YELLOWSTONE GRIZZLY BEAR INVESTIGATIONS

ANNUAL REPORT OF THE
INTERAGENCY STUDY TEAM
1990

National Park Service
U.S. Forest Service
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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 (Knight et al. 1984, 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 Knight and Eberhardt (1985).

RESULTS AND DISCUSSION

MONITORING/POPULATION TREND

Marked Animals

Fifteen individual grizzly bears were captured and marked during 1990 (Table 1), including 8 females (4 adult) and 7 males (1 adult). Two subadults were recaptured once each. Ten of the 15 had not been marked previously. Four captures were a result of research efforts and those bears were released on-site. Thirteen captures resulted from management actions and these bears were transported to 8 sites within the study area, and 1 adult female was removed from the population.

A total of 35 grizzly bears were monitored for varying intervals during 1990, including 17 adult females. A maximum of 11 adult females were monitored consecutively during April and July (Fig. 1). Seven 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. Procedures used to determine whether or not observations are duplicates were reported by Knight et al. (1989).

Twenty-four unduplicated females with 57 COY were observed in 11 Bear Management Units (BMU's) within the Recovery Zone during 1990 (Fig. 2). The current running 6-year average for the entire study area is 18 females per year with an average litter size of 2.08 cubs compared to 1.95 for the entire study period (Table 2). This 6-year average has steadily increased from 12 females per year during the period of 1973-78 (Fig. 3) to 18 during the period 1985-90. One female was observed with 4 COY during 1990. This litter size had not been recorded since the 1960's when 3 litters of 4 were observed (Craighead and Mitchell 1982).

During 1989, 33% of the unduplicated females with COY were seen on IGBST observation flights (Table 3). Observation flights accounted for an average 37% of the unduplicated observations during 1986-90 when methodology was similar; 6% were recorded incidentally on observation flights made by other researchers over the study area, 39% from ground sightings, and 18% from IGBST trapping efforts and radio-tracking flights only. Greater effort was made during 1990 to observe females with young in areas where none had been sighted in the 3 previous years. This included the Boulder and Hilgard areas in Gallatin National Forest and the Bechler and Island Park areas of the Targhee National Forest. These areas were each flown 3 times and no females with young were observed. The 16 flight areas were flow an average 2.5 times for 2.21 hours each flight between 29 June and 10 September. An average 7.56 hours were flow between sightings of unduplicated females with COY. Grizzly bear observation rate was 0.94 bears per hour on observation flights (Table 4) compared to 0.69 unmarked bears per hour on radio-tracking flights.

Table 1. Grizzly bears captured –1990.

Bear	Sex	Age	Date	Location[a]	Release site	Trapper
134	F	8	04/14	Lake, YNP (mgt)	Removed to lab, Pullman, WA	YNP
181	M	1	04/15 08/23	Lake, YNP (mgt) Yancey's Hole, YNP (mgt)	Slough Cr, YNP Nez Perce Cr, YNP	YNP YNP/IGBST
154	F	3	05/11 07/27	Blackrock, BTNF (mgt) Soda Fork, SNF (mgt)	On site On site	WY WY
173	M	SAd	05/21	Grant Village, YNP (mgt)	Blacktail, YNP	YNP
174	M	4	06/02	W Fork Long Cr, BTNF	On site	WY
175	F	Ad	06/19	Box Cr, BTNF	On site	WY
125	F	7	07/01	Antelope Cr, YNP	On site	IGBST
176	M	SAd	08/01	Dunraven Pass, YNP (mgt)	Head of Phlox Cr, YNP	YNP
177	M	12	08/08	Angle Lakes, BTNF	On site	WY
178	M	4	08/20	Natural Br Rd, TNF (mgt)	Arnica Cr, YNP	YNP
79	F	16	08/21	Gardiner, MT (mgt)	Thorofare, BTNF	YNP/IGBST
179	F	1	08/23	Gardiner, MT (mgt)	Grassy Lk Reservoir, RP	YNP/IGBST
180	M	3	08/22	Bird Mtn, SNF (mgt)	On site	WY/IGBST
182	F	1	08/24	Gardiner, MT (mgt)	Grassy Lk Reservoir, RP	YNP/IGBST
183	F	4	08/24	Bird Mtn, SNF (mgt)	Sunlight Basin, WY	WY/IGBST

