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NORTH SLOPE GRIZZLY BEAR STUDIES

by
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Volume I
Project Progress Report
Federal Aid in Wildlife Restoration
Project W-17-6, Jobs 4.8R, 4.9R, 4.10R and 4.11R

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JOB PROGRESS REPORT (RESEARCH)

State: Alaska

Cooperators: Harry Reynolds and Renewable Resources Consulting Services, Ltd.

Project No.: W-17-6 Project Title: Big Game Investigations

Job Nos.:	Job Titles:
4.8R	Movements and Population Discreteness of North Slope Grizzly Bears
4.10R	Comparison of Censusing Techniques of North Slope Grizzly Bears
4.11R	Food Habits of North Slope Grizzly Bears

Period Covered: July 1, 1973 through June 30, 1974

SUMMARY

The Alaska Department of Fish and Game and Renewable Resources Consulting Services, Ltd., an environmental consulting firm, conducted a cooperative study of the grizzly bear in the eastern Brooks Range, Alaska. A total of 39 bears were captured, individually color-marked and released. The sex ratio of captured bears was nearly equal; although there was some disparity observed between ratios on the north and south sides of the Brooks Range it was assumed to have been an artifact of small sample size.

The age at which female grizzlies first produce young in the eastern Brooks Range was tentatively estimated at 8.5 years on the basis of limited data, and a mean litter size of 1.8 was calculated from observations of 13 family groups.

Delayed implantation was documented when a reproductive tract was collected from an 11.5-year-old female and 2 free blastocysts were recovered from her uterus on September 29, 4 months after the bear was captured in estrous condition.

The usefulness of three census techniques was evaluated: the differential efficiency method, the Lincoln Index and the direct count. The differential efficiency method was judged completely inadequate. The Lincoln Index and the direct count gave similar results with acceptable accuracy.

Food habits and mortality are discussed.

Movement was determined from resightings of marked bears; males traveled greater distances than females. Bears were observed to cross the Brooks Range hydrographic divide to reach denning areas, and likely cross throughout the season. There is no basis to assume that discrete populations occur on either side of the crest of the range.

CONTENTS

BACKGROUND

Much of the scientific interest in Alaskan brown bears (*Ursus arctos*) has centered around life history, census techniques and denning characteristics of those populations inhabiting the coastal regions from Southeastern Alaska to the Alaska Peninsula including Kodiak Island (cf. Klein 1958, Rausch 1958, Troyer and Hensel 1964, Erickson 1965, Erickson et al. 1968, Lentfer et al. 1969 and 1972, Glenn 1972 and 1973, Wood 1973). Sport hunters have also concentrated their efforts in these regions as 67 percent of the bears shot in the state from 1961 to 1973 came from game management units in these areas.

On the other hand, there have been few investigations of grizzly bear biology in northern Alaska (cf. Rausch 1951, 1969, Crook 1971). It is generally believed that grizzly bear populations in the Arctic exhibit relatively lower densities and reproductive potential than populations further south and consequently are more susceptible to overharvest by hunters. In the past, bears in northern Alaska (including the Brooks Range and North Slope) have been protected from over-hunting by the region's isolation and low human population. In recent years, however, hunting pressure in this area has shown a gradual increase despite more restrictive seasons. At the same time there is a mounting concern that development of oil and gas resources might adversely affect bear populations. Brooks et al. (1971) pointed out the possible detrimental effects that the disruption of habitat, increased human development and increased access which could accompany development of resources would have on grizzlies on the Arctic Slope.

Before the potential impact of hunting pressure and increased resource development on grizzly bears of the Arctic Slope can be evaluated, it is necessary to garner basic biological information including sex and age structure, reproductive biology, movements, home range size and population boundaries. Rausch (1969 and personal communication) studied some aspects of the sex and age structure of grizzly bears killed near Anaktuvuk Pass. Also, tentative estimates of abundance and productivity, instances

of movement and evaluation of survey techniques for grizzly bears were reported by Crook (1971, 1972) in the central North Slope.

OBJECTIVES

1. To determine seasonal movements and population discreteness of North Slope grizzly bears.

2. To determine food habits of grizzly bears in the eastern Brooks Range.

3. To test the feasibility of several census techniques for North Slope grizzly bears.

4. To gather basic information on the size and structure of grizzly bear populations in the eastern Brooks Range.

PROCEDURES

The study area encompassed the headwaters and upper portions of two contiguous river drainages in the eastern Brooks Range: the Canning River, including the Marsh Fork of the Canning north of the divide, and the East Fork of the Chandalar River to the south. These two river systems abut the western edge of the Arctic National Wildlife Range and are fed by tributaries reaching into the Range. Intensive study was centered outside of the Range boundaries.

