

AN ECOLOGICAL STUDY OF THE GRIZZLY BEAR

Third Annual Report
Summary of Work Accomplished
1959-1961

NOT FOR PUBLICATION

Marked grizzlies - lone indiv, ³⁸ p. 4, 5
Unmarked but recog. p. 12

Family groups p. 6-11

Mortality - 47

Movement Table p. 32, 34

Marked bears deceased 1959-61

Hematology & Pathology - 48

Growth & Dev - 52

Wts & Measurements - 52

Milk Analysis - 57

Autopsies - 57

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Unmarked recognizable bears
Marked grizzlies (#)
Family # 2 Ear Tags

Sub-project 2.9 An Ecological Study of the Grizzly Bear. Project leaders: John J. Craighead and Frank C. Craighead, Jr. Student Investigator: Maurice Hornocker, Graduate Fellow. Assistants: Wes Woodgerd, Mike Stephen, Donald Seibert, Harry Reynolds, Jr. Cooperators: National Park Service, The U. S. Fish and Wildlife Service, Montana Fish and Game Department, National Science Foundation, National Geographic Society, Wildlife Management Institute, Philco Corporation.

General Objectives:

1. To develop and perfect methods and techniques of capturing, handling, marking, and immobilizing grizzly bears.
2. To study the population dynamics of grizzlies and with the aid of marked animals, determine population size, density, sex and age composition, breeding age, reproductive capacity, growth rate, mortality rate, and population turnover.
3. To study population behavior, family composition and activities, breeding behavior, and relationships between various units in the population.
4. To determine home ranges, daily and seasonal movements, and distances traveled to food, to hibernation sites, and for breeding purposes.
5. To determine carrying capacity and habitat requirements and relate these to existing conditions of food abundance, habitat types and hibernation sites.
6. To collaborate with specialists in conducting physiological hematologic, and pathological studies.
7. To adopt and utilize electronic equipment in obtaining ecological data.

Financial Support: This project is supported by a five-year grant from the National Science Foundation and from annual grants from the Research and Exploration Committee of the National Geographic Society and the Wildlife Management Institute. Funds from the Montana Cooperative Wildlife Research Unit are annually budgeted for operational expenses and some salaries. The National Park Service and the Yellowstone Park Company have made laboratory facilities and special equipment available. The student fellow was supported in part by grants from the National Wildlife Federation and the American Museum of Natural History. The radio-tracking phase is supported by a three-year grant from the National Science Foundation and by funds allocated by Philco Corporation for development of radio-tracking equipment by engineers of their Western Research and Development Laboratory.

Procedure: This long-term study of the grizzly bear in Yellowstone National Park is designed to investigate all important aspects of grizzly bear ecology. The general as well as many of the specific objectives are dependent upon observations of marked known-age animals either in the wild or when captured and placed under sedation. The procedures of capturing,

marking, and then recapturing or observing identifiable individuals in the population must of necessity be carried on from year to year. The time and effort devoted to this is considerable.

During the past three years, field work began the last of May and terminated in early November. Quarterly and Annual reports of the Montana Cooperative Wildlife Research Unit have reported on previous work accomplished in the field. Findings and conclusions will be presented in technical papers as the study progresses. Results of the investigations from 1959 through 1961 are here summarized for the benefit of financial supporters and the research team.

CAPTURING AND MARKING:

One hundred and twenty-two grizzlies have been captured and marked since field work began in 1959.

Forty-five new individuals were trapped during the course of the 1961 season, immobilized, individually marked, weighed, measured, and released. Dental impressions were made on all known and established-age animals. Blood samples were taken from most individuals. Of the 45 bears captured, 20 were males and 25 were females. Thirteen cubs and 5 yearlings were among those captured.

At least one member of 32 different family groups has been marked since 1959. These families are recorded in Table II. Since the initial marking, some of these families have broken up. The behavior of these families has been followed closely and their behavior patterns recorded.

A list of "lone individuals" marked since the start of the study is presented in Table I. This list, and the list of family groups, does not include those bears that have died in the past three years.

A summary of all bears captured and marked since the start of the study is presented in Table V. Unmarked but recognizable animals are recorded in Tables III and IV. With the exception of one old male, all permanently recognizable (but unmarked) bears present in 1960 were re-observed in 1961.

A total of 103 color-marked or otherwise identifiable grizzlies were observed from one to many times throughout the 1961 field season. Thus approximately 62 percent of the grizzlies tallied in Yellowstone during 1961 were recognizable as individuals in the population.

Trapping Success:

Trapping success for 1959, 1960, and 1961 is presented in Table VI. The decrease in trapping success is not so drastic as it appears. On 6 occasions during 1961, failure of the trap to operate properly lost bears that otherwise would have been captured. These 6 bears, had they been trapped, would have raised the trapping success in 1961 to 67.5 percent, only 4.3 percent below that in 1960. There is evidence that some bears are becoming trap-shy and it is expected that trapping success will continue to decline slowly but steadily as the study progresses. To overcome this

TABLE I

MARKED GRIZZLIES, 1959 - 1961, LONE INDIVIDUALS

No.	Date	Sex	Age*	Wt. Lbs.	Place Captured	Place Released	Color Marker		Ear Tag	
							R. Ear	L. Ear	R. Ear	L. Ear
2	6/27/59	M	A	300	Thumb	Trout Creek		Yellow	G-15	G-16
9	7/ 9/59	F	2	160	Thumb	Trout Creek	Pink- Purple	Pink- Purple	00-168	00-167
12	7/21/59	M	A	620	Fishing Bridge	Crystal Creek	Purple	Purple	00-200	00-199
14	7/26/59	M	A	520	Trout Creek	Trout Creek	Purple		00-193	
20	8/ 4/59	M	A	280	Gardiner	Gardiner	Purple	Purple	00-195	00-194
27	8/22/59	M	A	505	Trout Creek	Trout Creek	Red- green	Red- green	00-285	00-284
28	8/28/59	M	A	500	Trout Creek	Trout Creek	Red- white	Red- white	00-286	00-287
30	9/10/59	M	A	710	Trout Creek	Trout Creek	Red- blue	Red- blue	00-289	00-288
33	6/25/60	M	A	425	Trout Creek	Trout Creek	Red- pink	Red- pink	00-281	00-290
41	7/ 5/60	M	A	550	Trout Creek	Trout Creek	Blue- orange	Blue- orange	00-259	00-257
42	7/ 5/60	F	A	250	Trout Creek	Trout Creek	Blue- white	Blue- white	00-260	00-254
44	7/11/60	F	A	300	Trout Creek	Trout Creek	Blue- green	Blue- green	00-218	00-219
45	7/13/60	F	3-4	185	Trout Creek	Trout Creek	White- pink	White- pink	00-270	00-271
46	7/14/60	M	A	355	Trout Creek	Trout Creek	Blue- pink	Blue- pink	00-225	00-224
54	8/ 2/60	F	2(?)	225	Rabbit Creek	Rabbit Creek	Pink- white	Pink- white	H-1553	H-1554
55	8/ 2/60	F	2(?)	200	Rabbit Creek	Rabbit Creek	Pink- green	Pink- green	H-1552	H-1556
60	8/10/60	M	A	600+	W. Yellowstone	W. Yellowstone	Purple- blue	Purple- blue	H-1555	H-1564
62	8/12/60	F	2-3	230	W. Yellowstone	W. Yellowstone	Pink- blue	Pink- blue	H-1567	H-1569

*Age when first marked.

A = "Adult".

YA = "Young Adult".

TABLE I (Cont.)

MARKED GRIZZLIES, 1959 - 1961, LONE INDIVIDUALS

No.	Date	Sex	Age*	Wt.Lbs.	Place Captured	Place Released	Color Marker		Ear Tag	
							R. Ear	L. Ear	R. Ear	L. Ear
63	8/13/60	M	A	560	W. Yellowstone	W. Yellowstone	Purple-pink	Purple-pink	H-1574	H-1528
64	8/17/60	F	A	495	Trout Creek	Trout Creek	Pink-yellow	Pink-yellow	H-1549	H-1531
66	8/26/60	F	2	225	Gardiner	Gardiner	Blue-yellow	Blue-yellow	H-1535	H-1534
67	8/26/60	M	3-4	275	Gardiner	Gardiner	Green-red	Green-red	H-1573	H-1548
69	8/30/60	M	A	580	Gardiner	Gardiner	Purple-green	Purple-green	H-1570	H-1571
73	9/ 8/60	M	A	780	Trout Creek	Trout Creek	Black & yellow rope-blue fg.	Black & yellow rope-blue fg.	H-1511	H-1513
74	9/25/60	M	2-3	200	Trout Creek	Trout Creek			H-1512	G-19
75	9/25/60	F	A	350- (est.)	Trout Creek	Trout Creek	White	White	H-1542	H-1543
78	6/ 8/61	M	cub	20	Old Faithful	Trout Creek	Yellow-white H.		00-226 blue	00-269 green
79	6/16/61	F	1	65	Gardiner	Trout Creek	Gray-white H.	Gray-white H.	G-1 Alum-rd	G-2 rd-alum
80	7/ 2/61	M	2	116	Canyon	Hayden Valley				
81	7/ 5/61	F	YA	220	Trout Creek	Trout Creek	Blue-H. redgray	Blue-H. redgray	G-7 rd-alum	G-8 rd-alum
85	7/ 8/61	M	A	465	Trout Creek	Trout Creek			G-6 rd-alum	G-25 rd-alum
86	7/12/61	F	2	115	Trout Creek	Trout Creek	White-H. yellow	White-H. yellow	H-1600 sq-alum	00-327 rd-red
87	7/13/61	M	A	450	Trout Creek	Trout Creek			H-1545 sq-alum	G-21 rd-alum
88	7/18/61	M	A	500	Trout Creek	Trout Creek			G-9 rd-alum	G-12 rd-alum

*Age when first marked.

A = "Adult".

YA = "Young Adult".

TABLE I (Cont.)

MARKED GRIZZLIES, 1959 - 1961, LONE INDIVIDUALS

No.	Date	Sex	Age*	Wt. Lbs.	Place Captured	Place Released	Color Marker		Ear Tag	
							R. Ear	L. Ear	R. Ear	L. Ear
89	7/19/61	M	A	635	Rabbit Creek	Rabbit Creek			G-14	G-13
									rd-alum	rd-alum
90	7/19/61	M	YA	260	Rabbit Creek	Rabbit Creek			00-390	00-329
									rd-yell	rd-red
101	8/ 3/61	F	YA	285	Trout Creek	Trout Creek	Red-H.	Red-H.	H-1590	H-1578
							bluegray	bluegray	sq-alum	sq-alum
102	8/ 7/61	F	YA	260	Fishing Bridge	Trout Creek		Green-H.	00-333	H-1589
			(est.)					bluegray	rd-red	sq-alum
104	8/10/61	F	A	375	W. Yellowstone	W. Yellowstone		White-H.	G-17	G-18
			(est.)					gray	rd-alum	rd-alum
105	8/10/61	M	YA	315	W. Yellowstone	W. Yellowstone			H-1579	H-1544
									sq-alum	sq-alum
106	8/11/61	M	2	255	W. Yellowstone	W. Yellowstone			G-77	G-76
									rd-alum	rd-alum
107	8/10/61	F	A	275-	Canyon	Trout Creek			00-347	G-75
			(est.)						rd-red	rd-alum
108	8/12/61	F	A	300	Trout Creek	Trout Creek	Green-H.	Green-H.	G-73	00-334
							bluegray	bluegray	rd-alum	rd-red
111	8/14/61	M	A	530-	Trout Creek					G-51
			(est.)							rd-alum
113	8/17/61	M	A	345	Trout Creek	Trout Creek			00-338	G-72
									rd-red	rd-alum
121	9/19/61	F	1(?)	115	Canyon	Trout Creek	Yellow	Yellow	G-18	00-252
							tape	tape	rd-alum	sq-alum

151

*Age when first marked.