	Females	Males
Adult	4	1
Subadult	4	6

					Retraps			
	Females		Males		Females		Males	
	Ad	SAd	Ad	SAd	Ad	SAd	Ad	SAd
Research	2	0	1	1				
Management	2	4	0	5	1		1	

NEW BEARS: 10

TOTAL INDIVIDUAL BEARS: 15

[a] BTNF = Bridger-Teton National Forest; RP = John D. Rockefeller, Jr. Memorial Parkway; SNF = Shoshone National Forest; TNF = Targhee National Forest; YNP = Yellowstone National Park.

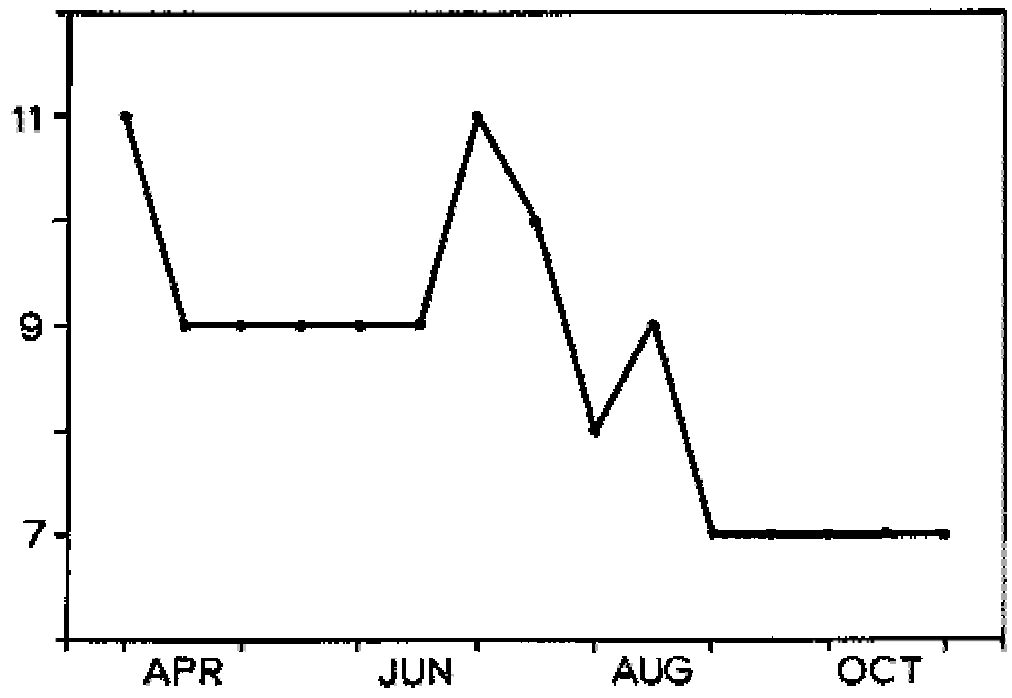

Fig. 1. Adult female grizzly bears radio-monitored by 2-week intervals, 1990.

