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ROCKY MOUNTAIN FRONT GRIZZLY BEAR MONITORING
AND INVESTIGATION

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INTRODUCTION

In the conterminous 48 states, only six areas are found to contain self-perpetuating or remnant populations of grizzly bears (*Ursus arctos horribilis*) (US Fish & Wildlife Service 1981). Of these six areas, only the Northern Continental Divide population is contiguous with Canadian and Alaskan grizzly bear populations, and stands the best chance of survival in the future. The Northern Continental Divide ecosystem includes Glacier National Park, parts of the Flathead and Blackfoot Indian reservations, parts of five national forests (Flathead, Helena, Kootenai, Lewis and Clark, and Lolo), four wilderness areas (Bob Marshall, Great Bear, Mission Mountains and Scapegoat), and a significant amount of state and private land. One of the more unique segments of this ecosystem is the Eastern Rocky Mountain Front where the great plains meet the steep north and south running ridges which form the Sawtooth Range, more commonly known as the Rocky Mountain Front range. Here, along a narrow strip exists the last plains habitat which is inhabited by the grizzly bear.

In 1977, research was initiated on the grizzly bear along the east slope of the Rocky Mountains in northwestern Montana. The study, which was continued until 1979 by the Border Grizzly Project, provided much baseline data concerning grizzly bear populations, home range, movement and habitat use (Schallenger and Jonkel 1980). Research efforts were continued in 1980 through a contract agreement between the Bureau of Land Management and the Montana Department of Fish, Wildlife & Parks personnel and Border Grizzly Project personnel (Aune and Stivers 1981). The 1981 monitoring of the East Front grizzly population was continued with support and funding from the Bureau of Land Management, Montana Department of Fish, Wildlife & Parks, United States Forest Service, Williams Exploration Company and Sun Exploration Company. Impetus for continuing research on the grizzly bear in this area is the Endangered Species Act of 1973, the grizzly's listing as a threatened species in 1975, and the Bureau of Land Management, US Forest Service and Montana Department of Fish, Wildlife & Parks' need for information on the species in making resource management decisions. This is especially important in relation to increased oil and gas exploration/development and human activities within the study area.

The objectives of the study were: (1) to review and analyze previously accumulated data on grizzly bears, (2) to further delineate and define critical habitat and important use areas with the study area, (3) to determine impacts associated with oil and gas exploration and other human activities, and (4) make recommendations to protect and maintain grizzly populations and habitat. Specific information regarding plant phenology and presence of bear foods, grizzly bear habitat requirements on a seasonal basis, population numbers on a seasonal and yearlong basis, food habits on a seasonal basis, interaction with other wildlife species, and bear home ranges, movements, and distribution were gathered.

DESCRIPTION OF THE STUDY AREA

The study area lies along the east face of the Continental Divide in northwestern Montana (Fig. 1). The northern boundary is Highway 2, and the southern boundary is the Sun River. The study area is bounded on the west by the upper portions of the South Fork of the Flathead River, and the Middle Fork of the Flathead River within the Flathead National Forest. The eastern boundary extends to approximately Range 6 West. Bureau of Land Management (BLM), Montana Department of Fish, Wildlife & Parks (MDFWP) and private lands with federal oil, gas and mineral rights were the primary focus of the research.

The study area has been described in Picton (1960), Schallenger (1966), Knight (1970), Mudge (1972), Erickson (1972), Frisina (1974), Holdorf (1981), Schallenger (1974 and 1976), Schallenger and Jonkel (1978, 1979 and 1980), and USDA Forest Service (1977). Picton and Picton (1975), Schallenger (1974 and 1976), Dupuyer Centennial Committee (1977) and USFS (1977) present historical information from the study area. Information on grizzly bears in the region has been reported by Jonkel (1976 and 1977), Schallenger (1974 and 1976), Sumner and Craighead (1973), Hamlin and Frisina (1974), Schallenger and Jonkel (1978, 1979 and 1980), and Aune and Stivers (1981).

Briefly described, elevations on the study area range from about 4200 feet (1280 m) in river valleys east of the mountains to 9392 feet (2863 m) on mountain tops. Sedimentary rocks of the limestone and dolomite types generally form the peaks and high ridges, while rocks of the sandstone type often underlie the valley bottoms. Alpine glaciers extensively modified landforms in the past.

Annual precipitation averages about 12 inches (31cm) at Choteau and up to 65 inches (167 cm) near the Continental Divide. Approximately 80 percent of the precipitation falls as snow. Temperatures range from 90 F (32 C) to about -50 F (-46 C). The climate is characterized by long, cool winters, short, warm summers and strong southwest winds. Climatological data from two reporting stations along the east front are presented in Appendix A.

The major drainage systems within the study area include the Sun River, Teton River and Birch Creek. Many of the drainages form a characteristic trellis pattern with narrow canyons joining main rivers at abrupt angles (Mudge 1972). Riparian vegetation extends into the high plains and provides food and cover for black and grizzly bears far from mountainous habitat (Schallenger and Jonkel 1980).

Subalpine fir (*Abies lasiocarpa*) is dominant and represents climax on most of the timberline forest. Stands of spruce (*Picea* spp.), white-bark pine (*Pinus albicaulis*), lodgepole pine (*Pinus contorta*), Douglas fir (*Pseudotsuga menziesii*), limber pine (*Pinus flexilis*), aspen (*Populus tremuloides*), and cottonwood (*Populus trichocarpa*) are found on select locations, depending on landform, aspect and elevation. Natural grasslands cover the plains and foothills at lower elevations and intergrade westward into limber pine savanna (Schallenger and Jonkel 1980).

METHODS

Distribution, Home Range, Movement and Activity Patterns

Bears were trapped using front foot snares (Aldrich Snare Co., Clallam Bay, Wash.). Before trapping began, snares were boiled for several hours in bark, needles and leaves from willow, kinnikinnick and juniper. Then the snares were lightly waxed with melted paraffin. All trapping equipment and bait were handled with gloves. Bait included carcasses of road-killed deer, horses and cattle, plus miscellaneous meat scraps.

Snares were set at the mouth of log cubbies, on trails, and occasionally a dip or barrel set was made. Cubbies were built and pre-baited before snares were set. A drag, which consisted of a piece of ripe bait on a rope, was pulled between each snare set and along bear travel routes to attract bears to the set. Warning signs were posted announcing the general location of the set to minimize human/bear encounters.

Traplines were operated from April 21 until May 31 in the Black-leaf-Antelope Butte area. A selective trapping operation aimed at capturing one more adult black bear was conducted from June 8 until June 24. The traps were checked by vehicle or with saddle horse and pack string.

Captured bears were darted with a Palmer Cap-chur gun. Phencyclidine hydrochloride (Sernylan) and promazine hydrochloride (Sparine) mixed in equal portions were used to immobilize grizzly bears. A 2:1 ratio of ketamine hydrochloride (Ketaset) and xylazine (Rompun) was used on small grizzly bears and black bears.

Grizzly and black bears were marked with two colored plastic ear tags, all with the same number. One tag was placed in each ear. A numbered lip tattoo which matched the ear tag number was applied to the inside upper lip.

Grizzly bears were fitted with radio transmitters in the 164 MHz range (Telonics, Inc., Mesa, Ariz.). Small grizzlies were not collared to avoid problems associated with increasing neck girth of growing individuals and the possible restriction by the radio collar. The collars placed on subadult grizzlies were padded with foam up to 2 inches thick to allow for expected increases in neck girth over time.

Once trapped and drugged, physical measurements of the bear were taken. Weight was determined using a cattle weighing tape. Blood samples were taken from the femoral vein to aid in determining genetic traits. The first premolar was extracted and used to determine age of the bear from cementum annuli counts (Stoneberg and Jonkel 1966).

Radio-instrumented bears were monitored during frequent (at least weekly) aerial flights made in a Piper Supercub. The airplane was

equipped with a belly-mounted antenna system. Black and white photos were taken at each location for future reference. Ground tracking efforts were conducted immediately after aerial flights were completed. All locations were plotted on USGS 1:24,000 quad maps by UTM coordinates. Bears were tracked until they denned or until the radio malfunctioned.

Scats and reports of grizzly bear sightings, tracks, dens, kills and depredations were collected from many sources during the study. Federal and state government agencies, outfitters, guides, hunters, ranchers and other outdoorsmen cooperated by reporting such information. Observation data were then plotted on USFS ($\frac{1}{2}$ inch:1 mile) maps to record distribution. Distribution maps for each spring, summer and fall season were prepared. The information collected since 1980 was recorded by UTM's and section, township and range. Each observation represented at least one grizzly bear and ranged to eight.

Grizzly bear home ranges were described by the minimum home range method (Mohr 1947, Hayne 1959) and the modified minimum method (Harvey and Barbour 1965).

Activity patterns were determined by 24-48 hour continuous monitoring of individuals. Motion sensing collars were placed on two bears to increase reliability of activity data. Nonmotion sensing collars could yield activity data by interpretation of signal strength by an experienced observer. Motion sensing collars are designed to transmit in two different modes, depending on the collar position. Constant transmission in either mode indicates a stationary collar. Intermittency of mode indicates motion of collar, and bear.

Bears were selected for 24-48 hour monitoring according to their availability and proximity to areas of disturbance. Instrumented bears were ground tracked by foot, horseback, or vehicle, for as long as possible. Observers monitored the bears every one-quarter to one-half hour, from as close as possible (for maximum radio reception) without disturbing the bear. Activity and locations were determined by triangulation, signal integrity, visual contact, or state of transmitted mode. A standard clock type form was used, where activity could be proportioned into a 12-hour monitoring period. Information recorded on the activity forms included date, bear number, observers, receiver type, observation time, location of observer, location of bear, signal strength, constancy or intermittency of signal, and transmitter mode.

Bear activities were recorded as inactive, stationary active, or fully active. Inactive periods are defined as bear being stationary with a constant signal, and signal strength, or mode. Stationary active is defined as bear being stationary with a light-to-moderate intermittency of signal, signal strength, and, or, mode. Fully active is defined as bear not stationary with a moderate-to-heavy intermittency of signal, signal strength, and, or, mode. The stationary active periods prior to fully active periods were termed periods of arousal. The stationary active periods following fully active periods were termed periods of quiescence.

To quantify daily movements, all consecutive day radio locations were pooled from 5 years of data (1977-1981). Airline distances (in meters) from one day's location to the next, were determined using each day's UTM coordinates to calculate the hypotenuse of a right triangle. Where there was more than one location on each consecutive day, the pair of coordinates yielding the greatest distance was used. These daily movements were categorized by season. Seasonal dates are spring - den emergence through June, summer - July through August, and fall - September to den entrance. All radioed bear movements have been plotted on USGS topographic quadrat maps.

Food Habits

Grizzly and black bear scats were collected, tagged and frozen. Scats were differentiated as to species when collected from unknown bears. Scats of greater than 2-inch diameter or 1 quart in volume were labeled grizzly bear scats. Some scats were differentiated as to species by keying guard hairs found in beds and on trees or brush near the scat collection site. Most of the grizzly scats collected were from known radio-collared grizzlies.

Frozen and dried scats were soaked, then washed through two wire mesh screens twice. The first wash, using hot water, was followed by a second with cold water. Coarser materials gather in the coarse mesh screen (0.156), while finer materials gather in the finer mesh screen (0.0937 inch). The contents of each screen were then placed in a large porcelain pan. Cold water was added and the scat material examined. Items present are identified as to genus and species when possible. The part of each item is also identified (e.g., leaf, stem, root, berry, etc.). The percent volume of each item is visually estimated. Data from each scat, including information about the collection site, are coded on computer sheets. Data analysis is conducted by computer methods.

The frequency, percent frequency, total volume, percent volume, percent composition, importance value and importance value percent are calculated. Formulas are presented below:

Frequency = Number of scats having the same item

$$\text{Frequency percent} = \frac{\text{Frequency of item}}{\text{Total number of scats}} \times 100$$

Total volume = Total volume of the same item in all scats of the sample

$$\text{Total volume percent} = \frac{\text{Total volume of item}}{\text{Total volume of scat sample}} \times 100$$

$$\text{Percent composition} = \frac{\text{Total volume of item}}{\text{Number of scats with item}}$$

$$\text{Importance value} = \frac{\text{Percent composition} \times \text{percent frequency}}{100}$$

$$\text{Importance value percent} = \frac{\text{Importance value of item}}{\text{Sum of importance values for all items}}$$

Den Studies

Dens were located by random chance and by radio tracking bears to their dens from air or ground. Dens were inspected on the ground as time permitted. Pertinent data gathered from each inspection included elevation, aspect, slope, habitat type, land type, den type and condition of the den. Dens which were not visited on the ground were accurately plotted on USGS maps and data were extracted from the maps and air photos. Dates of entrance and emergence from dens by grizzly bears were determined by radio monitoring individuals.

Impacts of Oil and Gas Exploration and Development Activities

Home ranges were mapped in relation to oil and gas drilling and seismic exploration activities. Radioed bears were monitored for 24-48 hour periods in the area of oil and gas exploration/development activities. Grizzly bear movements and locations were plotted by UTM's on USGS quadrat maps.

A simple comparative analysis of distribution of radioed bears in relation to relation to drill sites and roads was conducted by measuring distance in feet to proposed and active drill sites, as well as roads and perennial water. A Chi-square test was used to determine if statistical differences existed between the period in 1980 before drilling activity and the August 1980 to November 1981 period when drilling activity was present within the Blackleaf area.

Comparisons were made of home ranges of two radioed bears before and after drilling activity began in the study area. One radioed bear monitored during similar time periods but outside the area of intense oil and gas exploration was compared as a control.

Accurate records of oil and gas drilling activity and the associated phases of activity were kept. Seismic activity information was recorded by the US Forest Service. However, the data recorded were not complete enough to allow even simple analysis techniques.

Habitat Studies

Habitat data recorded at each radio location included elevation, aspect, slope, habitat component, habitat type, land type, site information, topography, distance to perennial water (feet), and distance to road (feet). The radio location is plotted on USGS maps and information is recorded from maps and air photos, or if possible, when the site is visited on the ground. Habitat types were recorded according to Pfister et al. (1977) and Mueggler and Handl (1974). Land types follow Holdorf (1981) and Holdorf, Martinson and On (1980), and were determined by current land type maps of the study area obtained from the US Forest Service. Habitat components were defined in Aune and Stivers (1981) (Appendix B).

Specific radio locations made by ground and aerial tracking efforts were visited to determine the reasons for the bears' presence at each site. Scats, tracks, beds, digging sites, den sites, destruction of rotten logs, dug up squirrel caches, marking trees, hair on fences and other objects, trails, evidence of feeding activity or any other evidence of activity were noted. A 375 m² (0.1 acre) circular plot was delineated within the activity site. Plant species and canopy coverage of each were recorded at the site. Vegetation structure was determined by assigning canopy coverage values to structural tree and shrub heights. Plants were identified according to Hitchcock and Cronquist (1973). Habitat data from radio locations and vegetation data from circular plots were coded and analyzed by computer methods.

Data from 616 specific radio locations from 10 individual bears monitored from 1977-1981 were coded and keypunched on computer cards. Data were analyzed by the spss statistical program to determine frequency and relative percent of each input parameter. Data put in were those recorded at each radio location described above.

Availability of habitat parameters has yet to be determined. Current techniques are being considered and developed. Composite home range polygons were developed according to methods described in Servheen (1981). A composite home range polygon was developed for each season - spring, summer and fall.

Black Bear Investigations

Methods utilized in black bear investigations paralleled those described above. Radio collars were placed only on mature animals. Subadults and smaller adults were ear-tagged but not fitted with radio collars. No site inspections of black bear radio locations were made, as time limited the development of these studies. Habitat data were extrapolated from maps, air photos and examination of sites from the air. Black bear habitat use was tabulated without the aid of computer methods. However, data were coded and will be input as this study continues to progress.

RESULTS AND DISCUSSION

Trapping and Tracking

An extensive trapline was operated for 41 days. A selective trap operation was conducted an additional 17 days during 1981. Four individual grizzlies were captured four times (Table 1), and five individual black bears were captured seven times during the 1981 trapping season. One female grizzly (273) was captured at the site of a cattle depredation, but was not involved in the depredation.

A total of six different grizzly bears was monitored during the 1981 report period. These included two males and four females. Two grizzlies (220, 273) had old collars replaced. One grizzly (333) was refitted with a collar this year after he cast his collar in August 1980. Only one grizzly (335) had not previously worn a radio collar, but had been captured and ear tagged in 1980. Two bears (257, 223) which were monitored in 1981 were radio collared in 1980.

Table 1. Physical measurements and marking data from grizzly bears captured on the Rocky Mountain east front 1981.

		283-333*	220*	273*	335*
Date		4/21/81	4/29/81	5/16/81	5/29/81
Age and sex ^{1/}		3.5 M	20.5 F	7.5 F	3.5 F
Weight ^{2/}					
Behind hump	lb	316	213	316	205
	kg	143	97	143	93
Over hump	lb	348	244	-	230
	kg	158	111	-	104
Color		Brownish-silvertip Dark leggings	Silvertip Dark leggings	Dark silvertip	Silvertip w. tan sides & shoulders
Total body length ^{3/}	in cm	63.5 161.3	63 160.0	69 175.3	61 154.9
Neck girth ^{4/}	in cm	27 68.6	23 58.4	26 66.0	24 61.0
Chest girth ^{5/}	in cm	56 116.8	40 101.6	46 116.8	39.5 100.3
Shoulder ^{6/}	in cm	34 86.4	- -	32.5 82.5	- -
Shank ^{7/}	in cm	17 43.2	15 38.1	20 50.8	12 30.5

Table 1 continued.

		283-333*	220*	273*	335*
Foot Measurements ^{8/}					
Front pad width	in	5.75	5.75	5.5	-
	cm	14.6	14.6	14.0	-
Front pad length	in	2.625	3	3	3
	cm	6.7	7.6	7.6	7.6
Front foot length	in	5	5.25	5.25	5.25
	cm	12.7	13.3	13.3	13.3
Front claw length	in	2.25	2.75	2	-
	mm	57.2	69.8	50.8	-
Front claw arc ^{9/}	in	3.5	4	2.75	3.25
	mm	88.9	101.6	69.8	82.5
Hind pad width	in	6	5.5	6	-
	cm	15.2	14.0	15.2	-
Hind pad length	in	7	7	7.25	5.25
	cm	17.8	17.8	18.4	13.3
Hind foot length	in	9	8	9	9.25
	cm	22.9	20.3	22.9	23.5
Testes length	in	2.875	-	-	-
	mm	73.0	-	-	-
Testes width	in	1.25	-	-	-
	mm	31.7	-	-	-
Baculum length ^{10/}	in	6.5	-	-	-
	mm	165.1	-	-	-
Reproductive state		-	Lactating	Lactating	No
Fat index ^{11/}		4	3	3	3

Table 1 continued.

	283-333*	220*	273*	335*
Ear tags				
Left No.	283	220	-	335
Front	0 red	0 yellow	-	1 red
Back	0 yellow	0 yellow	-	-
Right No.	333	220	273	335
Front	0 red	0 blue	0 yellow	0 orange
Back	0 red	0 blue	-	0 red
Tattoo	333 green	220 green	273 green	335 green
Collar color	Silver tape	Blue & yellow tape	Silver, yellow, black, blue & red tape	Silver tape

* Recapture

- 1 - Age was determined by the number of cementum annuli rings in extracted premolar tooth
- 2 - Weight determined by the WE=80 livestock weight-tape (live weight of cattle in pounds in relation to chest measure in inches). Measured around chest in a prone position.
- 3 - Total body length indicates length from tip of nose to base of tail, following natural body contours; i.e., zoological.
- 4 - Neck size measured at smallest circumference of neck.
- 5 - Chest girth measurement around the body just posterior to the shoulders.
- 6 - Shoulder length indicates measurement from middle of hump to distal end of humerus.
- 7 - Shank length indicates measurement from knee to base of heel.
- 8 - Foot measurements:
  - a. Front pad length
  - b. Front pad width
  - c. Front foot length
  - d. Front claw length
  - a. Hind pad length
  - b. Hind pad width
  - c. Hind foot length
- 9 - Front claw outside arc is measured from base of claw to tip over contour.
- 10 - Baculum length measured by palpation.
- 11 - Fat index is an arbitrary measure of the bear's condition on a scale of 1 to 5; 1 being emaciated, 3 being average and 5 being extremely fat.

Only one radio collar ceased functioning during 1981. The transmitter collar on bear 223 had a weak radio signal but was audible at close range until June 2 when either the collar ceased functioning or the bear was killed.

A total of 246 radio contacts was made with six different grizzly bears from the period beginning March 10 and ending November 15 for an average of 31 locations a month. Table 2 presents the distribution of tracking efforts for each bear by the month. Two hundred twenty-one of these locations were specific, and generated habitat use data for 1981.

Table 2. Bears radio-monitored in the study area, 1981.

Bear No.	Sex	Age	Number of Locations							Total
			Apr-May	Jun	Jul	Aug	Sept	Oct	Nov	
Grizzly										
220	F	20.5	23	8	7	6	3	8	Den	55
257	F	11.5	21	8	10	12	7	5	Den	63
333	M	3.5	9	13	5	4	3	4	4	42
223	M	6.5	7	2	0	0	0	0	0	9
273	F	7.5	4	10	10	14	5	5	Den	48
335	F	3.5	3	6	6	5	4	5	Den	29
			67	47	38	41	22	27	4	246

Distribution

Distribution of grizzly bears was determined by plotting 1296 observations gathered between the years 1977 and 1981 (Fig. 2). A total of 698 of these observations is reported in Schallenberger and Jonkel (1980). Five hundred ninety-eight were collected during the 1980 and 1981 field seasons. Table 3 presents the distribution of observation data for each year by season. Approximately 43 percent were collected during the summer season, while 30 and 27 percent were gathered during spring and fall, respectively. Figures 3, 4 and 5 show the seasonal distribution of observation data. Seasons are defined as spring (March-June 30), summer (July 1-August 30), and fall (September 1-November).

Table 4 presents the 1981 observation data by type for each season. A total of 60.2 percent of the observations during 1981 come from the Teton drainage, while 29.6 percent, 8.2 percent, 1.1 percent, and 0.9 percent come from the Marias, Sun River, Middle Fork of the Flathead and South Fork of the Flathead drainage, respectively.

Figure 2. Distribution of 1296 grizzly bear observations, 1977-1981.

Figure 3. Distribution of 348 grizzly bear observations collected during spring, 1977-1981.

Figure 4. Distribution of 556 grizzly bear observations collected during summer, 1977-1981.

Figure 5. Distribution of 356 grizzly bear observations collected during fall, 1977-1981.

Table 3. The number of observations plotted on the overall and seasonal distribution maps, 1977-1981.

Period	Spring	Summer	Fall	Total
1977-79 ^{1/}	148	345	205	698
1980	50	83	62	195
1981	186	128	89	403
Total	384	556	356	1296

1 - Reported in Schallenger and Jonkel (1979).

Table 4. Number of observations for each season by observation type, 1981.

Observation type	Spring	Summer	Fall	Year
Radio location	114	79	53	246
Sighting	23	29	12	64
Scat	23	12	10	45
Track	18	3	8	29
Other	8	5	6	19
Total	186	128	89	403

Schallenger and Jonkel (1980) discussed two important bear use areas within the study area. These are the Antelope Butte-Muddy Creek and the Ear Mountain-Pine Butte areas. Additional information from continued investigations confirms the importance of these areas to grizzly bears. Several other areas of high use by grizzly bears have been identified, also. One, the Teton-Sun River Divide is used mostly during the summer-fall period. The area provides important alpine digging slopes, pine nut diggings and shrubfields with *Shepherdia canadensis* in abundance. Another important area for grizzlies is the Dupuyer Creek-Walling Reef complex. This area has shown high grizzly bear use in 1980 and 1981 and qualifies as excellent spring grizzly habitat. Information from this area indicates that bears travel long distances down Sheep Creek, Scoffin Creek and Dupuyer Creek, similar to movements reported on the Muddy Creek, Blackleaf Creek and Teton rivers. The Dupuyer-Walling Reef area is probably contiguous with the Antelope Butte-Muddy Creek area, separated only by interspersed open grasslands.

Seasonal distribution maps reveal the importance of river valley, creek bottom and foothill habitat to grizzly bears during the spring. Schallenberger and Jonkel (1980), Servheen (1981), and Jonkel (1980) report the importance of low elevation wet sites and creek bottoms to grizzly bears in the spring. The concentration of grizzly bears along these foothills, creek and river bottoms appears to be related to the early snow melt from these sites and the phenology of important bear foods. Grizzly bears distribute themselves more evenly throughout the area during summer and fall.

Several biases exist in present distribution maps. The study area is large and the extreme southern, extreme northern, and back country areas receive less field effort. Much of the information in these regions reflects low intensity of field work, rather than the true distribution of grizzly bears. Restricted access to some private land also prohibited field work in areas which deserve attention. The Deep Creek area probably receives high grizzly bear use; however, observation data are nearly absent from this area.

Home Ranges

Annual home ranges were mapped for different grizzly bears monitored during 1981 (Fig. 6-10). Minimum and modified minimum home range sizes were calculated for five different grizzly bears. One bear (223), did not generate enough radio location data to calculate a modified minimum home range size (Fig. 11). This illustration is a modified minimum range based on locations from August 1980 until June 2, 1981 and cannot be considered an accurate depiction of this bear's true annual home range. Comparisons of home range sizes are presented in Table 5.

Table 5. Modified minimum and minimum home range sizes of five grizzly bears, 1980 and 1981.

Bear No.	Sex	1980(km ²)		1981(km ²)	
		Modified Min.	Min.	Modified Min.	Min.
220	F	242.7	447.5	165.8	449.6
257	F	113.7	370.9	243.2	-31.3
273	F	-	-	195.8	334.1
335	F	-	-	206.2	374.0
333	M	-	83.9 ^{1/}	481.8 ^{2/}	1293.7 ^{1/}
223	M	-2/	416.5 ^{1/}	-	1047.4 ^{1/}

1 - Only a partial home range.

2 - Too few radio locations were available for calculating a modified minimum home range.

Figure 6. Modified minimum home range of grizzly No. 220, 1981.

Figure 8. Modified minimum home range of grizzly No. 335, 1981.

Figure 9. Modified minimum home range of grizzly No. 273, 1981.

Figure 10. Modified minimum home range of grizzly No. 333, 1981.

Figure 12 presents the home range overlap of five individual grizzlies monitored during 1981. Overlap exists among all the home ranges of these five bears and also bear 223 not shown in this figure.

