YELLOWSTONE GRIZZLY BEAR INVESTIGATIONS

ANNUAL REPORT OF THE INTERAGENCY STUDY TEAM

1991

National Park Service
U.S. Forest Service
Montana Fish, Wildlife and Parks Department
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INTRODUCTION

The Interagency Grizzly Bear Study Team (IGBST) was initiated in 1973 and is a cooperative effort of the National Park Service, Forest Service, and since 1974 the States of Idaho, Montana, and Wyoming. The IGBST conducts research that provides information needed by various agencies for immediate and long-term management of grizzly bears (*Ursus arctos horribilis*) inhabiting the Yellowstone area. With increasing demands on most resources in the area, current quantitative data on grizzly bears are required for formulation of management decisions that will insure survival of the population. IGBST annual reports are intended to facilitate the timely transfer of research results and perspectives to management of the population.

Objectives of the study are to determine the status and trend of the grizzly bear population, the use of habitats and food items by the bears, and the effects of land management practices on the bear population. Earlier research on grizzlies within Yellowstone National Park provided data for the period 1959-67 (Craighead et al. 1974). However, changes in management operations by the National Park Service since 1967 - mainly the closing of open pit garbage dumps - have markedly changed some food habits (Mattson et al. 1991), population parameters (Knight and Eberhardt 1985), and growth patterns (Blanchard 1987).

Distribution of grizzly bears within the study area (Basile 1982, Blanchard et al. in press), movement patterns (Blanchard and Knight 1991), food habits (Mattson et al. 1991), and habitat use (Knight et al. 1984) have been largely determined and are now being studied on a monitoring and updating level. Efforts are being concentrated on gathering population parameter data, determining behavior patterns, and assessing the effects of land use practices.

Movement data conclusively indicate that the existence of semi-autonomous population segments is unlikely and that the determination of population size will be difficult due to the average home range sizes of individual bears (cf. Blanchard and Knight 1991). Population trend indices appear to be more meaningful and measurable than a number estimate (Eberhardt et al. 1986). Research is ongoing in the attempt to document a sensitive and reliable trend index.

Data analyses and summaries presented in this report supersede all previously published data. Study methods are reported by Blanchard (1985) and Mattson et al. (1991). The study area has been described in detail by Blanchard and Knight (1991) and Mattson et al. (1991).

RESULTS AND DISCUSSION

MONITORING/POPULATION TREND

Marked Animals

Twenty-seven individual grizzly bears were captured and marked during 1991 (Table 1), including 8 females (7 adult) and 19 males (13 adult). Two adult males, 1 adult female, and 1 subadult male were recaptured once each. Thirteen of the 27 had not been marked previously. Twenty-eight captures were a result of research efforts and all but 1 of those bears were released on-site. Three captures resulted from management actions and those 2 subadult males (Nos. 180, 181) were transported to 3 sites within the study area.

A total of 42 grizzly bears were monitored for varying intervals during 1991, including 16 adult females. A maximum of 9 adult females were monitored consecutively during October and November (Fig. 1). Those 9 adult females were wearing active transmitters at denning.

Unduplicated Females

One method of monitoring population trend is recording the number of unduplicated females with cubs-of-the-year (COY) each year. A summary of procedures used to determine whether or not observations are duplicates were reported by Knight et al. (1989). Detailed discussions of methodology and biases are presented by Knight et al. (in prep.).

Twenty-four unduplicated females with COY were observed in 9 Bear Management Units (BMUs) within the Recovery Zone during 1991 (Fig. 2). The current running 6-year average (1986-91) for the entire study area is 20 females/year with an average litter size of 2.06 cubs compared to an average of 15 females/year with an average litter size of 1.94 for the entire study period (Table 2). This 6-year average has steadily increased from 12 females/year during the period of 1973-78 to 20 during the period 1986-91.

Table 1. Grizzly bears captured during 1991.