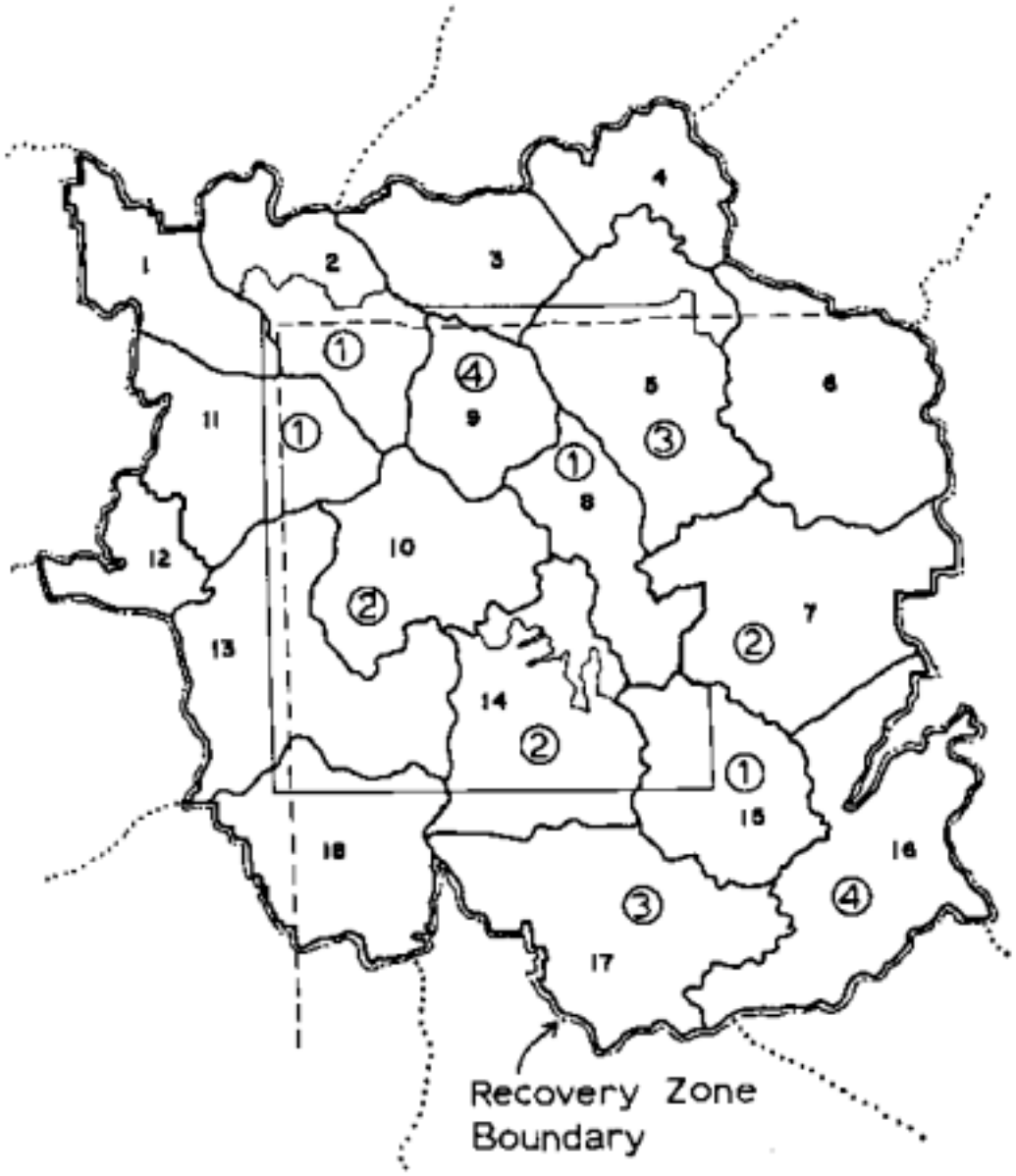

Fig. 2. Locations of initial observations of unduplicated females with cubs-of-the-year within Bear Management Units during 1990. Number of females is circled.

Table 2. Annual unduplicated female grizzly bears with cubs-of-the-year and adult female deaths, 1973-90.

