YELLOWSTONE GRIZZLY BEAR INVESTIGATIONS

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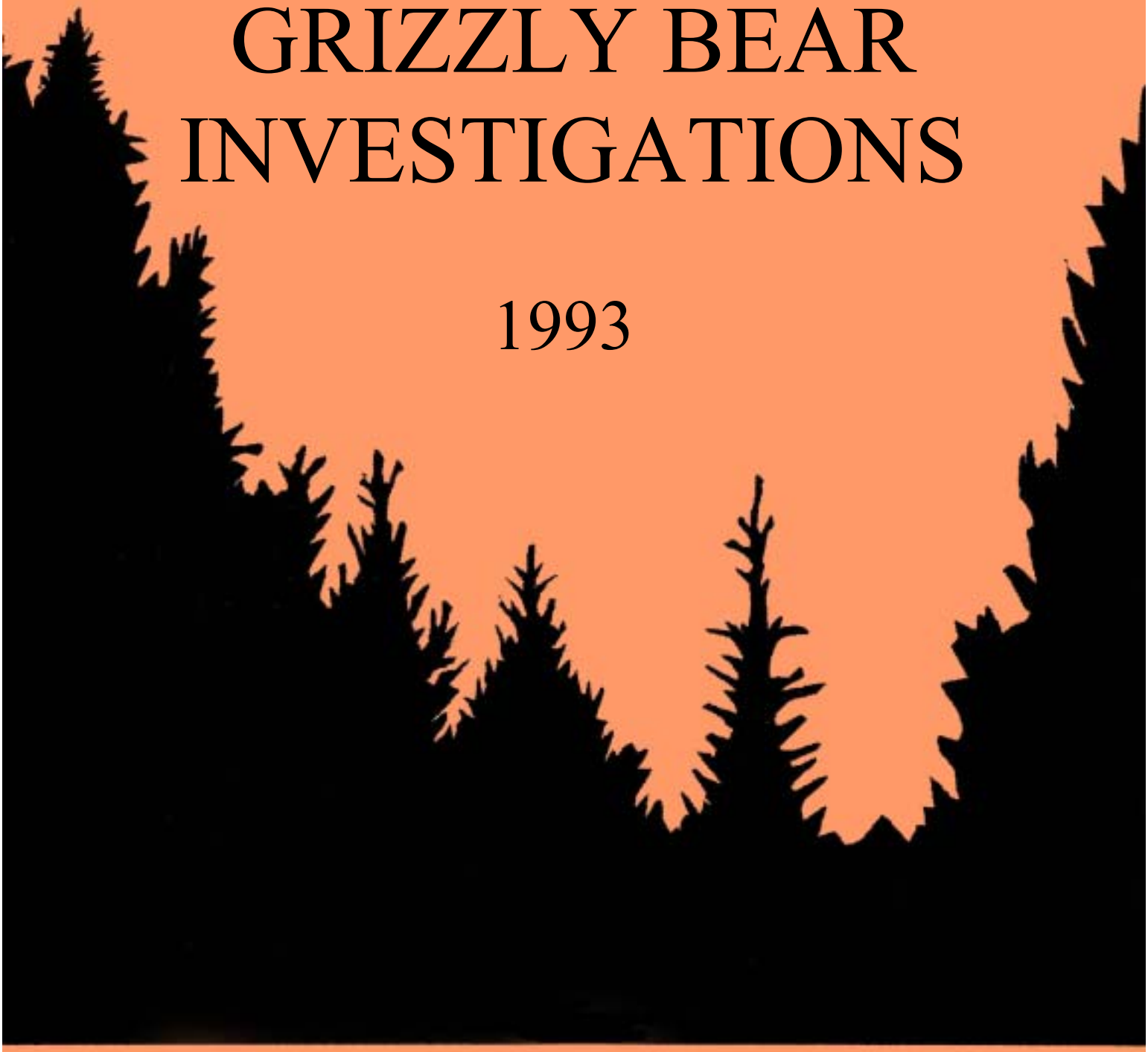

Annual Report of the Interagency Grizzly Study Team

YELLOWSTONE GRIZZLY BEAR INVESTIGATIONS

Report of the Interagency Study Team

1993

National Park Service
Wyoming Game and Fish Department
U.S. Fish and Wildlife Service
Montana Department of Fish, Wildlife and Parks
U.S. Forest Service
Idaho Fish and Game Department

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U.S. Department of the Interior
National Park Service
May 1994

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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. 1992), 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-one individual grizzly bears were captured and marked during 1993 (Table 1), including 9 females (7 adult) and 12 males (6 adult). Fifteen of the 21 had not been marked previously. Thirteen captures were a result of research efforts and were released on-site. Eight captures resulted from management actions involving livestock depredations (2 males), conflicts on private land (1 adult male, 2 subadult males, 1 adult female), roadside habituation (1 subadult male), and campground conflict (1 adult male). Two non-target males were released on site, and the other 6 were transported to release sites within Yellowstone National Park.