Bear	Sex	Age	Date	Location[a]	Release site	Trapper
184	M	10	4/28	DuNoir R, Diamond G Ranch, WY	On site	WY
185	M	5	4/30	DuNoir R, Diamond G Ranch, WY	On site	WY
			8/10	Grizzly Cr, SNF	On site	WY
164	M	7	5/5	DuNoir R, Diamond G Ranch, WY	On site	WY/IGBST
158	M	5	5/11	F&G cabin, Mormon Cr, SNF	On site	WY/IGBST
			9/26	Siggins Fork, BTNF	On site	WY/IGBST
186	M	3	5/12	F&G cabin, Mormon Cr, SNF	On site	WY/IGBST
174	M	5	5/13	DuNoir R, Diamond G Ranch, WY	On site	WY
104	F	9	5/14	Wilsey's cabin, N Fk Shoshone, SNF	On site	WY/IGBST
34	M	19	5/17	DuNoir R, Diamond G Ranch, WY	On site	WY
141	M	5	5/17	Mesa Pit, YNP	On site	IGBST
187	M	4	5/20	Mesa Pit, YNP	On site	IGBST
188	F	3	5/21	Sunlight Cr, SNF	On site	WY
189	F	10	5/27	DuNoir R, Diamond G Ranch, WY	On site	WY
181	M	2	6/15	Lake, YNP (mgt)	Younts Peak, BTNF	YNP
			6/30	Little Thumb Cr, YNP (mgt)	Crescent Peak, BTNF	YNP
190	F	6	6/23	Flat Mountain Arm, YNP	On site	IGBST
180	M	4	7/6	B4 Ranch, WY (mgt)	Big Game Ridge, YNP	WY
191	M	14	7/13	9 Quarter Circle Ranch, MT	Tepee Cr, GNF	IGBST
128	F	6	7/13	Horse Cr, SNF	On site	WY
192	M	4	7/29	Cooke City, GNF	On site	IGBST
152	M	18	7/30	W Fork Long Cr, SNF	On site	WY
193	F	5	8/29	Mesa Pit road, YNP	On site	IGBST
			9/29	Mesa Pit road, YNP	On site	IGBST
168	M	5	8/31	DuNoir/Long Cr, SNF	On site	WY
195	M	4	9/22	Siggins Fork, BTNF	On site	WY/IGBST
1	M	27	9/23	Siggins Fork, BTNF	On site	WY/IGBST
194	F	15	9/25	Siggins Fork/Open Cr, BTNF	On site	WY/IGBST
196	F	6	10/14	Grebe Lake road, YNP	On site	IGBST
142	M	10	10/15	Otter Cr, YNP	On site	IGBST
155	M	5	10/16	Grebe Lake road, YNP	On site	IGBST

	Females	Males
Adults	7	13
Subadults	1	6

					Retraps			
	Females		Males		Females		Males	
	Ad	SAd	Ad	SAd	Ad	SAd	Ad	SAd
Research	7	1	13	4	1		2	
Management				2				1

New bears: 13
Total individual bears: 27

[a] BTNF = Bridger-Teton National Forest, GNF = Gallatin National Forest, SNF = Shoshone National Forest, YNP = Yellowstone National Park, (mgt) = management.

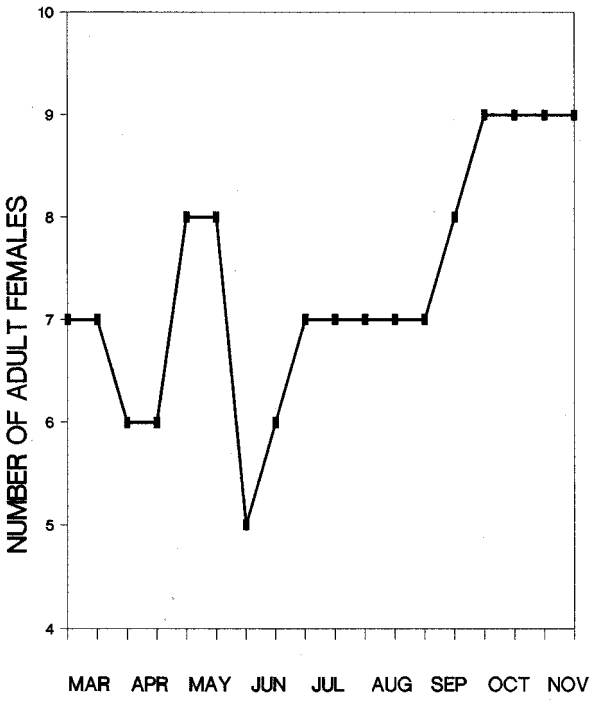

Fig. 1. Adult female grizzly bears radio-monitored by 2-week intervals during 1991.