A = "Adult".

YA = "Young Adult".

Family Groups

TABLE II

MARKED GRIZZLIES, 1959 - 1961, FAMILY GROUPS

Family No.	Marked Bear No.	Unmarked Members	Sex	Age 1961	Color Marker		Ear Tag	
					R. Ear	L. Ear	R. Ear	L. Ear
1.	5		F	3	Red tape	Red tape	00342 rd. red	00345 rd. red
		Sow	F	A	Unmarked			
		Yrl.	?	2	Unmarked			
2.	6		F	2	Blue-white rope	Green-yellow H.	00177	G 98 rd. alum
			F	A	Green tape	Green tape	00190	00189
			M	2	Green-pink tape	Red-white rope	H 1520	H 1519
			F	2	Gray-redgray H.	Gray-redgray H.	sq. alum G 78 rd. alum	sq. alum H 1585 sq. alum
3.	10		F	3	Blue tape	Blue tape	00170	G 74 rd. alum
			M	3	Missing	Missing	00292	00291
		Litter mate	?	3	Unmarked			
4.	15		F	3 or 4	Red-green H.	Red-green H.	00328 rd. red	00388 rd. yellow
		Litter mate	?	3 or 4	Unmarked			
5.	17		F	A	Green tape	Green tape	00186	00185
		1960 cub	?	1	Unmarked			
6.	16		F	A	Green tape	Green tape	00184	00183
		3-1960 cubs	?	1	Unmarked			

TABLE II (Cont.)

MARKED GRIZZLIES, 1959 - 1961, FAMILY GROUPS

Family No.	Marked Bear No.	Unmarked Members	Sex	Age 1961	Color Marker		Ear Tag	
					R. Ear	L. Ear	R. Ear	L. Ear
7.	8	3-1960 cubs	F	A	Green tape	Green tape	00180	00181
			?	1	Unmarked			
8.	21	2-1960 cubs	F	A	Green tape	Green tape	00274	00275
			?	1	Unmarked			
9.	25	Sow Litter mate	?	2	Yellow-red tape	Yellow-red tape	00141	00145
			F	A	Unmarked			
			?	2	Unmarked			
10.	26	Sow	M	2	Missing	Missing	Missing	00215
			F	A	Unmarked			
	77		F	2	White rope, w/red flag	White rope, w/red flag	H 1540	H 1541
	95		M	2	Yellow-blk rope, w/red flag	Yellow-blk rope, w/red flag	G 100 rd. alum	H 1598 sq. alum
11.	29	Sow	F	2	White-green H.	White-green H.	00389 yellow	G 20 rd. alum
	36		M	2	White-yellow tape	White-yellow tape	00294	00295
			F	A	Unmarked			
12.	32	Litter mate	M	3	None	None	00387	00266
			F	3	Unmarked			

TABLE II (Cont.)

MARKED GRIZZLIES, 1959 - 1961, FAMILY GROUPS

Family No.	Marked Bear No.	Unmarked Members	Sex	Age 1961	Color Marker		Ear Tag	
					R. Ear	L. Ear	R. Ear	L. Ear
13.	37		M	2	Green-redgray H.	None	00178 yellow	00326 red
	38		M	2	Red-yellow H.	None	G 11 rd. alum	G 10 rd. alum
	39		F	A	White-purple tape	White-purple tape	00251	00255
14.	40	Litter mate Sow	F	3 or 4	White tape	Yellow tape	00253	00258
			M	3 or 4	Unmarked			
			F	A	Unmarked			
15.	43		M	1	Blue-white rope	Green-gray H.	H 1591	00160
	52		M	1	Yellow-black rope, w/red flag	None	G 3	H 1504
	65		F	A	Blue-white rope, w/white flag	Blue-white rope, w/white flag	H 1533	H 1532
16.	48		F	A	Green-yellow tape	Green-yellow tape	H 1522	H 1521
	49		F	1	Green-white tape	Green-white tape	H 1523	H 1524
17.	53		M	1	Yellow rope, w/red flag	Yellow rope, w/red flag	H 1507	H 1506
	114		M	1	Blue-white rope	Black-yellow rope	00133 rd. green	00398 rd. yellow
		Sow	F	A	Unmarked			
18.	56		M	2	Purple-white tape	Purple-white tape	H 1551	H 1558
	57		M	2	Purple-yel tape	Purple-yel tape	H 1560	H 1561
	58		F	A	Red-white rope, w/yellow flag	Red-white rope, w/yellow flag	H 1563	H 1562
19.	59	1960 cub	F	A	Purple-red tape	Purple-red tape	H 1557	H 1559
			?	1	Unmarked			

TABLE II (Cont.)

MARKED GRIZZLIES, 1959 - 1961, FAMILY GROUPS

Family No.	Marked Bear No.	Unmarked Members	Sex	Age 1961	Color Marker		Ear Tag	
					R. Ear	L. Ear	R. Ear	L. Ear
20.	70		F	1	Yellow rope, w/green flag	Yellow rope, w/green flag	H 1517	H 1518
	72		F	A	Red-white rope, w/green flag	Red-white rope, w/green flag	H 1516	H 1510
21.	82		F	cub	None	Red-white H.	G 5	00227
							rd. alum	sq. blue
	83		M	cub	Yellow-redgray H.	None	00386	G 4
							rd. yell	rd. alum
		Litter mate	?	cub	Unmarked			
	84		F	A	Blue-white H.	None	G 22	H 1546
							rd. alum	sq. alum
22.	34		F	A	Red-yell tape	Red-yellow tape	00298	00297
	92		M	cub	Red-white rope, w/red H. flag	Yellow-green H.	00391	00268
							rd. yell	sq. green
	93		F	cub	Blue-white rope	Yellow-gray H.	00394	00349
							rd. yell	rd. red
23.	94		M	cub	Red-white rope	Green-white H.	H 1599	00137
							sq. alum	rd. green
		Litter mate	?	cub	Unmarked			
		Sow	F	A	Unmarked			
24.	96		F	3 or 4	Gray-bluegray H.	Gray-bluegray H.	G 99	H 1596
							rd. alum	sq. alum
	76		M	3 or 4	None	None	H 1538	H 1539

TABLE II (Cont.)

MARKED GRIZZLIES, 1959 - 1961, FAMILY GROUPS

Family No.	Marked Bear No.	Unmarked Members	Sex	Age 1961	Color Marker		Ear Tag	
					R. Ear	L. Ear	R. Ear	L. Ear
25.	97		M	cub	Gray-yellow H.	Yellow rope	H 1594	00330
							sq. alum	rd. red
	100		M	cub	White-bluegray H.	White rope	00348	00136
							rd. red	rd. green
	112		F	A	Blue-gray H.	Red-white rope	H 1588	00399
							sq. alum	rd. yellow
		Litter mate	?	cub	Unmarked			
26.	98		M	1	Yellow-bluegray H.	White rope	00395	H 1576
							rd. yell	sq. alum
		Litter mate	?	1	Unmarked			
		Sow	F	A	Unmarked			
27.	99		F	cub	Redgray H.	Yell-black rope	H 1592	00331
							sq. alum	rd. red
	119		F	A	None	None	H 1584	00340
							sq. alum	rd. red
		Litter mate	?	cub	Unmarked			
28.	91		F	2	White-redgray H.	White-redgray H.	00392	00393
							rd. yell	rd. yell
		Litter mate	?	2	Unmarked			
		Litter mate	?	2	Unmarked			
		Sow	F	A	Unmarked			

TABLE II (Cont.)

MARKED GRIZZLIES, 1959 - 1961, FAMILY GROUPS

Family No.	Marked Bear No.	Unmarked Members	Sex	Age 1961	Color Marker		Ear Tag	
					R. Ear	L. Ear	R. Ear	L. Ear
29.	109		F	cub	Red-yellow H.	Yellow rope	00337 rd. red	00396 rd. yell
	110		F	cub	Yellow rope	Blue-yellow H.	00400 rd. yell	00335 rd. red
		Sow	F	A	Unmarked			
		Litter mate	?	cub	Unmarked			
30.	117		F	cub	Blue-white rope, w/yellow flag	Blue-white rope, w/yellow flag	00344 rd. red	00343 rd. red
		Sow	F	A	Unmarked			
31.	120		F	A	None	Yellow tape	00339 rd. red	H 1583 sq. alum
		1961 cub	?	cub	Unmarked			
		1961 cub	?	cub	Unmarked			
32.	116		M	1	White rope, w/red flag	White rope, w/green flag	00341 rd. red	G 97 rd. alum
		Litter mate	?	1	Unmarked			
		Sow	F	A	Unmarked			

TABLE III

UNMARKED BUT PERMANENTLY RECOGNIZABLE BEARS
1959 - 1961

I. Recognizable from year to year.

Designation	Sex	Age	Characteristics
1. Scarface	M	Adult	Left ear missing; massive scars on both sides of head. Large male. Not observed in 1961.
2. Cutlip	M	Adult	Very large male, right lower lip torn, hangs down.
3. Collared pair	?	?	(one is marked). Very prominent light colored collars. Younger bears (3-5 years old).
4. Old Mose (white claw)	M	Adult	Old appearing male, light colored, very white claws.
5. Shorty	M	Adult	Large male, very short and stocky, very massive head. Deep, short body.
6. Scarneck	M	Adult	Large, black male, left ear very short, end of right ear gone, scar on top of muzzle. Scar on right shoulder. Rabbit Creek.
7. Notch-ear	M	Adult	Large, black male, lower part of left ear gone. Scar on right side. Rabbit Creek.
8. Old Ear-less	M	Adult	Large, old appearing brown male. Both ears gone, large bare area on right rump. Rabbit Creek.
9. Fidel	M	Adult	Large, black male. Characteristic scars on head and neck.
10. Giant	M	Adult	Very large, old male, bad scar on right upper lip, upper canine exposed.
11. Mother of #29	F	Adult	Large light-colored female.

*Description of
Recognizable Bears
Unmarked*

UNMARKED BUT TEMPORARILY RECOGNIZABLE BEARS*
1959 - 1960

II. Recognizable by family groupings, by pelage color, wounds, etc. Not permanently recognizable as individuals.

Designation	Sex	Age	Characteristics
1. Mae West	F	Adult	Slightly built black sow with two black cubs. Prominent hump. Marked one cub in 1961 (#98).
2. Sow with Collar- ed Cubs	F	Adult	Cubs have prominent light-colored collars (2 cubs).
3. Highpockets	?	3 - 4	Short bodied, fairly large bear (male ?) with very big, high rump. Not observed (recognized ?) in 1961.
4. Brown sow with 2 brown cubs	F	Adult	Whole family a dull brown color. Not observed in 1961.
5. Sow with 3 very small cubs	F	Adult	Slightly built sow; cubs are very small, not half as large as average cubs. Not observed in 1961.
6. Sow with sharp- pointed head with 2 white- faced and white- shouldered cubs.	F	Adult	Slightly built sow with long tapered head; cubs have light-colored heads and shoulders. Not observed in 1961.

* Eight temporarily recognizable family groups were present at Trout Creek in 1961. However, at least one member of all eight families was marked and therefore are not included in this table. The same is true for several "lone individuals".