A total of 43 grizzly bears were monitored for varying intervals during 1993, including 18 adult females. A maximum of 14 adult females were monitored consecutively during October and November and were wearing active transmitters at denning.

Since 1975, 216 grizzly bears have been radio-marked (Table 2). Thirty-three percent are known to be dead and an additional 7% are suspected dead. Human-caused deaths accounted for 79% of known and suspected deaths. Twenty-five bears wore active transmitters at fall denning in 1993, and the fates of 106 are unknown due to radio loss or failure.

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).

Twenty unduplicated females with COY were observed in 9 Bear Management Units (BMUs) within the Recovery Zone during 1993, and 2 were observed outside the Recovery Zone (Fig. 1). The current running 6-year average (1986-1993) for the entire study area is 21 females/year with an average litter size of 2.14 cubs (Table 3). This 6-year average has steadily increased from 12 females/year with 1.85 cubs/litter during the period of 1973-78.

Table 1. Grizzly bears captured during 1993.

Bear	Sex	Age	Date	Location[a]	Release site	Trapper
207	M	12	07/01	Elk Fork, N Fork Shoshone, SNF	on site	IGBST
208	M	6	07/07	S Fork Shoshone, WY (private)(mgt)	Deep Cr, YNP	WY
209	M	6	07/14	NW of Baldy Mtn, BTNF (mgt)	Timothy Cr, YNP	WY
210	F	10	07/18	Hayden Valley, YNP	on site	IGBST
148	F	10	07/19	Grebe Lake road, YNP	on site	IGBST
211	M	3	07/21	Chittenden road, YNP (mgt-nontarget)	on site	YNP
212	M	2	07/22	Meteetsee Cr, WY (mgt-nontarget)	on site	WY
125	F	10	07/29	Antelope Cr, YNP	on site	IGBST
97	F	16	08/04	Wapiti Cr, GNF	on site	IGBST
191	M	16	08/04	Wapiti Cr, GNF	on site	IGBST
213	F	1	08/04	Wapiti Cr, GNF	on site	IGBST
G50	M	1	08/04	Wapiti Cr, GNF	on site	IGBST
G51	M	1	08/04	Wapiti Cr, GNF	on site	IGBST
140	M	14	09/13	Mesa Pit, YNP	on site	IGBST
214	F	1	09/15	Stephens Cr, YNP	on site	IGBST
215	M	Ad	09/16	Turpin Meadows, BTNF (mgt)	Blacktail Cr, YNP	WY
79	F	19	09/16	Stephens Cr, YNP	on site	IGBST
216	F	7	10/09	S Fork Shoshone, private (mgt)	Blacktail Cr, YNP	WY
217	F	9	10/11	Arizona Lake, BTNF	on site	WY
218	M	4	10/12	S Fork Shoshone, private (mgt)	Hayden Valley, YNP	WY
219	M	3	10/14	S Fork Shoshone, private (mgt)	Otter Cr, YNP	WY

	Females	Males
Adults	7	6
Subadult	2	6

	Females		Males	
	Ad	SAd	Ad	SAd
Research	6	2	3	2
Management	1	0	3	4

NEW BEARS: 15
TOTAL INDIVIDUAL BEARS: 21

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

Table 2. Status of radio-marked grizzly bears, 1993. (Age when died or age in 1993).

Known dead					Suspected dead	
Human-caused			Natural	Unknown	Human-caused	Natural or unknown
3 (7)	49 (3)	150 (5)	1 (28[a])	77 (9)	7 (5)	16 (27[a])
4 (5)	58 (2)	154 (4)	12 (25[a])	108 (4)	11 (7)	36 (25[a])
5 (14)	59 (8)	158 (7)	56 (1)	___	24 (2)	51 (26[a])
6 (8)	60 (6)	160 (5)	65 (3)		32 (4)	54 (1)
8 (17)	62 (3)	176 (5)	145 (2)		75 (1)	55 (1)
9 (17)	63 (4)	177 (12)	161 (20)		102 (2)	84 (31[a])
10 (12)	67 (4)	183 (4)	187 (5)		147 (10)	109 (7)
14 (12)	69 (3)	186 (4)	180 (5)		___	___
15 (12)	76 (6)	198 (Ad)	200 (11)			
17 (2)	81 (4)	202 (4)	___			
18 (3)	83 (19)	___				
20 (14)	88 (7)					
22 (9)	90 (2)					
25 (5)	93 (2)					
26 (22)	94 (1)					
27 (2)	95 (11)					
28 (16)	97 (16)					
29 (1)	105 (Ad)					
30 (2)	110 (5)					
31 (C)	113 (2)					
38 (13)	120 (3)					
39 (3)	121 (6)					
45 (6)	122 (3)					
46 (5)	127 (1)					
47 (2)	134 (8)					
		60 Total	9 Total	2 Total	7 Total	7 Total

[a] Suspected died of old age.
[b] Known alive in 1991.
[c] Known alive in 1992.
[d] Known alive in 1993.

Table 2. Continued.