Fig. 2. Locations of initial observations of 24 unduplicated females with cubs-of-the-year within Bear Management Units during 1991.

Table 2. Annual unduplicated female grizzly bears with cubs-of-the-year and adult female deaths, 1973-91.

Year	Females	Cubs	Mean litter size	Adult female deaths (known and probable)
1973	14	26	1.86	4
1974	15	26	1.73	4
1975	4	6	1.50	1
1976	16	30	1.88	1
1977	13	25	1.92	6
1978	9	18	2.00	1
1979	13	29	2.23	2
1980	12	23	1.92	1
1981	13	24	1.85	5
1982	11	20	1.82	4
1983	13	22	1.69	2
1984	17	30	1.76	2
1985	9	16	1.78	2
1986	25	48	1.92	2
1987	13	29	2.23	2
1988	19	40	2.11	2
1989	16	30	1.88	0
1990	24	57	2.38	4
1991	24	43[a]	1.87	0
Total	280	542		45
Mean	14.74	28.53	1.94	2.37

[a] Number of cubs for 23 females; litter size for 1 female unknown.

Observation Flights

During 1991, 71% of the unduplicated females with COY were seen on IGBST observation flights (Table 3). Observation flights accounted for an average 44% of the unduplicated observations during 1986-91 when methodology was similar; 7% were recorded incidentally on observation flights made by other researchers over the study area, 33% from ground sightings, and 17% from IGBST trapping efforts and radio-tracking flights only. Eighty-two percent of the 17 unduplicated females with COY seen on observation flights were on talus slopes above timberline where the bears were feeding on aggregations of army cutworm moths (*Euxoa auxillaris*).

Table 3. Annual unduplicated female grizzly bears with cubs-of-the-year by prioritized method of observation, 1973-91.

Year	Observation flights		Ground sightings	Radio flights and trapping	Total
	IGBST	Other			
1973	2	5	7		14
1974	9		6		15
1975	1	2	1		4
1976	1	3	9	3	16
1977		1	8	4	13
1978			6	3	9
1979	3		7	3	13
1980	4		4	4	12
1981		2	7	13	
1982	3		5	3	11
1983	4		5	4	13
1984	7		10		17
1985	2		5	2	9
1986	9	2	10	4	25
1987	5	1	4	3	13
1988	7	1	7	4	19
1989	7	2	5	2	16
1990	8	0	12	4	24
1991	17	2	2	3	24

The 16 flight areas were flown an average 2.5 times for 2.21 hours each flight between 29 June and 10 September. An average 6 hours were flown between sightings of unduplicated females with COY. Grizzly bear observation rate was 2.59 bears/hour on 46 observation flights (Table 4) compared to 0.69 unmarked bears/hour on 66 radio-tracking flights.

Table 4. Unmarked grizzly bears observed during observation flights, 1973-91.

Year	Number flights	Number hours	Total bears	Bears/hour	Unduplicated females with COY/hour
1973	24	75.90	59	0.78	0.03
1974	47	146.30	128	0.87	0.06
1975	24	47.20	20	0.42	0.02
1976	5	18.50	30	1.62	0.05
1977	0				
1978	0				
1979	7	23.00	14	0.61	0.13
1980	6	22.30	27	1.21	0.18
1981	4	16.00	13	0.81	0.25
1982	6	23.70	23	0.97	0.13
1983	41	124.30	36	0.29	0.03
1984	11	29.00	27	0.93	0.24
1985	16	30.50	21	0.69	0.07
1986	24	52.00	29	0.56	0.17
1987	20	47.20	35	0.74	0.11
1988	17	33.87	62	0.66	0.21
1989	37	88.71	87	0.98	0.08
1990	39	86.01	81	0.94	0.09
1991	46	99.24	257	2.59	0.17

Survivorship

Survivorship of marked animals through 1991 is given in Table 5. Both males and females have the lowest chance of surviving their 2-year-old year, the time most young are weaned. Females have a greater chance of surviving after 6 years than they did during 1986, while male survivorship has increased after 3 years (Fig. 3).