Male and female home ranges on the east front were generally larger than those reported in other areas of northwestern Montana (Jonkel 1978, 1980 and Servheen 1981). Home range sizes were similar to those reported in Schallenger and Jonkel (1980) for the East Front area. In general, males had larger home ranges than females within the area. This has been reported in other studies of grizzly bears (Jonkel 1977, 1978, 1980; Servheen 1981, Knight 1979, 1980; Pearson 1975, and Schallenger and Jonkel 1980). A complete summary of home range data from the east front will be prepared by 1983.

Activity Patterns and Daily Movements

24-48 Hour Activity Patterns

Activities of five individual grizzly bears were monitored for varying periods from June to September in the Pine Butte-Teton River and Blackleaf-Antelope Butte areas. Individual activity patterns are in Appendix D. The five monitored bears were nocturnal in these areas. Table 6 presents the range and average length of each activity in 1981.

Table 6. The range and average length of each activity period as recorded during 1981.

	Range (hrs)	Average	SD	N
Fully active	6.5-10.5	8.8	1.29	18
Stationary active				
Period of quiescence	1.0-2.5	1.56	.65	17
Period of arousal	0.0-3.0	1.05	.85	19
Inactive	11.0-15.0	12.9	1.50	8

In general, the bears became fully active between 2100 and 2400 hours, and remained active until 0600 to 0900 hours, with the fully active period averaging 8.8 hours. The inactive periods were generally from 0800 to 2000 hours, with the period averaging 12.9 hours. The stationary active periods occurred in the twilight morning and evening hours. The morning period of quiescence averaged 1.56 hours, while the evening period of quiescence averaged 1.05 hours.

The fully active periods were typically composed of feeding, traveling and feeding, and traveling to and from feeding sites. Grizzly bears were bedded during the inactive periods. During these mid-day bedding sessions, an occasional interruption of signal mode, or change of signal integrity

Figure 12. Home range overlap of five grizzlies and concurrent drilling activities conducted during 1981.

was noted when the bear moved within its bed, moved to another bed site nearby, or simply raised its head for sensing. Human and mechanical noises generally caused this latter response. In one instance, bear 257 was disturbed in her day bed at 1700 hours by children swimming in a beaver pond 150 yards away. Bear 257 became fully active, moving approximately 300 yards upstream through willow cover to bed again an hour later when the human disturbances ceased. Interruptions of the inactive period were generally of short duration.

The stationary active period of arousal was associated with the awakening of the bear with some slight feeding and moving about. The period of quiescence was associated with a "winding down" of activities, generally combined with bed construction and some last minute feeding.

Differences in activity patterns have been noted for the same bears in the same timeframes, but in different locales. Generally, bears seem to be more crepuscular within more mountainous or isolated terrain. Significant differences in activity patterns may be correlated with different habitat and disturbance parameters, sex and age of bears, and the bears' social position. Activity data from bears in more remote areas would be necessary to make comparisons with activity patterns of bears which occupy the east front foothills areas.

Activity Categories

Activities of grizzly bears at each radio location were recorded and placed in a general activity category. Figure 13 displays the seasonal activities of grizzly bears. The data represent only known activities from radio locations where bear activities were observed or a site inspection was made. For many locations, activity could not be categorized within our system or was not known. If it could not be clearly categorized, it was placed in a general feeding or nonfeeding group.

Nine different feeding activities and four different nonfeeding activities were recorded during spring. Grazing on forbs and grasses, feeding on carcasses or carrion, and turning over cow chips and rocks for ants and grubs were the three most frequently observed feeding activities during spring. Bedding and traveling were the two most commonly observed nonfeeding activities.

During summer, 12 different feeding activities and 2 different nonfeeding activities were recorded. Grazing, digging for roots, digging small mammals, tearing logs, and feeding on berries were the more significant feeding activities. Bedding and traveling were the most frequently observed nonfeeding activities.

Ten different feeding and four different nonfeeding activities were recorded for fall. Feeding on carcasses and carrion and digging for pine nuts were commonly observed feeding activities during fall. Nonfeeding activities include bedding, traveling and denning/pre-denning activities.

Figure 13. Known seasonal activities of grizzly bears, Rocky Mountain east front, 1977-1981.

Activity information correlates well with known food habits of grizzly bears. The extent of time bears spend grazing is probably greater than the activity data show. Grazing activity is the most difficult to observe, so it may easily be overlooked. Scat analysis data will supplement existing data.

Daily Movements

Although instrumented grizzly bears often move long distances in short time intervals, their mean daily movements during the study (1977-81) were: spring, $\bar{x}$ = 3.04 km, n = 49; summer, $\bar{x}$ = 2.96 km, n = 52; fall, $\bar{x}$ = 1.73 km, n = 27 (Figure 14). Spring daily movements of male grizzly bears ($\bar{x}$ = 3.47 km, n = 14) exceeded those of females ($\bar{x}$ = 2.88 km, n = 36). Sexual comparisons for summer and fall were not made due to a lack of radio data for male grizzly bears in these seasons.

Sizemore (1980) reports mean daily movements for individual bears ranging from approximately 1.9-4.8 km for the spring-summer period and 4.0-6.0 km during the summer-fall period. He reported movement patterns varied among sexes, ages and individuals. Generally, the observed mean daily movement from spring to fall in this study was decreasing. This may represent a sample bias. During fall, bears are in more remote areas and access is difficult. Bears monitored on consecutive days were probably at good feed sites or near dens, so they may not have traveled as extensively during monitoring periods. A more complete investigation of seasonal bear movements would be desirable.

Food Habits

A total of 164 grizzly bear scats from 1980 and approximately 250 grizzly scats from 1981 have been analyzed. Data are currently being coded for computer analysis and processing. No data were available at the time of this report. Scat analysis with the aid of computer will enable greater manipulation and flexibility in analysis. The coding system devised will allow separate analyses for scats from differing seasons, years, administrative lands, different components, habitat types or elevations. The possible combinations which can be manipulated quickly will facilitate our understanding of food habits and habitat selection. A complete summary analysis of food habits will be prepared by 1983.

Den Studies

Twelve grizzly bear dens have been located since 1977 in the study area. Figure 15 shows the relative distribution of these dens throughout the region. Table 7 presents the data acquired from each den or den location. Data from those dens not visited or found on the ground are considered accurate, but may be subject to change if a ground inspection is made.

Figure 14. Spring male and female (and seasonal) mean minimum daily movements of grizzly bears, 1977-81.

Figure 15. Dens found within the study area, 1977-81.

Table 7. Data from 12 grizzly bear dens within the study area, 1977-81.

Den No.	Name Location	Type Den	Eleva. (m)	Aspect	% Slope	Habitat Type	Land Type	No. Years Used	Condition	Bear No.
1 ^{1/}	Hurricane Mtn	Unknown	2073	N40°E	60	PIAL/ABLA	VI	1	Good	335
2 ^{2/}	Hog Gulch	Dug	2012	N40°E	50	ABLA/XETE/ VASC	VI	1	Unknown	257
3 ^{3/}	Kid Creek	Natural cavity	2060	N35°W	40	PIAL/ABLA	VI	1	Good	220
4 ^{1/}	Rival Creek	Unknown	2256	N26°W	60	PIAL/ABLA	VI	1	Good	220
*5 ^{3/}	Rival Creek	Dug	2012	N47°E	52	PIAL/ABLA	VI	3	Good	257
6 ^{3/}	Bruce Creek	Dug	2012	N335°W	35	ABLA/PIAL/ XETE	VI	1	Caved in	Unknown
*7 ^{1/}	Mt Lockhart	Dug	2256	N20°E	50	ABLA/PIAL/ VASC	202	1	Unknown	220
*8 ^{3/}	Ear Mtn	Dug	2073	N20°E	40	ABLA/PIAL/ VASC	202	2	Good	273
*9 ^{1/}	Headquarters Cr	Dug	2073	N70°E	60	Unknown	VIII	1	Unknown	218
10 ^{1/}	Lick Creek	Dug	2073	N20°E	50	ABLA/XETE/ VASC	VIII	1	Unknown	223
*11 ^{1/}	Rock Creek	Dug	2134	N50°E	40	ABLA/XETE/ VASC	VII	1	Unknown	271
12 ^{2/}	Slategoat Mtn	Dug	2134	N40°E	40	ABLA/VASC	VC	1	Unknown	510

*Reported in Schallenger and Jonkel 1980.

1 - Located by air only.

2 - Den area visited but den not located.

3 - Ground inspection.

Nine of twelve dens had north by east aspects, while two had only slightly north by west aspects, and only one had a strong northwest aspect. Dens were found in five different land types and three different habitat types. These dens ranged in elevation from 2012-2256 m (6600-7400 ft) and averaged 2097 m (6880 ft). Slopes ranged between 35-60 percent and averaged 48 percent. Gillespie and Jonkel (1980) reported den sites in the South Fork of the Flathead River were on southwestern to southeastern exposures on steep slopes from 29° to 41°. They report dens in the elevational range from 1768 to 2033 (5800-6670 ft). Servheen (1981) found grizzly dens in the Mission Mountains were on aspects between 45° and 277° with slopes between 28° and 35°. He found dens within the elevational range of 2050 and 2500 m (6724 and 8200 ft).

It appears that grizzly bear dens on the east front are on aspects where a consistent snowpack would remain for long periods of time. This is probably related to the strong southwest Chinook winds which develop periodically along the east front. Craighead and Craighead (1972), Vroom et al. (1980), Reynolds et al. (1976); Reynolds and Hechtel (1980); Gillespie and Jonkel (1980); Servheen (1981) have discussed the importance of snow depth in the selection of den sites and its importance toward the survival of hibernating bears.

All dens were dug except one which was a natural cavity. Three natural cave dens were found in this one area, but only one was recorded as used by a grizzly bear. It was used by a female with three yearling cubs and all denned together. The other cave dens had been used by bears in the past. Two dens in our sample were recorded as being used more than 1 year by the same grizzly bear. Only one den was in such a condition that it was not reusable.

Tables 8 and 9 present den entrance and emergence dates recorded during this study. Grizzly bears entered their dens from November 2 until November 23. Movement to den sites occurred from October 6 to November 8. Servheen (1981) reported that bears in the Mission Mountains moved to dens between October 10 and November 20 and denned between November 2 and November 22. Gillespie and Jonkel (1980) reported den entry between November 2 and November 26 for grizzly bears in the South Fork of the Flathead River.

Further discussion of den site selection will be presented in summary papers scheduled to be written in 1983.

Impacts of Oil and Gas Activity

During the 1981 field season, seven oil and gas exploratory drilling operations were conducted. Five of these wells were drilled within the Blackleaf gas field and were closely associated with bears and bear habitat. Figure 12 displays the relationship of oil/gas exploration to five different grizzly bears. The Blackleaf wells were all located in one small area which is important bear habitat; therefore, radio-monitoring efforts were intensified in this area.

Table 8. Dates of movements to dens and final entry of dens, 1980 and 1981.

Bear No.	Sex	Age	Year	Movement to Den Site	Approximate Den Entry	Reproductive Status
257	F	10.5	1980	October 18	November 5	Cubs present
220	F	19.5	1980	October 20	November 5	Cubs present
223	M	6.5	1980	After October 6	November 23	-
257	F	11.5	1981	October 13	November 2	No cubs
220	F	20.5	1981	October 22	November 2	No cubs
335	F	3.5	1981	After October 28	November 2	No cubs
273	F	7.5	1981	October 28	November 2	No cubs
333	M	3.5	1981	November 8	Unknown	-

Table 9. Dates of den emergence and movement from den sites, 1980 and 1981.

Bear No.	Sex	Age	Year	Approximate Den Emergence	Movement from Den Site	Reproductive Status
220	F	19.5	1980	April 29-May 13	May 13	Cubs present
257	F	11.5	1981	March 10-March 28	March 28	Yearling cubs present
220	F	20.5	1981	April 18	April 24	Yearling cubs present
223	M	7.5	1981	March 28	March 28-April 15	

The first exploratory gas well was drilled in the Blackleaf field in August 1980. It was hypothesized that increased human activity associated with oil and gas exploration might begin to affect bears after, but not before, August 1980. A simple comparison of 33 radio locations from five different bears reported in the area during 1980 (but before August) and 38 radio locations from five individual bears recorded after August 1980 was made. Only radio locations within the immediate area of the Blackleaf field were used in the comparison to determine if the distribution of bears was similar or had changed between years 1980 and 1981 (Fig. 16). Table 10 presents the results of measuring the distance to nearest proposed/active well site, perennial water and to roads. On the average, bears in this area were located significantly further from water, roads and proposed/active well sites in 1981 than during 1980. The largest change in average distance measured was to proposed/active well sites.

Table 10. Comparative distribution of grizzly bear radio locations from 1 year before and year during exploratory gas well drilling in the Blackleaf area, 1980 and 1981.

Distance to (m)	1980		1981		p Value
	Mean	S.D.	Mean	S.D.	
Perennial water	497.7	712.3	896.3	716.0	0.005
Roads ^{1/}	678.8	568.8	990.6	685.5	0.010
Well Site ^{2/}	1380.7	1316.4	2404.3	1645.9	0.005

1 - As mapped on USGS quadrat maps.

2 - Distance from proposed well site March-August 1980 and distance to actual well sites drilled August 1980-November 1981.

Comparisons of individual home ranges of two bears were made. Bear 257 whose spring, summer and fall home range is centered in the Blackleaf-Antelope Butte area, was tested for shifts in home range use patterns before and after the August 1980 exploration activity in the Blackleaf area. Figure 17 shows the home range of bear 257 determined from 63 radio locations from May 20, 1977 to July 7, 1978 and June 14, 1980 until August 1980. Figure 18 is a comparison of the pre-development home range to bear 257's home range determined by radio locations made after August 1980. The calculated modified minimum home range has more than doubled when comparing the two periods. Radio locations reveal that bear 257 did use the area within the gas field, but less frequently and for shorter periods of time.

Figure 16. Comparative analysis of radio location data within the Blackleaf area, before and during oil and gas drilling activities, 1980 and 1981.

Figure 18. Comparison of bear No. 257's home range after August 1980, with her pre-development home range.

Bear 220, whose spring range was predominantly within the area of the Blackleaf field, was also examined for shifts in home range before and after exploration activity. Figure 19 depicts the home range of bear 220 from the period May 1979 until August 1980. Figure 20 compares the pre-development home range to the home range determined by radio locations following exploration activity. The calculated modified minimum home range did not increase substantially, but distribution of use did change.

To test the hypotheses that oil and gas development may have an influence in these home range shifts, a comparison of bear 273's home range from June 9, 1977 until April 14, 1978 (Fig. 21) to her 1981 home range (Fig. 22) was made. The shift in home range use patterns and centers of activity was less than that depicted in Figure 18 and Figure 20 for bears 257 and 220, respectively. The home range of 273 has not been heavily influenced by drilling or seismic operations.

Table 11 presents the magnitude in change of home range size between the pre-development and development time periods for three grizzly bears. Bear 275's modified minimum and minimum home range size increased substantially between time periods. Bear 220's modified minimum and minimum home range size did not change significantly. Both bears displayed unexplained shifts in home range use patterns. Each bear was accompanied by cubs of the year in 1980 and yearling cubs during a portion of 1981. Bear 273's home range increased substantially between time periods, but activity centers did not shift. An increase in home range size for bear 273 would be expected as she matured from a subadult (3.5 years) in 1977-78 to an adult (7.5 years) in 1981.

Table 11. Comparisons of home range before and during the development of the Blackleaf gas field.

Bear No.	(km ²)		During		Change in km ²	
	Predevelopment		Development (km ²)		Modified	
	Modified	Minimum	Modified	Minimum	Minimum	Minimum
257	129.5	210.3	314.0	454.0	+184.5	+243.7
220	171.0	567.2	172.0	566.0	+ 1.0	- 1.2
273 (control)	37.3	73.0	196.0	334.1	+158.7	+261.1

Valid conclusions regarding the impacts of oil and gas activity cannot be drawn at this time. Preliminary evidence suggests that bears may be adjusting home range use patterns in response to oil and gas activity. However, a better understanding of natural shifts in use patterns and the effects of other human activities on grizzly bear home ranges must be evaluated before conclusions can be made. Other factors could influence range use patterns, including annual changes in weather patterns, phenology of vegetation, reproductive status of the bear, and the age and sex of bears.

Figure 19. Pre-development home range of grizzly No. 220.

Figure 20. Comparison of bear No. 220's home range after August 1980, with her pre-development home range.

Figure 21. Predevelopment home range of grizzly No. 273, 1977-78.

Figure 22. Comparison of bear No. 273's predevelopment home range with 1981 home range.

Continued monitoring of bears within and outside of the influence of oil and gas activity must be conducted to supplement the data base. A summary of existing home range data should be conducted to gain an understanding of natural changes in home range use patterns.

Seismic activity was conducted within all six radioed grizzly bear home ranges during 1981. Figures 23, 24, 25, 26 and 27 show the relationship between individual grizzly bear home ranges and seismic exploration. A summary of seismic data as they occurred within the study area is presented in Appendix E. Table 12 presents an informational summary of seismic activity (provided by the US Forest Service).

Table 12. Seismic mileage summary by company, 1981.

Company	Surface Charges	Shot Holes	Deep Shot Holes	Tail-spread	Total
Mtn Geophysical for Amoco		11.75			11.75
Consolidated Georex Geophysics	33.8				33.8
Sefel Geophysical for Geodata, RARE **	4.0				4.0
Sefel Geophysical for Geodata	49.5				49.5
Sefel Geophysical For Williams Exploration	1.0				1.0
Seis-Port Explorations, Inc.		7.8			7.8
Seiscom Delta	2.25		2.5	6.75	11.5
Seisdata Services, Inc. for American Petrofina Co.	41.4	14.0			55.4
Totals	131.95	33.55	2.5	6.75	174.75

Surface charges were the most common method of seismic exploration occurring within grizzly bear range. The deep shot hole seismic method would be the second most common method of seismic exploration conducted on grizzly bear habitat. The characteristics of all seismic methods probably result in displacement of bears temporarily from the affected areas. The three major activities with disturbance potential which occurred during seismic exploration include blasting, helicopter transport and vehicle noise on roads and seismic trails.

Figure 23. Home range of bear No. 257 in relation to seismic activities, 1981.

Figure 25. Home range of bear No. 273 in relation to seismic activities, 1981.

Figure 26. Home range of bear No. 335 in relation to seismic activities, 1981.

No significant data relating the disturbance potential of seismic exploration to grizzly bears were gathered during 1981. Accurate dates upon which each seismic line was worked are not available, so an examination of the influences of seismic activity on bears was not possible.

Habitat Studies

Elevation

Figure 28 displays the monthly means, standard deviations, and ranges of elevations at which radio-collared grizzly bears were located from 1977-81. In general, bears were found at lower elevations during the spring (April-June). During summer (July and August) the mean and range of elevations used by grizzlies increased. In summer, bears were located on high elevation peaks and alpine slopes. The ripening of berries in September brought the mean elevation below that for July and August. During October and November, elevations at which bears were located increased as bears moved to subalpine fir types to dig pine nuts and to den sites. The elevational movement of individual bears varies a great deal, but generally follows the pattern depicted in Figure 28. Servheen (1981) reports similar elevational movements for grizzly bears in the Mission Mountains of Montana.

Aspect and Slope

Table 13 presents monthly means and ranges of aspects and slopes of radio locations from 10 grizzly bears monitored in 1977-81. Mean aspect used by grizzlies shifted from easterly to southeasterly from spring to fall. Mean slope was lowest in May and June. Mean slope for October and November were higher than for all other months. Relationships between bear use and aspect or slope are complicated, and deserve further scrutiny.

Table 13. Monthly mean and range of aspect and slope from grizzly bear radio locations 1977-81.

	<u>April</u>	<u>May</u>	<u>June</u>	<u>July</u>	<u>Aug.</u>	<u>Sept.</u>	<u>Oct.</u>	<u>Nov.</u>
$\bar{X}$ Aspect								
Degrees	94.5	81.3	89.1	112.3	106.9	114.4	119.1	149.4
Minimum	5	0	0	0	0	0	0	0
Maximum	350	350	312	340	325	340	340	360
$\bar{X}$ Slope								
Percent	17.4	12.9	12.4	17.7	17.2	12.3	27.8	42.7
Minimum	1	1	1	1	1	1	1	5
Maximum	60	50	60	60	65	60	80	70
No.								
Locations	31	65	106	111	113	85	68	26

Habitat Types Used by Grizzly Bears

Grizzly bears used 55 different habitat types between 1977 and 1981. Thirty-five habitat types were used by bears during spring, while 31 and 32 different types were used during summer and fall. Table 14 presents the frequency and relative percent of each habitat type used by grizzly bears during each month and for the season. The five habitat types used most (5 percent or more) were: *Populus tremuloides*/*Salix*, *Salix*/*Betula*, *Salix*/*Carex*, *Picea/Smilacena stellata* and *Populus tremuloides*/*Symphoricarpos albus* in that order. The *Potentilla fruticosa*/*Festuca scabrella* type was the most highly utilized grassland type. Table 15 presents frequency and relative percent of each habitat type used during the summer months and season. During summer the POTRE/*Salix*, alpine scree, *Salix*/*Betula*, *Salix*, grass, and *Pseudotsuga menziesii*/*Spirea beautifulia* habitat types were the five most frequently utilized habitat types. Also, significant use of the *Picea*/SMST and *Abies lasiocarpa*/*Pinus albicaulis*/*Vaccinium scoparium* types were noted. Table 16 presents frequency and relative percent of habitat type used during fall. Habitat types most important during fall included the ABLA/PIAL/VASC, POTRE/*Salix*, POTRE/SYAL, *Salix*/*Betula*, and ABLA/XETE.

Table 17 displays the frequency and relative percent of each timbered habitat type series utilized by grizzly bears. The PSME series shows a significant decrease in utilization from spring to fall while the ABLA series shows an increasing trend in utilization for this period. This correlates with annual elevational movements of grizzly bears.

Habitat Components Used by Grizzly Bears

Differences in seasonal use of habitat components were noted (Fig. 29, 30 and 31). Grizzly bears used 14 different habitat components during spring. Important components used in spring are *Populus* stands, riparian shrub, and timber components. Limber pine savanna and prairie grasslands were used at a significant rate, as well. During summer, grizzlies were located within 18 different habitat components. Components commonly used included timbered, *Populus* stand, riparian shrub, and rock/talus/scree/rubble. The increase in use of rock/talus/scree/rubble correlates with elevational movements of grizzlies to alpine digging areas. Nine different habitat components were used by grizzly bears in the fall. A substantial increase in use of the timber component was observed. Use was prevalent in *Populus* stand, riparian shrub, and rock/talus/scree/rubble components, as well, during fall. The increase in use of timber correlates with bears searching pine nuts and moving to den sites.

Land Types Used by Grizzly Bears

Table 18 presents the seasonal bear use of land types on the Lewis and Clark National Forest. The land type classification system was not extrapolated to areas outside of the forest boundaries. Data presented are land types radioed bears selected within the national forest for each season. No radio-collared bears spent a large portion of time during the spring within the national forest. Therefore, data may be biased for this period and must be viewed with caution. Certainly there are bears that

Table 14. Number and relative percent of grizzly bear radio locations in each habitat type for spring, 1977-81.

Habitat Type	April	May	June	Spring
AGSP/BOGR	0/0.0	0/0.0	2/1.9	2/1.0
FESC/FEID	0/0.0	0/0.0	1/0.9	1/0.5
POFR/FESC	0/0.0	3/4.6	6/5.7	9/4.5
POFR/RESC/DAIN	0/0.0	1/1.5	0/0.0	1/0.5
PIFL/AGSP	0/0.0	0/0.0	1/0.9	1/0.5
PIFL/FEID	0/0.0	0/0.0	3/2.8	3/1.5
PIFL/FEID/FESC	0/0.0	2/3.1	4/3.8	6/3.0
PSME series	2/6.5	1/1.5	6/5.7	9/4.5
PSME/SYAL	4/12.9	0/0.0	1/0.9	5/2.5
PSME/SYAL/CARU	0/0.0	3/4.6	0/0.0	3/1.5
PSME/SYAL/SYAL	0/0.0	1/1.5	0/0.0	1/0.5
PSME/CARU	1/3.2	0/0.0	1/0.9	2/1.0
PSME/CARU/CARU	1/3.2	1/1.5	0/0.0	2/1.0
PSME/SPBE	0/0.0	4/6.2	0/0.0	4/2.0
PSME/JUCO	0/0.0	0/0.0	2/1.0	2/1.0
PSME/ARCO	0/0.0	3/4.6	0/0.0	3/1.5
PICEA/GATR	0/0.0	1/1.5	0/0.0	1/0.5
PICEA/SHST	2/6.5	1/1.5	8/7.5	11/5.4
ABLA series	2/6.5	2/3.1	1/1.0	5/2.5
ABLA/GATR	0/0.0	0/0.0	1/0.9	1/0.5
ABLA/VACA	1/3.2	0/0.0	0/0.0	1/0.5
ABLA/LIBO	0/0.0	0/0.0	1/0.9	1/0.5
ABLA/LIBO/VASC	0/0.0	0/0.0	2/1.0	2/1.0
ABLA/MEFE	0/0.0	0/0.0	1/0.9	1/0.5
ABLA/VASC	0/0.0	1/1.5	0/0.0	1/0.5
ABLA/CLPS	0/0.0	2/3.1	2/1.0	4/2.0
ABLA/PIAL/VASC	2/6.5	3/4.6	4/3.8	9/4.5
PICO series	0/0.0	1/1.5	0/0.0	1/0.5
PICO/LIBO	0/0.0	0/0.0	1/0.9	1/0.5
PICO/VASC	0/0.0	1/1.5	1/0.9	2/1.0
POTRE/ <i>Salix</i>	8/25.8	21/32.3	19/17.9	48/23.8
POTRE/SYAL	1/3.2	3/4.6	6/5.7	10/5.0
<i>Salix/Carex</i>	2/6.5	6/9.2	6/5.7	14/6.9
<i>Salix/grass</i>	0/0.0	1/1.5	6/5.7	7/3.5
<i>Salix/Betula</i>	3/9.7	1/1.5	16/15.1	20/9.9
<i>Betula/Carex</i>	0/0.0	0/0.0	1/0.9	1/0.5
Alpine scree	1/3.2	0/0.0	2/1.9	3/1.5
Scree	1/3.2	2/3.1	0/0.0	3/1.5
Unknown	0/0.0	0/0.0	1/0.9	1/0.5
Total	31	65	106	202

Table 15. Number and relative percent of grizzly bear radio locations in each habitat type for summer, 1977-81.