Off air												Active	
2	(22)	78	(14)	124	(13)	159	(Ad)	195[c]	(6)			79	(19)
13	(24)	80	(13)	126	(21)	162	(19)	201[c]	(3)			101	(11)
19	(23)	82	(17)	129	(12)	164[b]	(9)	203[c]	(Ad)			104	(11)
21	(20)	85	(17)	130	(11)	165[b]	(15)	206[d]	(19)			125	(10)
23	(17)	86	(23)	131	(12)	166[b]	(10)	209[d]	(6)			128	(8)
33	(18)	87	(13)	132	(10)	167	(18)	213[d]	(1)			148	(10)
34[b]	(21)	89	(12)	133	(12)	168[d]	(7)	___				163	(9)
35	(18)	91	(12)	135	(12)	169[c]	(7)					189	(12)
37	(15)	92	(14)	136	(10)	170	(12)					191	(16)
40	(18)	96	(unk)	137	(13)	171	(12)					196	(8)
41	(15)	98	(Ad)	138	(15)	172	(6)					197	(9)
42	(22)	99	(12)	139	(14)	173[b]	(Ad)					199	(4)
43	(16)	100	(10)	140[d]	(14)	174[c]	(7)					204	(3)
44	(unk)	103	(19)	141[b]	(7)	175[b]	(Ad)					205	(9)
48	(15)	106	(17)	142[c]	(12)	178[b]	(7)					207	(12)
50	(19)	107	(14)	143	(14)	179[d]	(4)					208	(6)
57	(22)	111	(10)	144	(7)	181[b]	(4)					210	(10)
61	(17)	112	(20)	146	(13)	182[d]	(4)					211	(3)
64	(15)	114	(11)	149	(Ad)	184[d]	(12)					212	(2)
68	(24)	115	(17)	151	(13)	185[c]	(7)					214	(1)
70	(15)	116	(19)	152[d]	(20)	188[b]	(5)					215	(Ad)
71	(15)	117[b]	(10)	153	(13)	190	(8)					216	(7)
72	(16)	118	(10)	155[d]	(7)	192	(6)					217	(Ad)
73	(14)	119	(12)	156	(11)	193	(7)					218	(6)
74	(12)	123	(9)	157	(Ad)	194	(17)					219	(3)
												___	
										106 Total		25 Total	