Table 5. Grizzly bear survivorship by sex and age class.

	Sample size			Survivorship		
Age	Male	All	Female	Male	All	Female
Cub	26	112	27	0.88	0.83	0.89
1	27	101	26	0.78	0.84	0.85
2	27	53	23	0.67	0.75	0.83
3	28	51	23	0.86	0.86	0.87
4	26	51	25	0.85	0.88	0.92
	134	368	124	0.81	0.83	0.87
5	22	48	26	0.82	0.85	0.88
6	15	43	28	0.87	0.91	0.93
7	11	36	25	0.91	0.92	0.92
8	15	37	22	1.00	0.92	0.86
9	11	27	16	0.91	0.93	0.94
10	11	27	16	1.00	1.00	1.00
11	9	22	13	1.00	1.00	1.00
12	9	21	12	0.67	0.81	0.92
	103	261	158	0.89	0.91	0.92
13	7	16	9	1.00	0.94	0.89
14	8	16	8	0.75	0.87	1.00
15	6	13	7	1.00	1.00	1.00
16	4	11	7	1.00	0.78	0.71
17	4	9	5	0.75	0.89	1.00
18	3	6	3	1.00	1.00	1.00
19	2	4	2	1.00	0.75	0.50
20	2	4	2	1.00	1.00	1.00
21	2	4	2	1.00	1.00	1.00
22	2	4	2	1.00	0.75	0.50
	40	87	47	0.92	0.91	0.89
All adults	143	348	205	0.90	0.91	0.92
Survival to age 5:				0.33	0.40	0.50
Total bear years:	277	716	329			