TABLE V

SUMMARY OF BEARS CAPTURED AND MARKED, 1959 - 1961,
AND NUMBER OF MARKED BEARS DECEASED

<u>Year</u>	<u>No. Marked</u>	<u>No. Lost From Marked Population*</u>
1959	30	10
1960	47	10
1961	45	4
3-year Totals	122	24

* Killed by hunters, NPS, sacrificed for scientific study, or shipped to zoos.

difficulty new methods of capture are being tested and developed. A 200-lb. pull Stevens crossbow with syringe bolts showed possibilities of effective performance at 60 yards.

Methods of Capture:

One hundred and fifty-seven grizzlies have been captured in culvert traps and 35 have been shot free-roaming in the field with a CO₂ gun using a drug-laden propulsive syringe. Methods of capture for three years are summarized in Table VII.

Marking:

As in previous years metal (aluminum) tags were placed in each ear. In 1961, however, different colors were used in combinations and the tags were placed in the lower edge of the ear as well as the upper, or leading, edge. It was found that this increased the visibility of the metal ear tags and aided greatly in identifying a bear that had lost its color markers. New metal tags were placed in the ears of 11 retrapped bears. This was done only when the original tag was worn or missing or had caused irritation.

Previously all bears were marked with colored polyvinyl tape with the exception of 8 individuals marked with polyethylene rope in 1960. In 1961, Herculite, a nylon impregnated plastic, was used on a large number of bears. This fabric was obtained from the Herculite Protective Fabrics Corporation, 661 Fourth Street, Newark, New Jersey. This fabric is very "tough", yet light in weight. Braided polyethylene rope was again used on some individuals. This material has proved to be very durable, but is not as visible as polyvinyl tape.

TABLE VI

TRAPPING SUCCESS, 1959 - 1961

<u>Year</u>	<u>Trap Nights</u>	<u>Successful Trap Nights</u>	<u>Trapping Success</u>
1959	21	14	76%
1960	71	51	71.8%
1961	77	46	59.6%

TABLE VII

SUMMARY, METHOD OF CAPTURE, 1959 - 1961

<u>Year</u>	<u>Total No. Bears Handled (Initial Capture & Recapture)</u>	<u>Total No. Trapped</u>	<u>Total No. Shot Free-Roaming</u>
1959	33	27	6
1960	64	56	8
1961	95	74	21
3-year totals	192	157	35

The number of bears marked with each material were:

<u>Marking Material</u>	<u>Number of Bears Marked</u>
Herculite:	24 new individuals (captured for the first time) were marked in one or both ears 7 individuals marked in previous years with polyvinyl tape were re-marked in one or both ears
Polyethylene rope:	13 new individuals were marked in one or both ears 2 individuals marked in previous years with polyvinyl tape were re-marked in one or both ears
Polyvinyl tape:	2 new individuals were marked in both ears 1 individual marked previously with this material was re-marked in both ears.

Several animals were marked with Herculite in one ear and polyethylene rope in the other. Comparison will be made of visibility, color retention, and durability.

Adult males captured in 1961 were not color marked but were marked with metal ear tags and were tattooed.

Color Marker Evaluation of Bears Marked in 1959:

Theoretically, 21 bears marked in 1959 were present in the population in the spring of 1961. Sixteen of these bears were either recaptured or observed at close enough range to determine the condition of the color markers. The 5 not observed were:

Nos.

- 8 and 9 - Both marked at Thumb. Observations in this area were difficult to obtain.
- 25 - Not observed in either 1960 or 1961.
- 27 and 28 - Possible that these adult males lost their markers and were in the population but not recognizable.

The 16 marked bears observed and condition of the markers is reported in Table VIII.

These 16 bears were originally earmarked with 31 polyvinyl tape streamers. Of these 31 markers, 8 were in good condition, 3 were broken but visible, 3 were broken and barely visible, and 17 were missing completely.

TABLE VIII
CONDITION OF COLOR MARKERS

<u>No.</u>	<u>Right Ear Marker</u>	<u>Left Ear Marker</u>	<u>Right Ear Tag</u>	<u>Left Ear Tag</u>
2	missing	broken, visible	missing	good
5	missing	missing	missing	good
6	missing	missing	good	good
7	good	good	good	good
10	broken, visible	broken, visible	missing	missing
12	missing	missing	missing	missing
14	missing	not marked here	good	not marked here
15	missing	missing	missing	good
16	missing	good	good	good
17	missing	good	good	good
18	good	good	good	good
20	good	good	good	good
21	broken, barely visible	missing	good	good
26	missing	missing	missing	good
29	missing	missing	missing	good
30	broken, barely visible	broken, barely visible	missing	missing

Despite the number of markers lost, all of these 16 bears were positively identified by their remaining markers or colored numbered ear tags. No. 12, a very large old male at Trout Creek, lost all his markings but was easily identified by pelage color and other natural markings.

Color Marker Evaluation of Bears Marked in 1960:

Theoretically 43 bears marked in 1960 were present in the population in the spring of 1961. Thirty-six of these bears were observed.

The 7 not observed were:

Nos.

36 - Not observed since marking in 1960

49 - Not observed since marking in 1960

58, 59, 70, 72, and 73 - Not observed since marking in 1960

The 36 marked bears observed and the condition of the markers* is reported in Table IX.

TABLE IX
CONDITION OF COLOR MARKERS

<u>No.</u>	<u>Right Ear Marker</u>	<u>Left Ear Marker</u>	<u>Right Ear Tag</u>	<u>Left Ear Tag</u>
32	missing	missing	not marked	not marked
33	good	missing	good	good
34	broken, easily visible	broken, easily visible	missing	good
35	missing	missing	good	good
37	missing	missing	good	good
38	missing	missing	good	missing
39	good	good	good	good
40	missing	missing	good	good
41	broken, visible	missing	missing	good
42	missing	broken, visible	good	missing
43	missing	missing	good	good
44	broken, visible	missing	good	good
45	broken, visible	broken, visible	good	good
46	broken, barely visible	missing	good	good
48	broken, easily visible	good	good	good
51	missing	good (rope)	good	good
52	good (rope)	good (rope)	good	good
53	good (rope)	good (rope)	good	good
54	missing	missing	good	good
55	missing	missing	good	good
56	missing	missing	good	missing
57	missing	missing	missing	good
60	good	good	missing	good
61	good	good	good	good
62	broken, visible	broken, visible	good	good
63	broken, visible	broken, visible	good	good
64	missing	good	good	good
65	good (rope)	good (rope)	good	good
66	missing	missing	good	missing
67	missing	missing	good	good
68	good	good	good	good
69	good	good	missing	good
74	not marked	not marked	good	not marked
75	good	good	good	good
76	not marked	not marked	good	good
77	good (rope)	good (rope)	good	good

* All color markers are polyvinyl tape unless stated otherwise.

These 36 bears were originally earmarked with 68 polyvinyl streamers or polyethylene rope markers. Of these 68 markers, 24 were in good condition, 12 were broken but visible, 1 was broken and barely visible, and 31 were missing completely.

Polyethylene rope was used as a marker in 1960 on an experimental basis. Nine bears were marked in one or both ears with the braided rope. Four of these bears were not observed in 1961. In the 5 bears observed, all 9 of the rope markers were in good condition and showed very little wear. Solid colors are preferable - they are much easier to identify than rope of two braided colors. The observability of colored polyvinyl tape appears to be better, but the polyethylene rope appears to be much more durable.

Color Marker Evaluation of Bears Marked in 1961:

Forty-four bears were marked and released in 1961. Ten of these bears were not observed after being released. These were:

Nos.	85	87	90	102	104
	105	106	108	111	113

Thirty-four bears were either observed or recaptured during the summer and fall. In all cases the markers were intact. However, re-marked bear No. 74 lost its Herculite marker within 10 days.

The system of using color markers in conjunction with colored metal ear tags has proven highly successful; however, field observations will be greatly facilitated if a more durable color marker can be developed. Experiments toward this end will be continued in the future.

Tattoo:

With the exception of Nos. 84, 104, 107, 111 and 120, all new individuals were tattooed behind the foreleg or in the upper lip or both. Tattoos were inspected on retrapped animals and in practically all cases were easily identifiable.

Recaptures:

Thirty individuals were recaptured in 1961. Of these, 8 were marked in 1959, 12 in 1960, and 10 earlier in 1961. Data on growth rates, fat deposition, dentition development, and movement were obtained from these animals.

A three-year summary of the number of bears recaptured is recorded in Table X.

IMMOBILIZING AND ANESTHETIZING:

Techniques, equipment, and drug dosages used in 1959 and 1960 have previously been reported in detail. These same procedures modified and perfected were utilized in 1961. Sixty-five dosages of both succinylcholine chloride and pentobarbital sodium were administered. Forty-seven

TABLE X

SUMMARY OF THE NUMBER OF BEARS RECAPTURED, 1959 - 1961

<u>Year</u>	<u>No. Individuals Recaptured</u>	<u>Total No. of Recaptures</u>
1959:	3	3
1960:		
Bears marked in 1959	6	7
Bears marked in 1960	7	10
1961:		
Bears marked in 1959	8	10
Bears marked in 1960	12	25
Bears marked in 1961	10	15
3-year Totals	46	70

dosages of succinylcholine chloride alone were administered. Thus, 112 successful druggings were made in 1961.*

Data concerning the dosages administered to different age groups and the number of individuals handled in each age group are presented in Table XI.

A correlation between stress and the amount of succinylcholine chloride necessary for successful immobilization has been noted by others working with ungulates and humans. This appears to be an important factor in the immobilization of grizzlies. Free-roaming bears have invariably required a much heavier dosage than bears of the same age and size captured in culvert traps. This observation has been further substantiated by immobilizing free-roaming bears with succinylcholine chloride, holding them overnight in culvert traps and drugging them the following morning. Dosages much lighter than those administered to the bear while free-roaming

* Ninety-five bears (initial captures and recaptures) were handled but a number of these animals were captured free-roaming and held overnight. The next morning they were then drugged a second time and processed.

TABLE XI

DRUG DOSAGES ADMINISTERED TO GRIZZLIES
1961

	Succinylcholine Chloride* only mg/lb body wt.	No. Doses Admin.	Succinylcholine Chloride & Pentobarbital Sodium*		No. Doses Admin.
			Succ. Chloride mg/lb body wt.	Pent. Sodium cc/lb body wt.	
Cubs	1:4.06	15	1:5.78	1:16.66	14
Yearlings	1:4.56	3	1:6.34	1:14.41	12
2 Year Olds	1:5.48	13	1:6.29	1:15.91	18
3or4 Year Olds	1:6.2	1	1:6.95	1:17.75	15
Adults	1:5.94	15	1:6.21	1:18.06	6
	-----	Total 47	-----	-----	Total 65
Overall average, all age classes	1:5.25		1:6.31	1:16.56	

Total of 112 dosages administered.

Two accidental deaths occurred:

No. 77, a 2-year-old female, died as a result of drug(s). The Succinylcholine Chloride dosage was 1:4.8, the Pentobarbital Sodium dosage 1:16.2, both well within safe limits.

No. 103, a 3- or 4-year-old female, also died as result of drug(s). Succinylcholine Chloride dosage was 1:6.75, the Pentobarbital Sodium 1:22.67, both safe appearing dosages.

Both these bears, it is believed, died because the Pentobarbital was administered too quickly after giving the Succinylcholine Chloride.

No. 118, a 2-year-old female, nuisance bear, was purposely killed at the request of NPS, with Succinylcholine Chloride; dosage was 1:3.22.