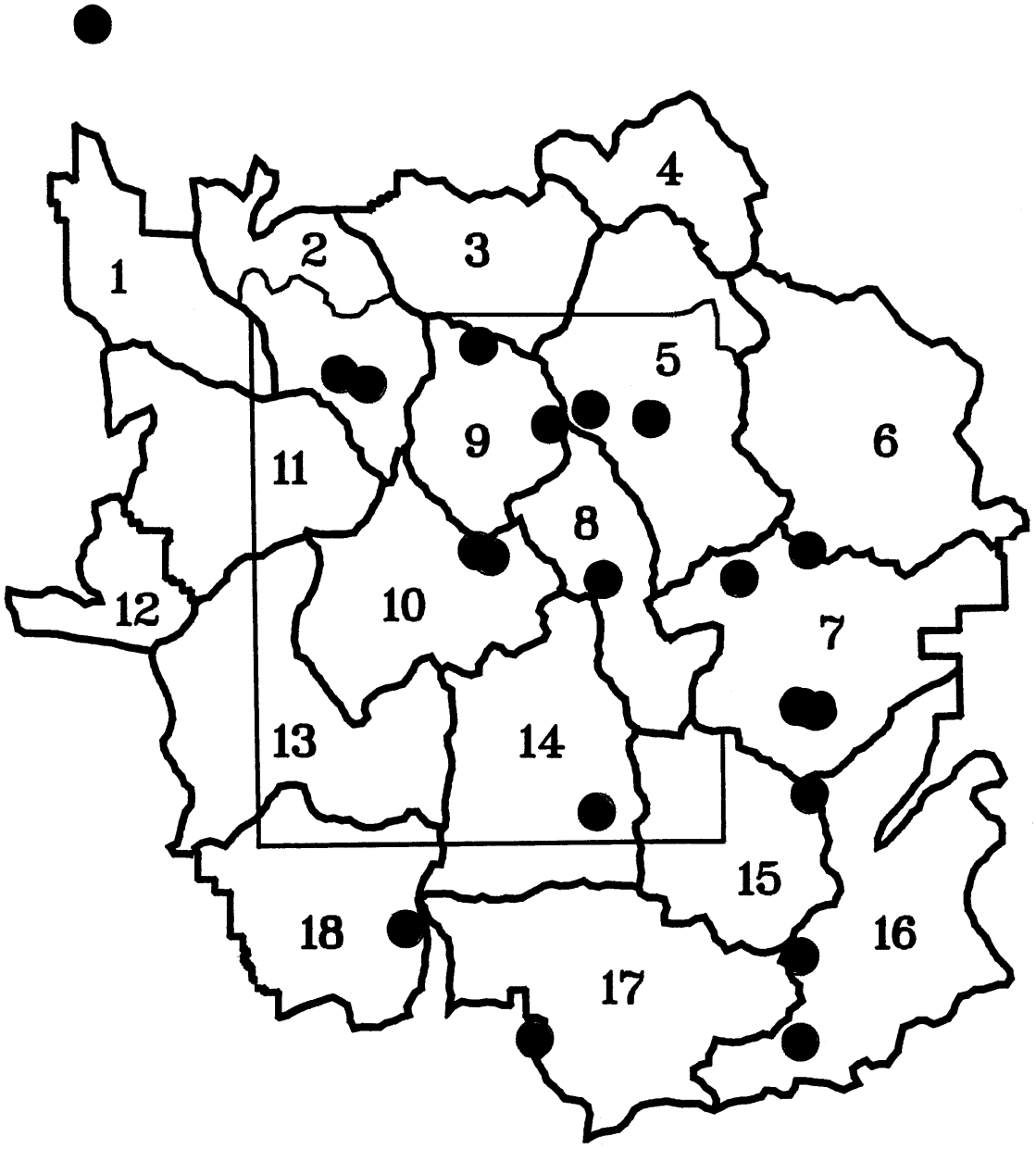

Fig. 1. Locations of initial observations of 20 unduplicated females with cubs-of-the-year within Bear Management Units inside the Recovery Zone during 1993.

Table 3. Annual unduplicated female grizzly bears with cubs-of-the-year and adult female deaths, 1973-93.

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
1992	23	56	2.43	0
1993	20	41	2.05	3
Total	323	639		48
Mean	15.38	30.44	1.99	2.29

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

Observation Flights

During 1993, 15% of the unduplicated females with COY were seen on IGBST observation flights (Table 4) and 50% were seen by IGBST personnel. Observation flights accounted for an average 40% of the unduplicated observations during 1986-93 when methodology was similar; 10% were recorded incidentally on observation flights made by other researchers over the study area, 34% from ground sightings, and 16% from IGBST trapping efforts and radio-tracking flights only.

Table 4. Annual unduplicated female grizzly bears with cubs-of-the-year by prioritized method of observation, 1986-93.

Year	Observation flights		Ground sightings	Radio flights/trap	Total
	IGBST	Other			
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
1992	10	4	6	3	23
1993	3	4	10	3	20

The 16 observation flight areas were flown at least once between 28 June and 3 September for an average 2.01 hours each. Four flight areas in Wyoming outside Yellowstone National Park were flown at least 4 times each. Grizzly bear observation rate was 0.74 bears/hour on 29 observation flights (Table 5) compared to 0.41 unmarked bears/hour on 52 radio-tracking flights.

Table 5. Unmarked grizzly bears observed during observation flights, 1973-93.

Year	Number flights	Number hours	Total bears	Bears/ hour	Unduplicated females with COY per 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
1992	31	68.73	204	2.97	0.15
1993	29	58.42	43	0.74	0.05

Survivorship

Survivorship of marked animals through 1993 is given in Table 6. Nearly 50% of females survive to 5 years compared to 35% of males.

Table 6. Grizzly bear survivorship by sex and age class, 1993.

Age	Sample size			Survivorship		
	Male	All	Female	Male	All	Female
Cub	26	113	27	0.88	0.84	0.89
1	29	107	29	0.79	0.85	0.86
2	29	55	23	0.69	0.76	0.83
3	32	57	25	0.88	0.88	0.88
4	28	54	26	0.82	0.85	0.88
	144	386	130	0.81	0.84	0.87
5	26	52	26	0.73	0.83	0.92
6	19	49	30	0.89	0.92	0.93
7	12	42	30	0.83	0.90	0.93
8	15	43	28	1.00	0.93	0.89
9	11	32	21	0.91	0.94	0.95
10	11	34	23	1.00	1.00	1.00
11	12	29	17	0.92	0.97	1.00
12	10	24	14	0.70	0.83	0.93
	116	305	184	0.86	0.91	0.94
13	7	17	10	1.00	0.94	0.90
14	9	18	9	0.78	0.89	1.00
15	6	14	8	1.00	1.00	1.00
16	5	14	9	1.00	0.79	0.67
17	4	9	5	0.75	0.89	1.00
18	4	7	3	1.00	1.00	1.00
19	4	7	3	0.75	0.71	0.67
20	2	5	3	1.00	0.80	0.67
21	2	4	2	1.00	1.00	1.00
22	2	4	2	1.00	0.75	0.50
	45	99	54	0.91	0.89	0.91
All adults:	161	304	243	0.88	0.91	0.93
Survival to age 5:				0.35	0.41	0.49
Total bear years:	305	790	373			

Mortalities

Five mortalities were recorded during 1993 (Table 7), including 3 human-caused and 2 from natural causes.

Table 7. Grizzly bear mortalities recorded during 1993.