Generally the procedures used to capture bears followed those of Lentfer et al. (1969), Glenn and Miller (1970), and Glenn (1971, 1972). Grizzlies were usually located and captured with the aid of a Hiller FH-1100 helicopter (Merric, Inc.), but a Bell 206A (Merric, Inc.) was also used.

During the spring and fall months, when snow cover was present, bears were located by following fresh tracks; otherwise searches were conducted in river or stream valleys with special attention given to willow patches where bears were less visible or in habitat types where they could be foraging. Most flights were made during late afternoon or evening when bears were more active.

Three persons including the pilot usually made up the tagging team. The person darting the animal sat in the right front seat of the helicopter where a zip-out window on the door provided shooting access. Once a bear was sighted the pilot made one pass near the bear so that its weight could be estimated. Then a dosage of Sernylan (Pheneyclidine hydrochloride, Bio-Ceutic Laboratories, St. Joseph, Missouri) was calculated and injected into the rump with Cap-Chur equipment (Palmer Chemical and Equipment Co., Douglasville, Georgia). After the bear was darted, the helicopter landed at a vantage point or moved some distance away until the bear was immobilized. However, if the animal approached water or heavy vegetative cover it was hazed toward a dry open area if possible.

Sernylan was used as the immobilizing drug throughout the project at the dosage of 0.75 mg/pound of body weight established by Lentfer et al. (1969). After the dosage of Sernylan was placed in the projectile syringe, sterile water was added to fill the syringe. Success of immobilizations with a single injection was sporadic after early August and some bears were given multiple injections of heavier dosages; this problem seemed to be alleviated when a new shipment of drug was used. Lentfer et al. (1969) encountered the same problems in August 1968 and theorized that the 1 1/2-inch dart needles were not long enough to penetrate the rump fat; however, in the present study, use of 2 1/2-inch needles did not improve immobilization capability.

During May, Sparine (Promazine hydrochloride, Wyeth Laboratories, Philadelphia, Pennsylvania) was used in conjunction with Sernylan as a tranquilizer to reduce the occurrence of convulsions. Since this drug seemed to prolong the period of immobilization its use was discontinued.

Bears were marked in each ear with numbered nylon Rototags (Oberach Patent, Ltd., London, England), or plastic cattle tags (Salt Lake Stamp Co., Salt Lake City, Utah).

One of three different types of collars was employed to individually color-mark each bear (Fig. 1 and Table 1). Two types were developed by Glenn (1971). One consisted of a 2-inch wide nylon belt covered with colored Saflag material (Safety Flag Co., Pawtucket, Rhode Island) with three 3-inch by 6-inch flags protruding from the belt, each attached equidistant from the other two. The flag colors of each collar were alike and in order to identify the bear wearing the collar, the colors of the collar and one flag had to be visible. Use of this collar was discontinued after it became apparent that the color of the collar was often obscured by hair from the bear's neck.

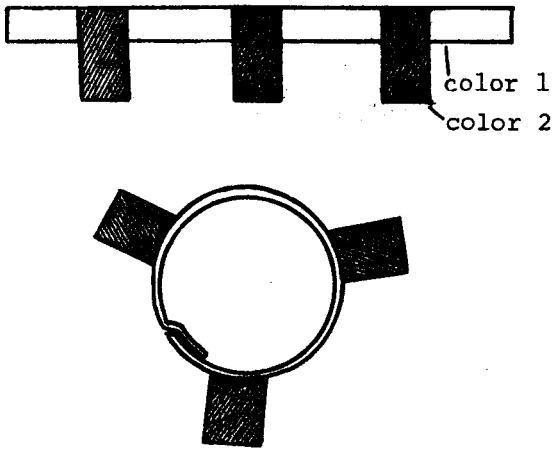
Construction of the second type of collar involved attaching colored Saflag to cotton clothesline rope. These collars were used to mark young bears because they would be expected to lose strength and break before the animal grew and the collar became tight. Simple color combinations were used on these collars -- either one color or two colors placed alternately.

The third type of collar utilized a 1/2-inch polyethylene, braided rope with color-coded nylon Saflag material threaded through the rope and secured with hog rings (Craighead et al. 1969a). Flags were arranged in identical clusters of three on opposite sides of the collar so that one cluster would be visible even though the other might be hidden below the bear's neck. Individual coding was determined by the arrangement of colors within the clusters and only two colors were used in most combinations. Bears marked with these collars were more readily identified from aircraft than those marked with nylon web collars; even so, some observers were unable to positively identify marked bears.