Habitat Type	July	August	Summer
FESC/AGSP	1/0.9	0/0.0	1/0.4
FESC/FEID	2/1.8	0/0.0	2/0.9
POFR/FESC	3/2.7	1/0.9	4/1.8
POFR/FEID	3/2.7	1/0.9	4/1.8
PIFL/FEID	2/1.8	0/0.0	2/0.9
PIFL/FEID/FESC	4/3.6	0/0.0	4/1.8
PSME series	1/0.9	2/1.8	3/1.3
PSME/SYAL	2/1.8	0/0.0	2/0.9
PSME/SYAL/CARU	2/1.8	0/0.0	2/0.9
PSME/SYAL/SYAL	0/0.0	2/1.8	2/0.9
PSME/SPBE	7/4.5	4/3.5	11/4.9
PSME/JUCO	1/0.9	0/0.0	1/0.9
PICEA/EQAR	1/0.9	0/0.0	1/0.9
PICEA/SEST/PSME	0/0.0	1/0.9	1/0.9
PICEA/SMST	3/2.7	7/6.2	10/4.5
ABLA series	4/3.6	2/1.8	6/2.7
ABLA/GATR	0/0.0	1/0.9	1/0.9
ABLA/CACA/CACA	1/0.9	0/0.0	1/0.9
ABLA/MEFC	0/0.0	1/0.9	1/0.9
ABLA/XETE	3/2.7	5/4.4	8/3.6
ABLA/XETE/VASC	5/4.5	0/0.0	5/2.2
ABLA/CLPS	0/0.0	2/1.8	2/0.9
ABLA/ARCO	1/0.9	0/0.0	1/0.4
ABLA/PIAL/VASC	5/4.5	5/4.4	10/4.5
PIAL/ABLA	4/3.6	2/1.8	6/2.7
POTRE/ <i>Salix</i>	29/26.1	36/31.9	65/29.0
POTRE/SYAL	1/0.9	1/0.9	2/0.9
POTRI/ <i>Salix</i>	0/0.0	3/2.7	3/1.3
<i>Salix/Carex</i>	1/0.9	1/0.9	2/0.9
<i>Salix/grass</i>	6/5.4	5/4.4	11/4.9
<i>Salix/Betula</i>	8/7.2	12/10.6	20/8.9
Alpine scree	10/9.0	18/15.9	28/12.5
Scree	0/0.0	1/0.9	1/0.4
Unknown	1/0.9	0/0.0	1/0.4
Total	111	113	224

Table 16. Number and relative percent of grizzly bear radio locations in each habitat type for fall, 1977-81.

Habitat Type	Sept.	Oct.	Nov.	Fall
POFR/FESC	0/0.0	1/1.5	0/0.0	1/0.6
POFR/FEID	1/1.2	0/0.0	0/0.0	1/0.6
PIFL/JUCO	1/1.2	0/0.0	0/0.0	1/0.6
PSME series	2/2.4	1/1.5	0/0.0	3/1.7
PSME/SYAL/SYAL	1/1.2	0/0.0	0/0.0	1/0.6
PSME/CAGE	0/0.0	1/1.5	0/0.0	1/0.6
PSME/SPBE	1/1.2	1/1.5	0/0.0	2/1.1
PICEA series	0/0.0	1/1.5	0/0.0	1/0.6
PICEA/LIBO	0/0.0	3/4.4	0/0.0	3/1.7
ABLA series	1/1.2	6/8.8	2/7.7	9/5.0
ABLA/GATR	1/1.2	0/0.0	0/0.0	1/0.6
ABLA/VACA	2/2.4	1/1.5	0/0.0	3/1.7
ABLA/CACA	1/1.2	0/0.0	0/0.0	1/0.6
ABLA/CACA/CACA	1/1.2	2/2.9	0/0.0	3/1.7
ABLA/CACA/GATR	2/2.4	1/1.5	0/0.0	3/1.7
ABLA/LIBO	1/1.2	0/0.0	0/0.0	1/0.6
ABLA/LIBO/LIBO	0/0.0	5/7.4	0/0.0	5/2.8
ABLA/LIBO/VASC	0/0.0	2/2.9	0/0.0	2/1.1
ABLA/XETE	0/0.0	2/2.9	5/19.2	7/3.9
ABLA/XETE/VASC	2/2.4	0/0.0	0/0.0	2/1.1
ABLA/VASC/CARU	0/0.0	0/0.0	1/1.5	1/0.6
ABLA/VASC/VASC	2/2.4	0/0.0	0/0.0	2/1.1
ABLA/VASC/THOC	1/1.2	0/0.0	0/0.0	1/0.6
ABLA/ALSI	0/0.0	1/1.5	0/0.0	1/0.6
ABLA/CLPS	0/0.0	1/1.5	0/0.0	1/0.6
ABLA/PIAL/VASC	10/11.8	23/33.8	9/34.6	42/23.5
ABLA/LUHI/VASC	1/1.2	3/4.4	0/0.0	4/2.2
ABLA/LUHI/MEFE	1/1.2	2/2.9	3/11.5	6/3.3
PIAL/ABLA	0/0.0	3/4.4	3/11.5	6/3.3
PICO series	0/0.0	0/0.0	2/7.7	2/1.1
POTRE/ <i>Salix</i>	20/23.5	4/5.9	0/0.0	24/13.4
POTRE/SYAL	15/17.6	0/0.0	0/0.0	15/8.4
<i>Salix/Carex</i>	1/1.2	0/0.0	0/0.0	1/0.6
<i>Salix/grass</i>	1/1.2	0/0.0	0/0.0	1/0.6
<i>Salix/Betula</i>	12/14.1	1/1.5	0/0.0	13/7.3
Alpine scree	4/4.7	2/2.9	0/0.0	6/3.3
Unknown	0/0.0	1/1.5	0/0.0	1/0.6
Total	85	68	26	179

Table 17. Frequency and relative percent of each timbered habitat type series used by grizzly bears each season, 1977-81.

Habitat Series	Spring	Summer	Fall
PSME series	31/37.8	21/26.2	7/ 6.1
ABLA series	25/30.5	35/43.8	95/82.6
PICEA series	12/14.6	12/15.0	4/ 3.5
PIFL	10/12.2	6/ 7.5	1/ 0.9
PIAL	0/ 0.0	6/ 7.5	6/ 5.2
PICO	4/ 4.9	0/ 0.0	2/ 1.7

Table 18. The number and percent of grizzly bear radio locations in each land type on the Lewis & Clark National Forest by season, 1977-81.

No.	Nonwilderness Land Type	Spring	Summer	Fall
14D	Forested-moderately steep slump	0/0.0	0/0.0	2/1.7
18	Forested-steep reef backslopes	0/0.0	0/0.0	1/0.9
20B	Forested-moderately steep valley sideslopes	0/0.0	0/0.0	1/0.9
21A	Forested-moderately steep glacial drift	0/0.0	1/1.0	0/0.0
22	Low forested-moderately steep glacial drift	2/5.9	0/0.0	0/0.0
25	Forested-steep glacially plastered trough walls	1/2.9	5/5.6	3/2.6
25C	Same as above	0/0.0	0/0.0	5/4.3
71	Forested-steep interbedded sandstone and shales	2/5.9	18/20.0	5/4.3
161	Forested & grassland moderately steep mtn foothills	5/14.7	14/15.6	0/0.0
171	Forested & grassland steep glacially scoured slopes	0/0.0	1/1.1	0/0.0
181	Rock lands and scree	1/2.9	4/4.4	4/3.5
182	Rock outcrop and talus	0/0.0	1/1.1	0/0.0
183	Rock outcrop and talus	1/2.9	0/0.0	0/0.0
202	Rockland and scree	7/20.6	13/14.4	20/17.4
<u>Wilderness Land Type</u>				
Ib	Grass and forested stream terraces	1/2.9	1/1.1	4/3.5
II	Glacial cirque basins	0/0.0	0/0.0	2/1.7
III	Forested ground moraine	6/17.6	0/0.0	6/5.2
IIIa	Forested-steep lateral moraine	0/0.0	0/0.0	1/0.9
Va	Forested-high elevation ridges	0/0.0	7/7.7	9/7.8
Vb	Forested-smooth residual slopes	0/0.0	0/0.0	8/7.0
Vc	Forested-moderately dissected residual slopes	2/5.9	0/0.0	11/9.6
Ve	Forested & grassland smooth residual slopes	0/0.0	0/0.0	2/1.7
VI	Peaks and alpine ridges	5/14.7	22/24.4	23/20.0
VII	Forested, cool aspect break lands	1/2.9	2/2.2	7/6.1
VIII	Forested, warm aspect break lands	1/2.9	1/1.1	1/0.9
Totals		34	90	115

Figure 28. Mean + SD and range of elevations at which 10 radio-collared grizzly bears were located in 1977-81, Sun River to Birch Creek, Rocky Mountain East Front.

Figure 29. Spring use of habitat components by grizzly bears, 1977-81.

Figure 30. Summer use of habitat components by grizzly bears, 1977-81.

Figure 31. Fall use of habitat components by grizzly bears, 1977-81.

have interior spring ranges within river valleys and as such would select somewhat different land types during the spring period than bears whose spring range lies mostly in the foothills and bottoms outside the forest.

A total of 14 different nonwilderness land types and 12 different wilderness land types was used by grizzly bears, 1977-81. During spring, bears used seven nonwilderness land types and six wilderness land types. The more frequently used types include the rockland and scree (202), the forested and grassland mountain foothills (161), the forested ground moraine (111) and peaks and alpine ridges (VI). Bears used eight different nonwilderness land types and five different wilderness land types during summer. Important land types for this season are forested steep slopes underlain with sandstone and shales (71), forested and grassland mountain foothills (161), rockland and scree (202), forested high elevation ridges (Va), and peaks and alpine ridges (VI). Both rockland and scree (202) and peaks and alpine ridges (VI) received significant use during the fall. These types are important land types for den sites of grizzly bears.

Grizzly bear use of habitat types, habitat components and land types should be compared with relative availability of types and components to present a clearer view of habitat preference. Servheen (1981), Zager (1980), and Aune and Stivers (1981) used a random sampling technique (Marcum and Loftsgaarden 1980) to determine the relative availability of habitat components in studies of grizzly bear habitat preference. We submit that an extensive project be completed to determine availability of components, types, elevations, aspects, slopes and disturbance factors within grizzly bear home ranges on the east front. Such a project is scheduled for completion by 1983 and results presented in a complete summary of habitat use and preference for grizzly bears of the east front.

Nonvegetative Characteristics and Disturbance Factors of Habitat

Nonvegetative characteristics and disturbance factors may also influence the selection of habitat by grizzly bears. Two parameters measured during this study are the distance to water and the distance to roads. Figure 32 graphically displays the mean monthly distance of radioed grizzly bears to roads and perennial water. On an average, grizzly bears were within .5 km from perennial streams, creeks, or rivers for all months except November, when they moved up to den sites. Bears were found closer to roads during spring and summer than during fall. Spring, and, to a lesser degree, summer, habitat of our radioed grizzlies are more heavily roaded than fall habitat. During the fall our grizzlies ranged within the national forest where roads were less prevalent. Further studies in the relationship of disturbance factors and grizzly bears' distribution and habitat selection are needed. Schallenberger and Jonkel (1979) discuss the implication of disturbance factors on grizzly bears of the east front.

Figure 32. Monthly mean distances to water and roads for grizzly bear locations, 1977-81.

Vegetation Studies

A total of 187 activity site plots has been recorded at radio locations between 1978 and 1981. Data from 1978 and 1979 are presented in Schallenberger and Jonkel (1980). Data from these plots and plots conducted during 1980 and 1981 are being coded for analysis by computer. Specific information regarding species composition, tree stand density, shrub and tree vertical structure, and canopy coverage of species from each plot is available. Plots are separated into feeding site and bed site plots or both. Analysis by computer will allow flexibility in analysis so any combination of parameters can be correlated quickly. The relationship of plant communities between and within habitat components or habitat types to grizzly bears can be examined. Each plot was evaluated as to the current grazing regime which existed at the time the plot was completed. With such data, the influences of grazing on cover and grizzly bear foods can be evaluated. Seasonal importance of specific plants and plant communities will be more thoroughly analyzed. Data analysis of vegetation plots is not complete, but is expected to be in rough form by 1983.

To facilitate computer analysis of data from activity plots, a complete plant species list for the east front is being developed. Appendix F presents the preliminary list. Expansion and development of the list is not complete. Eventually, the source (current literature) in which each species has been reported and the plant collection it is represented in will be included. This list will aid field personnel in plant identification.

At the present time, 9 species representing 6 genera of trees, 56 species from 33 genera of shrubs, 7 species within 4 genera of ferns or fern allies, 95 species representing 36 genera of graminoids, and 318 species from 175 genera of forbs have been reported and listed. A total of 485 species of plants representing 175 genera is listed.

Population Biology

Sex and Age Data

Table 19 presents age and sex data from the marked population within the study area during 1981. Since 1977, 14 individual grizzly bears have been ear tagged and 11 of these have been radio monitored at some time during this period. One of these 14 was relocated to the South Fork of the Flathead River and 4 are known to be dead. During the 1981 field season the marked population consisted of nine individual bears and five of the yearling offspring. In addition, observations indicate that four unknown subadults, one subadult male, two adult females (one with two cubs and one with two yearlings) and one adult male were present on the study area. Between Deep Creek and Birch Creek at least 26 different grizzlies were identified. Table 20 presents age and sex data from this population.

Table 19. Age and sex data from the marked grizzly bear population, 1981.

	Adult	Subadult	Yearlings	Cubs	Total
Male	2	2	0	0	4
Female	4	1	0	0	5
Unknown	0	0	5	0	5
Total	6	3	5	0	14

Table 20. Age and sex data from marked plus observed grizzly bear population, 1981.

	Adult	Subadult	Yearlings	Cubs	Total
Male	3	3	0	0	6
Female	6	1	0	0	7
Unknown	0	4	7	2	13
Total	9	8	7	2	26

Table 21 presents data reported on the population and age structure of individuals observed in the Antelope Butte-Blackleaf area 1979 and 1980 as well as the data from the Deep Creek to Birch Creek area 1980 and 1981.

Table 21. Age structure reported 1979-81.

	Adult	Subadult	Known Yearlings	Cubs	Total
1979* $\frac{1}{1}$	4	5	6	0	15
1980 $\frac{1}{2}$	5	6	2	5	18
1980 $\frac{2}{2}$	8	6	6	7	27
1981 $\frac{2}{2}$	9	8	7	2	26

*Schallenger and Jonkel (1980).

1 - Antelope Butte-Blackleaf area.

2 - Deep Creek-Birch Creek area.

Density Estimation

Bear density calculations using the marked plus observed population within the study area were developed. An attempt was made to develop a representative range of densities as they may occur by seasons. Figure 33 depicts the composite home range map of 10 radioed grizzly bears for spring and a composite home range map of 8 radioed grizzly bears for the summer and fall period. Using this radioed bear data to delineate the area for density calculations, we can develop seasonal density values. Table 22 presents density calculations based on the marked plus observed populations for 1980 and 1981.

Table 22. Density of grizzly bears within the study area, 1980 and 1981.

	Spring 990.4(km ²)	Summer 1039.1(km ²)	Fall 1494.9(km ²)
1980	1/36.8	1/38.6	1/56.5
1981	1/38.1	1/39.9	1/57.5
Average	1/37.5	1/39.4	1/57.0

Grizzly bear density within the study area may range between 1 bear per 36.8 km² (14.2 mi²) in the spring and 1 bear per 57.5 km² (22.2 mi²) in the fall. Servheen (1981) reports a conservative density of 1 grizzly bear per 41.6 km² (16 mi²) for the Mission Mountains in Montana. Mace and Jonkel (1980) calculate a density of 1 grizzly bear per 25 km² (9.8 mi²) for grizzlies in the South Fork of the Flathead River. In an un hunted population of grizzly bears in Glacier National Park, Martinka (1974) estimated a density of 1 bear per 22 km² (8.48 mi²). The lower density of bears on the east front area as compared to the South Fork of the Flathead correlates well with the larger home ranges of grizzlies on the east front as compared to home range size of grizzlies in the South Fork of the Flathead River. Intensive trapping and marking of bears would be needed to further refine density calculations and estimate populations within our study area. Indications are that we may be approaching saturation trapping in the Antelope Butte-Blackleaf area. Observations of unmarked animals during 1981 was almost exclusively outside of the Antelope Butte-Blackleaf area and mostly in outlying areas of Ear Mountain to the south and the Dupuyer Creek-Walling reef area to the north.

Density calculations from within the study area may not be extrapolated to all areas of the east front. Certain areas probably have lower densities based on land uses and the poor image of grizzly bears by individual landowners. We believe that mortality sumps exist along the east front. These places where landowners or local residents are less tolerant of grizzlies

Figure 33. Seasonal composite home range of grizzly bears radio tracked 1977-81.

probably contain less grizzlies than expected, based on density estimates. Two areas where such a problem may exist are the Deep Creek area and the Badger-Two Medicine area. Further trapping and intensive monitoring within these areas would prove or disprove this hypothesis.

Production Data

Production data are weak within the study area. Table 21 indicates that no cubs per four adults were reported in the Antelope Butte-Blackleaf area in 1979, while five cubs per five adults were present on the area in 1980. In the area from Deep Creek to Birch Creek, seven cubs per eight adults were observed in 1980 and only two cubs per nine adults were present in 1981.

Two bears, 257 and 220, have been reported to produce offspring every second year in the study area. Bear 257 was reported with at least one cub in 1978 (Schallenger and Jonkel 1978). In 1980 she was trapped and marked and later observed with two cubs at her side. In 1981 she was accompanied by her two yearling cubs. In 1981, 257 cast off her yearling cubs and bred with radioed male 223. She is expected to bear cubs in 1982. Bear 220 reported with three yearlings at her side in 1979 (Schallenger and Jonkel 1980) was observed with three cubs of the year in 1980 and three yearling cubs in 1981. She cast them off in August 1981. She was also observed with radioed male 223 this spring, but was probably not bred this year.

Mortality

Known bear mortality in the study area since 1977 has included one adult male poached (271), one subadult male killed by USFWS depredation control officers (348), one subadult male killed by a hunter, and two subadult females transplanted and eventually killed (110, 430) for a total of five grizzly bears. In addition, one adult male (531) was transplanted to the South Fork of the Flathead River and one adult female (510) relocated into the Bob Marshall Wilderness was shot by a hunter. Suspected illegal mortalities within the area include one or possibly two subadult grizzlies from the Teton River, one subadult female (291) who has mysteriously disappeared with a new, fully functional collar, and one adult male (223) possibly killed on the Blackfoot Indian Reservation. It would be possible then, that between 5 and 11 grizzly bears have been lost from the population within the study area since 1977.

Along the entire east front, a total of 18 grizzlies has been captured and handled by various agencies and researchers since 1977 (includes bears reported by Schallenger and Jonkel 1980, US Fish & Wildlife Service control officers, and Aune and Stivers 1980, 1981). Seven of these bears were lost to the population by relocation to British Columbia or direct mortality. In addition, two are strongly suspected of being dead. Therefore, from a marked population of 18 bears, at least 7 (38.8%) and possibly 9 (50.0%) were removed from the population since 1977. No information pertaining to natural mortality within the study area is available.

Black Bear Studies

Black bears and grizzly bears are sympatric on the Rocky Mountain East Front. Since they are closely related species, some black bear information was accumulated incidental to the ongoing grizzly bear monitoring program.

Distribution and Home Range

During the 1981 trapping operation, five individual black bears were captured seven times. All bears were ear tagged and two, adult male 521 and adult female 509, were fitted with radio collars. Physical measurement data of these bears are presented in Table 23. The number of monthly radio locations is presented in Table 24.

Table 23. Black bears captured on the east front, 1981.

Date	5/14/81*	5/20/81	5/23/81	5/27/81	6/13/81*
Age	10.5	3.5 est.	3.5 est.	3.5 est.	6.5
Weight	59 kg 130 lb	29 kg 63 lb	35 kg 77 lb	30 kg 65 lb	79 kg 175 lb
Sex	F	F	F	M	M
Color	Black	Black	Dk Brown	Cinnamon	Black
Ear Tags ^{1,2/}					
Left	Red I Red O	Blue I Blue O	Blue I Blue O	Red I Red O	Blue Red I/O
Right	Red I Red O	Blue I Blue O	Blue I Blue O	Red I Red O	Red I Red O
Number	509 509	545 545	546 546	516 516	521 521
Lip tattoo	509 Black	545 Black	546 Black	516 Black	521 Black
Collar color	Red tape	None	None	None	Black/Silver
Location	N Fk Muddy Cr	Muddy Cr	N Fk Blindhorse Cr	N Fk Muddy Cr	Antelope Butte Swamp

*Denotes a recapture from previous years.

1 - Two tags were placed in each ear until 5/21/80 when only one tag was placed in each ear.

2 - Letters indicate position of wide part of tag in ear (O=out, I=in). Plastic ear tags (P) have the wide part on both sides of ear.

Table 24. Monthly radio locations for two black bears on the east front, 1981.

Black Bear	Sex	Age	May	June	July	Aug.	Sept.	Oct.	Nov.	Total
#509	F	10.5	7	3	5	4	3	5	den	27
#212	M	6.5	-	2	8	3	3	5	den	21
Total			7	5	12	7	6	10	0	48

Thirty-four different black bears have been ear tagged since 1976 (Appendix H). A total of 244 black bear observations has been recorded since 1978. Table 25 presents the distribution of black bear observation data by each observation type. Figure 34 presents the best known distribution of black bears north of the Sun River.

Table 25. East front black bear observations by observation type, 1978-81.

	1978-79	1980	1981	Total
Radio location	9	9	48	48
Observation	6	20	50	76
Scat	3	2	51	56
Track	1	1	10	12
Other	1	0	4	5
Trap	30	10	7	47
Total	41	33	170	244

The modified minimum home ranges of two radio collared black bears are presented in Figures 35 and 36. Table 26 compares the modified minimum and minimum home range sizes of each bear. The modified minimum home range size of adult female 509 (14.5 km²) was only 59 percent as large as that of adult male 521 (24.6 km²). Amstrup and Beecham (1976) report adult female black bears in Idaho with minimum home range sizes between 16.6-130.3 km² and an average size of 48.9 km². Minimum home range size of adult males ranged from 109-115 km² and averaged 112.1 km².

Figure 35. Home range of black bear No. 509, 1981.

Figure 36. Home range of black bear No. 521, 1981.

Table 26. Modified minimum and minimum home range sizes of two black bears, 1981.

Bear Number	Modified Minimum		Minimum	
	km ²	mi ²	km ²	mi ²
509	14.4	5.6	45.6	17.6
521	24.6	9.5	391.608	151.2

Den Studies

A total of seven black bear dens has been located within the study area. Ground inspection of each was accomplished, excluding two dens presently occupied by radioed black bears. Table 27 presents the data from these seven black bear dens. All of the inspected dens were dug. Black bear dens ranged in elevation from 1524-2073 m for an average of 1725.5 m. Slopes of den sites ranged from 5-50 percent, for an average of 27 percent. Black bear dens were found in seven different habitat types and six different land types.

Food Habits

Sixty-five black bear scats were collected in 1981. All scats have been analyzed for food content, and presently are being coded for computer and future competitive analysis.

Habitat Use

Limited black bear habitat use data were collected in 1981. Tables 28 and 29 present that data by month. Analysis of black bear habitat use will be presented in further reports as data are accumulated.

MANAGEMENT RECOMMENDATIONS

General Recommendations

Management guidelines developed by the Interagency Wildlife Monitoring and Evaluation Program are presented in Appendix G. These guidelines were developed as a direct result of grizzly bear monitoring conducted on the east front. They represent guidelines that, when followed, will mitigate but not eliminate influences of human activities on grizzly bears and grizzly bear habitat. Human activities within grizzly bear range will have effects, however subtle, on grizzly bears. The fact that rapid distributional recession and declines in grizzly bear populations occurred with the development of increased human activity has been well documented in Europe and North America (Martinka 1980, US Fish & Wildlife Service 1981, Roben 1980, Cowen 1972, Mysterud 1980, Buchalczyk 1980, Markov 1980, Roth 1976, Elgmork 1978, Grachev 1976, Kaa1 1976, Vereschagin

Table 27. Data from seven black bear dens, 1978-81.

Den No.	Location	Type of Den	Elevation	(°) Aspect	Slope	Habitat Type	Land Type	Recorded Years Used	Bear No.	Condition
1	Glenn Cr	Dug	1737	N 350W	5	ABLA/LIBO/LIBO	III	1	Unkn	Old ^{1/}
2	Muddy Cr	Dug	1585	N 20E	30	PSME/SYAL	140	1	Unkn	Good ^{1/}
3	Muddy Cr	Dug	1625	N 60E	16	PSME/SPBE	140	1	Unkn	Old ^{1/}
4	Moose Cr	Dug	1768	N 20E	30	ABLA/VASC	Vc	1	Unkn	Good ^{1/}
5	N Fk Sun	Dug	1524	N360E	20	PSME/CARU/CARU	I	1	Unkn*	Good ^{1/}
6	Wright Cr	Unkn	2073	N 80E	40	ABLA/PIAL/VASC	25	1	212	Good ^{2/}
7	Blackleaf Cr	Unkn	1768	N 5E	50	ABLA/ARCO	21A	1	509	Good ^{2/}

*Subadult Male

1 - Ground inspection.

2 - Located from air.

Table 28. Characteristics of habitats used by month by black bear No. 509, a 10½ year old female, 1981.

	May	June	July	Aug.	Sept.	Oct.	Den	Total
<u>No. locations</u>	6	2	4	3	3	1	4	23
<u>Elevations</u>								
M	1618	1722	1771	1786	1829	1975	1763	1745
$\bar{X}$ ft	5310	5650	5810	5860	6000	6480	5800	5724
<u>Range M</u>	1536-	1615-	1749-	1640-	1701-	-	-	1536-
	1737	1829	1798	2012	1957	-	-	2012
ft	5040-	5300-	5740-	5380-	5580-	-	-	5040-
	5700	6000	5900	6600	6420	-	-	6600
<u>Aspect</u>								
Degrees	43	70	40	70	80	120	5	
	46	310	85	315	30	-	-	
	65		90	40	40	-	-	
	55		40	-	-	-	-	
	25			-	-	-	-	
	90			-	-	-	-	
$\bar{X}$ Degree Aspect	54	190	64	142	50	120	5	73
<u>Topography</u>								
Ridge	-	-	-	-	-	-	-	-
Upper slope	1	1	3	1	1	-	-	7
Mid slope	2	1	1	1	2	1	4	12
Lower slope	3	-	-	-	-	-	-	3
Flat bench	-	-	-	-	-	-	-	-
Creek bottom	-	-	-	1	-	-	-	1
<u>Site</u>								
Timbered ^{1/}	6	2	4	3	2	1	4	22
Open timber	-	-	-	-	1	-	-	1
Shrub	-	-	-	-	-	-	-	-
Open	-	-	-	-	-	-	-	-
$\bar{X}$ % Slope	14	25	18	18	29	15	70	28
<u>Habitat Type</u>								
PSME series	3	1	2	-	-	1	-	7
PSME/SYAL/SYAL	-	1	2	1	-	-	-	4
ABLA series	-	-	-	-	1	-	-	1
ABLA/LIBO	-	-	-	-	-	-	4	4
ABLA/XETE	-	-	-	1	-	-	-	1
ABLA/PIAL/VASC	-	-	-	-	-	-	-	-
POTR series	-	-	-	-	1	-	-	1
POTR/ <i>Salix</i>	-	-	-	-	-	-	-	-
POTR/SYAL	3	-	-	1	1	-	-	1
Unknown	-	-	-	-	1	-	-	1

Table 28 continued.