Bear	Sex	Age	Date	Type	Location	Cause
158	M	7	05/12	Known	N Fork Shoshone, SNF	Human-caused: illegally shot
200	M	11	05/20	Known	Big Springs Cr, GNF	Unknown; prob. natural
unm	F	Ad	10/10	Known	Crazy Cr, SNF	Human-caused: hunter self-defense
97	F	16	10/24	Known	Little Wapiti Cr, GNF	Human-caused: hunter self-defense
161	F	20	11/	Known	Ishawooa Cr, SNF	Natural: fell from cliff

Grizzly bear mortalities from 1973-93 are depicted in Table 8. These deaths include known and probable mortalities as defined by Craighead et al. (1988).

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 1993 are presented in Table 9.

During spring and summer, scats were primarily composed of graminoid and forb foliage. Percent volume of forb foliage was above the 1977-87 average (Fig. 2). *Cirsium* and *Taraxacum* were the predominate forbs in May scats while *Trifolium* and *Taraxacum* were the most common forbs in June, July, and August scats.

During fall, virtually no whitebark pine (*Pinus albicaulis*) seeds were found in 1993 scats compared to the 1977-87 average volume of 39% during September and October. Consumption of graminoid and forb foliage remained above average with *Trifolium* foliage comprising 45% of September scat volume.

Above average rainfall during spring and summer produced abundant root crops of both yampa (*Perideridia gairdneri*) and biscuitroot (*Lomatium cous*) which the majority of radio-telemetered bears consumed throughout the growing season and during fall. Root maturation was apparently both delayed and prolonged due to cool temperatures and delayed snowmelt. Above average rainfall and below average temperatures during summer and fall also produced forb and graminoid foliage which remained succulent well into fall.

Table 8. Known and probable grizzly bear deaths, 1973-93.

	All bears		All adult females	
Year	Human-caused	Other[a]	Human-caused	Other
1973	14	3	4	0
1974	15	1	4	0
1975	3	0	1	0
1976	6	1	1	0
1977	16	1	6	0
1978	7	0	1	0
1979	8	0	1	0
1980	6	4	1	0
1981	10	3	3	2
1982	14	3	4	0
1983	6	1	2	0
1984	9	2	2	0
1985	6	7	2	0
1986	9	2	2	0
1987	3	0	2	0
1988	5	8	0	2
1989	2	1	0	0
1990	9	0	4	0
1991	0	0	0	0
1992	4	4	0	0
1993	3	2	2	1

[a] Includes deaths from natural and unknown causes.

Table 9. Seasonal grizzly bear scat contents for 1993.

	Spring[a] (*n* = 59)		Summer[b] (*n* = 150)		Fall[c] (*n* = 33)		Total (*n* = 244)	
	% Freq.	% Vol.	% Freq.	% Vol.	% Freq.	% Vol.	% Freq.	% Vol.
Whitebark pine seeds	0	0	0	0	15.15	2.21	2.05	0.30
Berries								
Vaccinium	0	0	0	0	0	0	0	0
Fragaria	0	0	1.33	0.68	0	0	0	0
Sporophytes								
Equisetum	8.47	3.05	3.33	1.07	0	0	4.10	1.39
others	1.69	0.17	0.67	0.17	15.15	13.30	0.82	0.14
Graminoids	71.19	37.17	68.00	42.33	48.48	32.48	65.98	39.42
Forbs	47.46	26.73	78.00	50.12	72.73	44.70	70.08	44.11
Cirsium	11.86	5.51	6.00	4.52	0	0	6.56	4.11
Epilobium	1.69	1.19	0	0	0	0	0.41	0.29
Osmorhiza	3.39	0.44	0.67	0.47	0	0	1.23	0.39
Taraxacum	8.47	4.76	25.33	12.78	33.33	14.24	22.54	11.32
Trifolium	13.56	4.92	42.67	20.81	18.18	14.55	32.38	16.35
Roots								
Lomatium	0	0	3.33	1.87	9.09	3.64	3.28	1.64
Melica	0	0	0.67	0.67	0	0	0.41	0.41
Perideridia	6.78	4.07	5.33	2.15	3.03	1.06	5.33	2.45
Mammals	55.93	20.93	10.00	2.91	12.12	2.45	21.72	7.19
Elk	23.73	9.86	0	0	9.09	1.97	6.97	2.65
Bison	18.64	7.98	6.00	2.37	6.06	0.42	9.02	3.45
small mammals	10.17	2.78	0.67	0.43	6.06	0.06	3.69	0.94
Insects	5.08	0.19	13.33	1.29	3.03	0.15	9.84	0.86
Ants	5.08	0.19	12.67	1.29	3.03	0.15	9.43	0.86
Debris	44.07	11.75	16.67	2.11	18.18	4.70	23.36	4.77