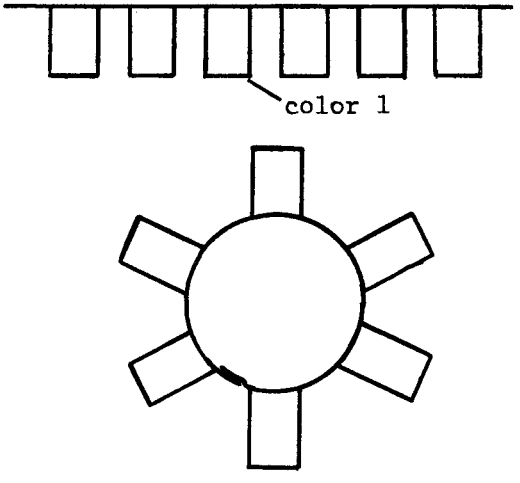
Captured bears were tattooed on the inside of the lips and on the skin under the left fore and hind limbs where hair covering is sparse (tattoo pliers, numbers, and ink were purchased from Stone Manufacturing and Supply Co., Kansas City, Missouri).

Figure 1. Collars used to individually mark grizzly bears in the eastern Brooks Range, 1973.

Nylon Webbing with Flags



Cotton Rope with Flags



Nylon Rope with Flags

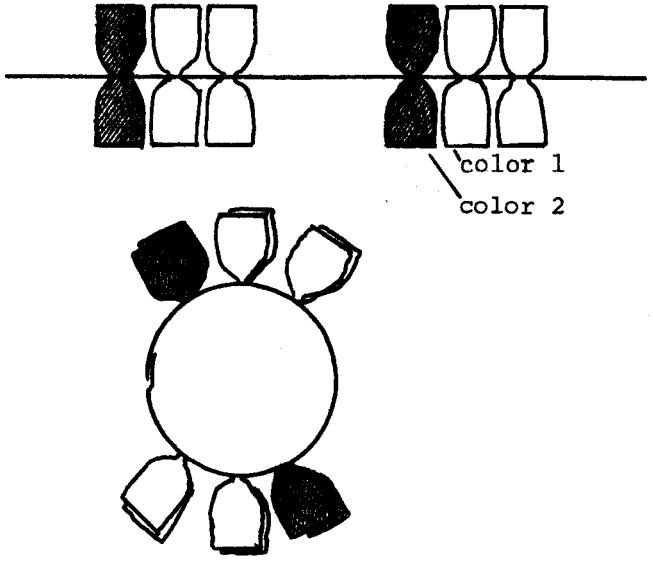


Table 1. Bears marked in eastern Brooks Range, 1973.