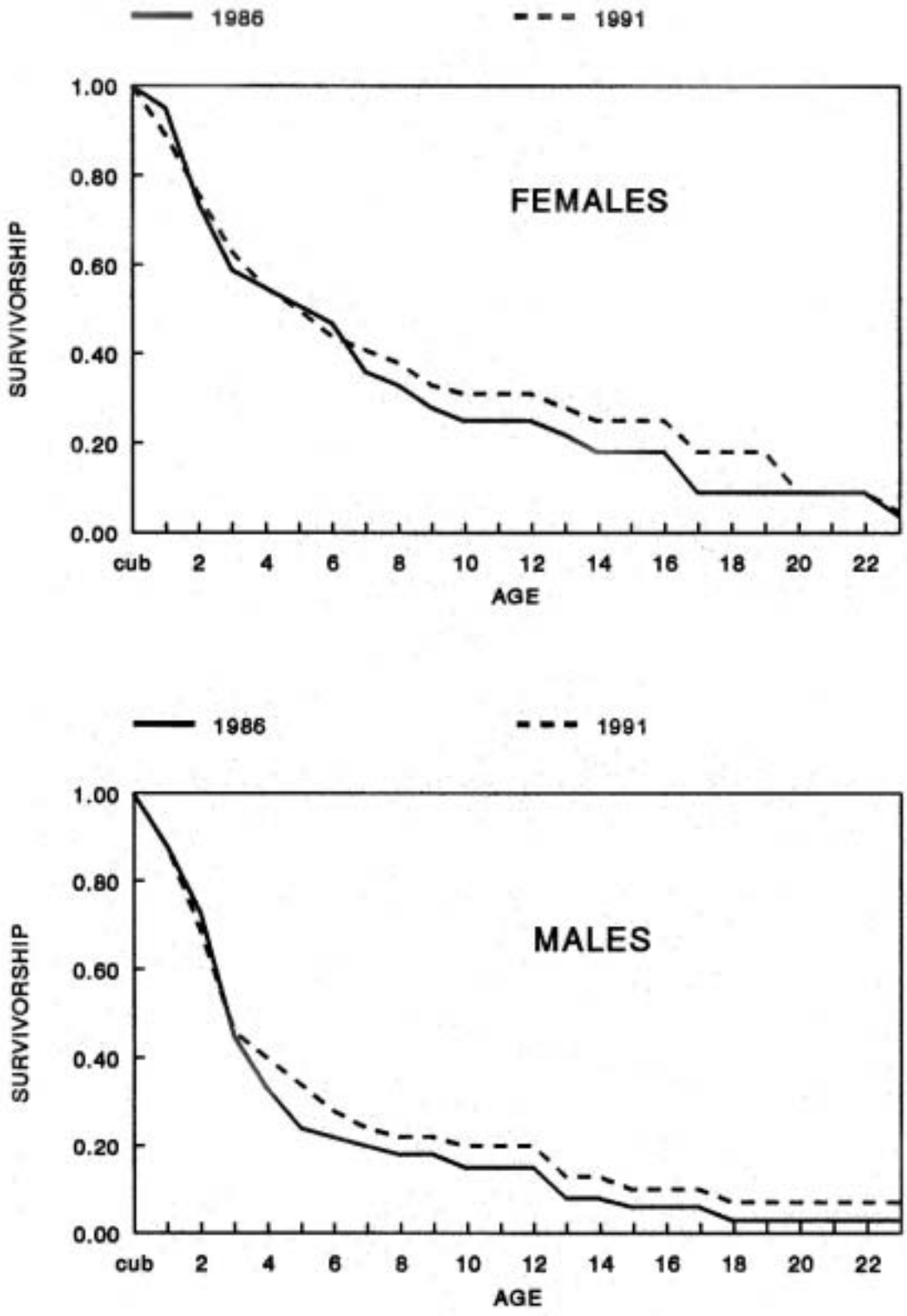

Fig. 3. Comparison of cumulative female and male survivorship rates.

Mortalities

Two possible mortalities were recorded during 1991. A hiker with pack-goats shot at a charging female with 2 yearlings, but did not know if she was hit. No blood or carcass was found, however, 2 lone yearlings were seen in the vicinity a month after the incident. The second incident involved a hunter shooting and hitting a grizzly in self-defense. Blood was found, but no carcass was located. Both incidents occurred in the backcountry in the Bridger-Teton National Forest.

Grizzly bear mortalities from 1973-91 are depicted in Fig. 4. These deaths include known and probable mortalities as defined by Craighead et al. (1988). 1991 was the only year during that period when no known or probable deaths were recorded.