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

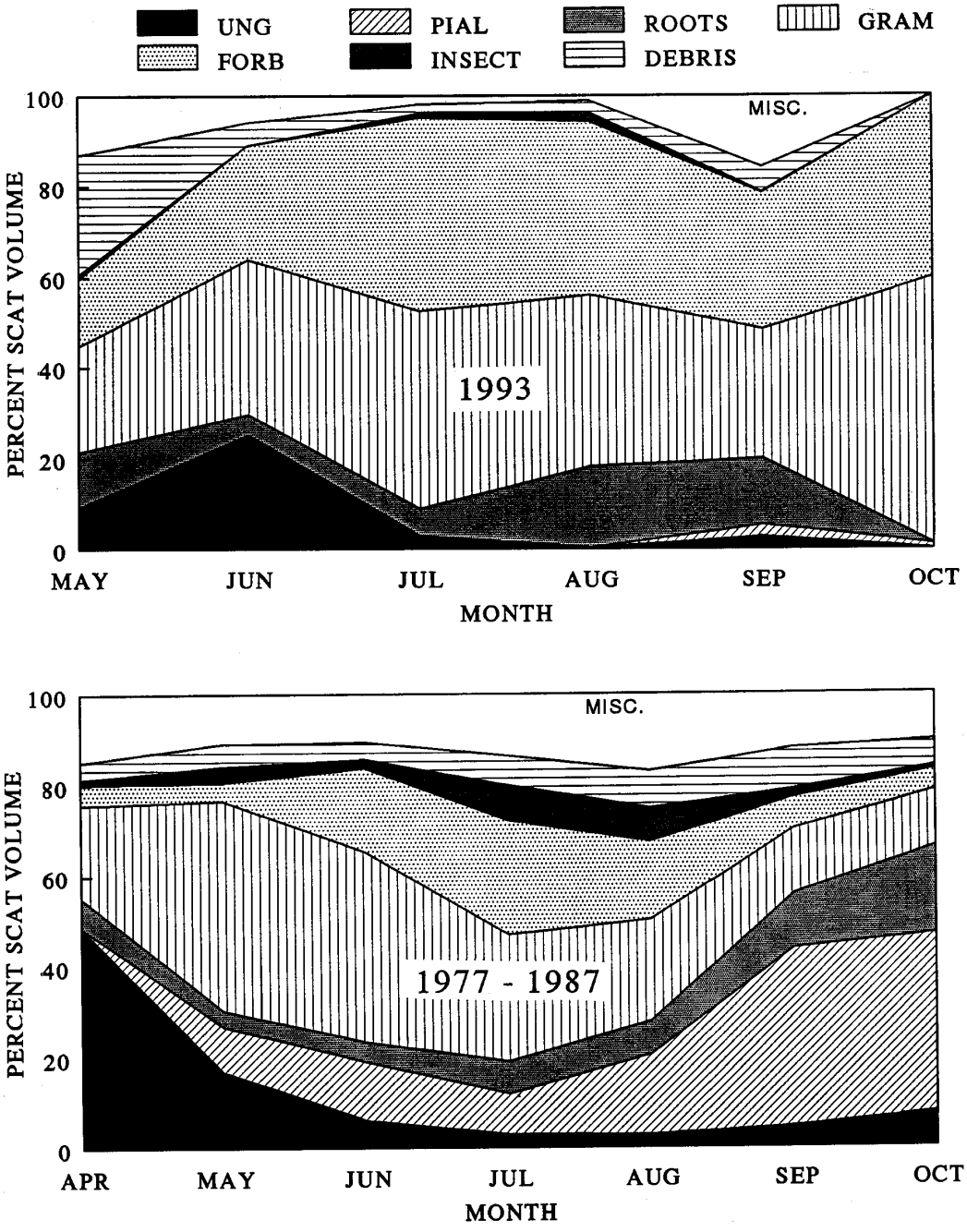

Fig. 2. Percent scat volume of food items during 1993 compared to the 1977-87 average.

Whitebark Pine Cone Production

Grizzly bears generally consume the seeds of whitebark pine to the near exclusion of other food items when available in sufficient quantities. These seeds are largely unavailable to bears until cone production approaches 20 cones/tree (Blanchard 1990). Widespread use by bears generally occurs when production exceeds 22 cones/tree (Mattson et al. 1992). Cone production during 1993 averaged 9 cones/tree for the 19 transects in the Yellowstone ecosystem (Fig. 3). Only 2 transects produced more than 20 cones/tree (Fig. 4).

Root crops and succulent foliage apparently replaced whitebark pine seeds in the fall diet of most grizzly bears due to their widespread availability. During years of low whitebark pine seed availability, grizzly bears often seek alternate foods in association with human activities and the number of management actions and mortalities both increase during fall. Seven grizzly bears were captured in September and October (4 in management actions), very likely a result of these individuals seeking alternate foods at lower elevations.