Bear No.	Sex	Cem. Age	Date Marked	Ear Tags[1] Left No.	Color	Type	Pos.	Right No.	Color	Type	Pos.	Collar[2] Type	Color	Remarks
1000	M	23.5	4/24/73	601	Y/G	Roto	-	602	Y/G	Roto	-	N. Web	R/R	
1001	M	14.5	4/25/73	603	Y/G	Roto	-	604	Y/G	Roto	-	N. Web	G/G	
1002	M	14.5	4/27/73	605	Y/G	Roto	-	606	Y/G	Roto	-	N. Rope	WWRW	Dead
1003	F	5.5	4/29/73	611	Y/G	Roto	-	607	Y/G	Roto	-	N. Rope	WWB/WWB	
1004	M	9.5	5/3/73	613	Y/G	Roto	-	612	Y/G	Roto	-	N. Rope	GRG	
1005	M	11.5	5/6/73	614	Y/G	Roto	-	615	Y/G	Roto	-	Radio		Dead
1006	F	5.5	5/10/73	617	Y/G	Roto	-	616	Y/G	Roto	-	C. Rope	WRWW	
1007	M	14.5	5/10/73	621	Y/G	Roto	-	618	Y/G	Roto	-	N. Rope	RWR/RWR	
1008	M	19.5	5/11/73	622	Y/G	Roto	-	623	Y/G	Roto	-	N. Web	R/B	
1009	M	16.5	5/11/73	625	Y/G	Roto	-	624	Y/G	Roto	-	N. Rope	RRBdG	
1010	M	13.5	5/11/73	631	Y/G	Roto	-	641	Y/G	Roto	-	N. Web	R/S	Dead
1011	M	19.5	5/12/73	644	Y/G	Roto	-	643	Y/G	Roto	-	N. Web	G/W	Dead
1012	M	11.5	5/17/73	652	Y/G	Roto	-	651	Y/G	Roto	-	N. Web	G/B	
1013	F	11.5	5/30/73	656	Y/G	Roto	-	655	Y/G	Roto	-	N. Web	G/R	Dead
1014	F	4.5	6/1/73	653	Y/G	Roto	-	654	Y/G	Roto	-	N. Web	W/W	
1015	M	16.5	6/1/73	657	Y/G	Roto	-	658	Y/G	Roto	-	N. Web	W/R	
1016	F	6.5	6/3/73	659	Y/G	Roto	-	661	Y/G	Roto	-	N. Rope	BkW Bk/BkWBk	
1017	M	11.5	6/3/73	663	Y/G	Roto	-	662	Y/G	Roto	-	N. Rope	GWG/GWG	
1018	F	7.5	7/6/73	3025	Y	Plas.	-	3026	Y	Roto	-	C. Rope	BGBG	
1019	F	16.5	7/12/73	3028	Y	Plas.	-	3029	Y	Roto	-	N. Rope	WRW/WRW	
1020	F	11.5	7/13/73	3045	Y	Plas.	Out.	3046	Y	Roto	Ins.	N. Web	W/G	
1021	F	19.5	7/18/73	3047	Y	Plas.	-	3048	Y	Roto	-	N. Rope	BdBdBd/BdBdBd	
1022	M	14.5	7/23/73	3049	Y	Plas.	Out.	3050	Y	Roto	Ins.	N. Rope	GGW/GGW	
1023	F	8.5	7/28/73	3052	Y	Plas.	-	3053	Y	Roto	Ins.	C. Rope	BkBkBkBk	
1024	M	2.5	8/7/73	3055	Y	Plas.	Out.	3054	Y	Roto	Ins.	C. Rope	WWWWW	
1025	F	-	8/8/73	3057	Y	Plas.	Ins.	3056	Y	Roto	Out.	N. Rope	RR/RR	No tooth Removed
1026	F	11.5	8/9/73	3058	Y	Plas.	Out.	3059	Y	Roto	Out.	Radio	RRBdRR	
1027	M	9.5	9/3/73	3075	Y	Plas.	Ins.	3076	Y	Roto	Out.	N. Rope	GGR/GGR	
1028	M	10.5	9/3/73	3074	Y	Plas.	Ins.	3073	Y	Roto	Ins.	N. Rope	RRG/RRG	
1029	M	15.5	9/6/73	3072	Y	Plas.	Out.	3070 3071	Y	Roto	Out.	N. Rope	RWW/RWW	

Table 1. Continued.

Bear No.	Sex	Cem. Age	Date Marked	Ear Tags[1] Left No.	Color	Type	Pos.	Right No.	Color	Type	Pos.	Collar[2] Type	Color	Remarks
1030	F	9.5	9/6/73	3069	Y	Plas.	Out.	3068	Y	Roto	Ins.	N. Rope	BdWW/BdWW	
1031	F	9.5	9/6/73	3066	Y	Plas.	Ins.	3067	Y	Roto	Out.	N. Rope	BdWBd/BdWBd	
1032	F	6.5	9/7/73	3065	Y	Plas.	Out.	3064	Y	Roto	Out.	N. Rope	BdOBd/BdOBd	
1033	F	11.5	9/14/73	3063	Y	Plas.	Out.	3062	Y	Roto	Out.	N. Rope	RBR/RBR	
1034	F	5.5	9/15/73	3060	Y	Plas.	Out.	3061	Y	Roto	Out.	C. Rope	BBBBBB	
1035	M	4.5	9/17/73	3077	Y	Plas.	Out.	3051	Y	Roto	Out.	C. Rope	OOOOO	
1036	M	12.5	9/29/73	3078	Y	Plas.	Out.	3079	Y	Roto	Ins.	N. Web	R/G	
1037	F	11.5	10/2/73	3080	Y	Plas.	Out.	3081	Y	Roto	Ins.	N. Web	S/B	
1038	M	6.5	10/7/73	3082	Y	Plas.	Ins.	3083	Y	Roto	-	C. Rope	GBkGBkGBk	

[1] Ear Tags:
Color: Y = yellow, Y/G = one side yellow, one side green
Type: Roto = Rototag, Plas. = round plastic cattle tag
Pos. (Position of round portion of tag on ear): Ins. = inside, out. = outside

[2] Collar:
Type: N. web = nylon web, the first color signifies collar color; the second, flag color
N. rope = nylon rope
C. rope = cotton rope
Color: B = light blue, Bd = dark blue, Bk = black, G = light green, O = orange, R = red, S = silver

Measurements were recorded using the same format as described by Glenn (1973) to facilitate possible future comparison with Alaska Peninsula bears. Measurements taken included: estimated weight; total length from nose tip to the end of the tail; height at shoulder from the top of the hump to the tip of the longest claw; length of the left hind foot from the end of the calcaneus to the tip of the middle claw; circumference of the neck; girth, immediately posterior to the forelimbs; body length, from the head of the humerus to the base of the tail; head length, from the gum line of the first upper incisors to the posterior protuberance of the parietal crest; head width, at the widest point of the lateral edges of the zygomatic arches; and length of the upper and lower canines on the lateral side from the gum line to the tip of the tooth.