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
Total	256	499		45
Mean	14.22	27.72	1.95	

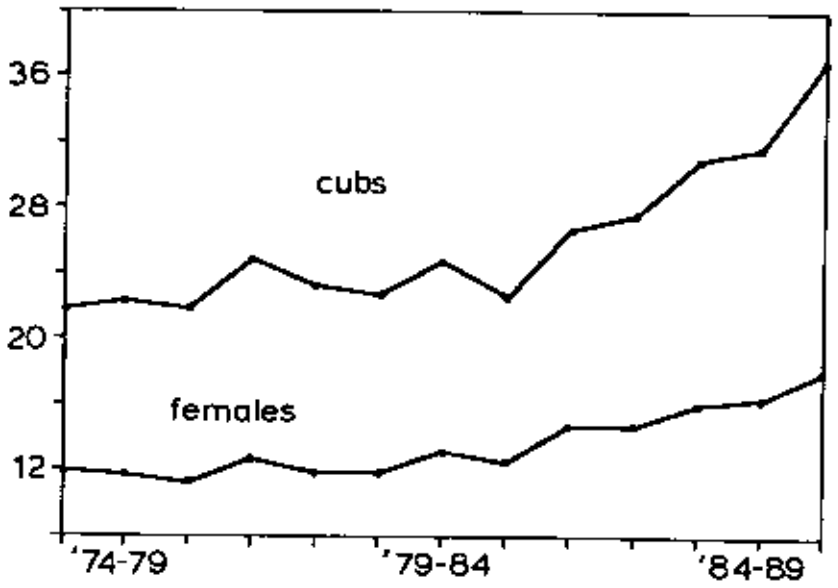

Fig. 3. Average annual number of unduplicated females with cubs-of-the-year observed during running 6-year periods, 1973-90.

Table 3. Annual unduplicated female grizzly bears with cubs-of-the-year by prioritized method of observation, 1973-90.

Year	Observation flights		Ground sightings	Radio flights/trap	Total
	IGBST	Other			
1973	2	5	7		14
74	9		6		15
75	1	2	1		4
76	1	3	9	3	16
77		1	8	4	13
78			6	3	9
79	3		7	3	13
1980	4		4	4	12
81	4		2	7	13
82	3		5	3	11
83	4		5	4	13
84	7		10		17
85	2		5	2	9
86	9	2	10	4	25
87	5	1	4	3	13
88	7	1	7	4	19
89	7	2	5	2	16
1990	8	0	12	4	24

Table 4. Unmarked grizzly bears observed during observation flights, 1973-90.

Year	Number flights	Number hours	Total bears	Bears/hour	Unduplicated females w/ COY per hour
1973	24	75.90	59	0.78	0.03
74	47	146.30	128	0.87	0.06
75	24	47.20	20	0.42	0.02
1976	5	18.50	30	1.62	0.05
77	0				
78	0				
79	7	23.00	14	0.61	0.13
80	6	22.30	27	1.21	0.18
1981	4	16.00	13	0.81	0.25
82	6	23.70	23	0.97	0.13
83	41	124.30	36	0.29	0.03
84	11	29.00	27	0.93	0.24
85	16	30.50	21	0.69	0.07
1986	24	52.00	29	0.56	0.17
87	20	47.20	35	0.74	0.11
88	17	33.87	62	0.66	0.21
89	37	88.71	87	0.98	0.08
90	39	86.01	81	0.94	0.09

POPULATION PARAMETERS

Reproductive Rate

Reproductive rates were calculated using data from marked females only. Twenty-one complete cycles were recorded for 18 individuals for which COY litter size was known (Table 5). Reproductive rate was lower during the 8-year period of 1973-80 compared to the 10-year period of 1981-90, even though the mean cycle length was shorter during the earlier period. Larger litters during the later period were responsible for the increased reproductive rate. The frequency of l-cub litters decreased from 0.27 in the earlier period to zero, while the frequency of 2- and 3-cub litters increased from 0.55 to 0.70 and from 0.18 to 0.30, respectively.

Table 5. Completed reproductive cycles of adult females for which entire cub litter size was known.