	May	June	July	Aug.	Sept.	Oct.	Den	Total
No. Locations	6	2	4	3	3	1	4	
<u>Component</u>								
Burns	-	-	-	-	-	-	-	-
Cutting unit	-	-	-	-	-	-	-	-
Meadows	-	-	-	-	-	-	-	-
Roads	-	-	-	-	-	-	-	-
Sidehill park	-	-	-	-	-	-	-	-
Snowchutes	-	-	-	-	-	-	-	-
Ridgetops	-	-	-	-	-	-	-	-
Shrub field	-	-	-	-	1	-	-	1
Rock/talus/ scree/rubble	-	-	-	-	-	-	-	-
Timbered	3	2	4	2	1	1	4	17
Limber pine savanna	-	-	-	-	-	-	-	-
Prairie								
grassland	-	-	-	-	-	-	-	-
Mtn grassland	-	-	-	-	-	-	-	-
Populus stand	3	-	-	1	1	-	-	5
Riparian shrub	-	-	-	-	-	-	-	-
Riparian complex	-	-	-	-	-	-	-	-
<u>AND Type</u>								
10	-	1	2	1	-	-	-	4
32	-	-	-	-	-	-	4	4
35	-	-	-	-	1	-	-	1
69	-	-	-	1	-	-	-	-
90	-	-	-	-	1	-	-	1

1 - Includes all timber greater than 30% canopy coverage.

Table 29. Characteristics of habitats used by month by black bear No. 521, a 6½ year old male, 1981.

	June	July	Aug.	Sept.	Oct.	Den	Total
<u>No. Locations</u>	1	5	3	3	3	4	19
<u>Elevations</u> M	1768	1499	1704	2032	1930	2072	1819
$\bar{X}$ ft	5800	4920	5590	6667	6333	6800	5967
M		1478-	1478-	2012-	1890-	-	1478
Range		1567	1841	2072	2012	-	2072
ft		4850-	4850-	6600-	6200-	-	4850-
		5140	6040	6800	6600	-	6800
<u>Aspect</u>							
Degrees	130	90	100	220	30	80	
		55	50	0010	30	-	
		100	80	320	260	-	
		85	-	-	-	-	
		140	-	-	-	-	
$\bar{X}$ Degree aspect	130	94	77	180	107	80	106
<u>Topography</u>							
Ridge	-	-	-	-	-	-	-
Upper slope	-	-	2	1	-	-	3
Mid slope	1	-	-	-	3	4	8
Lower slope	-	-	-	-	-	-	-
Flat/bench	-	-	-	-	-	-	-
Creek bottom	-	5	1	2	-	-	8
<u>Site</u>							
Timbered ^{1/}	1	5	1	2	3	4	16
Open timbered	-	-	2	-	-	-	2
Shrub	-	-	-	1	-	-	1
Open	-	-	-	-	-	-	-
$\bar{X}$ % slope	20	5	20	27	26	49	23
<u>Habitat type</u>							
ABLA series	-	-	-	1	3	-	4
ABLA/PIAL/VASC	-	-	-	-	-	4	4
POTR series	1	4	1	-	-	-	6
POTR/ <i>Salix</i>	-	1	-	-	-	-	1
Unknown	-	-	2	2	-	-	4

Table 29 continued.

	June	July	Aug.	Sept.	Oct.	Den	Total
No. Locations	1	5	3	3	3	4	19
<u>Component</u>							
Burns	-	-	-	-	-	-	-
Cutting unit	-	-	-	-	-	-	-
Meadows	-	-	-	-	-	-	-
Roads	-	-	-	-	-	-	-
Sidehill park	-	-	-	-	-	-	-
Snow chutes	-	-	-	-	-	-	-
Ridge tops	-	-	-	-	-	-	-
Shrubfields	-	-	1	1	-	-	2
Rock/talus/scree/ rubble	-	-	-	-	-	-	-
Timbered	-	-	1	2	3	4	10
Limber pine savanna	-	-	-	-	-	-	-
Prairie grassland	-	-	-	-	-	-	-
Mtn grassland	-	-	-	-	-	-	-
<i>Populus</i> stand	1	5	1	-	-	-	7
Riparian shrub	-	-	-	-	-	-	-
Riparian complex	-	-	-	-	-	-	-
<u>Land type</u>							
10	0	0	1	-	-	-	1
35	-	-	-	-	-	4	4
79	-	1	-	-	-	-	1
107	-	-	1	-	-	-	1

1 - Includes all timber greater than 30% canopy coverage.

1976, Pearson 1975, Curry-Lindahl 1972, Stebler 1972, Zunino and Herrero 1971, Guilday 1968, Buss 1956 and Storer and Trevis 1955).

Recent studies in North America have echoed concerns regarding increasing human access and activities within grizzly bear habitat. The influences of timber harvest, livestock grazing, boneyards and dumps, recreation, sport hunting, road access, mining, subdivision, and hydrocarbon exploitation have been discussed (Craighead 1979, 1980, Craighead and Craighead 1967, 1971, 1973, 1974; Knight et al. 1975, 1976, 1977, 1978, 1980 1980a, 1981; Chester 1976, Jonkel and Servheen 1977, Jonkel 1976, 1977, 1978, 1980; Harding and Nagy 1980; Schallenberger and Jonkel 1980, Knight and Judd 1980, Blanchard 1978, 1980; Servheen 1981, Pearson 1975, Reynolds and Hechtel 1980, Nagy and Russell 1978, Russell et al. 1978, Hamer et al. 1977, Mundy and Flook 1973). Each activity contributes an additive stress to grizzly bear populations. As such, it is essential that responsible land management agencies and state wildlife departments develop management programs to document and map each land use as it occurs. A cumulative impacts mapping has been conducted in some areas of Montana and should be implemented on the east front of the Rocky Mountains. This would be especially important on grizzly spring range where at present most of the impacts and activities are occurring. Such a project has widespread applicability to all species of wildlife concerned. Disturbance thresholds for management areas need to be determined and areas with overlapping activities identified. Both management and the resources would ultimately benefit from such a documentation and mapping.

The relationship of grizzly bears to all types of human activities as well as oil and gas development must be understood. Monitoring programs should be further directed and focused toward filling important gaps in the data base. A summary of existing data is needed to indicate where these gaps exist. A complete review of habitat preference, denning habits, distribution, food habits, movement and home range data should be conducted. Intensive efforts to gather data pertaining to livestock/bear relationships, population estimation, oil and gas development impacts, the role of sport hunting, the effects of animal predation control programs, and the interaction of black and grizzly bears deserve further investigation. Field emphasis should be directed toward securing baseline data in the Badger-Two Medicine, Sun River-south, and the remote backcountry areas.

Specific Recommendations

Many of the recommendations below overlap or support those presented in Appendix G.

(1) Specifically avoid imposing activities on riparian shrub and *Populus* stands during spring and early summer (April-July 15). Maintain a buffer zone of at least 1/4 mile between activities and the edge of these habitat components. It is at the edges of these components where many of the important bear foods occur.

(2) During the summer and fall period (July 1-Sept. 15) avoid imposing activities near open alpine areas where bears dig for roots. In this open alpine habitat bears are extremely vulnerable. Also important during late summer and fall (August-November) are the subalpine fir and white-bark pine habitat types at mid to upper elevations.

(3) Avoid important denning areas during the late fall and winter period (October 15-April 15) and known breeding areas during the period from May 15 until July 15. Denning sites are described in the text of this report. Known breeding areas include the upper Muddy Creek, the head of Rinkers Creek and the Ear Mountain area.

Oil and Gas Exploration/Development

(4) Air travel corridors should be established in advance when activities require the use of helicopters. Corridors should be designed to avoid seasonally important habitat components, known breeding areas (May 15-July 15), denning areas (Oct. 15-April 15), and open alpine areas which are known to be important digging sites (July 1-Sept. 15).

(5) No seismic or exploratory drilling activities should be conducted within a minimum of 2 miles of den sites during the Oct. 15-April 15 period.

(6) Helicopter flights and blasting should be permitted only between 1 hour after sunrise and 1 hour before sunset (April 15-Oct. 15). It is generally during the dusk through dawn hours that grizzly bears are most active.

(7) Seismic activities should be spaced by at least an acceptable distance of 8-10 miles and separated by substantial topographic screens. Simultaneous shooting of parallel lines within 8 miles should be avoided. A disturbance-free zone is essential between lines to accommodate displaced animals.

(8) Seismic permits should include a clause providing for cancellation or temporary cessation of activities, if necessary to prevent grizzly/human conflicts.

(9) Permittees should be required by administering agencies to log their activities each day. The location and line that each crew is working should be recorded. Such a record is necessary to fairly assess impacts on wildlife, and will provide valuable progress records for the management agency.

(10) Seismic trails and roads which were created during a seismic operation should not be used for other purposes after the operation has been completed. Seismic roads and trails should be obliterated and revegetated immediately after seismic operations have ceased.

(11) Drilling schedules on adjacent sites within important grizzly bear complexes should be staggered to provide a disturbance-free area for displaced bears.

(12) Pipeline construction required for the development of a gas or oil field should be condensed into the shortest timeframe as possible and subject to timing restrictions when conducted in important grizzly bear habitat components or complexes. Pipelines built through timbered or shrub areas should have several "dog-legs" inserted in them to prevent long straight corridors where vegetative cover has been removed.

(13) Field operation centers associated with seismic or oil/gas exploration activities should be placed carefully to avoid seasonally important habitat components, or important bear complexes. Such placement of sites is necessary in order to avoid direct or potential conflicts between man and grizzly bears.

Livestock/Bear Conflicts

(14) Livestock grazing on important spring habitat for grizzly bears should be deferred until after July 1. More research on the relationship and forage competition between livestock and bears should be conducted, and specific recommendations made.

(15) Boneyards and livestock dumps are prevalent along the east front and are frequented by grizzly bears. Ranchers and landowners should be encouraged to place carcasses of dead livestock and garbage on remote areas of their land. During calving, dead cows and calves should be hauled a considerable distance from calving grounds to discourage predation of newborn calves.

(16) The desirability of sheep grazing allotments on lands administered by government agencies should be evaluated. Serious conflicts between bears and sheep have repeatedly occurred at several locations along the east front and will continue to occur. Sheep are inherently more susceptible to bear predation than cattle. Since 1977, at least five grizzly bears have been known to kill sheep on two separate forest allotments. All five have subsequently been killed.

LITERATURE CITED

- Amstrup, S. C. and J. Beecham. 1976. Activity patterns of radio-collared black bears in Idaho. J. Wildl. Manage. 40(2):340-348.
- Aune, K. and T. Stivers. 1981. Rocky Mountain Front grizzly bear monitoring and investigation. Mont. Dept. Fish, Wildl. & Parks. Helena. 50pp.
- Blanchard, B. 1978. Grizzly bear distribution in relation to habitat areas and recreational use: Cabin Creek-Hilgard Mountains. M.S. thesis, Mont. St. Univ., Bozeman. 75pp.
- _____. 1980. Grizzly bear-timber relationships in the Yellowstone area. 5th Int. Conf. on Bear Res. and Manage. (In press)
- Buchalczyk, T. 1980. The brown bear in Poland. Pp. 229-232 in C. J. Martinka and K. L. McArthur, eds., Bears - Their Biology and Management. Bear Biol. Assoc. Conf. Ser. No. 3.
- Buss, I. O. 1956. California grizzly-North American moose. Ecology, Vol. 37(2): 403-405.
- Chester, J. M. 1976. Human wildlife interactions in the Gallatin Range, Yellowstone National Park, 1973-74. M.S. thesis, Mont. St. Univ., Bozeman. 114pp.
- Curry-Lindahl, K. 1972. The brown bear (Ursus arctos) in Europe: decline, present distribution, biology and ecology. Internat. Union for Conserva. of Nature & Natural Res. Publ. N.S. No. 23. pp. 74-80.
- Cowan, I. M. 1972. The status and conservation of bears (Ursidae) of the world, 1970. Internat. Union for Conserva. of Nature & Natural Res. Publ. N.S. No. 23 - pp. 343-367.
- Craighead, F. C. Jr. 1979. Track of the grizzly. Sierra Club Books, San Francisco, CA. 261pp.
- Craighead, J. J. 1980. A proposed delineation of critical grizzly bear habitat in the Yellowstone Region. In Bears-their biology and management. 4th Int. Conf. on Bear Res. and Manage. (In press)
- _____, and F. C. Craighead, Jr. 1967. Management of bears in Yellowstone National Park. Environ. Res. Inst. and Mont. Coop. Wildl. Res. Unit Rep. 113pp.
- _____ and _____. 1971. Grizzly bear-man relationship in Yellowstone National Park. BioSci. 21(16):845-857.
- _____, J. R. Varney, and F. C. Craighead. 1973. A computer analysis of the Yellowstone grizzly bear population. Mont. Coop. Wildl. Res. Unit Publ. 151pp.

- Craighead, J. J., J. Varney, and F. C. Craighead. 1974. A population analysis of the Yellowstone grizzly bears. *Mont. For. and Conserv. Exp. Stn. Bull.* 40. Univ. of Mont., Missoula. 20pp.
- Craighead, F. C., Jr., and J. J. Craighead. 1972. Grizzly bear pre-hibernation and denning activities as determined by radio tracking. *Wildl. Monogr.* 32. 35pp.
- Dupuyer Centennial Committee. 1977. *By gone days and modern ways.* Griggs Printing and Publishing. Havre, MT. 388pp.
- Elgmork, K. 1978. Human impact on a bear population (*Ursus arctos* L.) *England Biol. Conserv. No.* 13:81-103.
- Erickson, G. L. 1972. The ecology of Rocky Mountain bighorn sheep in the Sun River area of Montana with special reference to summer food habits and range movements. M.S. thesis, Mont. St. Univ., Bozeman. 50pp.
- Frisina, M. R. 1974. Ecology of bighorn sheep in the Sun River area of Montana during fall and spring. M.S. thesis, Mont. St. Univ., Bozeman. 68pp.
- Gillespie, O. and C. Jonkel. 1980. Grizzly bear denning in the South Fork of the Flathed River. Pp. 178-195 in *Ann. Rept. No. 5. Border Grizzly Proj.*, Univ. Montana, Missoula.
- Grachev, Y. A. 1976. Distribution and quantity of brown bears in Kazakhstan. Pp. 299-300 in M. R. Pelton, J. W. Lentfer, and G. E. Folk, eds., *Bears - Their Biology and Management.* IUCN Publ. New Ser. 40, Morges, Switzerland.
- Guilday, J. E. 1968. Grizzly bears from eastern North America. *American Midland Naturalist* 79:247-250.
- Hamer, J.D.W., S. Herrero, and R. T. Ogilvie. 1978. Ecological studies of the Banff National Park grizzly bear Cuthead/Wigmore Region 1977. Parks Canada Western Region, Calgary, Alberta. 50pp.
- _____, _____, and T. Toth. 1979. Ecological studies of the Banff National Park grizzly bear-Cuthead/Wigmore Region 1978. Parks Canada Western Region. 71pp.
- Hamer, D. S. Herrero, and R. T. Ogilvie. 1977. Ecological studies of the grizzly bear, Banff National Park. *Interim Rept.* 239pp.
- Hamlin, K. L. and M. Frisina. 1975. Special grizzly bear survey. *Job Prog. Rept. W-130-R-6, 1-1, 1-4,* Mont. Dept. Fish & Game, Helena. 64pp.
- Harding, L. and J. A. Nagy. 1980. Responses of grizzly bears to hydro-carbon exploration on Richards Island, Northwest Territories, Canada. Pp. 277-280 in C. J. Martinka and K. L. McArthur, eds., *Bears - Their Biology and Management,* Bear Biol. Assoc. Conf. Ser. No. 3.

- Harvey, M. J., and R. W. Barbour. 1965. Home range of Microtus ochroster as determined by a modified minimum area method. J. Mammal. 36(3): 398-402.
- Hayne, D. W. 1959. Calculation of size of home range. J. Mammal. 30(1):1-18.
- Holdorf, H. 1981. Soil resource inventory - interim in-service report - now wilderness portions. USDA, Forest Service. Lewis & Clark Natl. For., Great Falls, MT. 70pp.
- Holdorf, H., A. Martinson and D. On. 1980. Land system inventory of the Scapegoat and Danaher portion of the Bob Marshall Wilderness. USDA Forest Service, Flathead, Lolo, Lewis & Clark and Helena Nati. For. 52pp.
- Hitchcock, C., and A. Cronquist. 1973. Flora of the Pacific Northwest. Univ. of Wash. Press, Seattle and London. 730pp.
- Jonkel, C. 1976. Annual report No. 1, Border Grizzly Project, Univ. of Mont., Missoula. 111pp.
- _____. 1977. Annual report No. 2, Border Grizzly Project, Univ. of Mont., Missoula. 134pp.
- _____. 1978. Annual report No. 3, Border Grizzly Project, Univ. of Mont., Missoula. 256pp.
- _____. 1980. Annual report No. 5, Border Grizzly Project, Univ. of Mont., Missoula. 222pp.
- _____, and C. Servheen. 1977. Bears and people - a wilderness management challenge. Western Wildlands 4:22-25.
- Kaal, M. 1976. Ecology, protection and prospects of utilization of the brown bear in Estonian S.S.R. In Bears-Their Biology and Management. M. R. Pelton, J. W. Lentfer, G. E. Fold, eds. IUCN New Ser. No. 40:303-306.
- Knight, R. R. 1970. The Sun River elk herd. Wildl. Monogr. 23. 66pp.
- _____. 1980. Biological considerations in the delineation of critical habitat. Pp. 1-3 in C. J. Martinka and K. L. McArthur, eds., Bears - Their Biology and Management. Bear Biol. Assoc. Conf. Ser. No. 3.
- Knight, R., J. Basile, K. Greer, S. Judd, L. Oldenburg, and L. Roop. 1975. Yellowstone grizzly bear investigations. Ann. rept. of the Interagency Study Team, 1974. USDI-NPS Misc. Rep. No. 8. 44pp.
- _____, _____, _____, _____, and _____. 1976. Yellowstone grizzly bear investigations. Ann. rept. of the Interagency Study Team, 1975. USDI-NPS Misc. Rep. No. 9. 46pp.

- Knight, R., J. Basile, K. Greer, S. Judd, L. Oldenburg, and L. Roop. 1977. Yellowstone grizzly bear investigations. Ann. rept. of the Interagency Study Team, 1976. USDI-NPS Misc. Rep. No. 10. 75pp.
- _____, _____, _____, _____, and _____. 1978. Yellowstone grizzly bear investigations. Ann. rept. of the Interagency Study Team, 1977. USDI-NPS. 107pp.
- _____, B. Blanchard, K. Kendall, and L. Oldenburg. 1980. Yellowstone grizzly bear investigations. Ann. rept. of the Interagency Study Team, 1978-79. 91pp.
- _____, _____, _____, K. Greer, L. Oldenburg and L. Roop. 1981. Yellowstone grizzly bear investigations. Ann. rept. of the Interagency Study Team, 1980. 55pp.
- _____, and S. Judd. 1980. Grizzly bears that kill livestock. 5th Int. Conf. on Bear Res. and Mgt., Madison, WI. (In press)
- Mace, R. and C. Jonkel. 1980. Grizzly bear response to habitat disturbance. Pp 70-98 in Ann. rept. No. 5. Border Grizzly Project., Univ. Mont., Missoula.
- Marcum, L. C., and D. O. Loftsgaarden. 1980. A nonmapping technique for studying habitat preferences. J. Wildl. Manage. 44(4):963-968.
- Markov, G. 1980. On the distribution of the brown bear in Bulgaria. P. 259 (Abstract only) in C. J. Martinka and K. L. McArthur, eds., Bears - Their Biology and Management, Bear Biol. Assoc. Conf. Ser. No. 3.
- Martinka, C. J. 1982. Effects of conterminous land use on grizzly bears in Glacier National Park. (In press)
- _____. 1974. Population characteristics of grizzly bears in Glacier National Park, MT. J. Mammal. 55(1):21-29.
- Mohr, C. O. 1947. Table of equivalent populations of North American small mammals. Amer. Midl. Nat. 37:223-249.
- Mudge, M. R. 1972. Pre-quaternary rocks in the Sun Canyon area, north-western Montana. Geological Survey Professional Paper 663-A, US Govt. Print. Off., Washington, DC 142pp.
- Mueggler, W. F., and W. P. Handl. 1974. Mountain grassland and shrubland habitat types of western Montana. Intermountain For. and Rge. Exp. Sta. and N. Reg. USFS, Missoula. 89pp.
- Mundy, K.R.D., and D. R. Flock. 1973. Background for managing grizzly bears in the national parks of Canada. Can. Wildl. Serv. Rep. Ser. 22. 34pp.

- Mysterud, I. 1980. Bear management and sheep husbandry in Norway, with a discussion of predatory behavior significant for evaluation of livestock losses. Pp. 233-241 in C. J. Martinka and K. L. McArthur, eds., Bears - Their Biology and Management, Bear Biol. Assoc. Conf. Ser. No. 3.
- Nagy, J. A., and R. H. Russell. 1978. Ecological studies of the boreal grizzly bear (Ursus arctos L.) - annual report for 1977. Can. Wildl. Serv. 72pp.
- Pearson, A. M. 1975. The northern interior grizzly bear Ursus arctos L. Can. Wildl. Serv. Rep. Ser. 34. 86pp.
- Pfister, R., B. Kovalchik, S. Arno, and R. Presby. 1977. Forest habitat types of Montana. US For. Serv. Gen. Tech. Rep. INT-34. 174pp.
- Picton, H. D. 1960. Migration patterns of the Sun River elk herd, Montana. J. Wildl. Manage. 24(3):279-290.
- _____, and I. E. Picton. 1975. Saga of the Sun. Mont. Dept. Fish and Game, Helena. 55pp.
- Reynolds, H. J., J. A. Curatolo and R. Quimby. 1976. Denning ecology of grizzly bears in northeastern Alaska. Pp. 403-409 in M. R. Pelton, J. W. Lentfer, and G. E. Polks, eds, Bears - Their Biology and Management. IUCN Publ. New Ser. 40, Morges, Switzerland.
- _____, and J. Hechtel. 1980. Structure, status, reproductive biology, movement, distribution and habitat utilization of a grizzly bear population. Alaska Fed. Aid in Wildl. Rest. Proj. W-17-11. 65pp.
- Roben, P. 1980. Status of the brown bear in the Pyrenees. Pp. 243-247 in C. J. Martinka and K. L. McArthur, eds. Bears - Their Biology and Management, Bear Biol. Assoc. Conf. Ser. No. 3.
- Roth, H. U. 1976. Status of the last brown bears of the Alps in the Trentino, Italy. Papers of the 3rd Int. Conf. on Bear Res. and Manage.:307-308.
- Russell, R. H., J. W. Nolan, N. A. Woody, G. Anderson, and A. M. Pearson. 1978. Ecology of grizzly bears in Jasper National Park - a progress report, 1976-77. Can. Wildl. Serv., Edmonton. 95pp.

- Schallenger, A. 1966. Food habits, range use and interspecific relationships of bighorn sheep in Sun River area, westcentral Montana. M.S. Thesis, Mont. St. Univ., Bozeman. 44pp.
- _____. 1974. Reconnaissance survey of grizzly bear habitat Rocky Mountain Division, Lewis and Clark National Forest, USFS, Great Falls, MT. 46pp.
- _____. 1976. Grizzly bear habitat survey Badger Creek-South Fork Two Medicine Management Unit, Lewis and Clark National Forest, USFS, Great Falls, MT. 70pp.
- _____. 1977. Review of oil and gas exploitation impacts on grizzly bears. *In* Transactions of 4th Int. Bear Conf., Cliff Martinka, ed. In press.
- _____, and C. J. Jonkel. 1978. Rocky Mountain east front studies, 1977. First Ann. Rep. Border Grizzly Project. Sch. of For., Univ. of Mont., Missoula. BGP Spec. Rpt. No. 18:69pp.
- _____, and C. J. Jonkel. 1979. Rocky Mountain east front grizzly studies, 1978. Univ. of Mont., Missoula. BGP Spec. Rpt. No. 27. 115pp.
- _____, and _____. 1979a. Antelope Butte-Muddy Creek grizzly bear habitat. Univ. of Mont., Missoula. BGP Spec. Rpt. No. 35.
- _____, and _____. 1980. Rocky Mountain east front grizzly bear studies, 1979. Univ. of Mont., Missoula. BGP Spec. Rpt. No. 39. 209pp.
- Servheen, C. 1981. Denning ecology, food habits, habitat use, and movements of grizzly bears in the Mission Mountains, Montana. PhD dissertation, Univ. of Mont.
- _____, and L. C. Lee. 1979. An assessment of the grizzly bear population size and status and a description of important grizzly use sites in the Finley Logging Unit, Flathead Reservation, Montana. Rept. to BIA, Contr. No. C50-6-1420-4988. School of For., Univ. of Mont., Missoula. Unpubl. Rpt. 64pp.
- Sizemore, D. L. 1980. Foraging strategies of the grizzly bear as related to its ecological energetics. M.S. thesis, Univ. of Mont., Missoula. 67pp.
- Stebler, A. M. 1972. Conservation of the grizzly-ecological and cultural considerations. *In* Bears - Their Biology and Management. S. Herrero, ed. IUCN Publ. New Ser. No. 23:297-303.
- Stoneberg, R. and C. Jonkel. 1966. Age determination in black bears by cementum layers. J. Wildl. Manage. 30(2):411-414.