A first premolar tooth was extracted for age determination based on cementum layering (Mundy and Fuller 1964, Stoneburg and Jonkel 1966, Craighead et al. 1970) and stored in Loess' solution prior to processing. The techniques used to section, stain and mount teeth for age determination were described by Glenn (1972).

Whole blood was collected from femoral arteries using donor tubes and 150 cc vacuum plasma collection units (Travenol Laboratories, Forest Grove, Illinois). Blood smears were taken for studies of parasites and differential white blood cell counts being conducted by Glenn (1973). Whole blood was centrifuged at the field station and sera were frozen for determination of the presence of *Brucella suis* (Neiland in prep.) and for ongoing studies being conducted by Glenn.

Fecal samples were collected for determination of seasonal food habits.

Color photographs were taken of all bears to document eruption and wear of canines and incisors, body size, pelt color, information on breeding biology and color-marking combinations.

Information on breeding biology was obtained by: (1) recording data on the size, coloration and lactating condition of the mammae, condition of the vulva, baculum size and position of the testes; (2) observing male-female pairing and (3) recording litter size of all family groups.

Movement was determined from resightings of marked grizzlies during aerial surveys for bears, caribou (*Rangifer tarandus*) or Dall sheep (*Ovis dalli*) and from sightings by other biologists working in the study area. The collar types and color coding system were described to other biologists working in the eastern Brooks Range so that they were familiar with our marking system.

The Lincoln Index (Overtone and Davis in Giles 1969) and the differential efficiency method (Caughley and Goddard 1972) were used to estimate grizzly bear numbers along a specific survey route in the Canning River drainage. In addition, the minimum numbers of bears which utilized the upper Canning River drainage as part of their home range from May to October was determined by direct observation of marked and recognizable individuals.

The differential efficiency method estimates the number of animals in an area from two sets of counts. One condition under which each set is performed, such as aircraft type, is different so that the sets of surveys are conducted under two levels of efficiency. The mean and variance from each of the two sets of counts are calculated; then a good estimate of numbers is theoretically obtained by solving a pair of simultaneous equations describing the parobolic relationship between the mean and variance of the two sets (Caughley and Goddard 1972).

Of the 18 surveys which were conducted, half were flown with a Hiller FH-1100 helicopter at an average ground speed of 75 mph and half were flown with a Cessna 185 at an average speed of 120 mph. Both sets of counts were conducted from 3:00 to 6:00 p.m. at 200 feet elevation by observers of the same experience over the same 154-mile survey route. The last two surveys flown using each mode were not utilized in calculation of the population estimate since after September 14 the availability of soapberries (*Shepherdia canadensis*) declined and bears began to leave the area.

FINDINGS

Measurements

The cementum age, sex, estimated weight and measurements of bears marked are presented in Table 2. As expected, these grizzlies were generally small; the largest adult male captured weighed an estimated 600 pounds. Of 17 adult males over 7.5 years old, the mean estimated weight was 374 pounds and ranged from 220 to 600 pounds. Of 9 adult females over 7.5 years of age the mean estimated weight was 230 pounds and ranged from 200 to 275 pounds. For 7 young females, aged 4.5 to 7.5 years, mean estimated weight was 183 pounds and ranged from 150 to 250 pounds. For grizzlies captured throughout the season in the central North Slope, Crook (1971) reported that the mean weight of 12 males was 479 pounds (range 240-690) and the mean weight of 11 females was 325 pounds (range 205-460).

Sex and Age Composition

In the central Brooks Range, within a radius of 60 miles from Anaktuvuk Pass, Rausch (pers. comm.) recorded that of 171 grizzlies killed by natives from 1948-1972, 102 or 59.7 percent were males, 50 or 29.2 percent were females and 19 were of unknown sex. These animals were killed as they were encountered, mostly during the spring and fall, without intentional selection for any sex or age class. On the other hand, Crook (1971) working in the foothills and coastal plain north of Anaktuvuk Pass, captured an almost equal number of both sexes of grizzlies: 11 males and 12 females.

Of the 39 bears captured from April to October 1973, 21 (54%) were males and 18 (46%) were females. Twenty-three of the total number were captured on the north side of the Brooks Range physiographic divide in the upper Canning River drainage or the closely adjacent areas; 16 were captured on the south side in or near the East Fork of the Chandalar River drainage. More males (16) than females (7) were captured on the north side but on the south more females (11) were captured than males (5).