Year COY produced	Individual females	Litters	COY	Mean litter size	Mean cycle length	Reproductive rate
1973-80	8	11	21	1.91	2.45	0.778
1981-90	10	10	24	2.40	2.90	0.828
Total	18	21	34	2.14		0.804

Mortalities

Nine known mortalities were recorded during 1990; all mortalities were man-caused (Table 6).

Table 6. Grizzly bear mortalities – 1990.

Bear	Sex	Age	Date	Type	Location[a]	Cause
134	F	6	4/14	Known: man-caused	Lake, YNP	Mgt removal to zoo
Unm	F	14-18	4/28	Known: man-caused	Near Pahaska, SNF	Electrocuted by fallen power line
Unm	M	2	4/28	Known: man-caused	Near Pahaska, SNF	Electrocuted by fallen power line
Unm	M	3	7/2	Known: man-caused	Little Thumb, YNP	Roadkill
Unm	F	5	9/12	Known: man-caused	Thorofare, BTNF	Hunter; claimed self-defense
177	M	11	9/14	Known: man-caused	Soda Fork, BTNF	Hunter; claimed self-defense
Unm	F	5	9/15	Known: man-caused	Haystack Mdws, GNF	Illegal kill by hunter
154	F	4	9/22	Known: man-caused	Split Rock Cr, BTNF	Illegal; collar found cut off along Lost Lake Road
183	F	3	10/9	Known: man-caused	Table Mtn, SNF	Hunter; claimed self-defense

	SAd	Ad
Females	2	4
Males	2	1
Total	9	
Total man-caused	9	

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

Mortalities included 6 females (4 adult) and 3 males (1 adult). One adult female and her 2-year-old male cub were accidentally electrocuted by fallen power lines along the North Fork of the Shoshone River east of the park. This 14- to 18-year-old female wore part of a broken eartag which indicated she was probably tagged as a cub-of-the-year near Lake or Fishing Bridge. Three individuals were killed by hunters claiming self-defense, and 2 additional were illegally killed under unknown circumstances during hunting season. Three of these deaths occurred on the Bridger-Teton, one on the Shoshone, and one on the Gallatin National Forests.

FOOD HABITS

Scat Analysis

Scat content data were not completed at the publication deadline for this annual report, but will be presented in the 1991 annual report.

Whitebark Pine Production

Average whitebark pine cone production throughout the study area was the second lowest recorded since transects were established in 1980 (Table 7). Thirteen of the 21 transects produced no cones, and one 1 of the 7 remaining transects produced more than an average of 3 cones per tree. Transect T (Fig. 4) produced a mean 24.3 cones per tree which was above the 11-year mean of 15.7 cones per tree. This poor overall production was expected following the "bumper" 1989 cone crop. However, sufficient cones remained from 1989 that were available to bears throughout the 1990 season.

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 per transect/year STD	Min.	Max.	Mean Julian date read each year
1980	2,312	90	9	25.69	256.89	122.99	139	562	212
81	1,191	90	9	13.23	132.33	148.69	8	489	204
82	1,443	85	9	16.98	160.33	154.18	0	463	229
83	1,531	88	9	17.40	170.11	88.78	78	372	211
84	360	56	6	6.43	60.00	41.41	14	124	220
85	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
87	394	155	16	2.54	24.63	37.49	0	118	217
88	406	169	17	2.40	23.88	44.32	0	148	208
89	10,199	209	21	48.80	485.67	384.27	7	1,473	206
90	319	207	21	1.54	15.19	51.52	0	243	212