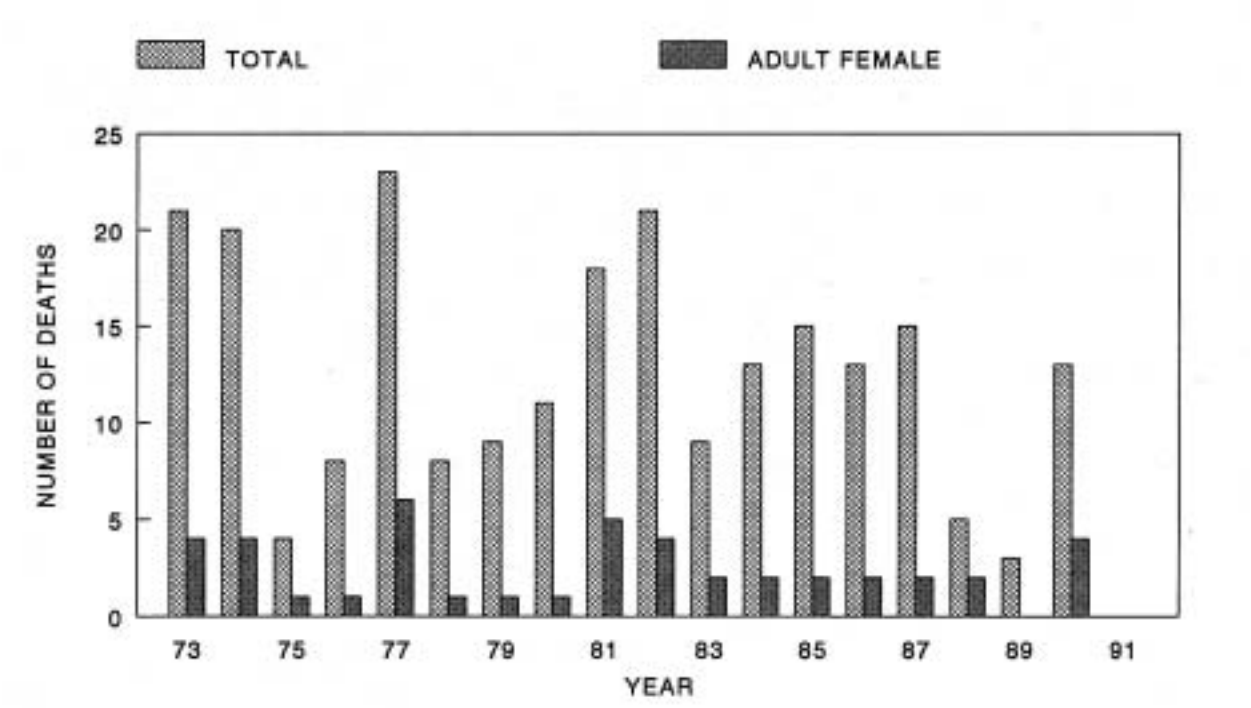

Fig. 4. Known and probable grizzly bear deaths, 1973-91.

Food Habits

Scat Analysis

Food habits represented by fecal analysis often do not accurately reflect relative proportions of ingested items because different diet items are digested at varying rates and to different degrees. More easily digested items such as meat and berries are under-represented in fecal analysis while vegetal items are over-represented.

Fecal analysis for scats collected during 1991 were not complete by time of publication of this report, but will be presented in the 1992 annual report.

During 1990, 583 scats were collected and analyzed for content (Table 6). Contents reflected the overall abundant native foraging opportunities available that year as discussed in the 1990 Annual Report (Knight et al. 1991). Grizzly bears consumed whitebark pine (*Pinus albicaulis*) seeds throughout the year which were largely available from the good seed crop produced during 1989. Whitebark pine seeds constituted over 20% of the scat volume during all 3 seasons and occurred in over 25% of the scats collected each season.

Ungulates comprised only 3%, 5%, and 3% of the scat volume during April, May, and June, respectively, compared to the 1977-87 average of 49%, 17%, and 6% for those three months. In addition to whitebark pine seeds, grizzly bears also consumed considerable volumes of the prolific root crops of yampa (*Perideridia gairdneri*) and biscuitroot (*Lomatium cous)* during summer and fall. During August, yampa and biscuitroot constituted 6% and 13% of the scat volume compared to the 10-year average of 7% for all root crops combined during that month. Berries also comprised a larger scat volume than average during fall. During September, berries accounted for 28% of the scat volume compared to the 10-year average of 5% for that month. *Vaccinium scoparium* was the major berry consumed during 1990.

Whitebark Pine Cone Production

Whitebark pine cone production throughout the study area averaged 15.5 cones/tree, which was not different from the 1980-90 mean of 15.7 cones/tree (Table 7). Seven of the 18 transects read produced above the 12-year mean and the other 11 transects produced below that mean (Fig. 5).

Table 6. Seasonal grizzly bear scat contents for 1990.