Table 2. Weights and measurements of grizzly bears captured in northeastern Alaska, 1973.

BODY MEASUREMENTS (cm. and lb.)

1. Estimated Wt. (lb.)
2. Total Length
3. Height at Shoulder
4. Hind Foot Length (left)
5. Neck Circumference
6. Girth
7. Body Length
8. Skull Width
9. Skull Length
10. Upper Left Canine
11. Lower Left Canine

Bear No.	Sex	Cem. Age	1	2	3	4	5	6	7	8	9	10	11
1000	M	23.5	295	206	105	29	67	108	96	22.6	36.8	3.8	3.4
1001	M	14.5	400	201	110	31	81	131	120	23.3	37.7	3.4	3.0
1002	M	14.5	350	183	120	31	80	119	118	22.2	34.7	3.5	2.9
1003	F	5.5	250	179	104	28	58.5	100	83	17.6	32.0	3.1	2.9
1004	M	9.5	220	193	105	36	68	106	96	21.7	34.3	3.7	3.1
1005	M	11.5	300	189	117	30.5	69	120	109	20.3	33.5	3.7	3.1
1006	F	5.5	150	162	92.5	25.3	50	86.5	85	15.7	30.5	3.1	2.9
1007	M	14.5	400	198	110	33	75	124	118	22.4	36	3.2	2.7
1008	M	19.5	350	188	107	29.5	72	116	101	20.0	35.3	3.4	3.0
1009	M	16.5	275	198	112	32.5	69	106	108	21.8	35.4	3.6	--
1010	M	13.5	450	200	117	35	79	147	121	23.0	37.6	3.5	3.1
1011	M	19.5	325	?119	128	36	74	124	100	22.7	37.6	3.7	3.8
1012	M	11.5	250	189	104	29	66	112	110	20.4	33.0	3.4	3.2
1013	F	11.5	225	181	106	29	64	112	100	19.8	33.7	3.3	3.2
1014	F	4.5	175	168	87	26	53	99	93	17.3	30.2	3.2	3.0
1015	M	16.5	450	218	116.5	29	81	143	113	24.4	38.8	4.0	3.6
1016	F	6.5	175	169	92	24	61	100	99	18.0	31.0	3.0	3.0
1017	M	11.5	350	208	102	33.5	--	124	121	22.4	34.8	3.5	3.0
1018	F	7.5	150	162	85	24	52	90	82	16.2	30.1	3.0	2.7
1019	F	16.5	200	160	89	30	64	48	89	19.6	32.7	2.8	2.9
1020	F	11.5	240	196	102	30	64	117	106.5	20.3	34.0	3.4	3.1
1021	F	19.5	225	180	105	30	57	116	101	19.2	31.3	3.1	2.7
1022	M	14.5	225	174	100	34	67	113	104	20.4	32.4	3.4	3.1
1023	F	8.5	205	159	96	27	55	105	94	18.0	32.0	3.0	2.5
1024	M	2.5	--	152	--	25	50	95	86	16.8	29.3	3.1	2.8
1025	F			Unable to measure									
1026	F	11.5	275	160	94	28	59	105	93	19.0	30.3	2.7	2.5
1027	M	9.5	470	176	116	30	78	125	114	20.8	35.2	3.2	3.2
1028	M	10.5	--	186	97	29	63	126	97	20.0	34.2	3.5	3.2
1029	M	15.5	450	195	121	33	74	140	116	22.3	36.0	3.6	3.4
1030	F	9.5	275	180	94	28	64	110	102	18.4	30.3	2.8	2.8
1031	F	9.5	225	158	98	29	63	117	95	18.1	28.0	2.8	2.7
1032	F	6.5	200	155	94	27	60	116	91	17.1	31.1	3.0	2.8
1033	F	11.5	--	178	112	29	63	116	100	19.4	31.1	3.4	3.1
1034	F	5.5	180	155	88	26	53	96	86	?16.5	28.5	3.2	2.7
1035	M	4.5	190	173	91	28.5	67.5	130	88	17.4	32.1	3.0	3.0
1036	M	12.5	600	211	118	37	81	--	115	23.5	37.6	4.1	3.7
1037	F	11.5	200	180	118	31	64	--	110	18.5	28.5	3.0	3.0
1038	M	6.5	175	190	115	30.5	66	--	--	18.1	34.4	--	--

There was no intentional selection for any sex or age class; all bears which were encountered during tagging operations were captured with the exception of young which were accompanied by adult females and bears which escaped due to inclement weather or dart malfunction.

From these data it appears possible that there was a greater proportion of males than females on the north side of the divide while the converse was true on the south. However, the significance of these ratios is not clear and until a larger sample size can be obtained, no conclusions can be made.