* Succinylcholine chloride: 100mg/cc solution
Pentobarbital sodium: 250mg/cc solution

invariably effectively immobilized the same animal after a period of holding in a trap. Data are presented in Table XII.

TABLE XII
COMPARISON OF DOSAGES OF SUCCINYLCHOLINE CHLORIDE
ADMINISTERED TO FREE ROAMING BEARS AND TRAPPED BEARS
(all age classes)
1961

	<u>No. Dosages Administered</u>	<u>Dosage, mg/lb body wt.</u>
Free Roaming Bears:	25	1:4.00
Trapped Bears:	85	1:6.35

Experiments were conducted using a cross-bow with disposable syringe attached to the bolt. Accuracy was excellent at distances of 60-70 yards. With a few minor changes, this technique should prove most effective for injecting drugs into animals at extreme ranges. Bows and arrows were field tested in 1960 but the skill required in using the bow discouraged further experimentation.

The handling and immobilizing techniques developed and used during 1959 and 1960 have been demonstrated to park rangers and are now being applied by the National Park Service in the management of black bears (*Ursus americanus*). These include dosages of succinylcholine chloride and such injection methods as use of the CO₂ gun with propulsive syringes, the "jab stick" (plastic syringe attached to the end of a pole), and the bow and arrow with syringe attached. Project personnel also demonstrated, on several occasions during the three-year period, procedure in removing dangerous individuals from congested camp areas. Using these tested and proven methods and techniques, the Park Service has been able to cope more effectively with mischievous black bears. Nuisance bears in campgrounds and along roadsides are either killed or immobilized and transported using succinylcholine chloride injected by one of the above methods.

GRIZZLY BEAR BEHAVIOR (Student Thesis). Project Leader: John J. Craighead.
Student Investigator: Maurice Hornocker, Graduate Fellow.

Objectives:

1. To capture, mark, and release grizzly bears for field observation.
2. To determine population size and structure as a background to behavioral studies.
3. To observe and record behavior of individuals and family groups in a population.

Observations on Marked Bears, 1961:

Intensive observations were again carried out in 1961 on both marked and recognizable bears. A number (16) of these individuals have now been under observation for 3 years. Thirty-seven marked bears have been observed for 2 years. Detailed patterns of behavior have been established on several individuals, as well as information recorded on movement, dominance, etc. Although several bears had lost some of their markings, positive identification was made on all bears recorded except three. These 3 were at West Yellowstone and Rabbit Creek where observations are difficult to make.

A total of 692 observations was made on bears marked from 1959 through 1961. Of these, 49 were obtained by retrapping, the other 643 were direct observations in the field by the student investigator on individually marked, free-roaming bears. Breakdown of these 643 observations is as follows:

196 observations on bears marked in 1959; 16 different individuals
339 observations on bears marked in 1960; 37 different individuals
108 observations on bears marked in 1961; 34 different individuals

Five bears marked in 1959 and 7 marked in 1960 were not observed in 1961.

Observations on Unmarked but Recognizable Bears, 1961:

A total of 238 observations was made on unmarked but recognizable individuals or family groups in 1961. Eighty-one were made on permanently recognizable individuals, while 157 were made on temporarily recognizable bears or family groups.

Total No. Observations, 1959-1961:

In 1959, 160 observations were made on marked animals. Those made on unmarked but known individuals were not recorded in 1959. In 1960, 719 observations were recorded on both marked and recognizable bears; this figure was 930 in 1961. Thus for the three-year period, a total of 1809 different observations have been made. These do not include hundreds of observations made by other members of the research team.

Behavior:

Many aspects of behavior have been observed intensively throughout the three-year period. Certain behavior patterns of individual bears have been well established. Although some behavior traits appear to be stereotyped, varying among individuals in degree and intensity, others appear to be highly individualistic. Seasonal and yearly differences in behavior have been noted. These and other aspects of behavior will be the subject of the student fellow's thesis which is now in preparation.

Concentration and Dispersal:

Bear numbers and concentrations have a direct bearing on the behavior of the individuals and groups composing the population. Bears tallied at long-established concentration sites followed fairly closely the number tallied in preceding years. A gradual increase occurred through June and July, peaking around August 1, followed by a gradual, then rather sharp decline in late August. This sharp decline in numbers was fully two weeks earlier in 1961 than in 1959 and 1960. Rather mild fall weather during 1959 and 1960 in contrast to cold temperatures and frequent snows in 1961 undoubtedly was a factor initiating early dispersal from the concentration sites and summering areas.

Dispersal was first noted and appeared most marked among individuals weaned in 1960 and in the spring of 1961. Several of these young bears were trapped and retrapped at various places throughout the Park. One yearling male, observed at Trout Creek as a cub in 1960 (with mother and litter mate) was killed by a rancher near Moran, Wyoming. This bear was observed, alone, near Canyon earlier in 1961. Other young bears traveled more than 40 miles.

Each year it becomes more evident that bears migrate to these concentration sites from areas outside Yellowstone, as well as from throughout the Park itself. We have made sightings of marked grizzlies in the spring in areas where none are sighted during the summer months. In early May bears No. 32 and 46, both marked at Trout Creek, and numbers 67 and 68, marked at Gardiner, were observed in the Lamar valley. Later in the summer, these bears were all observed at or near the area where they were originally captured and marked. Other similar observations were recorded later in the season.

Information on daily movement to and from the concentration sites has been difficult to obtain. Enough data, however, have been collected on different individuals to establish that daily movements are individualistic, varying from day to day and week to week. One to 20 miles have been recorded as distances traveled daily by several individuals.

Bear numbers at the concentration sites and in the summering areas dropped sharply the last week in August. On August 26, 60 grizzlies were observed at Trout Creek. By September 7, only 12 were counted. In 1960, 25 bears were tallied at Trout Creek as late as September 15. On September 22, 1959, 16 were still frequenting the concentration site. Sightings of grizzlies were reported by rangers in a number of areas far from Hayden Valley during September and early October.

Four marked bears (in addition to the one killed at Moran) were killed by hunters outside the Park. These further substantiate the apparent large home range of these animals. No. 32, a young male originally marked at Trout Creek in 1960 and retrapped there in 1961, was shot by a hunter 5 miles south of Cooke City, Montana. No. 50, an adult male marked at Trout Creek, was shot in the Thorofare area of Wyoming, several miles from the southeast corner of the Park. No. 68, a young male marked at Gardiner in 1960, was killed in the Slough Creek area north of Yellowstone Park. No. 61, a young female marked at West Yellowstone in 1960, was shot south of

Mortality

Hebgen Lake in the Madison Range of Montana. These kills, in addition to others in preceding years, show that many of the grizzlies in Yellowstone inhabit the Park in summer and move great distances each spring and fall.

Census:

Direct counts at the concentration sites were again used to arrive at minimum population figures. Different indices will be applied to data collected over the past 3 years (no. marked versus no. unmarked) and these findings compared with the direct count figures.

Direct Counts:

The number of counts and census figures for the past 3 years for each of the concentration sites are presented in Table XIII. These counts show a minimum of 166 grizzlies in Yellowstone in 1961, as compared with counts of 154 and 169 in 1959 and 1960, respectively.

TABLE XIII

CENSUS, 1959 - 1961

Site	1959		1960		1961	
	No. Counts	No. Bears	No. Counts	No. Bears	No. Counts	No. Bears
Trout Creek	17	96	24	98	31	98
Rabbit Creek	2	22	6	40	7	31
W. Yellowstone	2	27	3	16	4	19
Gardiner	2	9	2	9	2	10
West Thumb	—	—	2	4	1	4
Pelican Cr. Area*	—	—	—	2	—	4
	—	—	—	—	—	—
Totals	23	154	37	169	45	166

* No counts made here; bears trapped.

Classified Counts:

*Classified counts have been made since the start of the study and the following ages have been recognizable in the field:

Cubs of the year	-	5 - 9 months
Yearlings	-	17 - 21 months
Two year olds	-	29 - 33 months
Three or four year olds (or young adults)	41 - 45 months	53 - 57 months
Adults	-	65 months and over

It is believed that accurate classified counts were made in the cub and yearling classes in 1959 and 1960 and that two year olds and three or four year olds were recognized with reasonable accuracy. The criteria for distinguishing these latter two age classes were checked against established-age marked animals in 1961 and it is believed they were separated accurately this year.

Classified counts throughout the Park in 1961 are presented in Table XIV. These counts are quite similar to those made in previous years.

TABLE XIV

CLASSIFIED COUNTS - 1961

<u>Site</u>	<u>Cubs</u>	<u>Yearlings</u>	<u>2 Years</u>	<u>3or4 Years</u>	<u>Adults</u>	<u>Total</u>
Trout Creek	18	9	11	14	46	98
Rabbit Creek	6	---	3	4	18	31
W. Yellowstone	6	---	3	---	10	19
Gardiner	---	4	---	4	2	10
West Thumb	---	2	---	---	2	4
Pelican Cr. Area	---	2	---	1	1	4
Totals	30	17	17	23	79	166

* Age in months is based on an average birth date of January 30 and an average period of 7 months from November 1 to May 30 when bears were not observed due to hibernation or the difficulty of making field observations.

The age and sex of marked bears are presented in Table XV.

NATALITY, PRODUCTIVITY, AND MORTALITY:

Data on productivity, mortality and causes of mortality in the population have been gathered over a three-year period. Natality can be most accurately expressed at time of birth. Birth occurs in late winter when the sows are in hibernation and it has not been possible to obtain counts of cubs until late May or early June. Some sows giving birth to cubs late in winter are not seen with their cubs and accounted for until late July. Mortality of cubs occurring during a 5- to 6-month period when they are in hibernating dens or before they have begun to move extensively may be considerable. We have not yet obtained data on natality but hope to do so in the future. Productivity as used here is an expression of reproductive success at the age of 5 to 6 months.

Productivity:

In 1961, 13 sows were observed to have 30 cubs, making an average sow-cub ratio of 1:2.3. This is higher than the two preceding years. In 1959 the sow-cub ratio was 1:1.73 and in 1960 1:2.06. This higher ratio in 1961 is due to an increase in the number of triplets - 6 of 13 sows had 3 cubs each, 5 had twins, and only 2 had single cubs. Eighteen cubs were present at Trout Creek in 1961, compared to 18 in 1959 and 20 in 1960.

Mortality:

Marked bears killed since the start of the project and the causes of death are presented in Table XVII.

Since June 20, 1959, 5 unmarked grizzlies have been killed by Park Service personnel within Park boundaries. In addition, 3 unmarked and 2 marked bears have been captured and shipped to zoos.

In 1961, 4 unmarked animals were reported shot by hunters outside Yellowstone, one in the Beartooth Range northeast of the Park, and 3 in the Madison Range to the west. In 1961, 5 marked individuals were killed and reported by hunters outside Park boundaries, 3 in Wyoming and 2 in Montana. A total of 7 marked animals have been reported killed by hunters outside the Park over a 3-year period.

A questionnaire-type letter was mailed in the spring of 1961 to all guides and outfitters operating in areas bordering Yellowstone National Park. Cooperation has been good and data have been obtained on kills and sightings in several different areas.

There has been remarkably little mortality of cubs between the ages of 5 and 9 months. But if yearling counts (Table XVI) are an accurate expression of overwintering and early spring mortality then many cubs succumb during their first winter or as young yearlings. It is possible that dispersal and movement may account for some of this apparent mortality; but, to date, all evidence from marked sows and cubs indicates a high mortality rate at the ages to 10 and 17 months.