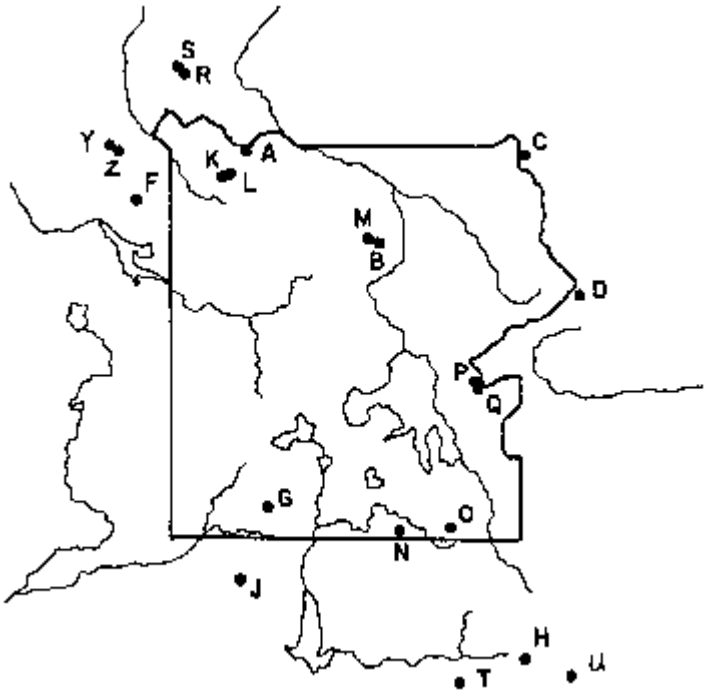

Fig. 4. Locations of whitebark pine cone production transects.

Feed Sites

Ground investigation at 147 aerial locations of instrumented bears from March-September revealed evidence of feeding activity at 42% of the sites compared to 42% of the sites investigated during 1989 and 60% during 1988. Least success at finding sign of feeding activity occurred during May and August, and greatest success was during April and September. Evidence of activity other than feeding was recorded at an additional 27 sites, and no sign of bear activity was observed at the remaining 59 sites. Activity was recorded at an additional 209 sites not associated with an aerial location of an instrumented bear (167 with feeding activity and 42 with other sign recorded). Activity at the 356 total feeding sites is summarized in Table 8.

The most frequently recorded feeding activities were grazing graminoids and forbs during spring, and digging roots, mostly biscuitroot *(Lomatium cous*) and yampa *(Perideridia gairdneri)* during summer and fall (Table 9). During 1990, only 15% of fall feed sites revealed feeding on pine seeds compared to 84% during 1989.

Table 8. Activities recorded at grizzly bear feeding sites, April-October 1990.

Month	No. of feed sites	Types of feeding activities: Large mammals	Grazing	Insects	Roots	Small mammals	Pial nuts	Misc.[a]
Mar	2	0	0	0	0	0	0	0
Apr	20	2	10	1	4	1	0	1
May	58	3	26	1	12	4	1	2
Jun	70	2	9	0	16	1	6	3
Jul	86	0	16	16	19	1	7	0
Aug	80	3	12	5	30	1	8	3
Sept	40	1	2	1	17	1	6	3
Total	356	11	75	24	98	9	28	12

[a] Miscellaneous – berries, mushrooms, fish, mineral digs.

Table 9. Seasonal frequency of feeding activities at 356 feed site examinations during 1990.

Feeding activity	Spring[a] (n = 80)	Summer[b] (n = 236)	Fall[c] (n = 40)	Total (n = 356)
Digging pine nuts	0.166	0.089	0.150	0.079
Grazing graminoids and forbs	0.450	0.157	0.050	0.211
Digging roots	0.200	0.275	0.425	0.275
Digging small mammals	0.063	0.013	0.025	0.025
Scavenging/preying large mammals	0.063	0.021	0.025	0.031
Searching insects	0.025	0.089	0.025	0.067
Miscellaneous[d]	0.038	0.025	0.075	0.034

[a] March, April, May.
[b] June, July, August.
[c] September, October.
[d] Miscellaneous = berries, mushrooms, fish, mineral digs.