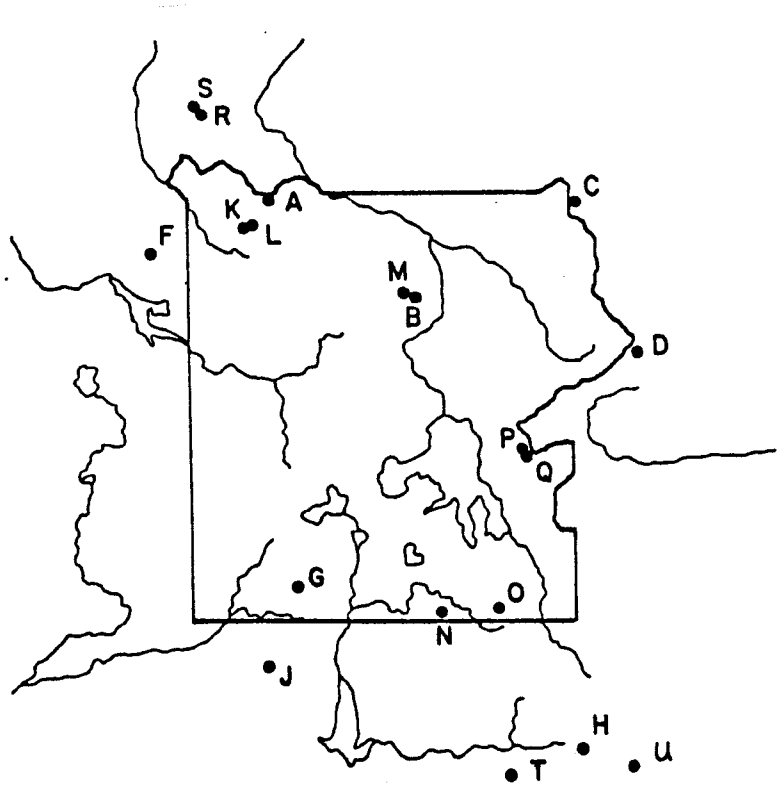

Fig. 3. Locations of whitebark pine cone transects within the study area.

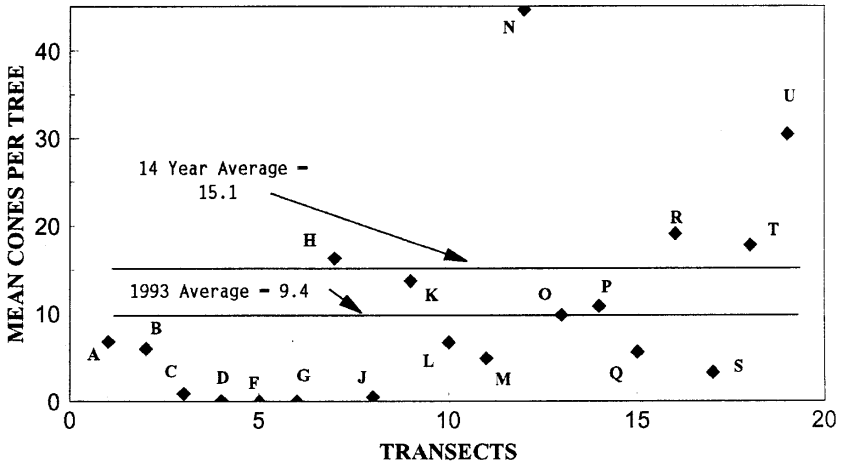

Fig. 4. Whitebark pine cone production on study area transects during 1993.

Table 10. Mean annual whitebark pine cone production on study transects, 1980-93.

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
1992	2,876	187	19	15.38	151.37	81.67	19	294	209
1993	1,926	189	19	10.19	101.37	114.97	0	456	217

Feed Sites

Ground investigation at 84 aerial locations of radio-marked grizzly bears from June-October revealed evidence of feeding activity at 55% of the sites. Evidence of activity other than feeding was recorded at an additional 9 sites, and no sign of bear activity was evident at the remaining 29 sites.

Grizzly bear activity was recorded at an additional 54 sites not associated with an aerial location of an instrumented bear (50 with feeding activity and 13 with other sign recorded). Activities are summarized in Table 10 for those 119 sites with evidence of feeding.

Table 11. Seasonal frequencies of activities at feeding sites during 1993.

Feeding activity	Spring[a] (*n* = 72)	Summer[b] (*n* = 37)	Fall[c] (*n* = 10)	Total (*n* = 119)
Whitebark pine seeds	0	0	0	0
Grazing	0.24	0.22	0	0.21
Digging roots	0.09	0.35	0.18	0.26
Digging rodents/caches	0.12	0.05	0	0.07
Large mammals	0.33	0.01	0	0.10
Searching insects	0.15	0.33	0.36	0.29
Miscellaneous[d]	0.06	0.04	0.46	0.08

[a] Spring = June.
[b] Summer = July - August.
[c] Fall = September - October.
[d] Miscellaneous = mineral dig, unknown dig, mushrooms.

The most frequently recorded feeding activity during spring was consumption of bison, elk, and moose carcasses and grazing. Over half (63%) of recorded grazing was on thistle (*Cirsium* sp.). During summer, digging for roots (*Lomatium cous* and *Perideridia gairdneri*), searching for insects (largely ants), and grazing were the most frequently observed feeding activities. Digging for truffles was the most frequently recorded fall feeding activity. No instances of searching for whitebark pine seeds were observed.