// mortality

TABLE XV
AGE AND SEX DESIGNATION OF MARKED BEAR

1959 - 1961

	1959			1960			1961			3-Year Totals
	<u>Total</u>	<u>M</u>	<u>F</u>	<u>Total</u>	<u>M</u>	<u>F</u>	<u>Total</u>	<u>M</u>	<u>F</u>	
Cubs	5	2	2	6	4	2	13	6	7	24
	(1 undetermined)									
Yearlings	3	0	3	5	4	1	5	3	2	13
2 Years	4	1	3	4	2	2	7	3	4	15
3 or 4 Years*	—	—	—	9	4	5	8	2	6	17
Adults	18	11	7	23	10	13	12	6	6	53
Totals	30	14	15	47	24	23	45	20	25	122

* Not classified in 1959.

3-year totals: 122 individuals

58 males

63 females

1 undetermined

TABLE XVI

CUB AND YEARLING COUNTS, 1959 - 1961
(Throughout Yellowstone National Park)

	<u>1959</u>	<u>1960</u>	<u>1961</u>	<u>Totals</u>
Cubs	26	35	30	91
Yearlings	23	13	17	53

TABLE XVII

MARKED BEARS DECEASED, 1959 - 1961

<u>Bear No.</u>	<u>Sex</u>	<u>Date Marked</u>	<u>Where Marked</u>	<u>Date Killed</u>	<u>Where Killed</u>	<u>How Killed</u>
(1)	M	6/26/59	Trout Creek	9/ 2/60	Old Faithful	Drug*
(3)	F	6/28/59	Trout Creek	7/ 4/59	Lake	Shot, NPS
(4)	M	7/ 2/59	Trout Creek	8/ 8/60	Trout Creek	Shot, NPS
(11)	F	7/19/59	Crystal Creek	7/31/59	Fishing Bridge	Shot, NPS
13	M	7/24/59	W. Yellowstone	7/24/59	W. Yellowstone	Drug
* (18)	F	6/ 8/61	Old Faithful	6/22/61	Not killed; shipped to zoo	
(19)	M	7/31/59	Gardiner	3/ 6/60	Gardiner	Shot by resident of Gardiner
(22)	M	8/ 7/59	Trout Creek	10/6/59	S.W. of Cooke City	Shot by hunter
23	F	8/10/59	Trout Creek	8/10/59	Trout Creek	Drug
24	M	8/11/59	Trout Creek	8/11/59	Trout Creek	Drug
31	F	6/19/60	Rabbit Creek	6/19/60	Rabbit Creek	Drug*
(32)	M	6/24/60	Trout Creek	10/-/61	S. of Cooke City	Shot by hunter
(47)	F	7/23/60	Trout Creek	8/ 6/60	Shoshone Lake	Unknown
(50)	M	7/28/60	Trout Creek	10/-/61	Thorofare	Shot by hunter

Mortality

distroin

distroin

distroin

TABLE XVII (Cont.)

MARKED BEARS DECEASED, 1959 - 1961

Bear No.	Sex	Date Marked	Where Marked	Date Killed	Where Killed	How Killed
(52)	M	7/30/60	Trout Creek	8/20/61	Moran, Wyo.	Shot by rancher
53	M	8/ 2/60	Trout Creek	8/24/61	Trout Creek	Specimen
(61)	F	8/12/60	W. Yellowstone	10/-/61	Hebgen Lake	Shot by hunter
(68)	M	8/30/60	Gardiner	10/-/61	Slough Creek	Shot by hunter
71	M	9/ 2/60	Trout Creek	9/ 2/60	Trout Creek	Drug*
77	F	9/28/60	Trout Creek	6/10/61	Trout Creek	Drug*
18A	F	6/ 8/61	Trout Creek	7/25/61	Not killed; shipped to zoo	
103	F	8/ 9/61	W. Yellowstone	8/ 9/61	W. Yellowstone	Drug
114	M	8/18/61	Canyon	8/24/61	Trout Creek	Specimen
✓ (118)	F	8/30/61	Trout Creek	9/ 2/61	Canyon	Drug* (at request of NPS)

distension

distension

* Note: Designated for shooting by rangers. In an attempt to save these bears they were shot with propulsive syringes in or near campgrounds. Because of the danger involved and the hazard to campers should the drug dose prove insufficient, a heavier than normal dose of succinylcholine chloride was used. Most bears survived the initial dose but succumbed to a second dose. A stress factor may be involved.

ACTIVITY AND MOVEMENT:

Certain activities of grizzlies have been discussed under Behavior. Other types of activity such as movements to bedding and hibernation sites, activity and movement in the vicinity of kills, induced movements following trapping and release and distances traveled by marked bears are more conveniently treated under the above heading.

Considerable data on activity and movement in the vicinity of kills has been recorded but not yet compiled.

Mortality

Major movements are recorded in Table XVIII and induced movements following capture and release at some distance from the area of capture are summarized in Table XIX.

BREEDING AGE AND POPULATION STRUCTURE:

Breeding age will be determined by observing marked known-age animals in the field. The following known-age bears have been captured and individually marked since 1959:

Cubs	- 24
Yearlings	- 13
2 Year olds	- 15
Total	<u>52</u>

In addition 17 three- or four-year-old bears have been captured and marked. Aging criteria for separating three and four year olds have not yet been thoroughly established, but it is expected that this will be worked out in greater detail next year from known-age bears.

To date no breeding has been observed among the known-age animals. However, breeding has been observed among established-age four-year-old bears.

Aging Techniques:

Specimens:

Eight known-age specimens have been collected over the past 3 years. These include the following:

Cubs	- 3
Yearlings	- 3
2 Year olds	- 2
Total	<u>8</u>

Four-, 3- or 4-year-old bears have been collected. The hide, skull and complete skeleton of all known-age and established-age bears have been processed and will be available for the aging study.

Dental Impressions:

Elastic impression material was used in 1960 for making dental impressions and reported on in the 2nd annual report. This was again used in 1961, but improved dental trays were utilized. Clay was molded over the upper and lower jaws of varied-size bear skulls representing age classes from cub to large adult. Fiber glass or acrylic was then fashioned or sprayed on these molds to form the trays. Seven sets, for both upper and lower jaws of various sizes were made. This type tray allowed the entire lower and upper dentition to be impressed with 2 trays. Casts made from these impressions not only show dentition development and wear but the mouth dimensions as well. In 1961 complete impressions were made on 40 different individuals; most of these were of known- or established-age bears. Positive casts were again poured with dental stone. Findings from these casts will be reported on later.

TABLE XVIII
MOVEMENT, 1959 - 1961

<u>Bear No.</u>	<u>Sex</u>	<u>Age</u>	<u>Area Marked</u>	<u>Date</u>	<u>Area Observed</u>	<u>Date</u>	<u>Distance from area where marked (airline miles)</u>
2	M	A	Trout Creek	6/27/59	Rabbit Creek	8/ 3/60 6/23/61	19.5
22	M	A	Trout Creek	8/ 7/59	N. of Cody, Wyo.	10/29/59	50
26	M	1 yr.	Trout Creek	8/21/59	Elk Park Trout Creek	5/ 7/60 6/21/60	14
00	M	A	Rabbit Creek	8/ 6/60	Hawk's Rest, Wyo.	9/---/60	<u>50</u>
65	F	A	Trout Creek	8/22/60	Cascade Lake	10/15/60	11
52	M	cub		7/30/60			
43	M	cub		7/ 9/60			
29	F	1 yr.	Trout Creek	8/28/59	Norris cutoff	10/29/60	7
50	M	A	Trout Creek	7/28/60	Thorofare Range, Wyo.	10/---/60	48
32	M	3-4	Trout Creek	6/24/60	Lamar Valley	5/ 2/61	24
					Pelican Creek	7/13/61	24
					Mary Lake	7/28/61	14
					5 mi S. Cooke City	10/-/61	54
46	M	A	Trout Creek	7/14/60	Lamar Valley	5/ 2/61	24
					Hayden Valley	6/17/61	24
67	M	3-4	Gardiner	8/26/60	Lamar Valley	5/ 2/61	29
					Gardiner	7/19/61	29
68	M	3-4	Gardiner	8/30/60	Lamar Valley	5/ 2/61	29
					Upper Slough Creek	10/-/61	14

Movement

TABLE XVIII (Cont.)
MOVEMENT, 1959 - 1961

<u>Bear No.</u>	<u>Sex</u>	<u>Age</u>	<u>Area Marked</u>	<u>Date</u>	<u>Area Observed</u>	<u>Date</u>	<u>Distance from area where marked (airline miles)</u>
77	F	1 yr.	Trout Creek	9/30/60	Norris Jct.	6/10/61	14
60	M	A	W. Yellowstone	8/10/60	Trout Creek	6/22/61	28
					W. Yellowstone	8/14/61	28
98	M	1 yr.	Trout Creek	7/28/61	Sylvan Lake	9/ 6/61	19
94	M	cub	Trout Creek	7/27/61	Cascade Lake	10/2/61	9
112	F	A	Trout Creek	8/15/61	Cascade Lake	10/18/61	9
61	F	2 yrs.	W. Yellowstone	8/12/60	S.E. Habgen Lake	10/-/61	8
Scarneck	M	A	Rabbit Creek	Season-'59	E. of Yellowstone River near Sulphur mtn. Rabbit Creek	6/9,11,16/61 6/23/61	21 21
Collared Bear	M	3-4	Trout Creek	Season-'60	Pelican Creek	10/12,16/61	11

TABLE XIX

INDUCED MOVEMENT AND DISTANCE TRAVELED, 1959 - 1961

<u>Bear No.</u>	<u>Sex</u>	<u>Age</u>	<u>Area Captured</u>	<u>Area Released</u>	<u>Date Released</u>	<u>Area Observed</u>	<u>Date Observed</u>	<u>Distance Traveled (airline miles)</u>
2	M	A	Thumb	Trout Creek	6/27/59	Thumb	7/ 2/59	15
			Thumb	Carnelian Cr.	7/ 6/59	Trout Creek	7/ 8/59	17
4	M	A	Thumb	Trout Creek	7/ 2/59	Thumb	7/ 5/59	15
			Thumb	Carnelian Cr.	7/11/59	Trout Creek	7/14/59	15
			Pelican Cr.	Trout Creek	7/25/60	Pelican Creek	7/27/60	10
			Pelican Cr.	Rabbit Creek	7/27/60	Pelican Creek	8/ 2/60	18
11	F	1 yr.	Canyon	Crystal Creek	7/19/59	Fishing Bridge	7/28/59	25
12	M	A	Fishing Bridge	Crystal Creek	7/21/59	Trout Creek	7/24/59	21
8	F	A	Thumb	Trout Creek	7/ 8/59	Rabbit Creek	7/24/59	18
9	F	A	Thumb	Trout Creek	7/ 8/59	Thumb	8/16/60	15
47	F	3-4	Thumb	Trout Creek	7/23/60	Shoshone Lake	8/18/60	18
1	M	A	Thumb	Trout Creek	6/26/59	Old Faithful	9/ 1/60	18
43	M	1 yr.	Canyon	Mary Lake	8/ 2/61	Fishing Bridge	8/15/61	14
80	M	2 yrs.	Canyon	Trout Creek	7/ 2/61	Canyon	8/ 4/61	8.5
				Mary Lake	8/ 4/61	Indian Creek	8/15/61	9
				Hayden Valley	8/15/61	Canyon	8/27/61	11
18 &	F	A	Old Faithful	Trout Creek	6/ 8/61	Clearwater Sp.	6/12/61	16
78	M	cub				Alum Creek	6/14/61	14
						Bridge Bay	6/15/61	11

TABLE XIX (Cont.)