- Storer, T. I., and L. P. Tevis. 1955. California grizzly. Univ. of California Press, Berkeley. 355pp.
- Sumner, J., and J. J. Craighead. 1973. Grizzly bear habitat survey in the Scapegoat Wilderness, Montana. Mont. Coop. Wildl. Res. Unit, Univ. of Mont., Missoula. 49pp.
- USDA, Forest Service. 1977. Environmental statement draft, Rocky Mountain Front Planning Unit, Part I, II, III. Great Falls, MT. 500+pp.
- US Fish & Wildlife Service. 1981. Grizzly bear recovery plan. US Dept. Interior, Washington, DC. 190pp.
- Vroom, G. W., S. Herrero, and R. T. Ogilvie. 1980. Environmental parameters associated with grizzly bear winter den sites in Banff National Park. Pp. 321-330 in C. J. Martinka and K. L. McArthur, eds., Bears - Their Biology and Management. Bear Biol. Assoc. Conf. Ser. No. 3.
- Vereschagin, N. K. 1976. The brown bear in Eurasia, particularly the Soviet Union. In Bears - Their Biology and Management. M. R. Pelton, J. W. Lentfer, and C. E. Folk, eds. IUCN New Ser. No. 40: 327-335.
- Zager, P. E. 1980. Grizzly bear habitat utilization. Pp. 99-132 in Ann. Rept. No. 5. Border Grizzly Project, Univ. of Mont., Missoula.
- Zunino, F., and S. Herrero. 1972. The status of the brown bear (Ursus arctos) in Abruzzo National Park, Italy, 1971. Biol. Conserv. 4:263-272.

Appendix A. Excerpted from Kasworm (1981) and Ihsle (1982) climatological data.

Month	Station ^a	Mean	Temperature (°C)	Amount	Precipitation (cm)	Snowfall (cm)
			Deviation (°C) from Long-term Average		Deviation (cm) from Long-term Average	
Oct. 1979	GD	8.9	+1.8	1.19	-1.78	0
	BL	8.3	+1.8	1.14	- .03	
Nov. 1979	GD	-.5	-1.2	.33	-2.72	3.05
	BL	-.2	+ .2	.51	-1.12	
Dec. 1979	GD	.4	+3.2	3.45	1.09	30.5
	BL	-.1	+4.2	2.26	+ .86	
Jan. 1980	GD	-9.0	-3.5	3.23	+ .76	42.7
	BL	-10.6	-3.3	2.46	+ .91	
Feb. 1980	GD	-1.6	+1.4	2.08	+ .20	45.7
	BL	-2.9	+1.2	2.08	+ .56	
Mar. 1980	GD	-1.1	+ .5	1.17	-1.45	13.2
	BL	-2.5	- .7	2.21	+ .53	
Apr. 1980	GD	7.5	+3.4	5.84	+1.96	35.6
	BL	7.2	+3.5	5.33	+1.75	
May 1980	GD	10.6	+2.0	15.47	+7.32	0
	BL	11.3	+2.2	10.26	+1.65	
June 1980	GD	12.5	+ .3	13.13	+2.57	0
	BL	-	-	-	-	
July 1980	GD	16.8	+ .3	1.70	-1.78	0
	BL	18.2	+1.2	.61	-2.97	
Aug. 1980	GD	13.9	-2.1	2.62	-1.02	0
	BL	13.9	-2.3	3.58	- .13	
Sept. 1980	GD	12.6	+1.2	3.48	- .43	0
	BL	11.7	+ .3	2.84	+ .10	

Month	Station ^a	Temperature (°C) Deviation (°C) from Long-term Average		Amount	Precipitation (cm) Deviation (cm) from Long-term Average		Snowfall (cm)
		Mean					
Oct. 1980	GD	8.2	+1.1	3.30	+ .33	-	
	BL	8.1	+1.5	3.48	+2.31	7.6	
Nov. 1980	GD	2.6	+1.9	1.17	-1.88	11.4	
	CH	4.2	+3.2	.18	- .91	7.6	
Dec. 1980	GD	-3.0	- .2	2.85	+ .48	24.1	
	BL	-7.2	-3.1	1.57	+ .15	2.8	
Jan. 1981	GD	.1	+5.4	.41	-2.06	-	
	BL	.1	+7.4	.84	- .71	-	
Feb. 1981	GD	-1.1	+1.8	1.73	- .15	27.9	
	CH	.4	+3.3	.23	- .66	3.8	
Mar. 1981	GD	2.4	+4.0	2.11	- .51	-	
	BL	2.2	+4.0	5.82	+4.14	-	
Apr. 1981	GD	5.9	+1.8	.66	-3.23	0	
	BL	6.2	+2.5	Trace	-3.58	Trace	
May 1981	GD	9.3	+ .7	17.70	+9.55	0	
	CH	11.6	+ .7	8.61	+2.97	0	
June 1981	GD	11.7	- .5	4.11	-6.45	0	
	CH	14.4	- .4	2.31	-5.97	0	
July 1981	GD	16.6	+ .1	4.78	+1.30	0	
	BL	17.4	+ .4	3.07	- .51	0	
Aug. 1981	GD	17.4	+1.5	4.04	+ .41	0	
	BL	18.9	+2.6	5.61	-1.91	0	
Sept. 1981	GD	12.8	+1.5	1.24	-2.67	0	
	BL	13.2		.51		0	

a - GD = Gibson Dam, BL = Blackleaf, CH = Choteau

Appendix B. East Front grizzly bear habitat component definitions.

Code No.

- 1 BURNS: early seral plant communities created or maintained by wildfire. Charred downfall and snags, fire scarred trees, charcoal in the surface horizons, distinctly even-aged stands of *Pinus contorta*, or *Larix occidentalis* (primarily west of the continental divide), and extensive *Epilobium angustifolium* cover are some clues in determining the fire history of the site.

A well-developed shrubfield created by catastrophic fire is classified as a "Shrubfield" and cross-referenced to the "Burn" category.

- 2 CUTTING UNITS: are disturbed, open, or vigorously timbered sites on which the effects of a tree harvest operation are detectable, regardless of the cutting system used, and regardless of the age of the stand.

- 3 MEADOWS: are naturally open, level, slightly concave (wet), or convex (dry) sites of any size or shape which may occur from low to relatively high elevations in the northern Rocky Mountains. Meadow sites are at least potentially dominated by particular associations of perennial graminoids and various forbs. Trees and shrubs are notably absent from meadows, but generally border and enclose the meadow. As such, meadows are plant communities of definite floristic composition that exhibit a uniform physiognomy and grow in relatively uniform habitat conditions within specific elevational ranges.

- 4 ROADS: are disturbed, open areas which have been purposefully cleared to permit vehicular traffic. Road is also inclusive of the term "utility corridor," which refers to routes cleared for man-made transportation (railroad right of way, pipeline, airfield, powerline corridor, or seismographic line).

- 5 SIDEHILL PARKS: are timber enclosed naturally open or sparsely timbered sites which occur from mid-montane to high elevations. Sites occur on moderate to steep slopes. Generally, sidehill parks resemble inclined meadows with straight, convex or undulating configurations. Sidehill park vegetation is the result of topo-edaphic and or zootic influences. The vegetation is variable and may be dominated by combinations of native and introduced graminoids.

Sidehill parks are distinguished from meadows by being inclined and sparsely timbered through-out or along the ecotones which separate the parks from adjacent stands of trees.

- 6 SNOWCHUTES: are concave, very steep, linear, open sites at mid-montane to high elevations where frequent snow movement limits vegetation to forbs, graminoids and shrubs. These sites may be perennially wet. Snowchutes often constitute the uppermost, ephemeral stream channels of major drainage systems. This component may exhibit a highly variable vegetation gradient along their length and cross sectional dimensions. Characteristic species are given in the appendix.
- 7 RIDGETOPS: are drainage divides which are distinguished from adjacent hillslopes by the convex configuration across the apex of the divide. Ridgetops include major and minor mountain range divides. This component may be open, open-timbered, or timbered. Typically, ridgetops are dominated by variable mosaics of vegetation, bare rock and relatively thin mantles of mineral soil, with high moisture infiltration. Since vegetation development is extremely variable, the ridgetops should be cross-referenced to another grizzly bear habitat component.
- 92 8 SHRUBFIELDS: are open sites dominated by extensive stands of shrubs occurring from low-montane to high elevations, from moderate to steep slopes. Heavy shifting snow packs, repeated wildfire, timber harvesting, or topo-edaphic influences are factors responsible for the creation or maintenance of these seral communities. Repeated disturbance by snowslides, or intense competition from shrubs, forbs, and graminoids, may preclude successful conifer regeneration on these sites. Individual trees may be found in shrubfields, but are generally confined to microsites where competition from shrubs, forbs, and graminoids is reduced, or where they are sheltered from sliding snow.
- 9 ROCK/TALUS/SCREE/RUBBLE: are flat to steeply sloped sites predominantly covered with rocks of varying size, shape and composition, occurring from lowlands to alpine. This broad component is composed of glacially scoured slabrock, bedrock cliffs, unstable sloughed-off slide areas, and flood scoured rubbled deposited dry river beds. Vegetation development within the rock/talus/scree/rubble component is extremely variable, and thus should be cross-referenced to another grizzly bear habitat component. Ecologically, the vegetation on these sites can be considered as topo-edaphic climaxes.

- 10 TIMBER: - plant communities dominated by coniferous trees with a canopy coverage of at least 30 percent. Associated understory species composition and coverage vary from site to site, yet have no bearing on this habitat component classification. Plant species composition and coverage are recorded on grizzly bear activity forms when grizzly use has been determined.
- 11 LIMBER PINE SAVANNA: - open timbered *Pinus flexilis* dominated plant communities with a canopy coverage of less than 30 percent. This habitat component forms a foothills transition between the prairie grasslands of the lower elevations and the dense, and wetter, timbered *Pseudotsuga* forests of the upper slopes. Due to the transitional position of the limber pine savanna habitat component, a large diversity of associated shrubs, forbs, and graminoids are found.
- 12 PRAIRIE GRASSLAND: - open sites dominated by extensive grass cover on varying aspects and slopes, from low elevations up to 6000 feet. Soil and moisture conditions vary from dry sandy soils to moist clays and loams. Meuggler's *Stipa comata/Bouteloua gracilis*, *Agropyron spicatum/Bouteloua gracilis*, *Agropyron spicatum/Agropyron smithii*, *Agropyron spicatum/Poa sandbergii* (MONT), and *Festuca scabrella/Agropyron spicatum* habitat types predominantly compose this grizzly bear habitat component. Farmland hay meadows are included in the prairie grassland habitat component.
- 13 MOUNTAIN GRASSLAND: - open sites dominated by extensive grass cover on varying aspects and slopes, above 6000 feet in elevation. Soils vary, with moisture conditions being more mesic than the lower prairie grassland component. Mueggler's *Festuca scabrella/Festuca idahoensis* and *Festuca idahoensis/Agropyron spicatum* habitat types are readily found in this mountain grassland habitat component within the East front study area.
- 14 POPULUS STANDS: are deciduous forests where *Populus tremuloides*, or *Populus trichocarpa* is the dominant tree species with the largest overstory canopy coverage. *Populus* stands occur from lowlands to mid-montane on soil and moisture conditions ranging from dry sandy soils to moderately wet clays and loams to standing or slow moving water on silted soils. *Populus* stands are rich in species diversity when occurring on wet sites. Understory shrub species composition range with the moisture gradient from *Rosa acicularis*, to *Symphoricarpos albus*, to *Betula* and *Salix* spp.

15   RIPARIAN SHRUB: - perennially wet sites with extensive areas where shrub species occupy the largest portion of the overstory canopy. The riparian shrub component occurs from lowlands to foothills, adjacent to, or bordering streams and rivers, and meadows, and is characteristic of wet seeps, bogs, glades and marshes. The riparian shrub habitat component displays a very gradual cross sectional moisture gradient. The associated riparian shrub species form extensive stands which integrate from the moderately wet perimeters to the very wet centers where the shrub overstory lessens and standing water often occurs.

16   RIPARIAN COMPLEX: - timbered, open-timbered, or open sites which are hydrologically active and which occur along permanent rivers and streams, or anywhere distinct channels carry free-flowing water, even if at times the flow is ephemeral. The riparian habitat component is narrow and linear in shape exhibiting a very abrupt cross sectional moisture gradient. The resultant transition from adjacent habitat components through the possible deciduous tree species and riparian shrubs to the associated riparian forbs and graminoids, occurs in a short distance. Consequently, this component generally displays an acute "V" shape in cross section.

94   17   OTHER

Appendix C. 1981 grizzly bear observations.

Date	Observer's Name	Occupation	Location	Observation			Age of	Remarks
				Sight- ing	Track	Other	Sign	
MARIAS RIVER								
5/1	Greg Kushnak	Agronomist	Scoffin Cr NE¼ S15 T27, R9		x		<1 wk	Track on 4x4 road, POTR/ <u>Salix</u> type, 5120' eleva, 45° aspect, 15% slope, <100 m to cover
5/4	Tom Selanski	Rancher	Dupuyer Cr NW¼ S19 T27 R 8	1 subadult			Obs	Observed 1 yrling near house, <u>Salix</u> /Sedge type, 4770 eleva. 45° aspect, 2% slope, <100 m to cover
5/19	Mike Durrell	Rancher	Birch Cr NE¼ S 14 T28 R 8		1 Ad		1 day	Tracks in ditch adjacent to county road; 4380' eleva., 70° aspect, 1% slope, < 500m to cover
5/21	Mike Durrell	Rancher	Sheep Cr NW¼ S 17 T28, R7	1 subadult			Obs	Late evening, subadult observed on bone pile. Willow shrub type, 4200' eleva., 60° aspect, 1% slope, <100 m to cover
5/29	Lewis Young	USFS	Red Poacher Cr, NESE S23,T29,R12		1 subadult		<5 days	Tracks on trail; PICO/POTR/ <u>Salix</u> type, 5240' eleva., 180° aspect, 5% slope, <100 m to cover

Appendix C. 1981 grizzly bear observations. (continued)

Date	Observer's Name	Occupation	Location	Observation			Age of Sign	Remarks
				Sight-ing	Track	Other		
MARIAS RIVER								
5/29	Lewis Young	USFS	Badger Cr		x		1 wk	2 bears tried to get in USFS cabin, bunkhouse & tack shed but failed. Left muddy foot-prints on doors, 5500' eleva., 90° aspect, 5% slope
5/20	Del Breeding	Rancher	Hightower Ridge	1 Ad			Obs	Observed large grizzly traveling west across prairie grassland, AGSP/FEID/FESC type, 500' eleva, 110° aspect, 10% slope, <100 m to cover
6/1	George Denboer	Rancher	Dupuyer Cr SW 1/4 S33 T28, R8			Sheep Depre- dation		Bear fed on dead sheep & next night killed a ewe in pasture next to house; AGSP/FEID, 4510' eleva., 340° aspect, 2% slope, <100 m to cover
6/2	Ken Wheeler	USFWS	Dupuyer Cr SE NW S5 T27 R8	1 Ad			Obs	Observed adult dark brown grizzly moving up coulee away from Dupuyer Cr bottom; POTR/FESC type, 4560' eleva., 80° aspect, 10% slope, <100 m to cover
6/5	Ken Wheeler	USFWS	Dupuyer Cr SE SW S5 T27 R8	1 Ad			Obs	Large grizzly came out of Dupuyer Cr bottom & traveled up grass hillside, POTR/FEID, 4600' eleva., 320° aspect, 15% slope, <100 m to cover

Appendix C. 1981 grizzly bear observations.

Date	Observer's Name	Occupation	Location	Observation			Age of Sign	Remarks
				Sight-ing	Track	Other		
MARIAS RIVER								
6/5	McKracken	Rancher	Hightower Ridge SWNE S24T27R8		2 Ad	Scats	1-2 wks	Bears have been feeding in dump on dead cows & sheep. Found scats, tracks & hair on fence. FESC/FEID type, 4700' eleva., 90° aspect, 2% slope, >500 m to cover
6/6	Tom Selanski	Rancher	S Fk Dupuyer Cr NW¼ S19 T27 R8	2 subadults			Obs	2 yearlings, one light colored, seen in corrals at night beneath yard light. <100 m to willow creek bottom, 4820' eleva., 90° aspect, 1% slope
6/13	Keith Aune	MDFWP	Middle Fk Dupuyer Cr SESE S26 T27R9			Scats	3-5 Days	2 large scats on 4x4 road, PSME/ARCO type, 5350' eleva., 45° aspect, 10% slope, <100 m to cover
6/18	Tom Stivers	MDFWP	Middle Fk Dupuyer Cr NE¼ S34, T27R9	2 yrlgs			Obs	2 yearlings of female #220 were spooked from timbered draw, fleeing up POFR/FESC slope, 5700' eleva., 160° aspect, 20% slope, <100 m to cover. One bear black colored, the other dark silvertip
6/18	Keith Aune Paul Suek	MDFWP	Middle Fk Dupuyer Cr SWNE S26 T27R9		1 ad		1-5 wks	Tracks on 4x4 road at creek crossing, POTR/Salix type, 5100' eleva., 50° aspect, 5% slope, <100 m to cover

Appendix C. 1981 grizzly bear observations.

Date	Observer's Name	Occupation	Location	Observation			Age of Sign	Remarks
				Sight-ing	Track	Other		
MARIAS RIVER								
6/22	Paul Suek	MDFWP	Middle Fk Dupuyer Cr S26T27R9			Scats	Last yr	3 pine nut scats in sidehill park, PSME/ARCO type, 5500' eleva., 1° aspect, 30% slope, <100 m to cover
6/22	Paul Suek	MDFWP	Middle Fk Dupuyer Cr SWSW S26 T27R9			Dig/Scat	~9 mos	Last year's scat & dig found in timber, PSME/ARCO, 5800' eleva., 35° aspect, 30% slope, <100 m to cover
6/22	Keith Aune	MDFWP	Middle Fk Dupuyer Cr SESE S27 T27, R9			Scat	1-2 mos	Scat found in aspen stand, POTR/PSME/Ribes type, 5350' eleva., 65° aspect, 5% slope, <100 m to cover
6/22	Paul Suek	MDFWP	Middle Fk Dupuyer Cr SENW S26 T27, R9			Scat	1 wk	Scat found in PSME timber 5160' eleva., 45° aspect, 10% slope, <100 m to cover
6/27	Kalispell Search & Rescue, reptd by Frank Horak	USFS	Muskrat Cr SE½ S25 T28, R12	1			Obs	Observed one grizzly in vic. of Blue Lake; approx. 5920' eleva., ABLA timber, <100 m to cover
6/28	Frank Horak	USFS	Lee Cr NE¼ S27, T29, R12		Sow & cub		Obs	Sow & cub (both silver-tipped) grazing in small meadow in PICO timber, 5360' eleva., 7° aspect, 5% slope, <100 m to cover

Appendix C. 1981 grizzly bear observations.

Date	Observer's Name	Occupation	Location	Observation			Age of	Remarks
				Sight- ing	Track	Other	Sign	
MARIAS RIVER								
6/29	Paul Suek	MDFWP	Middle Fk Dupuyer Cr S26T27R9			Scat	7 mos	Scat found in PSME timber, 5640' eleva., 45° aspect, 2% slope, <100 m to cover
7/6	Tom Selanski	Rancher	Middle Fk Dupuyer Cr	1 Ad			Obs	Dark adult came out of creek bottom & up grass sidehill, 5600' eleva., 30° aspect, 35% slope, <100 m to cover
7/19	Lewis Young	USFS	White Rock Cr SE¼ S9 T29, R12			Scat	1 wk	Scat on trail in ABLA/XETE timber, 5870' eleva., 225° aspect, 10% slope, <100 m to cover
7/21	Lewis Young	USFS	Mowitch Basin NESW S29 T24R10			Scat	2-3 wks	Scat found on trail in PICEA type, 5600' eleva., 90° aspect, 2% slope, <100 m to cover
7/26	Karen Horak	Teacher	Box Cr NE¼ S36 T30R13	1 Ad			Obs	Observed large grizzly at 6800' elev, in PICO timber, 350° aspect, 40% slope, <100 m to cover
7/28	Lewis Young	USFS	Red Poacher Cr NE¼ S23T29R12			Scat	2 wks	Scat found in PICO/ABLA/XETE timber 20 yds from creek, 5320' eleva., 150° aspect, 5% slope, <100 m to cover
7/29	Lewis Young	USFS	N Fk Badger Cr NW¼ S8 T28R12		Ad		1 wk	Track in mud on trail, PICO/XETE/VASC 5790' eleva., 110° aspect, 5% slope, <100 m to cover

Appendix C. 1981 grizzly bear observations.

Date	Observer's Name	Occupation	Location	Observation			Age of Sign	Remarks
				Sighting	Track	Other		
MARIAS RIVER								
8/1	Tom Selanski	Rancher	S Fk Dupuyer Cr NW $\frac{1}{4}$ S17 T27R8	1 Ad			Obs	A dark adult grizzly came through corrals into yard under light and grazed on lawn. <100 m to willow creek bottom, 4820' eleva., 40° aspect, 1% slope
8/15	Gary Olson	MDFWP	Walling Reef NE $\frac{1}{4}$ S17 T27R9		Dig		1-2 wks	1/4 acre dig on ridge, 7160' eleva., scree type, 110° aspect, 5% slope, <100 m to cover
8/29	Keith Aune Ken Wheeler	MDFWP USFWS	Dupuyer Cr NWNW S19 T27R8	1 Ad	Scat		1-3 days	Cow killed on muddy shoreline of stockpond, scat & tracks in mud; PIFL/FEID/FESC type, 4960' eleva., 140° aspect, 15% slope, <100 m to cover
9/5	Keith Aune	MDFWP	S Fk Dupuyer Cr, SENE S10 T26R9	1 Ad			1 wk	Adult track on trail through PSME/SPBE timber, 6680 eleva., 20° aspect, 30% slope, <100 m to cover
9/5	David Cole	Engineer	N Fk Badger Cr SE $\frac{1}{4}$ S33 T29R12	1 Ad			Obs	Large silvertip observed in snow-chute at 6000' eleva., 112° aspect, 45% slope, <100 m to cover
9/20-30	Albert Denboer	Rancher	Middle Fk Dry Fk Marias NWSW S9 T27R8		Carriion	1 day		Grizzly fed upon & buried a dead 2 yr old heifer in pasture behind house; 4800' eleva., 70° aspect, 13% slope, <500 m to cover

Appendix C. 1981 grizzly bear observations.

Date	Observer's Name	Occupation	Location	Observation			Age of Sign	Remarks
				Sight-ing	Track	Other		
MARIAS RIVER								
10/25	Niel Skogan	Rancher	S Fk Dupuyer Cr SE $\frac{1}{4}$ S32 T27R9	2 subadults			Obs	One of two grizzlies traveling together killed by hunter, ABLA type, open timbered scree, 6600' eleva., 160° aspect, 60% slope, <100 m to cover. One was brown silvertip, the other a blonde color
10/28	Keith Aune Tom Stivers	MDFWP	S Fk Dupuyer Cr SWNW S35 T27R9			Scat	2-4 wks	Pine nut scat on 4x4 road, PIFL/FEID/FE ^o SC type, 6060' eleva., 320° aspect, 5% slope, < 100 m to cover
10/29	Tom Stivers	MDFWP	S Fk Dupuyer Cr S4 T26R9			Scat	>1 mo	Scat in old burn-shrubfield, PIFL/POTR type, 130° aspect, 35% slope, <100 m to cover
10/20	Richard Jackson	Outfitter	Sawmill Cr SE $\frac{1}{4}$ S5 T29R11	Sow & cub			Obs	Sow (black silvertip) & 1 cub (brown) feeding on sidehill grass-land, 5620' eleva., 90° aspect, 10% slope, <500 m to cover

Appendix C. 1981 grizzly bear observations.

Date	Observer's Name	Occupation	Location	Observation			Age of Sign	Remarks
				Sight-ing	Track	Other		
SUN RIVER								
4/18	Lewis Young	USFS	S Fk Sun NESW S9 T20R10		1 subadult		<1 day	Tracks in snow & mud on road in campground; PICO/POTR type, 5280' eleva., 320° aspect, 2% slope, <100 m to cover
4/23	George Poorman	Retired	N Fk Sun NESW S31 T24R10		Sow & yrling		1-2 days	Sow with cub knocked hole in door of USFS Gates cabin & ate canned fruit, 5330' eleva., 45° aspect, 1% slope, <100 m to cover
5/8	Bert Goodman	MDFWP	Rose Cr SWNE S27 T21R8	2 Ad			Obs	From house, observed a courting pair wandering up creek. Both silvertipped w. one slightly darker; 4:00 p.m. 4840' eleva., POTR/FEID type, 180° aspect, 5% slope, <100 m to cover
5/15	Gene & Bud Swanson	Ranchers	Elk Cr NE¼ S28 T19R7	3 subadults			Obs	Three, same-sized dark silver-tipped subadults walked across pasture by house, 7:00 p.m. 4500' eleva., 45° aspect, 1% slope, <100 m to cover
5/31	Harvey Nyberg	MDFWP	Fairview Cr SWSW S 14 T20R10		1 Ad		<1 wk	Large tracks on trail through PSME/PICO timber, 5760' eleva., 145° aspect, 16% slope, <100 m to cover

Appendix C. 1981 grizzly bear observations.

Date	Observer's Name	Occupation	Location	Observation			Age of	Remarks
				Sight- ing	Track	Other	Sign	
SUN RIVER								
6/2	Cecil Goodman		Shed Cr SWSW S34 T21R8	2 subadults			Obs	Two light colored silvertips in grassy creek bottom, <u>Poa/</u> Sedge type, 5050' eleva., 105° aspect, 20% slope, <100 m to cover
7/3	Tom Simpson	USFS	W Fk South Fk Sun R SENW S17T21R11		x		<1 wk	A grizzly tore roof off shed at Indian Point Cabin, 5440' eleva., ABLA type, 235° aspect, 16% slope, <100 m to cover
7/7	Craig Jourdennai Cecil Goodman	MDFWP	Eddie Cr SWNW S4 T20R8	Sow & yrng			Obs	Sow & yearling silvertipped, on edge of Aspen/POTR. Fleed into conifers 5200' eleva., 50° aspect, 20% slope, <100 m to cover
7/7	Lyle Arps	USFS	Trail bet. Lick Cr & Red Shale Cr SENE S19 T24R11	Sow & 2 yrngs			Obs	Sow & 2 yearlings (silver- tipped observed on edge of PICO/Picea type, 6800' eleva., 100° aspect, 50% slope, <100 m to cover
7/13- 17	Cecil Goodman Bob Williams		N Fk Willow Cr NWNW S7T20R8	Sow & cub			Obs	Sow & cub in <u>Poa/</u> Sedge bottom 6360' eleva., 130° aspect, 12% slope, <500 m to cover
8/9	Keith Aune	MDFWP	Moose Cr SWSW S25 T23R11		x		2-4 wks	Rubbed & clawed grizzly marking tree in ABLA/XETE type, 5200' eleva., 140° aspect, 10% slope, <100 m to cover

Appendix C. 1981 grizzly bear observations.

