5	6
9EG		+							June-July	0.6	12
9LG	+					+			July-Sept.	0.4	25
10EG			+				+		June-July	0.3	18
10LG		+		+		+			Aug.-Oct.	0.4	23
11EG						+			June-July	0.3	18
11LG	+	+					+		July/Aug./Sept.[g]	0.5	26
4EG			+						Feb.-May	1.3	19
4U									Sept.-Feb.	2.2	10
4EG									Feb.-May	1.3	19
4WG			+			+			Jan.-March	3.2	26
4U									Sept.-Feb.	2.2	10
4WG			+			+			Jan.-March	3.2	26
6U			+		+				July-Sept.	0.6	7
6G							+	+	July-Sept.	0.6	7
7U					+				July-Sept.	0.6	1
7G									July-Sept.	0.6	1
8U									June-Aug.	0.3	7
8G			+						June-Aug.	0.4	4

[a]Abbreviations in Appendix A Table 9.
[b]Averaged for 1950 through 1985, or up to date of rest.
[c]Pasture area calculated minus steep slope closed timber areas.
[d]A cow with calf considered one Animal Unit (A.U.) until weaning.
[e]The proportion of pasture covered by aspen and willow.
[f]Grazed annually in either June or August through October.
[g]Grazed annually in either July, August, or September.

In 4 of the 6 paired site/pasture comparisons of grazing in June vs. later than June, grasses were more abundant when grazed after June (1G, 2G, 9LG, and 10LG). All 4 sites with significantly greater amounts of grass had a higher proportion of riparian vegetation in their respective pastures, and 2 (1G and 11LG) had greater stocking densities. Grass was also more abundant at site 4WG, where the pasture was grazed from January-March by more animal units and contained more riparian vegetation than sites 4EG and 4U with which it was compared (Table 6).

Common dandelion was more abundant at 4 paired site/pasture comparisons. Two of the sites with more dandelions (1G and 11LG) were grazed later than June (vs. during June) by more animal units in pastures with proportionately more riparian vegetation than the sites/pastures with which they were paired. Site 10EG had more dandelions, was grazed during June (vs. later than June), by less animal units, and occurred in a pasture with proportionately less riparian vegetation than did 10LG; and site 6G had more dandelions than 6U even though their respective pastures had the same grazing period, stocking densities, and proportions of riparian vegetation. Strawberry and clover differed significantly in 3 comparisons (strawberry in 6U/G and 7U/G, and clover in 6U/G) even though grazing period, stocking density, and

proportions of aspen and willow did not differ (Table 6).

Pasture Utilization by Cattle

Five pastures were measured to determine short term impacts of cattle grazing on herbaceous bear foods im mesic communities (Table 7). The Kurt Heinrich (KH) and North Cow Creek (NC) pastures were measured in 1985, the Tom Salansky (TS) and Hightower (HT) pastures in 1986, and the South Dupuyer Creek (SD) pasture in both years. These pastures varied in shape (Appendix D, Fig. 8), physiography (from a relatively flat grassland with shallow coulees, to gently rolling to steep foothills), and size (from 66 to 324 ha). The number of plots in each pasture ranged from 3 to 10 and was roughly proportional to the amount of aspen and willow present (ranging from 4 to 15 %). The distances of plots from the gate through which cattle entered the pasture ranged from 0.2 to 2.0 km. Black angus or crossbreed black angus yearlings or cow/calf pairs grazed the study pastures. Stocking densities were from 0.4 to 1.0 A.U./ha. All pastures were grazed for at least a 30 day period between June 1 and September 30. The earliest entry date was May 18, and the latest was July 1 (Table 7).

Cattle utilization of 2 categories of bear foods (1) grasses/sedges, common dandelion, and clover; and 2) members of the Umbelliferae family (sharptooth angelica, cow-parsnip, mountain and western sweet-cicely) varied widely

Table 7. Characteristics of 5 pastures in which cattle utilization patterns were monitored.

	Pasture				
	KH	NC	SD	TS	HT
Year	1985	1985	1985 and 1986	1986	1986
Plots/ pasture (#)	10	10	10	3	5
Range of plot distances from gate (km)	0.8-1.6	0.2-1.2	0.2-2.0	1.4-1.8	0.4-1.6
Pasture physiography	prairie and gently rolling foothills	prairie and shallow coulees	gently rolling to steep foothills	gently rolling prairie	gently rolling to steep foothills
Proportion of pasture in aspen and willow (%)	13	12	15	4	4
Pasture area (ha)	259	259	324	66	222
Class of livestock	yearling heifer	cow/calf	cow/calf	yearling heifer	cow/calf
Stocking density (A.U./ha)	0.6	1.0	0.5	0.6	0.4
Period grazed	June 10 - July 10	June 6 - July 5	June 25 - Aug. 21, '85 July 1 - Aug. 17, '86	June 1 - Sept. 30	May 18 - Aug. 1

among pastures (Appendix B, Tables 10-16), but on average cattle utilized 30% of the bear foods in 22-28 days (Figures 2 and 3). In 41-47 days, all bear foods were 50% utilized. Umbelliferae were 80% utilized by day 61, while grasses, sedges, dandelions, and clovers were 67% utilized after 82 days of grazing.

At the end of the grazed period, average use of plots closest to the gate of entry was generally no different than farther ones (Figures 4 and 5). Cattle utilization of Umbelliferae was similar in plots 0 to 0.5 and 1.0 to 1.5 km from the gate and greater at more distant plots. Grasses, sedges, dandelions, and clover were more heavily utilized at sites further from the entry point than at sites near the gate (Appendix B, Table 17).

Bear Food Phenology

Seven bear foods were analyzed for earliest and latest dates at the "seed ripe" stage (Fig. 6). The earliest plant species to produce seeds was common dandelion (May 19). Next were clover, the grasses (primarily Kentucky bluegrass, smooth brome, and timothy), and mountain sweet-cicely, which produced seeds in early June. Later were western sweet-cicely (June 15), cow-parsnip (June 25), and sharptooth angelica (July 14).