INDUCED MOVEMENT AND DISTANCE TRAVELED, 1959 - 1961

<u>Bear No.</u>	<u>Sex</u>	<u>Age</u>	<u>Area Captured</u>	<u>Area Released</u>	<u>Date Released</u>	<u>Area Observed</u>	<u>Date Observed</u>	<u>Distance Traveled (airline miles)</u>
78	M	cub	Bridge Bay	Trout Creek	6/16/61	Sulphur Mtn.	6/18/61	2
			Sulphur Mtn.	Hayden Valley	6/18/61	Grand View	6/24/61	6
			Grand View	Promontory Pt.	6/25/61	Steamboat Pt.	7/ 2/61	27
37	M	2 yr.	Thumb	Trout Creek	6/26/61	Wolf Point	7/ 8/61	26
						Thumb	7/15/61	9
			Thumb	Trout Creek	9/11/61	Thumb	7/28/61	15
52	M	1 yr.	Canyon	Blacktail Deer Creek	6/23/61	Canyon	6/25/61	14
			Canyon	Mary Lake	8/ 1/61	Moran, Wyo.	8/20/61	55
79	F	1 yr.	Gardiner	Trout Creek	6/16/61	Pelican Creek	7/ 3/61	10
			Pelican Cr.	Hayden Valley	6/ 4/61	Pelican Creek	8/21/61	15
38	M	2 yrs.	Pelican Cr.	Trout Creek	7/10/61	Pelican Creek	7/14/61	11
			Pelican Cr.	Promontory Pt.	7/18/61	Pelican Creek	7/21/61	31
			Pelican Cr.	Gardiner	7/24/61	Indian Creek	8/ 6/61	12
107	F	A	Canyon	Trout Creek	8/10/61	Canyon	9/12/61	9
116	M	1 yr.	Fishing Bridge	Trout Creek	8/24/61	Fishing Bridge	8/29/61	9

The value of making dental impressions and casts is that a perfect replica of the dentition can be made periodically from re-trapped, marked, known-age or established-age animals. Thus a series of casts from individual bears from cub stage through adulthood can be obtained and these used for comparative study.

The technique yields information on changes in dentition that can be associated with age in the grizzly bear. Tooth succession, eruption, development, and wear are readily discerned from the casts.

Foot Impressions:

To determine if there is a correlation between foot size and age of the animal, impressions were made of the right fore-foot of 31 individuals. All but one of these bears were known-age or established-age animals. Of the 31, 11 were cubs, 8 were yearlings, 9 were 2-year-olds, and 2 were 3-year-old animals. Findings from these casts will also be reported on later.

X-Rays:

A portable X-ray machine was used in 1961 to photograph the dentition, epiphyseal sutures and phalanges of a number of known-age individuals. A total of 16 bears - 6 cubs, 5 yearlings, and 5 2-year-olds - was X-rayed during the course of the 1961 season. These X-rays clearly show the pattern of tooth replacement and the degree of bone and suture development. Complete analyses of these will be made in the future.

Population Structure:

Cohorts for five generations of bears 1957 through 1961 have been computed from captured known-age or established-age bears. Some modification of these may be necessary when criteria for aging 3- and 4-year-olds becomes more precise. The 1960 and 1961 cohorts will be enlarged with the addition of 1-, 2-, and 3-year-old bears trapped and aged in future years.

The fate of the individuals included in each cohort will be determined over the years to establish age specific mortality rate, longevity, mean life and population turnover. //

The 1957 cohort was determined by aging 2-, 3-, and 4-year-old bears captured in 1959, 1960, and 1961 respectively.

The 1958 cohort was determined by aging yearlings, and 2- and 3-year-old bears captured in 1959, 1960, and 1961 respectively.

The 1959 cohort was compiled after aging cubs, yearlings, and 2-year-old bears captured in 1959, 1960, and 1961 respectively.

The 1960 cohort was compiled by aging cubs and yearlings captured in 1960 and 1961 respectively.

The 1961 cohort represents cubs captured in 1961.

The cohorts are as follows.

1957 - COHORT

2 Year Olds Captured in 1959

Established-Age Bears

<u>Bear No.</u>	<u>Sex</u>	<u>Date</u>	<u>Re-capture Dates</u>	<u>Dental Casts</u>	<u>Longevity</u>
10	F	7/19/59	8/12/61	No Yes	30 mos. 55 mos.
15	F	7/27/59	7/13/61	No Yes	30 mos. 54 mos.
<u>3*</u>	F	6/28/59	Shot by Rangers.		29 mos.
9	F	7/ 9/59	8/16/60	No No	30 mos. 43 mos.
<u>19*</u>	M	7/31/59	Shot in Gardiner.		30 mos.

* Dead

1957 - COHORT

3 Year Olds Captured in 1960

Established-Age Bears

<u>Bear No.</u>	<u>Sex</u>	<u>Date</u>	<u>Re-capture Dates</u>	<u>Dental Casts</u>	<u>Longevity</u>
45	F	7/13/60	8/16/61	Yes Yes	42 mos. 55 mos.
<u>32*</u>	M	6/24/60	7/13/61	No Yes	41 mos. 54 mos.
35	M	6/26/60		No	41 mos.
47*	F	7/23/60	Shot at Shoshone Lake	Yes	42 mos.
50	M	7/28/60		Yes	42 mos.
54	F	8/ 2/60		Yes	43 mos.
55	F	8/ 2/60		Yes	43 mos.
62	F	8/12/60		Yes	43 mos.
67	M	8/26/60		Yes	43 mos.
68*	M	8/30/60		Yes	43 mos.
74	M	9/25/60	7/14/61	No No	44 mos. 54 mos.
76	M	9/28/60		No	44 mos.

* Dead

1957 - COHORT

4 Year Olds Captured in 1961

Established-Age Bears

<u>Bear No.</u>	<u>Sex</u>	<u>Date</u>	<u>Re-capture Dates</u>	<u>Dental Casts</u>	<u>Longevity</u>
81	F	7/ 5/61		Yes	54 mos.
101	F	8/ 3/61		No	55 mos.

1958 - COHORT

Yearlings Captured in 1959

Established-Age Bears

<u>Bear No.</u>	<u>Sex</u>	<u>Date</u>	<u>Re-capture Dates</u>	<u>Dental Casts</u>	<u>Longevity</u>
5	F	7/ 4/59	9/ 2/60	No No	18 mos. 32 mos.
11*	F	7/19/59	7/31/59 (Killed by Ranger) Have Skull (may have been a 2-year-old check skull)	No	

1958 - COHORT

2 Year Olds Captured in 1960

Established-Age Bears

<u>Bear No.</u>	<u>Sex</u>	<u>Date</u>	<u>Re-capture Dates</u>	<u>Dental Casts</u>	<u>Longevity</u>
40	F	7/ 1/60	10/24/60 9/22/61	No No Yes	30 mos. 33 mos. 44 mos.
61*	F	8/12/60		Yes	31 mos.
66	F	8/26/60		Yes	31 mos.

1958 - COHORT

3 Year Olds Captured in 1961

Established-Age Bears

<u>Bear No.</u>	<u>Sex</u>	<u>Date</u>	<u>Re-capture Dates</u>	<u>Dental Casts</u>	<u>Longevity</u>
96	F	7/27/61		Yes	42 mos.
103*	F	8/ 9/61	Killed by drug.	Have Skull.	43 mos.

* Dead

1959 - COHORT

Cubs Captured in 1959

KNOWN-AGE BEARS
(Marked as cubs)

<u>Bear No.</u>	<u>Sex</u>	<u>Date</u>	<u>Re-capture Dates</u>	<u>Dental Casts</u>	<u>Longevity</u>
6	F	7/ 4/59	7/29/60 8/19/60 8/ 2/61	No No Yes Yes	6 mos. 18 mos. 19 mos. 31 mos.
26	M	8/21/59	7/14/60	No Yes	7 mos. 18 mos.
24*	M	8/11/59	Killed by Drug. Have Skull.		
25	Unk.	8/20/59		No	7 mos.
29	F	8/28/59	7/14/61	No Yes	7 mos. 30 mos.

* Dead

1959 - COHORT

Yearlings Captured in 1960

Established-Age Bears

<u>Bear No.</u>	<u>Sex</u>	<u>Date</u>	<u>Re-capture Dates</u>	<u>Dental Casts</u>	<u>Longevity</u>
77*	F	9/28/60		Yes	20 mos.
			6/10/61	Yes	29 mos.
			Killed by drug 6/10/61. Have Skull.		
38	M	6/29/60		Yes	17 mos.
			7/11/61	Yes	30 mos.
			8/ 7/61	No	31 mos.
51	M	7/29/60		Yes	18 mos.
56	M	8/ 4/60		Yes	19 mos.
			5/28/61	No	28 mos.
57	M	8/ 4/60		Yes	19 mos.
37	M	6/29/60		No	17 mos.
			8/22/60	Yes	19 mos.
			6/27/61	Yes	29 mos.
36	M	6/26/60		Yes	17 mos.

* Dead

1959 - COHORT

2 Year Olds Captured in 1961

Established-Age Bears

<u>Bear No.</u>	<u>Sex</u>	<u>Date</u>	<u>Re-capture Dates</u>	<u>Dental Casts</u>	<u>Longevity</u>
80	M	7/ 2/61	8/ 4/61 8/15/61 8/27/61	Yes No No No	30 mos. 31 mos. 31 mos. 31 mos.
86	F	7/12/61		Yes	30 mos.
91	F	7/20/61		Yes	30 mos.
95	M	7/27/61		Yes	30 mos.
106	M	8/11/61		Yes	31 mos.
115	F	8/23/61		Yes	31 mos.
118*	F	8/30/61	9/ 2/61 Killed by drug.	Yes	31 mos.

* Dead

1960 - COHORT

Cubs Captured in 1960

KNOWN-AGE BEARS
(Marked as cubs)

<u>Bear No.</u>	<u>Sex</u>	<u>Date</u>	<u>Re-capture Dates</u>	<u>Dental Casts</u>	<u>Longevity</u>
53*	M	8/ 2/60		Yes	7 mos.
			8/17/61	Yes	19 mos.
			Sacrificed for known-age specimen. Have Skull.		
43	M	7/ 9/60		Yes	6 mos.
			8/ 2/61	Yes	19 mos.
49	F	7/26/60		Yes	6 mos.
52*	M	7/30/60		Yes	6 mos.
			8/22/60	No	7 mos.
			6/22/61	Yes	17 mos.
			8/ 1/61	Yes	19 mos.
70	F	9/ 2/60		Yes	8 mos.
71*	M	9/ 1/60		No	8 mos.
			Killed by drug 9/1/60. Have Skull.		

1960 - COHORT

Yearlings Captured in 1961

Established-Age Bears

<u>Bear No.</u>	<u>Sex</u>	<u>Date</u>	<u>Re-capture Dates</u>	<u>Dental Casts</u>	<u>Longevity</u>
79	F	6/16/61		Yes	17 mos.
			7/ 3/61	No	18 mos.
			8/21/61	No	19 mos.
98	M	7/28/61		Yes	18 mos.
114*	M	8/18/61		Yes	19 mos.
			8/21/61	Sacrificed for known-age specimen. Have Skull.	
116	M	8/24/61		Yes	19 mos.
121	F	9/19/61		Yes	20 mos.
			10/17/61	Yes	21 mos.