	Spring[a] (*n* = 139)		Summer[b] (*n* = 331)		Fall[c] (*n* = 96)		Total (*n* = 583)	
	% freq.	% vol.	% freq.	% vol.	% freq.	% vol.	% freq.	% vol.
Whitebark pine seeds	25.18	20.63	31.12	22.87	30.21	25.35	29.50	22.48
Berries								
Vaccinium	1.44	0.22	2.72	0.60	29.17	20.85	6.86	3.87
others			0.91	0.24	4.16	1.69	1.03	0.37
Sporophytes								
Equisetum	3.60	1.47	1.81	0.45	2.08	0.21	2.23	0.64
Others			0.61	0.11	3.13	0.11	0.86	0.08
Foliage								
Graminoids	62.59	36.37	58.31	24.82	34.38	14.77	54.89	25.69
Forbs	27.33	12.02	43.82	30.31	23.96	15.46	35.85	23.66
Cirsium	0.72	0.18	4.83	3.06	2.08	1.07	3.60	2.30
Claytonia	1.44	0.68					0.34	0.16
Epilobium	5.04	0.90	8.46	3.83	1.40	1.04	6.69	2.77
Heracleum			0.30	0.05			0.17	0.03
Lomatium	3.60	0.67	0.30	0.02			0.69	0.22
Osmorhiza	0.72	0.72	0.60	0.29	1.04	0.81	0.68	0.64
Taraxacum	12.95	5.52	22.96	9.95	13.54	7.23	18.52	8.19
Trifolium	7.19	1.20	19.64	4.99	5.21	1.21	14.07	3.37
Roots	15.11	9.58	24.46	12.94	17.71	9.56	21.78	11.76
Claytonia	0.72	0.02					0.17	0.01
Lomatium	10.79	6.80	14.80	7.05	8.33	5.38	13.38	6.78
Perideridia	2.88	2.04	6.95	4.13	2.08	0.57	4.98	2.29
Mammals	15.83	3.63	9.06	1.71	7.29	0.44	10.46	1.92
Elk	12.95	3.46	3.32	0.98	2.08	0.15	5.49	1.41
Bison	0.72	0.01	0.30	T			0.34	0.01
Moose	1.44	0.12	0.91	0.13	3.13	0.04	1.54	0.11
Small mammals	0.72	0.04	2.11	0.13			1.36	0.08
Insects	7.91	0.53	11.48	1.31	13.54	2.69	10.81	1.32
Ants	6.47	0.50	10.27	0.95	9.38	0.95	9.09	0.82
Trout	4.32	2.34					1.03	0.56
Birds	0.72	0.01	0.30	T			0.34	T
Garbage	1.44	0.10	0.91	0.07	2.08	0.13	1.20	0.08
Debris	50.36	13.09	24.47	4.55	20.83	8.74	30.36	7.76

[a] March, April, May, and June.
[b] July and August.
[c] September and October.

Table 7. Mean annual whitebark pine cone production on study transects.

Year	Total cones	Total trees	Total transects	Mean cones per tree	Mean cones per transect	Cones/transect/year SD	Min.	Max.	Mean Julian date read each year
1980	2,312	90	9	25.69	256.89	122.99	139	562	212
1981	1,191	90	9	13.23	132.33	148.69	8	489	204
1982	1,443	85	9	16.98	160.33	154.18	0	463	229
1983	1,531	88	9	17.40	170.11	88.78	78	372	211
1984	360	56	6	6.43	60.00	41.41	14	124	220
1985	2,312	85	9	27.20	256.89	192.27	17	625	214
1986	103	75	8	1.37	12.88	13.18	0	38	207
1987	394	155	16	2.54	24.63	37.49	0	118	217
1988	406	169	17	2.40	23.88	44.32	0	148	208
1989	10,199	209	21	48.80	485.67	384.27	7	1,473	206
1990	319	207	21	1.54	15.19	51.52	0	243	212
1991	2,744	177	18	15.50	152.44	107.99	7	366	215

Fig. 5. Locations of whitebark pine cone production transects. Larger circles represent transects producing above the 1980-90 mean. X's indicate transects which were not read during 1991.

Feed Sites

Ground investigation at 156 aerial locations of instrumented bears from May-October revealed evidence of feeding activity at 39% of the sites compared to 42% during 1989 and 1990 and 60% during 1988. Evidence of activity other than feeding was recorded at an additional 22 sites, and no sign of bear activity was evident at the remaining 74 sites.