Movements and Feeding Strategies

Annual range sizes and seasonal rates of movement were generally less than the cohort means recorded 1975-87. Lower than average movements typically occur during years of overall adequate native food supply. Exceptions to this trend included a female with COY that exhibited movements much greater than previously recorded for that cohort, and an adult male with much lower than expected rates of movement and a range only 29 km^2. Both individuals live in the Dunoir River drainage in the southeast corner of the study area.

Table 12. Annual range sizes (km^2) of grizzly bears located ≥12 times and during all 3 seasons of 1993.

Cohort	Number of locations	MCP[a]	1975-87 cohort mean MCP	(SD)
Females				
With COY[b]	26	1,061	231	(136)
	24	88		
With yearlings	19	127	397	(309)
	26	199		
	17	208		
Lone adult	23	103	236	(114)
	23	172		
Males				
Subadults	20	598	698	(598)
Adults	12	230	874	(630)
	13	29		

[a] Minimum Convex Polygon.
[b] Cub-of-the-year.

Table 13. Seasonal rates of movement for radio-marked grizzly bears during 1993.

Season	Cohort (number of animals)		Locations/bear Mean	Range	Mean km/day/animal 1993	1975-87 Mean	(SD)
Spring	Adult females with COY	(3)	6	(4-9)	1.6	0.7	(0.3)
	Females with yearling	(3)	6	(5-7)	0.6	1.1	(0.7)
	Lone adult females	(5)	7	(4-9)	1.1	1.0	(0.6)
	Subadult males	(1)	6		1.0	1.1	(0.6)
	Adult males	(2)	4	(4)	0.2	1.3	(0.8)
Summer	Adult females with COY	(3)	6	(6-14)	1.3	1.3	(1.0)
	Females with yearling	(4)	5	(4-13)	0.9	1.7	(0.9)
	Lone adult females	(6)	7	(5-9)	0.5	1.3	(0.7)
	Subadult males	(3)	7	(3-8)	0.9	1.1	(0.9)
	Adult males	(6)	6	(5-6)	0.5	1.9	(1.1)
Fall	Adult females with COY	(2)	7	(7)	0.9	1.2	(1.0)
	Females with yearling	(5)	5	(6-9)	0.7	1.6	(0.9)
	Lone adult females	(5)	6	(6)	0.7	1.0	(0.7)
	Subadult males	(3)	10	(5-7)	0.8	1.1	(0.8)
	Adult males	(5)	6	(3-7)	0.4	1.4	(0.8)

LITERATURE CITED

Basile, J. 1982. Grizzly bear distribution in the Yellowstone area, 1973-79. U.S. Forest Service Research Note INT-321. 11pp.

Blanchard, B. 1985. Field techniques used in the study of grizzly bears. National Park Service, Interagency Grizzly Bear Study Team report. 24pp.

Blanchard, B. 1987. Size and growth patterns of the Yellowstone grizzly bear. International Conference on Bear Research and Management 7:99-108.

Blanchard, B. 1990. Relationships between whitebark pine cone production and fall grizzly bear movements. Page 362 *in* W.C. Schmidt and K.J. McDonald, compilers. Proceedings of the symposium on whitebark pine ecosystems: ecology and management of a high-mountain resource. U.S. Forest Service General Technical Report INT-270.

Blanchard, B., and R. Knight. 1991. Movements of Yellowstone grizzly bears. Biological Conservation 58:41-67.

Blanchard, B., R. Knight, and D. Mattson. 1992. Distribution of Yellowstone grizzly bears during the 1980s. American Midland Naturalist 128:332-338.

Craighead, J.J., J. Varney, and F. Craighead, Jr. 1974. A population analysis of the Yellowstone grizzly bears. Montana Forest and Conservation Experiment Station Bulletin 40. University of Montana, Missoula. 20pp.

Eberhardt, L.L., R.R. Knight, and B.M. Blanchard. 1986. Monitoring grizzly bear population trends. Journal of Wildlife Management 50:613-618.

Knight, R.R., B.M. Blanchard, and D.J. Mattson. 1989. Yellowstone grizzly bear investigations: annual report of the Interagency Study Team, 1988. National Park Service. 34 pp.

Knight, R.R., and L.L. Eberhardt. 1985. Population dynamics of Yellowstone grizzly bears. Ecology 66:323-334.

Knight, R.R., D.J. Mattson, and B.M. Blanchard. 1984. Movements and habitat use of the Yellowstone grizzly bear. National Park Service, Interagency Grizzly Bear Study Team report. 177pp.

Mattson, D.J., B.M. Blanchard, and R.R. Knight. 1991. Food habits of Yellowstone grizzly bears, 1977-87. Canadian Journal of Zoology 69:1619-1629.

Mattson, D.J., B.M. Blanchard, and R.R. Knight. 1992. Yellowstone grizzly bear mortality, human-habituation, and whitebark pine seed crops. Journal of Wildlife Management 56:432-442.