Date	Observer's Name	Occupation	Location	Observation			Age of Sign	Remarks
				Sight-ing	Track	Other		
SUN RIVER								
9/28	Bert Goodman	MDFWP	S Fk Sun SW $\frac{1}{4}$ S34 T21R10		Subadult?		2 days	Medium sized track in mud heading down through PSME/VASC timber toward river, 6520' eleva., 180° aspect, 30% slope, <100 m to cover
10/3	Bert Goodman	MDFWP	Ahorn Cr S31T21R11		Subadult?			Medium sized track heading north on trail in spruce timbered bog, 5600' eleva., 270° aspect, 10% slope, <100 m to cover
10/3	Bert Goodman	MDFWP	Camp Cr Pass S14T20R12		Ad		1 day	Large grizzly tracks heading down trail to north, PIAL type, 7000' eleva., 100° aspect, 15% slope, <100 m to cover
10/9	Lewis Young	USFS	Bailey Cr S22T18R8		Ad		1-2 hrs	Tracks going from creek bottom up to ridge through PICQ/ABLA/Picea, 6400' eleva., 110° aspect, 30% slope, <100 m to cover
10/28	William Huntley	Unkn.	Circle Cr NWNW S4 T22R10	1 Ad			Obs	Adult grizzly #510 killed by hunter on edge of PSME/Carex timber while feeding on gut pile, 5010' eleva., 260° aspect, 10% slope, <100 m to cover

Appendix C. 1981 grizzly bear observations.

Date	Observer's Name	Occupation	Location	Observation			Age of Sign	Remarks
				Sight-ing	Track	Other		
SUN RIVER								
11/12-14	Jeff Hirsh	Beaver trapper	Gates Cr NWNW S31 T24R10	1 Ad			Obs	Large silvertip grizzly going from POTR/FESC meadow into PSME/ABLA timber, 5360' eleva., 110° aspect, 5% slope <100 m to cover
11/16-30	Jeff Hirsh	Beaver trapper	Gates Cr NE¼ S 6 T23R10	1 subadult			Obs	Subadult grizzly in POTR/FESC meadow adjacent to trail, 5290' eleva., 140° aspect, 2% slope, <100 m to cover

Appendix C. 1981 grizzly bear observations.

Date	Observer's Name	Occupation	Location	Observation			Age of Sign	Remarks
				Sight-ing	Track	Other		
MIDDLE FORK FLATHEAD RIVER								
5/19	Gary Olson	MDFWP	Cox Cr NE $\frac{1}{4}$ S26 T27R12	Sow & 1 cub			Obs	Observed dark sow with 1 light cub in opening on top of west facing ridge, PICO type, <100 m to cover
9/15	Jack Salmond	Rancher	Basin Cr	Sow & 1 cub			Obs	Grizzly sow & 1 cub on Basin Cr
10/11	Jeff Schlamaus	JJJ Dude	Pale Cr SWSW S10 T26R12	Adult Male	Hunter kill			Adult male grizzly killed by hunter about 6000' eleva., subalpine scree, 70° aspect, 60% slope, <500 m to cover

Appendix C. 1981 grizzly bear observations.

Date	Observer's Name	Occupation	Location	Observation			Age of	Remarks
				Sight- ing	Track	Other	Sign	
SOUTH FORK FLATHEAD RIVER								
9/30	Bert Goodman	MDFWP	Fiction Cr SW $\frac{1}{4}$ S16 T19R11		SubAd		?	Subadult grizzly track on timbered ridge, 6400' eleva., PICO type, 200° aspect, 50% slope, <100 m to cover
9/30	Bert Goodman	MDFWP	Basin Cr NWNW S14 T19R11			x	?	Found where a grizzly had torn open a USFS shed, 4960' eleva., 270° aspect, 2% slope, <100 m to cover
10/2	Bert Goodman	MDFWP	Woodtick Mtn S15T19R12		x		?	Grizzly track on game trail in PSME timber, 5160' eleva., 90° aspect, 50% slope, <100 m to cover
10/3	Bert Goodman	MDFWP	Camp Cr NESW S27 T20R12		X			Grizzly track crossed trail heading south in PICO/VASC timber, 5600' eleva., 180° aspect, 5% slope, <100 m to cover

Appendix C. 1981 grizzly bear observations.

Date	Observer's Name	Occupation	Location	Observation			Age of Sign	Remarks
				Sight- ing	Track	Other		
TETON RIVER								
4/17	Keith Aune Tom Stivers	MDFWP	Antelope Bt SENE S29 T26R8		1 Ad		1 day	Track in mud adjacent to cubby, POTR/Salix type, 4940' eleva., 90° aspect, 2% slope, <100 m to cover
4/16	Tom Stivers Keith Aune	MDFWP	Muddy Cr SESE S24 T26R8			Scat	<1 wk	Scat at cow dump, POTR/FESC prairie grassland, 90° aspect, 1% slope, <500 m to cover, 4530' eleva.
4/23	Tom Stivers Keith Aune	MDFWP	Pine Butte NE½ S7 T24R7		1 Ad 2 yr/ing		6 days	Tracks of #257 & young at creek crossing, 4560' eleva., open site, 150° aspect, 2% slope, <100 m to cover
4/25	Bud Olson	Rancher	Teton R NE½ S 32 T25R8		1 Ad		1-2 days	Tracks on road near corral, Aspen type, 4580' eleva., 90° aspect, 1% slope, <100 m to cover
5/4	Tom Stivers Mark Priewert	MDFWP	Rinkers Cr SWNW S 33 T26R8			Scat	1 day	Scat & hair on sprung cubby POTR/Salix, 4960' eleva., 90° aspect, 2% slope, <100 m to cover
5/4-5	Keith Aune Tom Stivers Gary Olson	MDFWP	N Fk Muddy Cr NESE S18 T26R8		1 Ad	Scat	1 day	Track crossing creek, & scat in POTR/FESC meadow, 5140' eleva., 25° aspect, 10% slope, <100 m to cover

Appendix C. 1981 grizzly bear observations.

Date	Observer's Name	Occupation	Location	Observation			Age of Sign	Remarks
				Sight-ing	Track	Other		
TETON RIVER								
5/4	Marion & Jim Peebles	Rancher	Teton R NWNE S35 T25R7	3 Ad				3 silvertips passed through yard, 4420' eleva., 90° aspect, 1% slope, <100 m to cover
5/2	Keith Aune Tom Stivers	MDFWP	Antelope Bt NE 1/4 S 28 T26R8		1 Ad & Scats	1 day yrlngs		220 & yrlngs broke barrel set at swamp, 4840' eleva., Salix, 90° aspect, 1% slope, <100 m to cover
5/8	Keith Aune Tom Stivers	MDFWP	Rinkers Cr SWNW S33 T26R8		1 Ad		1 day	Bear sprung cubby and left track in mud, 4900' eleva., 90° aspect, 2% slope, <100 m to cover
5/1	Keith Aune	MDFWP	Muddy Cr SESE S18 T26R8		2 yrlngs			Tracks in mud, Salix type, 5110' eleva., 90° aspect, 4% slope, <100 m to cover
5/5	Seismographers reported to Leo Klotz	MDFWP	Blackleaf Cr SWNE S10 T26R8	1 Ad				Large grizzly walking through aspen/willow, 4740' eleva., 90° aspect, 1% slope, <100 m to cover
5/6	Keith Aune Tom Stivers	MDFWP	Muddy Cr NWSE S16 T26R8			Scat	1 day	Scat found at cubby, PIFL/FEID type, 4910' eleva., 90° aspect, 2% slope, <100 m to cover
5/7	Keith Aune Tom Stivers	MDFWP	Muddy Cr NWSE S 16 T26 R8			Scat	1 day	Bear sprung snare & left one scat, PIFL/FEID type, 4910' eleva., 90° aspect, 2% slope, <100 m to cover

Appendix C. 1981 grizzly bear observations.

Date	Observer's Name	Occupation	Location	Observation			Age of	Remarks
				Sight- ing	Track	Other	Sign	
TETON RIVER								
5/10	Keith Aune Tom Stivers	MDFWP	Bundhorse Cr SWSW S33 T26R8	1 Ad 2 yrings	Scat		1 day	Sprung snare, scats & track nearby, POTR/Salix type, 5020' eleva., 90° aspect, 5% slope, <100 m to cover
5/11	Tom Bivens Jack Lavalie	MDFWP	Deep Cr SE¼ S26 T23R8		Calf depredation			Calf killed in creek bottom adjacent to road, 4605' eleva., 120° aspect, 2% slope, <100 m to cover
5/12	Salmond reptd to Bivens	Rancher MDFWP	Deep Cr NENE S2 T23R8	1 sow & 2 yearlings or 3 subadults				Bears cornered & mauled 2-yr old heifer in corner of pasture, 4820' eleva., <100 m to cover
5/13	Keith Aune Tom Stivers Tom Bivens Jack Lavalie Wayne Gollehon	MDFWP	Willow Cr SW¼ S10 T24R8		X		1 day	Bear killed calf & ate entrails in Willow Cr bottom, 4910' eleva., 180° aspect, 2% slope, <100 m to cover
5/13	Mark & Kay Priewert	Rancher Ranchers	Muddy Cr NENW S23 T26R8	2 yrings			Obs	2 yearlings (1 light, 1 chocolate) traveled through back yard POTR/Poa type, 4670' eleva., <100 m to cover
5/16	Tom Stivers Keith Aune	MDFWP	Ear Mtn NENW S17 T24R8	1 subadult			2 days	Tracks on 4x4 road, 5800' eleva., 300° aspect, 2% slope, <100 m to cover
5/22	Roy Aggee	Rancher	Dupuyer Cr NE¼ S33 T28R8	1 Ad	Scat		1 day	2 lambs killed adjacent to shed, tracks nearby, POTR/Salix cr bottom, 4475' eleva., 40° aspect, 2% slope, <100 m to cover

Appendix C. 1981 grizzly bear observations.

Date	Observer's Name	Occupation	Location	Observation			Remarks
				Sight- ing	Track	Other	
TETON RIVER							
5/27	Keith Aune Tom Stivers	MDFWP	Rinkers Cr SWNW S33 T26R8		Scat	1 day	Scat found in vicinity of cubby, 4860' eleva., POTR/ Salix type, 90° aspect, 2% slope, <100 m to cover
5/28	Mark Priewert	Rancher	Muddy Cr S23T26R8	1 Sow, 1 cub		Obs	Sow & cub of year observed at 2:30 a.m. across road east of house in light of yard lamp, 4670' eleva., 90° aspect, 1% slope <100 m to cover
5/28	Keith Aune Tom Stivers Paul Suek	MDFWP	Rinkers Cr S33T26R8	1 ad		1 day	Adult (probably 257) walked on 4x4 road in night, POTR/ AGSP type, 4840' eleva., 70° aspect, 2% slope, <100 m to cover
6/3	Richard Anderson	Rancher	Teton R NENE S33 T25R6W	2 subadults		Obs	2 tannish brown subadults crossed gravel road, 10:30 p.m. Salix type, 4210' eleva., 90° aspect, 1% slope, <100 m to cover
6/4	Keith Aune	MDFWP	Blackleaf Cr S9T26R8		Scat	1-2 wk	Scat found on road, PIFL/POTR/ FEID type, 4880' eleva., 50° aspect, 1% slope, <100 m to cover
6/5	Tom Stivers	MDFWP	Ear Mtn NWNW S 17 T24R8	1 Ad		<1 wk	Tracks for 3/4 mile on 4x4 road. 5800' eleva., 60° aspect, 1% slope, <100 m to cover

Appendix C. 1981 grizzly bear observations.

Date	Observer's Name	Occupation	Location	Observation			Age of Sign	Remarks
				Sight-ing	Track	Other		
TETON RIVER								
6/5	Gary Olson Greg Kushnak	MDFWP Agronomist	Blackleaf Cr SW $\frac{1}{4}$ S13 T26R9	1 Ad			Obs	Spooked light colored grizzly on trail, PICO/POTR type, 6000' eleva., 350° aspect, 20% slope, <100 m to cover
6/6	Tom Stivers	MDFWP	Ear Mtn S7T24R8				Scats <1 wk	4 large scats found in grass meadow Poa/Calamagrostis/TAOF adjacent to aspen stand, 5840' eleva., 270° aspect, 2% slope, <100 m to cover
6/6	Tom Stivers	MDFWP	Ear Mtn S7T24R8				Scats <1 wk	6 large scats found in aspen stand, POTR/Poa/TAOF, 5840' eleva., 270° aspect, 2% slope, <100 m to cover
6/10	Paul Suek	MDFWP	Rinkers Cr S32T26R8				Scat 2-4 wks	Scat found in sidehill park, 40° aspect, 15% slope, <100 m to cover, 5260' eleva.
6/12	Keith Aune	MDFWP	Muddy Cr SENW S24 T26R8		1 subadult		1-2 wks	Tracks on trail, 4580' eleva., POFR/FEID/FESC, 130° aspect, 2% slope, <100 m to cover
6/13	Al Haas	Outfitter	Ear Mtn S12T24R9	1 ad			Obs	Very large grizzly fled from aspen stand, 4:00 p.m., North end of Ear Mtn SW aspect, <100 m to cover
6/13	Al Haas	Outfitter	NWNW S5 T24R8		Sow & 2 yrngs		Obs	Seen from house grazing in POFR/FESC meadow, 5070' eleva., 25° aspect, 6% slope, <100 m to cover

Appendix C. 1981 grizzly bear observations.

Date	Observer's Name	Occupation	Location	Observation			Age of Sign	Remarks
				Sight-ing	Track	Other		
TETON RIVER								
6/16	Tom Stivers Paul Suek	MDFWP	Antelope Bt NWNE S29 T26R8	1 Ad	Scat		<1 day	Tracks in mud in POFR/Salix stand, 4980' eleva., 90° aspect, 2% slope, <100 m to cover
6/16	Keith Aune Gary Hammond	MDFWP	Ear Mtn NWNW S17 T24R8	1 Subadult	Dig		4-5 days	Lomatium dig in scree, 5840' eleva., 40° aspect, 10% slope, < 100 m to cover
6/17	Keith Aune Tom Stivers	MDFWP	Ear Mtn NW 1/4 S17 T24R8	1 ad	dig		1 wk	Tracks on 4x4 road, dug Lomatium in adjacent scree, 5800' eleva., 40° aspect, 15% slope, <100 m to cover
6/17	Keith Aune	MDFWP	Ear Mtn SWSE S7 T24R8	2 ad	scat		1 wk	Tracks & scats in aspen stand, POFR/Poa type, 5640' eleva. 120° aspect, 10% slope, <100m to cover
6/17	Keith Aune	MDFWP	Ear Mtn NESW S 7 T24R8		Scats		1 wk	Scats found in PSME/ARCO timber type, 5845' eleva., 330° aspect, 5% slope, <100 m to cover
6/17	Keith Aune	MDFWP	Ear Mtn SE 1/4 S 7 T24R8	1 ad	dig		1 wk	Dug Lomatium and tracks AGSP/FEID grassland, 5960' eleva. 210° aspect, 20% slope, <100 m to cover
6/23	Leo Klotz	MDFWP	Ear Mtn SE 1/4 S8 T24R8	1 sow 2 yrngs			Obs	Dark sow & 2 yrngs (1 dark & 1 silvertip) obs. on sidehill POFR/FEID type, 5700' eleva. 150° aspect, 30% slope, <100 m to cover

Appendix C. 1981 grizzly bear observations.

Date	Observer's Name	Occupation	Location	Observation			Age of Sign	Remarks
				Sight- ing	Track	Other		
TETON RIVER								
6/26	Gary Olson Greg Kushnak	MDFWP Agronomist	Chicken Coulee S18T25R8		1 Ad		1 wk	Adult track in mud at creek crossing, POFR/Salix type, 6160' eleva., 100° aspect, 15% slope, <100 m to cover
6/26	Gary Olson Greg Kushnak	MDFWP Agronomist	Muddy Cr SE $\frac{1}{4}$ S25 T26R9			Scat	<1 wk	Scat adjacent to trail in PICO meadow, 6440' eleva., 170° aspect, 15% slope, <100 m to cover
7/5	Cindy McAllister	Nature Conservancy	S Fk Teton SW $\frac{1}{4}$ S 6 T24R8	1 Ad			Obs	Large brownish bear observed grazing in POFR/FESC meadow, 5:00 p.m., 5600' eleva., 180° aspect, 10% slope, <100 m to cover
7/6	Tom Stivers	MDFWP	Teton R S36T25R7			Scat	1 wk	Scat found in aspen stand, POFR/Salix, 4380' eleva., 90° aspect, 1% slope, <100 m to cover
7/7	Dave Genter	Ranch hand	Teton R SESE S31 T25R8	1 subadult			Obs	Cinnamon colored, in poor condition outside Circle 8 Lodge, 90° aspect, 2% slope, <100 m to cover
7/9 7/21 7/29	Tom Scully	Wrangler, Circle 8	Teton R NWNW S 5 T24R8	Sow & 2 cubs			Obs	On three occasions observed same adult female with 2 cubs in same aspen swale, 5160' eleva., 10% slope, N aspect, <100 m to cover

Appendix C. 1981 grizzly bear observations.

Date	Observer's Name	Occupation	Location	Observation			Age of Sign	Remarks
				Sight-ing	Track	Other		
TETON RIVER								
7/12	Sam Rose	Teacher/ Rancher	S Fk Willow NWNE S 30 T24R8	Sow & 1 cub			Obs	Sow & cub on edge of willow/ sedge/grass, 4590' el., 90° aspect, 2% slope, <100 m to cover
7/13	Jon Siddoway Pete Lesica	Range Technicians	Ear Mtn NWNE S 16 T24R8	1 subadult			Obs	1 brown grizzly came from aspen onto prairie grassland, AGSP/ FEID, 5250' el., 10% aspect, 20% slope, <100 m to cover
7/14	Bob Findorf	Surveyor	Blackleaf Cr SESW S16 T26R8	1 subadult			Obs	1 blondish grizzly ambling through PIFL/FEID/FESC 4900' el, 15% slope, N aspect, <100 m to cover
7/14	Keith Aune	MDFWP	Nk Fk Blindhorse Cr S5T25R8			Scat 2-4 wk		Scat found in PSME/SPBE, timber 5450' el., 55° aspect, 20% slope <100 m to cover
7/20	Leo Klotz	MDFWP	Ear Mtn SW $\frac{1}{2}$ S 9 T24R8	1 yrlyng			Obs	1 dark brown yearling walked down 4x4 road, 10:30 a.m., 5340' el., 90° aspect, 5% slope, <100 m to cover
7/21	Keith Aune Paul Suek	MDFWP	Nk Fk Blindhorse Cr S33 T26R8			Scats 2-4 wk		Two scats found on prairie grassland adjacent to cow car- cass, 4910' el., POFR/FESC, 75° aspect, 2% slope <100 m/cover
7/22	Paul Suek	MDFWP	Same as above			Scat <1 mo		Scat found in limber pine savanna, PIFL/FEID type, 5080' el., 150° aspect, 15% slope <100 m/cover

Appendix C. 1981 grizzly bear observations.

Date	Observer's Name	Occupation	Location	Observation			Age of Sign	Remarks
				Sight-ing	Track	Other		
TETON RIVER								
7/23	Keith Aune Paul Suek	MDFWP	Rocky Mtn S29T24R9		Scats	2-4 wk		Scats found in alpine scree 8680' eleva., 90° aspect, slope 35%, <500 m to cover
7/23	Keith Aune Paul Suek	MDFWP	Same as above		Scat	2-4 wk		Scat found in alpine talus 8320' el., 90° aspect, 40% slope, <500 m to cover
7/29	Keith Aune	MDFWP	Bruce Cr/ Crazy Cr Div. NESW S10 T26R10		Dig	2-4 wk		Bear digs for <u>Ranunculus</u> below melting snowbank, alpine scree, 7600' el. 150° aspect, 40% slope, <100 m to cover
7/29	Keith Aune Paul Suek	MDFWP	Same as above	1 Ad	Dig	1-2 2-4 wk		Tracks & digs in alpine basin, days/ scree type, 7600-7800' el., <100 m to cover
7/30	Keith Aune Paul Suek	MDFWP	Kid Cr	1 Ad		3-4 wk		Track crossing Kid Cr., <u>Picea</u> type, 6380' el, 230° aspect, 10% slope, <100 m to cover
7/31	Keith Aune Paul Suek	MDFWP	S Fk Rinkers Cr S32T26R8		Scat	2-4 wk		Scat found in aspen stand, POFR/Salix type, 5180' el. 20% aspect, 1% slope <100 m to cover
8/3	Keith Aune Gene Sherman	MDFWP Pilot	Old Baldy Mt NE 1/4 S 12 T24R9	1 Ad		Obs		Large dark adult above timberline, alpine scree type, 8700' el, 260° aspect, 40% slope, <500 m to cover

Appendix C. 1981 grizzly bear observations.

TETON RIVER				Observation			Age of Sign	Remarks
Date	Observer's Name	Occupation	Location	Sight-ing	Track	Other		
8/7	Dave Carlson Doug Crary	Rancher	Teton R NWSE S 30 T25R6	2 subadults			Obs	2 dark subadults crossed highway & private airstrip, 5:00 p.m., 4320' el., POFR/FESC, 90° aspect, 1% slope <100m/cover
8/8	Unknown	Logger	Rocky Mtn NWNE S 30 T24R9	3 subadults			Obs	3 dark subadults (1 slightly larger), digging in pass, alpine talus/scree type, 8650' el., 340° aspect, 15% slope, <500m to cover.
8/10	Tom Stivers Gene Sherman	MDFWP Pilot	Old Baldy Mt SESE S 1 T24R9	3 subadults			Obs	3 dark subadults (1 slightly larger), digging in talus/scree, above timberline, 7:00 a.m., 8400' el., 330° aspect, 50% slope, >500 m to cover.
8/16	Frank Plachetka	Fire Chief	S Fk Teton R SESW S 32 T25R8	2 cubs			Obs	2 lone grizzly cubs playing on S Fk Teton R bottom, 2:30 p.m., willow type, 5020' el., 110° aspect, 1% slope, <100m/cover
8/17	Keith Aune Gene Sherman	MDFWP Pilot	Rocky Mt SESW S 20 T24R9	1 subadult			Obs	1 dark silvertip, digging in alpine talus, 8640' el., 320° aspect, 35% slope, >500 m/cover, 7:00 a.m.
8/17	Lyle C. Arps	USFS	Rierdon Glch SE 1/4 S 3 T24R9	1 Ad			Obs	Light tan grizzly grubbing on open ridge adjacent to PIFL timber, 6200' el., 295° aspect, 50% slope, <100 m/cover, 10:00 a.m.

Appendix C. 1981 grizzly bear observations.

TETON RIVER				Observation				
Date	Observer's Name	Occupation	Location	Sight- ing	Track	Other	Age of Sign	Remarks
8/18	Keith Aune	MDFWP	McDonald Cr NE $\frac{1}{4}$ S 9 T24R7	2 subadults			Obs	2 dark (1 lighter), came out of willows & traveled across POFR/FEID grassland, 7:00 p.m., 4520' el., 80° aspect, 1% slope, <100 m /cover
8/19	Keith Aune	MDFWP	Ear Mtn SWSW S 9 T 24R8		1 ad		1 day	Track on road at creek crossing, POFR/FEID type, 5210' el., 80° aspect, 5% slope, <100 m/cover
8/21	Greg Smith	BLM	Chicken Coulee NE $\frac{1}{4}$ S 7 T25R8	1 ad			Obs	Golden colored grizzly in POFR/FESC type, 6200' el., 90° aspect, 10% slope, <500 m/cover, 11:00 a.m.
8/24	Keith Aune Gene Sherman	MDFWP Pilot	Rocky Mtn SWNE S 29 T24R9	3 yrings			Obs	3 yearlings, possibly 220's, digging in alpine scree, 6:30 a.m., 8600' el., 100° aspect, 35% slope, >500 m/cover
8/26	Keith Aune Gary Olson Gary Hammond	MDFWP MDFWP Nature Conservancy	Teton R SENW S 31 T25R6	1 sub- adult	Scat	1-2 days		Tracks across freshly plowed field, berry scat nearby, POFR/FEID type, 4320' el., 90° aspect, 1% slope, <100 m/cover
8/26	Tom Stivers Gene Sherman	MDFWP Pilot	Rocky Mtn NWNE S 29 T24R9	3 sub- adults	Dig	Obs		3 subadults (yearlings), 1 larger, digging in alpine scree, 8780' el., 110° aspect, 50% slope, >500 m/cover, 7:00 a.m.

Appendix C. 1981 grizzly bear observations.

TETON RIVER				Observation				
Date	Observer's Name	Occupation	Location	Sight- ing	Track	Other	Age of Sign	Remarks
8/26	Tom Stivers Paul Suek	MDFWP MDFWP	S Fk Teton R S 29 T24R9	1 subadult			Obs	1 subadult feeding on SHCA berries, Mtn grassland, 6:30 p.m., 6840' el., 110° aspect, 20% slope, <100 m/cover
8/27	Tom Stivers Paul Suek	MDFWP MDFWP	Rocky Mtn NWNE S 29 T24R9	3 subadults	Dig		Obs	3 subadults (yearlings), 1 larger, digging on alpine scree, 6:30-11:00 a.m., 8780' el., 110° aspect, 50% slope, >500 m/cover
8/28	Tom Stivers Paul Suek	MDFWP MDFWP	Rocky Mtn NWNE S 29 T24R9	3 subadults	Dig		Obs	3 subadults (yearlings), 1 larger, digging on alpine scree, 8:00 a.m., 8780' el., 110° aspect, 50% slope, >500 m/cover
9/1	Keith Aune Tom Stivers	MDFWP MDFWP	Teton R S36T25R7				Scat 1-2 wks	Scat found in willow shrub, 4365' el., 90° aspect, 1% slope, <100 m/cover
9/1	Tom Stivers Keith Aune	MDFWP MDFWP	Teton R S36T25R7				Scat < 1 wk	Scat found in POTR/Salix, 4360' el., 90° aspect, 1% slope, <100 m/cover
9/1	Keith Aune Tom Stivers	MDFWP MDFWP	Teton R S31T25R6				Scat < 1 wk	Scat found in willow shrub type, 4320' el., 90° aspect 1% slope, <100 m/cover
9/1	Keith Aune Tom Stivers	MDFWP MDFWP	Teton R S36T25R7				Scat 2-4 wks	Scat found in willow shrub type, 4360' el., 30° aspect 1% slope, <100 m/cover

Appendix C. 1981 grizzly bear observations.