For the purposes of this study, a birth date of February 1 was assumed (Craighead et al. 1969b, Rausch 1969, Mundy and Flook 1973), and for simplification all bears captured during the study period were assigned the ages they would have reached on July 1.

The mean age of the male grizzlies captured, as determined by cementum annuli, was 13.0 years; a 2.5-year-old was the youngest and the oldest was 23.5 years old. Females had a lower average age (9.6 years) and ranged from 4.5 to 19.5 years. Using the same aging techniques for grizzlies captured west of this study area, Crook (1971) found the mean age of 11 males was 11.6 years and the mean age of females was 11.3 years.

Productivity

Craighead et al. (1969b) found that in a population of grizzly bears in Yellowstone National Park, the mating season, defined as the period between first and last copulation, averaged 26 days and lasted up to 29 days. Pre- and post-copulatory behavior were observed in their study as early as May 14 and as late as July 15, respectively. In comparison, we observed paired adults between May 26 and July 9, a period of 45 days. The one copulation which was observed occurred on June 16.

In Alaska, the age at sexual maturity for brown/grizzly bears on the Alaska Peninsula and Kodiak Island has ranged from 3.5 to 6.5 years (Hensel et al. 1969, Glenn 1973). Pearson (1972) concluded that in the southwestern Yukon Territory females are first capable of conception at 6.5 years. In Yellowstone National Park, Craighead et al. (1969b) reported that females bred at 4.5 to 8.5 years old and had their first litters the following spring. Moreover, they observed that some 3.5-year-old females copulated but none whelped the following spring.

The minimum age at sexual maturity in this study was tentatively established at 4.5 to 5.5 years when a 4.5-year-old female was observed to copulate and a 5.5-year-old was observed in close company with two adult males. However, in view of the observation of Craighead et al. (1969b) that some females mate several seasons before they conceive or successfully rear cubs, it may be that these animals will not produce young in 1974.

Information on the ages at which female grizzlies do bear young may provide another measure of sexual maturity. In Yellowstone National Park, Craighead et al. (1969) reported that 15 female grizzlies had their first litters between the ages of 4 and 9 years and that some of the bears had been observed to copulate during several seasons without producing young or at least young which survived until June. Pearson (1972) observed that female grizzlies in southwestern Yukon Territory did not whelp until their seventh year.

In this study the ages of the four captured females which were accompanied by cubs or yearlings were as follows: no. 1019 - 16.5 years (yearlings); no. 1020 - 11.5 years (yearlings); no. 1021 - 19.5 years (cubs); and no. 1037 - 11.5 years (cubs). These animals successfully bred at ages of 14.5, 9.5, 18.5 and 10.5 years, respectively. Also, Glenn (1973) and Lentfer et al. (1969) used the size, coloration and condition of mammae of females without young as an indicator of past production; this was not presented as conclusive documentation but instead used as strong circumstantial evidence. If these criteria are applied to the 14 females captured which were not accompanied by young, 10 had not produced young and 4 had produced young in the past. If these 4 had, in fact, successfully raised young, weaned them as two-year-olds and then been captured during the same summer in which weaning had occurred, their ages at conception would have been: numbers 1013, 1026 and 1034 -8.5 years; and number 1025, 7.5 years (age of no. 1025 was estimated, since a tooth was not obtained). Bears whose mammaries did not display evidence of rearing young included one which was 4.5 years old, three which were 5.5 years old, two which were 6.5 years old, one each at 7.5 and 8.5 years old and two at 9.5 years.

More data are necessary before the age at which females produce young can be established; however, the evidence presented above indicates that most females do not produce young until they reach 8.5 or more years of age. If additional data confirm this hypothesis and litter size and interval between litters are determined the reproductive potential of grizzlies in the eastern Brooks Range can be calculated.

Litters were comprised of one or two young. In the Canning and East Fork of the Chandalar River drainages, 13 marked or identifiable females were accompanied by 23 young (9 females with 15 cubs of the year, 4 females with 8 yearlings). There was a mean litter size of 1.8 compared with 2.3 on the Alaska Peninsula (Glenn 1973), 2.23 on Kodiak Island (Hensel et al. 1969), 2.2 in Yellowstone National Park (Craighead and Craighead 1967), 2.0 in Glacier National Park, British Columbia (Mundy and Flook 1973) and 1.58 in southwestern Yukon Territory (Pearson 1972). In the central North Slope of the Brooks Range, Crook (1972) found litter sizes of 1.8 and 2.1 during 1970 and 1971, respectively, but no attempt was made to eliminate duplicate sightings so these figures may be biased.