MOVEMENTS AND FEEDING STRATEGIES

Adequate data was available to determine annual range sizes for 9 grizzly bears during 1990 (Table 10). These range sizes were not significantly different from cohort means for the period 1975-87 as reported by Blanchard and Knight (1991), except for 3 individuals. These 3 bears exhibited atypically small annual ranges. The annual range size for one lone 17-year-old female (No. 161) was 49 km^2 compared to the mean of 236 km^2 for that cohort. This female's 1989 range was 530 km^2 when she was accompanied by yearlings. A 15-year-old male (No. 167) ranged over only 22 km^2 in 1990 compared to the 13-year average for this cohort of 874 km^2. This individual's range was 343 km^2 during 1989. Only 1 other adult male was recorded to have such a small annual range during this study. A 9-year-old (No. 140) in 1988 ranged over only 26 km^2 during 1988 compared to 343 km^2 in 1989. The 1990 range for a subadult male (No. 173) was only 27 km^2 compared to this cohort's average annual range of 698 km^2.

Table 10. Annual range sizes for grizzly bears in 1990 with 12 or more locations distributed during spring, summer, and fall.

Bear ID	Sex	Cohort	Number of locations	Minimum Convex Polygon (km^2)
101	F	Lone adult	28	320
117	F	With yearlings	14	178
154	F	Subadult	22	592
161	F	Lone adult	14	49
165	F	With COY	16	227
166	F	With COY	29	229
167	M	Adult	12	22
169	F	Subadult	29	164
173	M	Subadult	15	27

Abundant and concentrated food sources were most likely responsible for the small annual ranges of these 3 bears. The female was located in the whitebark pine zone through the middle of July, very probably feeding on whitebark seeds remaining in squirrel caches from the 1989 cone crop. She subsequently moved into nearby alpine talus feeding on aggregations of army cutworm moths *(Euxoa auxiliaris)* until late September. Both whitebark pine seeds and soft-bodied insects are high quality sources of fat (c.f. Mattson et al. 1991). The adult male was located in an area characterized by concentrations of succulent clover planted as ground cover following the 1988 wildfires and abundant biscuitroot crops. He was also implicated in an instance of predation on a black bear also grazing clover. The subadult male was captured in a management action at Grant Village, YNP, and transported to Blacktail Creek on 21 May. Although subadult males typically have very large annual ranges (Blanchard and Knight 1991) and seldom remain where they are relocated (IGBST data files), this individual evidently located abundant native foods at the relocation site in the form of biscuitroot, yampa tubers, and succulent vegetation such as dandelion *(Taraxacum officianale)* and graminoids.

Seasonal mean rates of movement and elevations of radio-marked bears also reflected typical feeding strategies during 1990. During spring, mean elevations of all cohorts were above 2360 m, the lower limits of the whitebark pine zone. When over-wintered seeds are not available, grizzly bears are typically found at lower elevations foraging upon succulent vegetation and carcasses of winter-killed and weakened ungulates. Spring rates of movement were lower than the 13-year average, but were similar to those characteristic during falls of good whitebark pine seed production (c.f. Blanchard and Knight 1991). The lowest spring rate of movement in 1990 (0.07 km/day) was demonstrated by an adult male (No. 159); adult males typically exhibit the largest spring rates of movement (1.30 km/day).

During summer, all cohorts except females with COY and adult males were located at elevations within the whitebark pine zone; these elevations were higher than the 1975-87 summer average. Mean rates of movement for all cohorts were lower than the 13-year average. Elevational distributions and low rates of movement reflected not only continued use of whitebark seeds through summer, but also considerable use of concentrated and prolific root crops of biscuitroot and yampa.

During fall, grizzly bears were generally located at higher than average elevations as they continued to consume over-wintered whitebark seeds (field data collection efforts ceased 30 September). Mean rates of movement were not significantly different from the 1975-87 average.

These data indicate that, on the average, Yellowstone grizzly bears were able to find adequate native foraging opportunities in 1990 and subsequently few conflicts with humans occurred as a consequence of bears seeking alternate food sources.

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