TETON RIVER				Observation				Remarks
Date	Observer's Name	Occupation	Location	Sight- ing	Track	Other	Age of Sign	
9/1	Keith Aune Gene Sherman	MDFWP Pilot	N Fk Willow Cr NWNE S 17 T24R7	Cr 2 ad			Obs	Brownish, silvertipped, observed in Salix/Carex type, 7:00 a.m., 4495' el., 90° aspect, 1% slope, <100 m/cover
9/2	Keith Aune Tom Stivers	MDFWP MDFWP	Willow Cr S17T24R7			Scat	< 1 wk	Scat found in willow shrub type, 4495' el., 90° aspect, 1% slope, <100 m/cover
9/8	Keith Aune Gene Sherman	MDFWP Pilot	Rocky Mtn NWNW S 29 T24R9	3 yrlns			Obs	3 subadults, yearlings, digging in alpine scree, 7880' el., 7:00 a.m., 100° aspect, 38% slope, <500 m/cover
9/12	Barry Austin	Carpenter	Deep Cr NWSW S 28 T23R6	1 sow 1 yrln			Obs	Sow hunting & observed sow & yearling in Salix/Carex type, 8:00 p.m., 4120' el., 90° aspect, 1% slope, <100 m/cover
9/28	Tom Stivers Keith Aune	MDFWP MDFWP	Teton R NWSE S23 T25R9			Scat	1 day	Rose hip scat found on Teton road, POTR type nearby, 5190' el., 180° aspect, 1% slope, <100 m/cover
9/29	Keith Aune Tom Stivers	MDFWP MDFWP	Bruce Cr NWNW S 15 T26R10			Scat Dig	2-4 days	Pine nut dig & scats adjacent to trail, ABLA/PIAL/VASC type, 7600' el., 240° aspect, 30% slope, < 100 m/cover

Appendix C. 1981 grizzly bear observations.

TETON RIVER				Observation			Age of Sign	Remarks
Date	Observer's Name	Occupation	Location	Sight- ing	Track	Other		
10/19	Tom Stivers	MDFWP	Blackleaf Cr NW $\frac{1}{4}$ S 10 T26R8			Day beds	?	2 grizzly beds in Salix/Betula type, present year's beds, specific age not known, 5745' el., 90° aspect, 1% slope, <100 m/cover
10/20	Bud Jackson	Hunting guide	Wright Cr SE $\frac{1}{4}$ S 27 T26R10	1 ad			Obs	Blondish, dark legged grizzly, feeding in grassy snowchute, 8000' el., 80° aspect, 50% slope, <100 m/cover
10/30	Keith Aune	MDFWP	Blackleaf Cr NWNW S 15 T26R9			Scat	4-5 mos	Old spring scat found in talus/ scree type, 7200' el., 120° aspect, 70% slope, <500 m/cover
11/1	Lewis Young	USFS	Waldron Cr SW $\frac{1}{4}$ S 13 T25R10			Dig	1 mo	Pine nut dig in ABLA/PIAL/VASC type, 6100' el., 135° aspect, 30% slope, <100 m/cover
11/1	Lewis Young	USFS	Waldron Cr SE $\frac{1}{4}$ S 13 T25R10			Dig	1 mo	Pine nut dig in ABLA/PIAL/VASC type, 7600' el., 135° aspect, 40% slope, <100 m/cover
11/15	Bill Hill	MDFWP	Teton R NENE S 29 T25R8			Scat ad	< 1 mo	Scat found on sidehill in ABLA timber, 5400' el., 135° aspect, 20% slope, <100 m/cover

Appendix D.

Grizzly bear activity patterns, Rocky Mountain East Front, 1981.

Bear No. 220, 7/9-7/10

Bear No. 257, 7/8-7/9

Bear No. 257, 7/9-7/10

Bear No. 257, 7/21-7/22

Bear No. 257, 8/3-8/4

Bear No. 257, 8/4-8/5

(Hours)

0800 1000 1200 1400 1600 1800 2000 2200 24 0200 0400 0600 0800 1000 1200

Inactive

Stationary active

Fully active

Grizzly bear activity patterns, Rocky Mountain East Front, 1981.

Bear No. 257, 8/5-8/6

Bear No. 257, 8/6-8/7

Bear No. 273, 8/4-8/5

Bear No. 273, 8/5-8/6

Bear No. 273, 8/6-8/7

Bear No. 257, 8/11-8/12

(Hours)

1200 1400 1600 1800 2000 2200 2400 0200 0400 0600 0800 1000 1200

Inactive

Stationary
Active

Fully Active

Grizzly bear activity patterns, Rocky Mountain East Front, 1981.

Bear No. 257, 8/12-8/13

Bear No. 273, 8/17-8/18

Bear No. 273, 8/18-8/19

Bear No. 273, 8/24-8/25

Bear No. 257, 8/31-9/1

Bear No. 257, 9/9-9/10

(Hours)

Inactive

Stationary
Active

Fully Active

1200 1400 1600 1800 2000 2200 2400 0200 0400 0600 0800 1000 1200

Grizzly bear activity patterns, Rocky Mountain East Front, 1981.

Appendix E. Seismic activity records (USFS) 1981.

Line No.	Description
1	#7 Seiscom Delta - dates unknown
2	#6 Sefel for Geodata - dates unknown
3	#6 Seiscom Delta - dates unknown
4	#5 Sefel for Geodata - dates unknown
5	#3 Mountain Geophysical - not completed
6	#4 Seiscom Delta - dates unknown
7	#4 Sefel for Geodata - dates unknown
8	102 Consolidated Georex Geophysical - began approximately 8/5/81 - completion date unknown
9	#4 Mountain Geophysical - not completed
10	#12 Seisdata Services Inc. Portadrill began 9/12/81, finished line 9/25/81.
11	#3 Sefel for Geodata - error in placement on map - began 9/8/81 - finished approximately 10/7/81.
12	#3 Seiscom Delta. Shot line on 8/22 and 8/23/81.
13	#11 Seisdata Services Inc. Beginning date unknown. Finished line 9/17/81.
14	101 Consolidated Georex Geophysical. Began approximately 7/13/81 - finish dates unknown
15	#10 Seisdata Services Inc. On line approximately 9/5-9/25/81.
16	#9 Seisdata Services Inc. On line approximately 8/12-8/26/81.
17	#5 Sefel for Williams. Dates unknown
18	#8 Seisdata Services Inc. On line approximately 9/5-9/12/81.
19	#2 Seiscom Delta - dates unknown
20	#4 Sefel for Williams - dates unknown
21	#3 Sefel for Williams - dates unknown
22	#2 Sefel for Williams - dates unknown
23	#1 Sefel for Williams - began in August. Finish dates unknown
24	#2 Sefel for Geodata - on line 10/21 until approximately 10/31/81.
25	#7 Seisdata Services Inc. On line in June
26	#6 Seisdata Services Inc. On line approximately 7/15 & 7/25/81.
27	#5 Seisdata Services Inc. - Worked on line during August
28	#5 Mountain Geophysical - not completed
29	#1 Sefel for Geodata - On line 8/24-9/16/81.
30	#4 Seisdata Services Inc. On line 8/12-9/4/81.
31	#6 Mountain Geophysical - not completed.
32	#3 Seisdata Services Inc. On line 8/17-8/19/81.
33	#7 Mountain Geophysical - not completed
34	#2 Seisdata Services Inc. - on line 8/8-8/15/81.
35	#12 Sefel for Geodata - on line 8/19-9/15/81.
36	#8 Mountain Geophysical - on line 10/8-11/1/81.
37	#1 Seisdata Services Inc. - on line 8/1-8/10/81.

Appendix F. Species and common names of East Front Rocky Mountain plants. Arranged alphabetically by life form. Nomenclature follows Hitchcock and Cronquist (1974). (*Carex* follows Hermann 1970.) Sources where species were reported in literature include: Harvey (1980), Schallenberger and Jonkel (1978, 1979, 1980), Kasworm (1980, Thompson (1980) and Ihle (1981).

Plant No.	Scientific binomial	Common name
TREES		
0010	<i>Abies lasiocarpa</i>	Subalpine fir
0020	<i>Juniperus scopulorum</i>	Rocky Mountain juniper
0030	<i>Picea engelmannii</i>	Engelmann spruce
0040	<i>Pinus albicaulis</i>	Whitebark pine
0050	<i>Pinus contorta</i> var. <i>latifolia</i>	Lodgepole pine
0060	<i>Pinus flexilis</i>	Limber pine
0070	<i>Populus tremuloides</i>	Quaking aspen
0080	<i>Populus trichocarpa</i>	Black cottonwood
0090	<i>Pseudotsuga mansueti</i>	Rocky Mtn. douglas fir
0100	Total Trees	
TALL SHRUBS		
0110	<i>Acer glabrum</i>	Rocky Mountain maple
0120	<i>Alnus sinuata</i>	Sitka alder
0130	<i>Betula glandulosa</i>	Bog birch
0140	<i>Betula occidentalis/occidentalis</i>	Water birch
0150	<i>Cornus stolonifera/stolonifera</i>	Red-osier dogwood
0160	<i>Eleagnus commutata</i>	Silverberry
0170	<i>Salix brachycarpa</i>	Short fruited willow
0180	<i>Salix bebbiana/perrostrata</i>	Bebb willow
0190	<i>Salix commutata</i>	Variable willow
0200	<i>Salix drummondiana</i>	Drummond willow
0210	<i>Salix exigua</i> ssp <i>exigua/stenophylla</i>	Narrow leafed willow
0220	<i>Salix monticola</i>	Mountain willow
0230	<i>Salix myrtillofolia</i>	Blueberry willow
0240	<i>Salix rigida/mackenziana</i>	Mackenzie willow
0250	<i>Salix scouleriana</i>	Scouler willow
0260	<i>Salix</i> spp.	
0265	Total Tall Shrubs	
MEDIUM SHRUBS		
0270	<i>Amelanchier alnifolia/alnifolia</i>	Western serviceberry
0280	<i>Artemisia tridentata</i> ssp <i>vaseyana</i>	Mountain big sagebrush
0290	<i>Chrysothamnus nauseosus/petrophilus</i>	Rubber rabbitbrush
0300	<i>Juniperus communis/montana</i>	Common juniper
0310	<i>Lonicera involucrata</i>	Black twinberry
0320	<i>Lonicera utahensis</i>	Utah twinberry
0330	<i>Philadelphus lewisii</i>	Mockorange
0340	<i>Potentilla fruticosa</i>	Shrubby Cinquefoil

Appendix E continued.

Plant No.	Scientific binomial	Common name
0350	<i>Prunus virginiana/melanocarpa</i>	Common chokecherry
0360	<i>Rhus trilobata</i>	Skunkbush sumac
0370	<i>Ribes cereum/inebrians</i>	Squaw currant
0380	<i>Ribes inerme</i>	Whitestem gooseberry
0390	<i>Ribes lacustre</i>	Prickly currant
0400	<i>Ribes montigenum</i>	Sticky currant
0410	<i>Ribes setosum</i>	Missouri gooseberry
0420	<i>Ribes</i> spp.	General
0430	<i>Rosa acicularis</i>	Prickly rose
0440	<i>Rosa arkansana</i>	Arkansas rose
0450	<i>Rosa woodsii/ultramontana</i>	Pearhip rose
0460	<i>Rosa</i> spp.	General
0470	<i>Rubus idaeus/paramoenus</i>	Red raspberry
0480	<i>Rubus parviflorus</i>	Thimbleberry
0490	<i>Sambucus racemosa</i>	Black elderberry
0500	<i>Shepherdia argentea</i>	Thorny buffaloberry
0510	<i>Shepherdia canadensis</i>	Canada buffaloberry
0520	<i>Spirea betulifolia/lucida</i>	Shiny-leaf spirea
0530	<i>Symphoricarpos albus/albus</i>	Common snowberry
0540	<i>Symphoricarpos occidentalis</i>	Western snowberry
0550	<i>Tetradymia canescens</i>	Gray horsebrush
0560	<i>Vaccinium globulare</i>	Globe huckleberry
0565	Total medium shrubs	

LOW SHRUBS AND VINES

0570	<i>Arctostaphylos uva-ursi</i>	Kinnikinnick
0580	<i>Artemisia frigida</i>	Fringed sagewort
0600	<i>Berberis repens</i>	Oregon grape
0610	<i>Clematis columbiana/columbiana</i>	Columbia clematis
0620	<i>Clematis ligusticifolia</i>	Western clematis
0630	<i>Clematis pseudoalpina</i>	Climbing purple virginsbower
0640	<i>Clematis tenuiloba</i>	Matted purple virginsbower
0650	<i>Dryas octopetala/hookeriana</i>	White dryas
0660	<i>Gutierrezia sarothrae</i>	Broom snakeweed
0670	<i>Juniperus horizontalis</i>	Creeping juniper
0680	<i>Ledum glandulosum</i>	Mountain labrador-tea
0690	<i>Vaccinium myrtillus</i>	Dwarf huckleberry
0700	<i>Vaccinium scoparium</i>	Whortleberry
0710	Total low shrubs and vines	

FERNS AND FERN ALLIES

0720	<i>Equisetum arvense</i>	Common horsetail
0730	<i>Equisetum fluviatile</i>	Water horsetail
0740	<i>Equisetum laevigatum</i>	Smooth scouring rush
0750	<i>Equisetum pratense</i>	Shady horsetail
0760	<i>Equisetum</i> spp.	

Appendix E continued.

Plant No.	Scientific binomial	Common name
0770	<i>Cystopteris fragilis</i>	Brittle bladder fern
0780	<i>Selaginella densa/densa</i>	Compact club moss
0790	<i>Thelypteris limbosperma</i>	Mountain fern
0800	Total ferns and fern allies	

GRAMINOIDES

0810	<i>Agropyron caninum</i> ssp <i>majus/majus</i>	Slender wheatgrass
0820	<i>Agropyron caninum</i> ssp <i>majus/andinum</i>	Bearded wheatgrass
0830	<i>Agropyron cristatum</i>	Crested wheatgrass
0840	<i>Agropyron dasystachyum</i>	Thick-spiked wheatgrass
0850	<i>Agropyron repens</i>	Quack grass
0860	<i>Agropyron scribneri</i>	Spreading wheatgrass
0870	<i>Agropyron smithii</i>	Western wheatgrass
0880	<i>Agropyron spicatum/spicatum</i>	Bluebunch wheatgrass
0890	<i>Agropyron</i> spp	Wheatgrass
0900	<i>Agrostis alba/alba</i>	Redtop
0910	<i>Alopecurus alpinus</i>	Alpine foxtail
0920	<i>Andropogon scoparius</i>	Little bluestem
0930	<i>Aristida fendleriana</i>	Fendler's threeawn
0940	<i>Aristida longiseta/robusta</i>	Red threeawn
0950	<i>Avena fatua</i>	Wild oats
0960	<i>Beckmannia syzigachne</i>	American sloughgrass
0970	<i>Bouteloua gracilis</i>	Blue grama
0980	<i>Bromus carinatus/carinatus</i>	Mountain brome
0990	<i>Bromus carinatus/linearis</i>	California brome
1000	<i>Bromus inermis/inermis</i>	Smooth brome
1010	<i>Bromus inermis</i> ssp <i>pumpellianus</i> var <i>pumpellianus</i>	Pumpelly brome
1020	<i>Bromus japonicus</i>	Japanese brome
1030	<i>Bromus tectorum</i>	Cheatgrass
1040	<i>Calamagrostis canadensis</i>	Bluejoint reedgrass
1050	<i>Calamagrostis inespansa/inespansa</i>	Narrow-spiked reedgrass
1060	<i>Calamagrostis neglecta/neglecta</i>	Slimstem reedgrass
1070	<i>Calamagrostis purpurascens</i>	Purple pinegrass
1080	<i>Calamagrostis rubescens</i>	Pinegrass
1090	<i>Calamovilfa longifolia</i>	Prairie sand reedgrass
1100	<i>Carex aquatilis</i>	Water sedge
1110	<i>Carex concinnoides</i>	Northwest sedge
1120	<i>Carex filifolia</i>	Thread-leaved sedge
1130	<i>Carex geyeri</i>	Elk sedge
1140	<i>Carex hoodii</i>	Wire sedge
1150	<i>Carex lanuginosa</i>	Wooly sedge
1160	<i>Carex microptera</i>	Small winged sedge
1170	<i>Carex muricata</i>	Muricate sedge
1180	<i>Carex nebraskensis</i>	Nebraska sedge
1190	<i>Carex praegracilis</i>	Clustered field sedge

Appendix E continued.

Plant No.	Scientific binomial	Common name
1200	<i>Carex raynoldsei</i>	Raynolds sedge
1210	<i>Carex rostrata</i>	Beaked sedge
1220	<i>Carex rupestris/durmondiana</i>	Curly sedge
1230	<i>Carex scirpiformis</i>	Single spike sedge
1240	<i>Carex stenophylla</i>	Narrow leaved sedge
1250	<i>Carex xerantica</i>	Dryland sedge
1260	<i>Carex</i> spp	
1270	<i>Dactylis glomerata</i>	Orchard grass
1280	<i>Danthonia intermedia</i>	Timbered danthonia
1290	<i>Danthonia parryi</i>	Parry's oatgrass
1300	<i>Danthonia wispiicata</i>	Few flowered wild oatgrass
1310	<i>Danthonia</i> spp	
1320	<i>Deschampsia cespitosa/cespitosa</i>	Tufted hairgrass
1330	<i>Deschampsia elongata</i>	Slender hairgrass
1340	<i>Distichlis stricta/stricta</i>	Alkali saltgrass
1350	<i>Echinochloa crusgalli</i>	Large barnyard grass
1360	<i>Eleocharis acicularis</i>	Needle spike-rush
1370	<i>Eleocharis palustris</i>	Common spike-rush
1380	<i>Elymus cinereus/cinereus</i>	Basin wildrye
1390	<i>Elymus glaucus</i>	Western ryegrass
1400	<i>Eriophorum viridicarinatum</i>	Green keeled cotton grass
1410	<i>Festuca idahoensis/idahoensis</i>	Idaho fescue
1420	<i>Festuca ovina</i>	Sheep fescue
1430	<i>Festuca pratensis</i>	English fescue
1440	<i>Festuca scabrella</i>	Rough fescue
1450	<i>Glyceria grandis</i>	American mannagrass
1460	<i>Helictotrichon hookeri</i>	Spike-oat
1470	<i>Hordeum jubatum</i>	Foxtail barley
1480	<i>Juncus alpinus</i>	Northern rush
1490	<i>Juncus balticus/montanus</i>	Wire rush
1500	<i>Juncus longistylis</i>	Long styled rush
1510	<i>Juncus nodosus</i>	Tuberous rush
1520	<i>Juncus trayci</i>	Tracy's rush
1530	<i>Juncus</i> spp	
1540	<i>Koeleria cristata</i>	Prairie junegrass
1550	<i>Luzula hitchcockii</i>	Smooth woodrush
1560	<i>Muhlenbergia cuspidata</i>	Plains muhly
1570	<i>Oryzopsis hymenoides</i>	Indian ricegrass
1580	<i>Phalaris arundinacea</i>	Reed canarygrass
1590	<i>Phleum alpinum</i>	Alpine timothy
1600	<i>Phleum pratense</i>	Common timothy
1610	<i>Poa compressa</i>	Canada bluegrass
1620	<i>Poa cusickii</i>	Cusick's bluegrass
1630	<i>Poa interior</i>	Inland bluegrass
1640	<i>Poa nervosa/wheeleri</i>	Wheelers bluegrass
1650	<i>Poa nevadensis</i>	Nevada bluegrass
1660	<i>Poa pratensis</i>	Kentucky bluegrass

1

2

3

Appendix E continued.

Plant No.	Scientific binomial	Common name
1670	<i>Poa rupicola</i>	Timberline bluegrass
1680	<i>Poa sandbergii</i>	Sandberg's bluegrass
1690	<i>Poa scabrella</i>	Pine bluegrass
1700	<i>Poa</i> spp	
1710	<i>Scirpus acutus</i>	Hardstem bulrush
1720	<i>Scirpus microcarpus</i>	Small-fruited bulrush
1730	<i>Spartina gracilis</i>	Alkali cordgrass
1740	<i>Stipa comata/comata</i>	Needle and thread
1750	<i>Stipa occidentalis/minor</i>	Western needlegrass
1760	<i>Stipa spartea/curtiseta</i>	Porcupine needlegrass
1770	<i>Stipa richardsonii</i>	Richardson's needlegrass
1780	<i>Stipa viridula</i>	Green needlegrass
1790	<i>Trisetum canescens</i>	Tall trisetum
1800	<i>Trisetum spicatum</i>	Downy oatgrass
1810	Unknown Graminae	
1820	Total Graminoids	
FORBS		
1830	<i>Achillea millefolium</i> spp	
	<i>lanulosa/lanulosa</i>	Common yarrow
1840	<i>Actea rubra/rubra</i>	Western red baneberry
1850	<i>Actea rubra/neglecta</i>	Western white baneberry
1860	<i>Agoseris glauca/dasycephala</i>	Pale agoseris
1870	<i>Allium cernuum</i>	Nodding onion
1880	<i>Allium textile</i>	Textile onion
1890	<i>Allium</i> spp	
1900	<i>Alyssum alyssoides</i>	Pale alyssum
1910	<i>Amarantinus californicus</i>	California amaranthus
1915	<i>Anaphalis margaritacea</i>	Pearly-everlasting
1920	<i>Androsace lahmmaniana</i>	Sweet-flowered androsace
1930	<i>Androsace septentrionalis</i>	Northern androsace
1940	<i>Anemone multifida/multifida</i>	Pacific anemone
1950	<i>Anemone nuttalliana</i>	Pasqueflower
1960	<i>Anemone parviflora</i>	Small flowered anemone
1970	<i>Anemone piperi</i>	Piper's anemone
1980	<i>Angelica arguta</i>	Sharptooth angelica
1990	<i>Angelica</i> spp	
2000	<i>Antennaria anaphaloides</i>	Tall pussytoes
2010	<i>Antennaria microphylla</i>	Rosy pussytoes
2020	<i>Antennaria parvifolia</i>	Nuttall's pussytoes
2030	<i>Antennaria racemosa</i>	Raceme pussytoes
2040	<i>Apocynum medium</i>	Western dogbane
2050	<i>Aquilegia flavescens</i>	Yellow columbine
2060	<i>Aquilegia jonesii</i>	Limestone columbine
2070	<i>Arenaria capillaris/americana</i>	Thread-leaved sandwort
2080	<i>Arenaria congesta</i>	Ballhead sandwort
2090	<i>Arenaria lateriflora</i>	Bluntleafed sandwort
2100	<i>Arenaria obtusiloba</i>	Arctic sandwort

Appendix E continued.

Plant No.	Scientific binomial	Common name
2110	<i>Arenaria rossii/apetala</i>	Ross sandwort
2120	<i>Arnica cordifolia/cordifolia</i>	Heartleaf arnica
2130	<i>Arnica fulgens</i>	Orange arnica
2140	<i>Arnica latifolia</i>	Mountain arnica
2150	<i>Arnica mollis</i>	Hairy arnica
2160	<i>Artemisia biennis</i>	Biennial wormwood
2170	<i>Artemisia campestris ssp borealis</i> var <i>scouleriana</i>	Northern wormwood
2175	<i>Artemisia cana</i>	Hoary sagewort
2176	<i>Artemisia dracunculoides</i>	Dragon sagewort
2178	<i>Artemisia ludoviciana/ludoviciana</i>	Cudweed sagewort
2179	<i>Artemisia ludoviciana/latiloba</i>	Western mugwort
2180	<i>Artemisia michauxiana</i>	Michaux mugwort
2185	<i>Aster chilensis ssp ascendens</i>	Long-leaved aster
2186	<i>Aster conspicuous</i>	Showy aster
2190	<i>Aster foliaceus/parryi</i>	Leafy aster
2200	<i>Aster hesperius</i>	Western willow aster
2210	<i>Aster laevis/geyeri</i>	Smooth aster
2220	<i>Aster modestus</i>	Few-flowered aster
2230	<i>Aster pauciflorus</i>	White prairie aster
2240	<i>Aster spp</i>	
2250	<i>Astragalus adsurgens</i>	Standing milkvetch
2260	<i>Astragalus argophyllus/argophyllus</i>	Silver-leaved milkvetch
2270	<i>Astragalus bisulcatus</i>	Two-grooved milkvetch
2280	<i>Astragalus ciliaris</i>	Browse milkvetch
2285	<i>Astragalus crassicaulis</i>	Ground plum
2290	<i>Astragalus drummondii</i>	Drummonds milkvetch
2300	<i>Astragalus gilviflorus</i>	Plains orophaca
2310	<i>Astragalus miser</i>	Weedy milkvetch
2320	<i>Astragalus missouriensis</i>	Missouri milkvetch
2325	<i>Astragalus robbinsii</i>	Robins milkvetch
2330	<i>Astragalus spp</i>	
2340	<i>Bahia oppositifolia</i>	Bahia
2350	<i>Balsamorhiza incana</i>	Hoary balsamroot
2360	<i>Balsamorhiza sagittata</i>	Arrowleaf balsamroot
2370	<i>Barbarea orthoceras</i>	American wintercress
2380	<i>Besseyia wyomingensis</i>	Wyoming besseyia
2390	<i>Eupatorium americanum</i>	American thorough-wax
2400	<i>Campanula rotundifolia</i>	Scott bluebell
2410	<i>Capsella bursa-pastoris</i>	Shepherd's purse
2415	<i>Cardus nutans</i>	Musk thistle
2420	<i>Carum carvi</i>	Caraway
2430	<i>Castilleja lutescens</i>	Yellowish paintbrush
2440	<i>Castilleja miniata/miniata</i>	Common paintbrush
2450	<i>Castilleja sessiliflora</i>	Downy paint-cup
2455	<i>Castilleja spp</i>	Paintbrush

Appendix E continued.