Grizzly bear activity was recorded at an additional 137 sites not associated with an aerial location of an instrumented bear (108 with feeding activity and 29 with other sign recorded). Activities are summarized in Table 8 for those sites with evidence of feeding.

Table 8. Seasonal frequencies of activities at feeding sites during 1991.

Feeding activity	Spring[a] (n = 33)	Summer[b] (n = 92)	Fall[c] (n = 43)	Total (n = 168)
Whitebark pine seeds	0	0.15	0.77	0.23
Grazing	0.09	0.16	0.02	0.11
Digging roots	0.21	0.34	0	0.23
Digging rodents/caches	0.49	0.04	0.05	0.13
Large mammals	0.12	0.10	0	0.08
Searching insects	0.09	0.26	0.21	0.21
Miscellaneous[d]	0.06	0.09	0.02	0.07

[a] May and June.
[b] July and August.
[c] September and October.
[d] Berries, cambium, fishing, mineral dig, unknown dig.

The most frequently recorded feeding activity during spring was digging for pocket gophers (*Thomomys thalpoides*) and their food caches. Diggings for roots were the most frequently observed activity during summer. The roots most commonly sought were biscuitroot and yampa. During fall, the most common feeding activity was searching for whitebark pine seeds, both in red squirrel *(Tamiasciurus hudsonicus*) middens and from fallen cones lying on the ground.

Movements and Feeding Strategies

Adequate data was available to determine annual range sizes for 16 grizzly bears during 1991 (Table 9). All ranges but 4 were not statistically different from cohort means recorded 1975-87. The 4 exceptions had annual ranges larger than expected. Three of these 4 bears were transported from their home ranges prior to 1991 and had not returned (Nos. 158, 176, 182). Their exceptionally large ranges were very likely a result of either attempts to return to their original range and/or failure to establish an alternate range. One adult male (No. 174) that had not been transported had a 2,140 km^2 annual range, the largest yet recorded for that cohort since 1975.

Seasonal rates of movement for individuals and cohorts during 1991 did not differ from the 1975-87 means (Table 10).

Table 9. Annual range sizes (km^2) of grizzly bears located ≥12 times and during all 3 seasons of 1991.

Cohort	Bear	Age	Number of locations	MCP[a]	1975-87 cohort mean MCP
Females					
Lone adult	79	17	24	57	236
	104	9	22	214	
	169	5	34	433	
	190	6	21	843	
With yearlings	125	8	27	130	338
	189	10	22	151	
Subadults	179	2	33	427	365
	182	2	44	1,515	
Males					
Adults	141	5	21	732	874
	158	Ad	37	2,113	
	174	5	25	2,140	
	178	5	29	951	
	185	5	19	513	
Subadults	176	SAd	29	4,520	698
	186	3	14	458	
	187	4	15	784	

[a] Minimum Convex Polygon.

Table 10. Seasonal rates of movement for radio-marked grizzly bears during 1991.

Season	Cohort (number of animals)		Locations/bear Mean	Locations/bear Range	Mean km/day/animal 1991	Mean km/day/animal 1975-87 Mean	Mean km/day/animal 1975-87 (SD)
Spring	Adult females	(6)	9	(5-18)	0.7	1.0	(0.5)
	Subadult females	(2)	17	(15-18)	1.6	1.1	(0.6)
	Subadult males	(6)	7	(3-16)	0.9	1.1	(0.6)
	Adult males	(7)	9	(5-16)	1.7	1.3	(0.8)
Summer	Adult females	(7)	9	(8-10)	1.0	1.4	(0.8)
	Subadult females	(2)	12	(8-16)	1.4	1.3	(0.6)
	Subadult males	(6)	7	(4-11)	1.1	1.1	(0.9)
	Adult males	(7)	9	(4-13)	1.9	1.9	(1.1)
Fall	Adult females	(9)	7	(5-10)	1.1	1.1	(0.8)
	Subadult females	(2)	10	(7-12)	1.4	0.9	(0.5)
	Subadult males	(6)	5	(4-7)	0.9	1.1	(0.8)
	Adult males	(9)	7	(3-14)	1.0	1.4	(0.8)

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