* Dead

1961 - COHORT

Cubs Captured in 1961

KNOWN-AGE BEARS
(Marked as cubs)

<u>Bear No.</u>	<u>Sex</u>	<u>Date</u>	<u>Re-capture Dates</u>	<u>Dental Casts</u>	<u>Longevity</u>
18A	F	6/22/61	7/10/61 7/21/61 7/25/61 8/13/61	Yes No Yes No Trapped and sent to zoo.	5 mos. 6 mos. 6 mos. 6 mos.
92	M	7/21/61	8/22/61	Yes Yes	6 mos. 7 mos.
78	M	6/ 8/61	6/16/61 7/ 7/61	No Yes No	5 mos. 5 mos. 6 mos.
82	F	7/ 5/61		No	6 mos.
83	M	7/ 5/61		Yes	6 mos.
93	F	7/25/61	8/22/61	Yes Yes	6 mos. 7 mos.
94	M	7/27/61		Yes	6 mos.
97	M	7/28/61		Yes	6 mos.
99	F	8/ 2/61		Yes	7 mos.
100	M	8/ 3/61		Yes	7 mos.
109	F	8/14/61		Yes	7 mos.
110	F	8/14/61		Yes	7 mos.
117	F	8/29/61		Yes	7 mos.

Mortality by generations or cohorts is presented in Table XX. If mortality records of a sufficient number of known or established-age bears can be obtained, life tables can be constructed to show mean life, age specific mortality and mean expectation of life as well as population turnover. Mortality curves will be compared with survival curves. Data on survival will be obtained by annually re-trapping and observing marked known-age bears in the population.

TABLE XX
MORTALITY BY GENERATIONS

Known or Established Age Bears

<u>Bear No.</u>	<u>Sex</u>	<u>Age</u>	<u>Weight, lbs.</u>	<u>Specimens Obtained</u>		<u>Fate</u>
				<u>Skull</u>	<u>Skeleton</u>	
1957 Cohort:						
3	F	2	150	X		Shot by Rangers, 7/4/59.
19	M	2	235			Shot in Gardiner, 4/6/60.
47	F	3	190	X		Shot at Shoshone Lake, 1960.
32	M	4(?)	310			Shot by hunter S. of Cooke City, 1961.
50	M	3(?)	270(7/60)			Shot by hunter in Thorofare, 1961.
68	M	4(?)	225(8/60)			Shot by hunter, Slough Cr., 1961.
1958 Cohort:						
11	F	1	120	X		Killed by Rangers, 7/31/59.
103	F	3	270	X	X	Killed by drug, 8/9/61.
61	F	3	185(8/60)			Killed by hunter, Hebgen Lake, Mont., 1961.

TABLE XX (Cont.)
MORTALITY BY GENERATIONS

Known or Established Age Bears

<u>Bear No.</u>	<u>Sex</u>	<u>Age</u>	<u>Weight, lbs.</u>	<u>Specimens Obtained</u>		<u>Fate</u>
				<u>Skull</u>	<u>Skeleton</u>	
1959 Cohort:						
24	M	cub	70	X		Killed by drug, 8/11/59.
77	F	1	145	X	X	Killed by drug, 6/10/61.
118	F	1	145	X	X	Killed by drug, 9/2/61.
1960 Cohort:						
53	M	cub	90	X	X	Sacrificed, 8/24/61.
114	M	1	95	X	X	Sacrificed, 8/24/61.
71	M	cub	85	X	X	Killed by drug, 9/1/60.
52	M	1	?			Shot by rancher, Moran, Wyo., 1961.
1961 Cohort:						
18A	F	cub	30			Sent to Zoo, 8/13/61.

HEMATOLOGY AND PATHOLOGY:

This phase of the study is being conducted by Dr. Morgan Berthrong, pathologist, Penrose Hospital, Colorado Springs, Colorado. It will be closely correlated with the ecological studies. The exploratory work to date is based on 2 autopsies of black bears, 2 autopsies of known-age grizzlies and hematologic studies of 1 black bear and 3 grizzlies. Analyses of other material and specimens are not yet complete, but the data accumulated to date has opened promising areas for further intensive study. Some notes from Dr. Berthrong's reports are presented. Remarks concerning hematology and pathology are made in comparison to man. Except where stated, no distinction is made between the grizzly and the black bear.

Gross Autopsies:

1. Two fat adult black bears and two young and rather thin yearling grizzlies showed a remarkable absence of arteriosclerosis. The ascending aortas of all were peculiarly thick-walled in relation to humans. This thickness tapered rapidly to an effected aortic wall in the arch and remainder of the aorta.
2. Coronary arteries were absolutely free of arteriosclerosis.
3. The livers, gall bladders and bile ducts were normal as were the pancreases and spleens.
4. Other than the striking lobulation of the kidneys, the urinary tracts were normal.
5. The adrenal weights were small for the size of the animals. A 100-200 lb. man would have about 12-16 grams of adrenals. These animals had about 6-8 grams of adrenals.
6. Intestines - 49 feet from anus to duodenum in grizzly No. 53.
7. The rugal folds of the stomach and the villi of the small intestine were extremely prominent as compared to man. In addition, the mucosal folds in the entire small intestine had a general pattern resembling the gastric mucosal rugal rather than the transverse folds seen in man.
8. Thyroid - very small and thin. These weighed from 5 to 10 grams. (Adult human thyroid glands weigh 30-40 grams. Very old humans may have 10 gram thyroids.)
9. Testes, skeletal muscle, veins, diaphragm, pleura, peritoneum, mediastinum, retroperitoneal space, lymphnodes, bones and bone marrow appeared normal and no parasites were seen.
10. Fat was pale yellow compared to man. In human infants and children the fat is pale yellow but adult man usually shows an orange-yellow colored fat.
11. The eyes are small; two-thirds the size of man.

Hematology &
Pathology

Microscopic Studies: (all observations are in comparison to tissues of man.)

1. Large, medium, and small arteries were totally free of intimal or medial arteriosclerosis.
2. The peculiar thickening of the ascending aorta seems to be the consequence of medial fibrous tissue which lies between the elastica in large bundles causing a loss of the usual regularity of the medial elastica. Smooth muscle is present also in these bundles. In the descending aorta, these fibrous and smooth muscle masses are much less evident and the aortic media more closely resembles man's. Perhaps this ascending aortic wall is related to cardiac output, blood pressure, etc., but whatever, is so striking a change as to warrant study.
3. The myocardium is normal as are the valves, epicardium and endocardium.
4. The livers of two bears, 53 and 114, contain small granulomas of unknown etiology. These granulomata are tiny, contain clefts which may represent fatty material, and probably are of no pathologic significance in these animals. One section of gall bladder is different from man's in the presence of accumulations of lymphocytes in the mucosa. No infiltrations of the muscularis are present. The pancreases show very prominent zymogen granules in the acini - suggestive of vigorous secretion of enzymes. The islets of Langerhans cells show hydropic change in one animal, 114. Perhaps stress. The spleens show remarkably prominent trabeculae, which appear very muscular; perhaps the bear spleen does act as a very significant reservoir for blood - not the case in man - definitely the case in dogs.
5. The multilobular kidneys were histologically normal except for a peculiar projection of the renal papillae into the calyces further than that in man. This suggests an ability to concentrate urine by greater water reabsorption in long loops of Henle. (Desert animals have extraordinarily long renal papillae projecting long ways into the calyces and pelves.)
6. The adrenals are quite different from man's. The zona glomerulosa is very broad and cellular. This zone is thought to produce the salt (Na^+ , Cl^- , K^+) regulating hormone. The zona fasciculata is cellular and the cells are large without much lipoid content. (Perhaps this has been lost during the 24 hours in the trap.) The medulla is huge in relation to the cortex - the medulla produces epinephrine and nor-epinephrine.
7. The stomachs show tremendously thick mucosa in which the parietal cells are especially prominent (HCl). The whole small intestine show extremely long and numerous villi. These are concerned with absorption of food in man. In malabsorption syndromes in man, the villi are absent or are blunted. Bears must have an absolutely fantastic absorption capacity as far as the gut mucosa is concerned.
8. The microscopic appearances of the thyroids are completely normal. There is no evidence of scarring, epithelial atrophy, or hyperplasia or of thyroiditis.

9. The testicles of 53 and 114 are clearly pre-pubertal as far as spermatogenesis is concerned. However the Leydig cells seem numerous and active. The mature tubules of the black bear were not producing sperm but the Leydig cells were foamy and abnormal.

No worms or cysts were found in the skeletal muscle but one granuloma in the skeletal muscle of 114 may be the residuum of a trichina cyst. One lymphnode was full of plasma cells. (These are related to gamma globulin in man.)

10. The fat is histologically normal.

11. The eyes show a rather thick layer of conjunctival cells over the cornea, and a retinal layer that extends far anterior and (lateral vision) seems rather thin.

Hematologic Studies:

The hematocrits and white blood cell counts seem reasonable. The grizzly with the heaviest infection of worms (not yet specifically identified), the abscess in the neck, and the lung lesions (53), had a leukocytosis and more polymorphonuclear cells than the others. The other grizzly with the most severe lung lesions (114), was slightly anemic. Eosinophilia was notably absent but my blood smears stained poorly! Blood platelets seem normal.

Chemical Studies:

The bears are, not surprisingly, similar to man in most regards.

Uric acid levels are distinctly low. (High uric acid levels are related to gout in man!) This may be a reflection of diet rather than a basic metabolic difference.

The protein bound iodine is definitely low and with the small thyroids suggests a metabolic difference from man. This may be related with high normal cholesterol levels. Hypothyroidism in man (PBI levels below 3.5) is usually associated with hypercholesterolemia. Both however are usually associated with some arteriosclerosis if not severe disease.

Paper electrophoresis of the serum proteins suggests low gamma globulins and an octnal or relative elevation of beta globulins. It has been suggested that beta globulins and related beta lipoproteins may function to increase solubility of fats in the blood and thus be anti-arteriosclerotic? The high vegetable diet of these animals may be far more important in preventing arteriosclerosis than these chemical findings but the studies should definitely be extended.

Detailed data are presented in Table XXI.

TABLE XXI

CHEMICAL STUDIES: BEARS, 1961

<u>Test</u>	<u>Black Bear</u>	<u>Grizzly 53</u>	<u>Grizzly 114</u>	<u>Grizzly 116</u>	<u>(in our lab.) Human Normals</u>
Amylase	—	42	67	86	20 - 150 units
Sodium	143	148	141	140	135 - 145 mEq/L
Potassium	5.3	5.1	5.1	5.0	3.5 - 5.0 mEq/L
Chloride	99	104	103	95	95 - 105 mEq/L
Blood urea nitrogen	11.1	13.2	14.6	13.3	8 - 25 Mgm%
Uric Acid	2.2	1.1	1.0	1.1	3 - 6 Mgm%
P.B.I. (protein bound iodine)	2.3	3.3	2.9	2.6	3.5 - 8 Mcg%
Prothrombin time	—	—	12.7 sec	16 sec	12.5 - 13.5 secs
Acid phosphatase	—	1.8	1.4	1.9	0 - 4 KA units
Cholesterol	313	299	220	273	150 - 280 Mgm%
Cholesterol esters	65%	35%	55%	63%	50 - 65%

Serum levels of:

mEq/L = Milliequivalents per liter

Mgm% = Milligram %

Mcg% = Microgram %

GROWTH AND DEVELOPMENT:

Information on growth and development is being obtained from weights and measurements of 46 individual bears recaptured and from the 77 dental casts and 34 foot casts made to date. Much of the information has not yet been compiled from the field form sheets. There is evidence of rapid growth and development during the first 3 to 4 years of life.