Plant No.	Scientific binomial	Common name
2460	<i>Centaurea maculosa</i>	Spotted knapweed
2470	<i>Cerastium arvense</i>	Field chickweed
2480	<i>Cerastium beringianum</i>	Alpine chickweed
2490	<i>Chimaphila umbellata</i>	Common prince's-pine
2500	<i>Chenopodium album</i>	Lambsquarter
2510	<i>Chenopodium chenopoides</i>	Red goosefoot
2520	<i>Chenopodium fremontii/atrovirens</i>	Fremont's goosefoot
2530	<i>Chenopodium rubrum</i>	Red goosefoot
2540	<i>Chrysopsis villosa/foliosa</i>	Hairy golden-aster
2550	<i>Cicuta douglasii</i>	Douglas' water-hemlock
2560	<i>Cirsium arvense/horridum</i>	Canadian thistle
2570	<i>Cirsium scariosum</i>	Elk thistle
2580	<i>Cirsium undulatum</i>	Wavy-leaved thistle
2590	<i>Cirsium vulgare</i>	Bull thistle
2600	<i>Cirsium</i> spp	
2610	<i>Clematis hirsutissima</i>	Douglas' clematis
2620	<i>Claytonia lanceolata</i>	Springbeauty
2630	<i>Claytonia megarhiza</i>	Alpine claytonia
2640	<i>Collomia linearis</i>	Narrow-leaf collomia
2650	<i>Collinsia parviflora</i>	Small flowered blue-eyed Mary
2660	<i>Comandra umbellata</i>	Bastard toad-flax
2670	<i>Conimitella williamsii</i>	William's conimitella
2680	<i>Conringia orientalis</i>	Hare's-ear mustard
2690	<i>Convolvulus arvensis</i>	Small bindweed
2700	<i>Corydalis aurea</i>	Golden corydalis
2710	<i>Coryphantha vivipara</i>	Cushion cactus
2720	<i>Crepis acuminata/acuminata</i>	Long-leaved hawksbeard
2725	<i>Crepis occidentalis</i>	Western hawksbeard
2730	<i>Cruciferae</i> spp	
2740	<i>Cryptantha</i>	Bristly cryptantha
2750	<i>Cryptantha nubigena</i>	Sierra cryptantha
2760	<i>Cynoglossum officinale</i>	Common hound's-tongue
2770	<i>Cypripedium calceolus</i>	Yellow lady's slipper
2780	<i>Descurainia pinnata</i>	Western tansymustard
2790	<i>Descurainia sophia</i>	Flixweed
2800	<i>Delphinium bicolor</i>	Little larkspur
2810	<i>Diplotaxis muralis</i>	Wallrocket
2820	<i>Disporum trachycarpum</i>	Rough-fruited fairybelle
2830	<i>Dodecatheon conjugans</i>	Slimpod shooting star
2840	<i>Dodecatheon pulchellum</i>	Few-flowered shooting star
2850	<i>Douglasia montana</i>	Rocky Mountain douglasia
2860	<i>Draba oligosperma/oligosperma</i>	Few-seeded draba
2870	<i>Draba reptans</i>	Carolina whitlow grass
2875	<i>Epilobium angustifolium</i>	Fireweed
2880	<i>Epilobium glandulosum</i>	Common willow-weed
2890	<i>Epilobium watsonii/watsonii</i>	Watson's willow-weed
2900	<i>Erigeron caespitosus</i>	Tufted fleabane

Appendix E continued.

Plant No.	Scientific binomial	Common name
2910	<i>Erigeron compositus/glabratus</i>	Cut-leaved daisy
2920	<i>Erigeron ochroleucus/ochroleucus</i>	Buff fleabane
2930	<i>Erigeron speciosus/speciosus</i>	Showy fleabane
2940	<i>Erigeron</i> spp	
2950	<i>Eriogonum flavum/flavum</i>	Yellow buckwheat
2960	<i>Eriogonum mancum</i>	Imperfect buckwheat
2970	<i>Eriogonum ovalifolium/macropodium</i>	Cushion buckwheat
2980	<i>Eriogonum umbellatum/subalpinum</i>	Sulphur buckwheat
2990	<i>Eriogonum</i> spp	
3000	<i>Eritrichium howardii</i>	Howards alpine forget-me-not
3010	<i>Eritrichium nanum</i>	Pale alpine forget-me-not
3020	<i>Erodium cicutarium</i>	Stork's-bill
3030	<i>Erysimum asperum</i>	Prairie rocket
3040	<i>Erythronium grandiflorum</i>	Glacier lily
3050	<i>Euphorbia esula</i>	Spurge
3060	<i>Fragaria virginiana/glauc</i>	blueleaf strawberry
3070	<i>Frasera speciosa</i>	Giant frasera
3080	<i>Fritillaria pudica</i>	Yellowbell
3090	<i>Gaillardia aristata</i>	Blanket flower gaillardia
3100	<i>Gallium boreale</i>	Northern bedstraw
3110	<i>Gallium triflorum</i>	Fragrant bedstraw
3120	<i>Gaura coccinea</i>	Scarlet gaura
3130	<i>Gentiana affinis</i>	Pleated gentian
3140	<i>Gentiana calycosa</i>	Mountain bog gentian
3150	<i>Gentiana detonsa</i>	Smaller fringed gentian
3160	<i>Geranium richardsonii</i>	White geranium
3170	<i>Geranium viscosissimum/viscosissimum</i>	Sticky geranium
3180	<i>Geum aleppicum</i>	Yellow avens
3190	<i>Geum macrophyllum/macrophyllum</i>	Large-leaved avens
3200	<i>Geum triflorum/triflorum</i>	Prairie smoke
3210	<i>Glycyrrhiza lepidota/lepidota</i>	American licorice
3220	<i>Goodyera oblongifolia</i>	Western rattlesnake-plantain
3230	<i>Grindelia squarrosa/quasiperennis</i>	Curly-cup gumweed
3235	<i>Gutierrezia sarothrae</i>	Matchbrush
3240	<i>Habenaria dilata</i>	White bog orchid
3250	<i>Habenaria hyperborea</i>	Northern green bog orchid
3260	<i>Habenaria walascensis</i>	Alaska bog orchid
3270	<i>Hackelia floribunda</i>	Many-flowered stickseed
3280	<i>Hackelia micrantha</i>	Blue stickseed
3290	<i>Hedysarum alpinum</i>	Alpine hedysarum
3300	<i>Hedysarum boreale/cinerascens</i>	Northern hedysarum
3310	<i>Hedysarum sulphurescens</i>	Yellow hedysarum
3320	<i>Helianthus annuus</i>	Common sunflower
3330	<i>Helianthus nuttallii/nuttallii</i>	Nuttall's sunflower
3340	<i>Helianthus rigidus/subrhomboides</i>	Showy sunflower
3350	<i>Hernandium lanatum</i>	Cow parsnip

Appendix E continued.

Plant No.	Scientific binomial	Common name
3360	<i>Heuchera cylindrica/glabella</i>	Roundleaf Alumroot
3370	<i>Heuchera parvifolia/dissecta</i>	Common alumroot
3375	<i>Heuchera</i> spp	Alumroot
3380	<i>Hieracium gracile</i>	Alpine hawkweed
3390	<i>Hieracium</i> spp	
3400	<i>Hydrophyllum capitatum</i>	Ballhead waterleaf
3410	<i>Hymenopappus filifolius/polycephalus</i>	Cut-leaved hymenopappus
3420	<i>Hymenoxys acaulis/acaulis</i>	Stemless hymenoxys
3430	<i>Hymenoxys richardsonii/richardsonii</i>	Richardsons hymenoxys
3440	<i>Ilama rivularis/rivularis</i>	Streambank globemallow
3450	<i>Iris missouriensis</i>	Rocky Mountain iris
3460	<i>Ivesia gordonii</i>	Gordons Ivesia
3470	<i>Kelseya uniflora</i>	Kelseya
3480	<i>Lactuca pulchella</i>	Blue lettuce
3490	<i>Lactuca serriola</i>	Prickly lettuce
3500	<i>Lappula redowskii/redowskii</i>	Western stickseed
3510	<i>Lathyrus ochroleucus</i>	Cream-flowered peavine
3515	<i>Lathyrus</i> spp	Peavine
3520	<i>Lepidium campestre</i>	Field pepperweed
3530	<i>Lesquerella alpina</i>	Alpine bladderpod
3540	<i>Liatrus pumotata</i>	Blazing-star
3550	<i>Lilium philadelphicum</i>	Wood lily
3560	<i>Linum perenne/lewisii</i>	Wild blue flax
3570	<i>Linum rigidum</i>	Yellow flax
3580	<i>Lithospermum ruderalis</i>	Western gromwell
3590	<i>Lomatium cous</i>	Cous biscuit-root
3600	<i>Lomatium dissectum/multifidum</i>	Fern-leaved Lomatium
3610	<i>Lomatium macrocarpum</i>	Large-leaved Lomatium
3620	<i>Lomatium tritermatum</i> spp <i>platycarpum</i>	Nine-leaf Lomatium
3630	<i>Lupinus sericeus/sericeus</i>	Silky lupine
3640	<i>Lycium apetala</i>	Apet champion
3650	<i>Lysimachia ciliata</i>	Fringed loosestrife
3660	<i>Madia</i> spp	Tarweed
3670	<i>Medicago lupulina</i>	Black medic
3680	<i>Medicago sativa</i>	Alfalfa
3690	<i>Melilotus alba</i>	White sweetclover
3700	<i>Melilotus officinalis</i>	Yellow sweetclover
3710	<i>Mentha arvensis/globrata</i>	Field mint
3720	<i>Mentzelia laevicaulis/laevicaulis</i>	Blazing-star mentzelia
3730	<i>Mertensia ciliata/ciliata</i>	Broadleaf bluebells
3740	<i>Microseris cuspidata</i>	Toothed microseris
3750	<i>Microseris</i> spp	
3760	<i>Mimulus guttatus/guttatus</i>	Yellow monkeyflower
3770	<i>Monarda fistulosa/menthaefolia</i>	Horsemint
3780	<i>Monolepis nuttalliana</i>	Patata
3790	<i>Musineon divaricatum</i>	Leafy musineon
3800	<i>Myriophyllum spicatum/ewalbescens</i>	Spiked water-milfoil
3810	<i>Oenothera caespitosa/caespitosa</i>	Desert evening primrose
3820	<i>Oenothera flava</i>	Long-tubed evening primrose
3830	<i>Oenothera strigosa</i>	Common evening primrose

Plant No.	Scientific binomial	Common name
3840	<i>Onobrychis viciifolia</i>	Saintfoin
3850	<i>Opuntia polycantha</i>	Prickly pear cactus
3860	<i>Orthocarpus luteus</i>	Yellow owlclow
3865	<i>Orthocarpus tenuifolius</i>	Thin-leaved owl clover
3870	<i>Osmorhiza chilensis</i>	Mountain sweet-cicely
3880	<i>Osmorhiza occidentalis</i>	Western sweet-cicely
3890	<i>Osmorhiza</i> spp	
3900	<i>Oxytropis campestris/gracilis</i>	Field crazyweed
3910	<i>Oxytropis lagopus</i>	Rabbit-foot crazyweed
3920	<i>Oxytropis sericea/spicata</i>	Silky crazyweed
3930	<i>Oxytropis splendens</i>	Showy crazyweed
3940	<i>Oxytropis viscidia</i>	Sticky crazyweed
3950	<i>Parnassia fimbriata/fimbriata</i>	Fringed grass-of-parnassiss
3960	<i>Parnassia palustris</i>	Northern grass-of-parnassiss
3970	<i>Paronychia sessiliflora</i>	Whitlow wort
3980	<i>Pedicularis bracteosa</i>	Bracted lousewort
3990	<i>Pedicularis contorta/contorta</i>	White coiled-beak lousewort
4000	<i>Pedicularis groenlandica</i>	Elephants head
4010	<i>Pedicularis racemosa</i>	Stickletop lousewort
4020	<i>Pedicularis</i> spp	
4030	<i>Penstemon albertinus</i>	Alberta penstemon
4040	<i>Penstemon confertus</i>	Yellow penstemon
4050	<i>Penstemon ellipticus</i>	Elliptic-leaved penstemon
4060	<i>Penstemon eriantherus/eriantherus</i>	Fuzzy-tongue penstemon
4070	<i>Penstemon nitidus/nitidus</i>	Shining penstemon
4080	<i>Penstemon procerus/procerus</i>	Small-flowered penstemon
4090	<i>Penstemon</i> spp	
4100	<i>Perideridia gairdneri</i> ssp <i>borealis</i>	Gairdner's yampah
4110	<i>Petalostemon candidum</i>	White prairie clover
4120	<i>Petalostemon purpureum</i>	Purple prairie clover
4130	<i>Phacelia sericea</i>	Silky phacelia
4140	<i>Phacelia hastata/alpina</i>	Virgate phacelia
4150	<i>Phacelia linearis</i>	Threadleaf phacelia
4160	<i>Phlox alyssifolia</i>	Alyssum-leaved phlox
4170	<i>Phlox hoodii</i>	Hood's phlox
4180	<i>Physaria didymocarpa</i>	Common twinpod
4190	<i>Plantago major/major</i>	Common plantain
4200	<i>Polemonium pulcherrimum</i>	Showy polemonium
4210	<i>Polygonum achoreum</i>	Striated knotweed
4220	<i>Polygonum amphibium</i>	Water smartweed
4230	<i>Polygonum bistortoides</i>	American bistort
4240	<i>Potentilla anserina</i>	Common silverweed
4250	<i>Potentilla arguta/convallaria</i>	Glandular cinquefoil
4260	<i>Potentilla diversifolia/diversifolia</i>	Diverse-leaved cinquefoil
4270	<i>Potentilla glandulosa</i>	Sticky cinquefoil
4280	<i>Potentilla gracilis/glabrata</i>	Slender cinquefoil
4290	<i>Potentilla hippiana</i>	Wooly cinquefoil
4300	<i>Potentilla ovina</i>	Sheep cinquefoil

Appendix E continued.

Plant No.	Scientific binomial	Common name
4310	<i>Potentilla pennsylvanica</i>	Prairie cinquefoil
4320	<i>Potentilla rivalis</i>	River cinquefoil
4330	<i>Potentilla</i> spp	
4340	<i>Pyrola chlorantha</i>	Wintergreen
4350	<i>Pyrola secunda</i>	One-sided wintergreen
4360	<i>Pyrola uniflora</i>	Wax-flowered wintergreen
4370	<i>Pyrola</i> spp	
4380	<i>Ranunculus acris</i> /formis/montanensis	Sharp buttercup
4390	<i>Ranunculus aquatilis</i> /capillaceus	White-water buttercup
4400	<i>Ranunculus eschscholtzii</i>	Subalpine buttercup
4410	<i>Ranunculus cymbalaria</i>	Shore buttercup
4420	<i>Ranunculus macounii</i> /macounii	Macoun's buttercup
4430	<i>Ranunculus orthorhynchus</i>	Straightbeak buttercup
4440	<i>Ranunculus sceleratus</i> /multifidus	Celeryleaved buttercup
4450	<i>Ranunculus</i> spp	
4460	<i>Ratibida columbifera</i>	Prairie coneflower
4470	<i>Rudbeckia laciniata</i> /ampla	Tall coneflower
4480	<i>Rumex crispus</i>	Curly dock
4490	<i>Ruppia maritima</i>	Seaside arrowgrass
4500	<i>Salsola kali</i>	Russian thistle
4510	<i>Sanicula marilandica</i>	Black snakeroot
4520	<i>Saxifraga bronchialis</i> /austromontana	Spotted saxifrage
4530	<i>Sedum lanceolatum</i> /lanceolatum	Lanceleaved stonecrop
4540	<i>Sedum stenopetalum</i>	Wormleaf stonecrop
4550	<i>Sedum</i> spp	
4560	<i>Senecio canus</i>	Wooly groundsel
4570	<i>Senecio fremonti</i>	Dwarf mountain butterweed
4580	<i>Senecio indecorus</i>	Rayless mountain butterweed
4590	<i>Senecio megacephalus</i>	Large-headed butterweed
4600	<i>Senecio paupercularis</i>	Balsam groundsel
4610	<i>Senecio pseudoreus</i> /pseudoreus	Streambank butterweed
4620	<i>Senecio serpa</i> /serpa	Butterweed groundsel
4630	<i>Senecio</i> spp	
4640	<i>Senecio triangularis</i> /triangularis	Arrowleaf groundsel
4650	<i>Sierinchium angustifolium</i>	Common blue-eyed grass
4660	<i>Sisymbrium altissimum</i>	Fieldmustard
4670	<i>Smilacina racemosa</i>	Feather solomon's seal
4680	<i>Smilacina stellata</i>	Starry false solomon's seal
4690	<i>Solidago canadensis</i> /salebrosa	Canada goldenrod
4700	<i>Solidago gigantea</i> /serotina	Smooth goldenrod
4710	<i>Solidago missouriensis</i> /missouriensis	Missouri goldenrod
4720	<i>Solidago multiradiata</i>	Northern goldenrod
4730	<i>Solidago rigida</i> /humilis	Stiff goldenrod
4740	<i>Solidago</i> spp	
4750	<i>Sonchus asper</i>	Prickly sowthistle
4760	<i>Sphaeralcea coccinea</i>	Red globemallow
4770	<i>Spiranthes romanzoffiana</i>	Ladies-tresses
4780	<i>Stachys palustris</i> /pilosa	Swamp hedge nettle
4790	<i>Streptopus amplexifolius</i> /chalcidatus	Large twisted stalk

Appendix E continued.

Plant No.	Scientific binomial	Common name
4800	<i>Taraxacum officinale</i>	Common dandelion
4810	<i>Taraxacum</i> spp	
4820	<i>Thalictrum occidentale</i>	Western meadowrue
4830	<i>Thelesperma subnudum/marginatum</i>	Thelesperma
4840	<i>Thermopsis montana</i>	Mountain thermopsis
4850	<i>Thermopsis rhombifolia</i>	Round-leaved thermopsis
4860	<i>Thlaspi arvense</i>	Field pennycress
4870	<i>Townsendia montana</i>	Mountain townsendia
4880	<i>Townsendia parryi</i>	Parry's townsendia
4890	<i>Tragopogon dubius</i>	Yellow salsify
4895	<i>Trifolium hybridum</i>	Alsike clover
4900	<i>Trifolium pratense</i>	Red clover
4910	<i>Trifolium repens</i>	White clover
4920	<i>Triglochin maritimum</i>	Seaside Arrow-grass
4930	<i>Trillium ovatum</i>	Western wake-robin
4940	<i>Typha latifolia</i>	Common cattail
4950	<i>Urtica dioica</i> ssp <i>gracilis/gracilis</i>	Slim nettle
4960	<i>Urtica dioica</i> ssp <i>gracilis/procera</i>	Stinging nettle
4970	Unknown forb	
4980	<i>Valeriana dioica</i>	Northern valerian
4990	<i>Valeriana edulis</i>	Edible valerian
5000	<i>Valeriana</i> spp	
5010	<i>Valeriana sitchensis</i>	Sitka valerian
5020	<i>Veratrum viride</i>	Green false hellebore
5030	<i>Verbena bracteata</i>	Bracted verbena
5040	<i>Veronica americana</i>	American brookline
5050	<i>Vicia americana/truncata</i>	American vetch
5060	<i>Vicia</i> spp	
5070	<i>Viola canadensis/rugulosa</i>	Western Canada violet
5080	<i>Viola glabella</i>	Stream violet
5090	<i>Viola orbiculata</i>	Round-leaved violet
5100	<i>Viola</i> spp	
5110	<i>Xanthium strumarium</i>	Common cocklebur
5115	<i>Xerophyllum tenax</i>	Beargrass
5120	<i>Zigadenus elegans</i>	Mountain death camas
5130	<i>Zigadenus venenosus/gramineus</i>	Meadow death camas
5140	<i>Zizia aptera/occidentalis</i>	Zizia
5150	Total forbs	
6000	Mineral soil	
6010	Rock	

Appendix G. Interim grizzly bear management guidelines, East Slope,
Rocky Mountain Front

INTRODUCTION

Study results documented to date along the East Rocky Mountain Front are the basis for the development of interim management guidelines for grizzly bear and their habitat. During the period from 1977-79, research was carried out by the Border Grizzly Project under a contract with the Bureau of Land Management which provided a major portion of the funding. In 1980 and 1981, the Montana Department of Fish, Wildlife & Parks assumed the intensive grizzly bear monitoring work with much of the funding continuing to be supplied by the BLM.

The need for these guidelines results from the following management concerns and/or potential conflicts between grizzly bear and other land uses or activities:

- A. Physical destruction of important grizzly bear habitat components.
- B. Human disturbance that would preclude the use of an area by grizzly bear.
- C. Increased grizzly bear/human interaction.
- D. Direct grizzly bear mortality.

These guidelines are based on the intensive grizzly bear monitoring information collected in recent years on the Rocky Mountain Front Study Area. They will be considered tentative and subject to revision as long as radio monitoring studies and associated habitat surveys are continued on grizzly bear in the area. Much of the information collected to date is concentrated in the area between the Teton River and the North Fork Dupuyer Creek. Intensive monitoring work will be expanded to other areas as funding becomes available. We anticipate grizzly bear studies to continue at least through 1985 under the Rocky Mountain Front Wildlife Monitor/Evaluation Program.

Interim Guidelines

1. Avoid superimposing activities on seasonally important habitats. For example, the best time to conduct activities is during the November-March time period outside of denning habitat. On-site recommendations by a wildlife biologist will be necessary.
2. Separate human activities and grizzly bear use by time and space.
3. Limit activity levels in relation to important grizzly bear complexes. If high activity level is occurring in one complex, limit any additional activity in adjacent complexes.
4. Limit activity levels within important grizzly bear complexes. If increased activity is occurring, limit activity in adjacent habitats (draws, etc.) to allow sufficient travel corridors and security for the bears.

5. Consolidate crew and equipment movements in order to minimize the number of trips. This may be accomplished by daily travel time restrictions and mass transit.
6. Proposed road construction should be based on completed transportation planning or tied to an existing transportation plan. Keep in mind important grizzly bear complexes and the disturbance possible within a complex when considering transportation needs. This may call for long parallel access rather than crossing draws, etc.
7. Use minimum road and site construction specifications necessary to provide adequate soil protection and personnel safety.
8. Schedule construction of roads and/or sites to avoid grizzly seasonal use periods and compress the activity into the shortest possible "timeframe."
9. Retain frequent dense cover areas adjacent to roads for travel corridors and security cover necessary to protect important habitat components. Three sight distances are desirable to provide security for grizzlies. A sight distance is the average distance at which a grizzly or other large animal is essentially hidden from the view of an observer by vegetative cover. The same security cover guideline also applies to timber harvest units.
10. Enhance security cover at road junctions by using dog-legs or other road alignment which will minimize sight distances along side roads as viewed off of the main road.
11. Seasonal closures, single purpose use restrictions, daily time restrictions, etc. will be road management techniques used, based on resource management needs and conflict potentials, to control use levels on roads and/or sites.
12. Single purpose roads will be administratively closed during construction and activity period, and will be physically closed, obliterated and rehabilitated when no longer needed.
13. No off-duty work camps will be allowed within identified grizzly bear complexes, and they will be discouraged within occupied grizzly habitat during periods of bear use. If conflicts should arise, the work camp will be removed.
14. No dogs will be allowed with increased commercial activity levels.
15. No firearms will be allowed during work periods or in vehicles traveling to and from work locations.
16. All potential bear attractants will be disposed of or stored in bear-proof containers.

17. Daily garbage removal will be required.
18. Consider the use of grizzly bear food species in the rehabilitation of roads and/or sites. As an example, it may be desirable to plant graminoids, forbs and shrubs which are palatable to grizzlies on an abandoned drill pad where the access road is physically closed and the site is located a safe distance from areas of significant human activity. Conversely, forage species which may attract grizzly bears will not be used in areas with a potential for increased human-bear interaction.
19. If high human activity levels develop on intermingled or adjoining private lands, all land management agencies should evaluate the need to restrict existing or planned activities on their lands.
20. Commercial activities permitted on public land should be planned and regulated to avoid conflicts with grizzly bear trapping operations being conducted under the monitoring program. General public use of areas where trapping operations are active will be controlled through appropriate administrative actions by the agencies involved.
21. Air travel restrictions (flight corridors, altitude limits, timing, etc.) will be considered based on an on-site evaluation of each proposed activity involving the use of aircraft.

Additional guidelines and management direction are available, and should be incorporated into specific project plans where appropriate. These include Border Grizzly Project annual and special reports, Montana Department of Fish, Wildlife & Parks annual and special reports, Yellowstone Management Guidelines, Grizzly Bear Recovery Plan, and Fish and Wildlife Service biological opinions.

Appendix H. Black bears, 1976-81.

No.	Date	Age	Weight	Sex	Color	Location	Fate	Ear Tags
190	9/15/76	6½	213	F	Black	Badger Cr	Recap 6/27/77	B1-Gr
153	9/20/76	Ad	187	F	Black	Badger Cr	Recap 10/16/76	Red-Gr
150	10/ 1/76	SA	108	M	Black	Badger Cr		Red-B1
2	10/ 2/76	Ad	160	M	Black	Badger Cr		Yellow
3	10/ 7/76	2½	90	M	Brown	Badger Cr		Yellow
117	4/30/77	5½	220	M	Black	Dupuyer	Recap 5/3/77	Y1-B1
173	5/ 9/77	3½	136	M	Black	Dupuyer		Y1-B1
262	5/ 9/77	9½	220	M	Brown	Dupuyer	Recap 6/3/78	Y1-Orange
207	5/22/77	2½	100	F	Brown	Teton		B1-Orange
201	5/23/77	2½	50	M	Black	Ear Mountain		Orange
265	5/27/77	4½	120	M	Brown	Ear Mountain	Recap 5/10/78; killed by hunter May 1980	
274	6/ 5/77	2½	65	M	Black	Ear Mountain		B1-Y1
209	6/ 8/77	15+	130	F	Brown	Ear Mountain		Y1-B1
213	6/19/77	2½	45	M	Black	Badger		Orange-Silver
219	6/25/77	8½	190	M	Black	Badger	Recap 6/28/77	B1-Gr
204	6/26/77	3½	95	M	Black	Badger		B1-Gr
								Orange-Silver
256	5/10/78	5½	161	M	Brown	Ear Mtn	Killed 6/3/79	Orange-Red
211	5/12/78	11½	175	M	Black	Ear Mtn	Relocated to Black- leaf 8/21/80 from Circle 8	Y1-Orange
212	6/ 6/78	3½	205	M	Black	Muddy Cr	Recap 9/25/80 and 6/23/81-Radioed new ear tag #521	
202	6/13/78	7½	155	M	Brown	Elk Cr		B1-Red
205	6/14/78	SA	95	M	Black	Elk Cr		Orange-B1
								Orange-Red

Appendix H continued.

No.	Date	Age	Weight	Sex	Color	Location	Fate	Ear Tags
288	5/20/79	10½	289	M	Brown	Antelope Butte	Recap 5/10/80	Gr-Red
255	5/28/79	3½	70	F	Brown	Ear Mtn		Orange-Silver
115	6/ 9/79	7½	175	M	Brown	Ear Mtn		Y1-Gr
294	6/ 9/79	6½	150	M	Black	Ear Mtn		Gr-Orange
329	5/19/80	3½	98	M	Black	Muddy Cr	Recap 9/1/80	Y1-Red
223	5/21/80	3½	81	M	Brown	Muddy Cr		B1
537	5/28/80	2½	68	M	Brown	Muddy Cr		B1
505	5/30/80	2½	60	M	Black	Antelope Butte		Red
542	6/ 7/80	3½	81	M	Black	Blackleaf	Recap 5/14 & 5/26 in 1981-Radioed	B1
509	6/ 9/80	9½	118	F	Black	Blackleaf		Red
545	5/20/81	3½	63	F	Black	Muddy Cr	Recap 5/25/81	B1
546	5/23/81	3½	77	F	Brown	Antelope Butte		B1
516	5/27/81	3½	65	M	Brown	Muddy Cr		Red