A young male captured and marked in 1959, weighed 200 lbs. Re-captured in 1960 he weighed 520 lbs.

A male cub marked in 1959, weighed 90 lbs. Re-captured in 1960 he weighed 145 lbs. A male litter mate captured in 1961 weighed 360 lbs.

Two-year-olds may weigh up to 360 lbs. with 64" total length and 9" rear foot pad.

Three- or four-year-olds may weigh up to 520 lbs. with 77" total length and $10\frac{1}{2}$ " rear foot pad.

Weights and measurements of some of the larger bears captured are presented in Table XXII.

Some Weights & measurements of Large Bears

TABLE XXII

SOME WEIGHTS AND MEASUREMENTS OF LARGE BEARS

<u>No.</u>	<u>Sex</u>	<u>Wt. (Lbs.)</u>	<u>Total Length (Inches)</u>	<u>Length Rear Foot Pad (Inches)*</u>
12	M	620	83	11
13	M	645	81	11
30	M	710	—	11
73	M	780	$76\frac{1}{2}$	$10\frac{1}{2}$
89	M	635	$80\frac{1}{2}$	$10\frac{1}{4}$

* Not including claws

RADIOTRACKING:

The radiotracking of grizzly bears is being conducted under a National Science Foundation grant (G-17502) as a part of the overall ecological study of the grizzly bear (Ursus horribilis). This phase of the study is being done by Dr. Frank C. Craighead, Jr., Research Associate, Montana State University, and Wildlife Consultant, National Geographic Society.

A prototype transmitter was field tested in 1960 and a complete tracking system assembled and operated in the fall of 1961.

Specific Objectives:

Specific objectives of this project:

1. To perfect and test a radio tracking system useful in gathering information about grizzly bears and other large mammals.
2. To apply the perfected tracking system to grizzly bears in Yellowstone National Park to obtain ecological and behavioral data.
3. To gather a background of information and experience that will lead to successful telemetering of data from wild mammals under natural conditions.

Results:

During 1961 in collaboration with Philco Corporation engineers we developed and field tested on grizzly bears the first stages of a radio-tracking system. We successfully attained our first season objectives by instrumenting two grizzly bears and tracking one of them intermittently for a period of one month--September 22 to October 19. (The grizzlies went into hibernation October 22 during a blizzard). We made sufficient progress to check theory with practice, to determine specifications for future radio equipment, to appraise our approach to the problem, and to chart more specifically future steps in a program to perfect a radiotracking system for grizzly bears and big game species. To some extent we were able to determine the capabilities as well as the potentialities of the system. Judging from results to date, it gives promise of being a useful contribution to ecological studies.

Transmitters - Receivers: Systems Performance

The initial transmitter requirements have been met by Philco's engineers. In field tests, CW and pulsed transmitter signals were picked up at distances varying from 3 to 5 miles. With the portable directional receivers the maximum distance attained with instrumented bears was one mile. This will be increased but is sufficient for the field requirements of the portable equipment. The first grizzly instrumented (#40) was located 16 times by means of the pulsed transmitter and directional receivers. In nearly every case the bear was tracked or approached and

further identified by color markings. The animal was tracked for distances of 2 to 3 miles and contact kept for several hours at a time. On four occasions the animal was located after dark and twice in snowstorms where location and identification without radio would have been impossible. The directional quality of the receivers was excellent but connection difficulties arising from rugged use of the equipment at times caused malfunctioning. Philco engineers plan to improve the next models based on these field tests.

Attachment:

The transmitter attachment has been satisfactorily solved even though one of two collars was lost. The loop antenna served as a collar, the transmitter and batteries naturally coming to rest under the neck of the bear. The antenna was encased in polyethylene braided rope and the entire package sealed with a combination of fiberglass and acrylic. There was no indication that bear #40 was annoyed or disturbed by the collar. The second bear to be instrumented (#37) had worn a dummy collar and transmitter for over a year. Consequently when this bear was re-trapped and a transmitter attached, the antenna collar was put on loosely--actually slipped over the bear's head--to attain increased signal distance. The bear managed to remove this collar.

Power, Weight, Life:

Power of 10 volts was obtained by connecting 7 (seven) Mallory mercury cells # RM-1450 RT 2 in series. Their total weight was slightly under a pound. The life with present transmitter is estimated at between 60 and 90 days. The batteries had the advantage of operating at full capacity at 32° F., 50 percent at 15° F., and the high temperature limit is 160° F. The total weight of the collar including transmitter, batteries, antenna and protective covering was approximately 2.5 pounds. With further experimentation the weight can be reduced and the life increased.

Mobile Unit:

A mobile unit consisting of a sensitive receiver, directional hi-gain yagi antenna and 110 volt AC generator used in conjunction with the portable equipment would have greatly improved tracking results. Equipment delays and early snows prevented field testing of a mobile unit.

Wildlife Tracking System:

The present wildlife tracking system consists of two separate systems functioning together--a voice communication system and a radio-tracking system. A brief description of the equipment comprising both systems used during 1961 is outlined later. Most of the tracking equipment was provided by Philco's Western Development Laboratories, but some items as well as servicing parts, tools, and meters were purchased with funds supplied by the NSF grant.

Voice Communication System:

The voice communication system consisted of a Citizen's Band transceiver, two mobile units and one portable walkie-talkie. Performance

tests were run and the equipment adjusted for maximum efficiency in the operating area. Several types of antennae were tested and compared, including a home-made dipole. The performance of the system proved adequate for our needs. The effective range was in the neighborhood of 10 to 12 miles. Points of good and poor reception were plotted. Performance improvements are possible and contemplated for next season.

Tracking system:

The grizzly bear tracking system will consist of pulsed transmitters, two or more portable directional receivers, two mobile receivers with high-gain yagi antennae and if necessary one fixed station with high gain antenna. The mobile and fixed stations will use 110 volt AC current. This summer we developed, tested, and put into operation the portable tracking components of the system. This part of the system required developmental work by Philco engineers and proved particularly valuable for following and approaching bears for observational purposes. It consisted of two directional receivers, a field strength meter, and one (CW) and two pulsed transmitters.

Collaboration:

In mid-September, Mr. Richard Davies, Chief Scientist, Philco's Western Development Laboratories, spent five days working with us in Yellowstone and testing the equipment he and his staff had developed.

Mr. H. L. Franciscus (W3ELV) of Carlisle, Pennsylvania, spent August 2-8 with us and contributed materially to the success of the project.

The National Park Service arranged for the loan of equipment and provided for a tracking frequency (Government). Mr. Fred Dennison, Land Air representative working under contract to the Park Service, gave needed technical help from time to time.

Description of Experimental Wildlife Tracking System:

Tracking Equipment:

1. Transmitter

32 megacycles; pulsed at a low audio rate with 10% duty cycle; peak power into antenna between 50 and 100 milliwatts; no telemetry modulation; pulse rate between 3 and 30 cps. Size: 1" x 1" x 2". Weight: 2 oz. Power: 9 volts and between 10 to 20 millilamps peak. Antenna: resonant loop, single turn, about 10 inches in diameter. This loop mounted around animal's neck. The transmitter is crystal controlled. The battery life, using Mallory type 1450 mercury cells, should be in excess of 60 days.

2. Receivers

- a. An Osborne Duo-Comm 100 Citizens Band transceiver was adapted to 32 mc. A BFO was added. The

receiving antenna is a loop, 12 inches in diameter. The total equipment weighs under 2 lb. The receiver is crystal controlled.

- b. A modified Duocom receiver with synchronous detector and antenna plus a phase detector with amplifier. The receiving antenna is a combination whip and 12" loop. The total equipment weighs 8 lb. The receiver is crystal controlled.
- c. Hallicrafters SX-42 using 110 volt AC current and a non-directional 18' wire or a horizontal wire dipole.

Voice Communication Equipment:

Two Citizens Band transceivers - Heathkit CB-1. 27 megacycles; maximum power input to final R.F. amplifier 5 watts; crystal controlled; power: 6 or 9 volts DC or 110 volts AC. Mobile or fixed.

One Citizens Band transceiver - Heathkit GW-10. 27 megacycles; max power input 5 watts; crystal controlled. Power 6 volt DC convertible to 12 volt DC or 117 volt AC.

One Citizens Band hand-held or portable transceiver - Heathkit model CW - 30. 27 megacycles; max power input 90 milliwatts; crystal controlled. Power 9 volt battery.

Of these, two units were used mobile, one fixed, one portable.

GENERAL COOPERATION:

Blood Samples:

Blood was collected from 31 different individuals. Nine of these samples, taken at intervals throughout the season, were sent to Dr. Murray Johnson, University of Puget Sound, for analysis. Dr. Morgan Berthrong, pathologist at Penrose Hospital, Colorado Springs, Colorado, also analyzed blood specimens taken in the field and immediately centrifuged in the laboratory.

These are reported in greater detail under the section Hematology and Pathology.

Milk Samples:

During the 1961 season, milk samples from two lactating grizzly sows and two black bear sows were collected and sent to Dr. Robert Jenness, University of Minnesota.

Analysis of the first sample sent to Dr. Jenness in 1960 appears in Table XXIII.

TABLE XXIII

ANALYSIS OF GRIZZLY BEAR MILK IN COMPARISON
WITH MILKS OF OTHER CARNIVORES AND OF COW

Constituents	Typical Cow	Grizzly Bear	Raccoon	Ferret		Dog		Lion
				a	b	a	b	
Total Solids	12.5	38.6	-	22.1	25.3	24.8	25.0	30.2
Fat	3.6	19.8	5.2	6.1	10.0	10.9	10.8	17.5
Casein	2.5	8.0	4.6	3.6	2.9	4.3	6.8	5.7
Whey Protein	0.8	5.4	0.9	2.5	3.0	2.4	2.8	3.6
Ash	0.7	1.3	-	0.8	0.7	-	1.2	-
Crude Carbohydrate ¹	4.9	4.1	-	9.1	8.7	-	3.4	2.4
Apparent ² Lactose	4.6	0.7	3.4	3.9	3.6	3.6	3.2	3.4

¹Crude Carbohydrate - Total Solids - (Fat + Casein + Whey Protein + Ash)

²Apparent Lactose - Lactose equivalent of reducing power (picric acid method)

Autopsies:

Dr. Morgan Berthrong performed complete autopsies on two grizzlies and two black bears. The grizzlies, both young males, were habitual nuisance bears and were sacrificed at the request of the Park Service. The small intestines of both were compacted with round worms and the bears were in extremely poor condition. Dr. Berthrong collected blood, tissues, and glands for further study and analysis.

Three other grizzlies were autopsied by project personnel and tissue and organs preserved. Hearts, from black bears killed by Park Service personnel in addition to those from grizzlies, were sent to the Armed Forces Institute for study. Complete skeletons of 7 grizzlies were taken to Ken Greer of the Animal Disease Laboratory at Montana State College, Bozeman, Montana. These skeletons will be cataloged and available for future study. All other materials and specimens, including hides, were cataloged at Montana State University.

Cooperation from National Park Service and the Yellowstone Park Company:

The project has received active support from the administration and personnel of Yellowstone National Park. Superintendent Garrison and his staff have helped to maintain conditions conducive to research. Special thanks are also due rangers Bill Burgen and Harry Reynolds. Much of the work has been done in their districts and they have helped project personnel in many ways.

We are most grateful to the Yellowstone Park Company for donating living quarters and other facilities. Mr. Gene Laitella and Mr. Lamar Bettinger, Company officials, not only made these quarters available, but helped the project in other ways as well.