Although grizzlies breed from May to July and give birth in January or February it has been established that implantation of blastocysts and thus embryonic development beyond the blastocyst stage does not commence until at least 50 days after conception (Craighead et al. 1969b). This

phenomenon of delayed implantation was also documented during the present study. When captured on May 31, 1973, an 11.5-year-old female, no. 1013, was in estrous condition as determined by the turgid condition of her vulva and by the fact that she and an adult male, no. 1002, were traveling in close company. On September 29, she was located shortly after she had been killed by another adult male, no. 1036, and her reproductive tract was collected. Examination of the ovaries showed that three *corpora lutea* were present; also, two free blastocysts were recovered from the horns of the uterus.

Mortality

Hunting was the greatest known source of mortality to grizzly bears on the study area and accounted for the deaths of six animals (four on the north side of the divide and two on the south). In addition, the deaths of two animals, both on the north side, were a direct result of the study: one drowned while under the effects of the drug, and one died from probable drug-induced hypothermia.

Two natural mortalities were recorded. The remains of a two-year-old bear were found at the base of a winter den. The other natural mortality occurred when an adult male, number 1036, killed an adult female, number 1013. From tracks found in the snow it appeared that the male had been moving along a ridge crest and changed his direction of travel when he was 75 feet from the female. He approached her at an oblique angle and then charged from 15 feet; she had not moved from her location near a hole which she had been digging. The struggle continued for 30 yards down the slope where the male killed her and then dragged her carcass another 40 yards down the slope. We arrived at the location no longer than 30 minutes after the incident had occurred and autopsied the female. She had been killed by a broken neck or by massive wounds along the top of the back near the hump; the male had not made any attempt to eat any flesh but had bitten the genitalia several times. When immobilized and examined the following day the male showed no wounds from the encounter.

Census Methods

Accurate census estimates for brown/grizzly bears are difficult to obtain because of the species' generally low densities and wide-ranging movement patterns. In order to overcome these problems most census estimates of bear populations have been conducted in areas where bears congregate in response to food sources (cf. Hornocker 1962, Erickson and Siniff 1963, Craighead and Craighead 1967). On the central North Slope, Crook (1971, 1972) developed an aerial survey method for bears which involved flying transects along river valleys; however, too few sightings were made to allow calculation of an index abundance.

In this study, timing of the aerial surveys was made to coincide with the period during late August and early September when bears appeared to be feeding exclusively on *Shepherdia canadensis* berries, which are found primarily in river valleys along gravel bars (Hulten 1968, Viereck and Little 1972).

Census estimates were calculated by using the differential efficiency method (Caughley and Goddard 1972) and the Lincoln Index. A direct count of marked and recognizable bears in the area served as a control figure.

In keeping with the differential efficiency method for estimating populations (Caughley and Goddard 1972) two sets of data were extracted from the counts shown in Table 3. The first set was comprised of the surveys conducted with a Hiller FH-1100 helicopter: 7 counts with a mean of 8.3 bear observations and a variance of 12.9. The second set was comprised of surveys conducted with a Cessna 185: 7 counts with a mean of 4.1 and a variance of 4.5. Four other counts, the last two from each set of surveys, were not used in the calculations because bears apparently left the area when the availability of *Shepherdia* sp. berries declined.

To calculate an estimate of the population of bears by this method, two equations, one from each set with its own mean and variance are solved simultaneously. The equation $\bar{x} = s^2(1/k) + x^2 (1/n)$ is used where $\bar{x}$ is the mean of the set of counts; s^2 the variance; k the coefficient of deviation from binomial variance; and n the estimate of true total. The two equations then are:

$8.3 = 12.9 (1/k) + 68.9 (1/n)$

$4.1 = 4.5 (1/k) + 16.8 (1/n)$

Multiplying the first by 4.5 and the second by 12.9 yields:

$37.4 = 58.1 (1/k) + 310.1 (1/n)$

$52.9 = 58.1 (1/k) + 216.7 (1/n)$

from which, by subtraction $-15.5 = 93.4 (1/n)$ and $n = -6.0$ bears. Obviously, under the conditions encountered in this study which resulted in one set with a low mean and variance and the other set with a higher mean and variance, this method is unreliable.

According to the Lincoln Index the estimated population of an area, N, can be calculated by the formula $N = nM/m$, where n is the total number of individual animals seen, M is the number of marked animals in the area and m is the number of marked animals seen during the census (Overton and Davis in Giles 1969). Since the number of individual bears sighted during any one count of the survey was small, the entire survey period was used in the determination of the number of marked and unmarked bears seen. Although this method included a larger number of bears in the sample size, it also increased the difficulty of distinguishing between individual unmarked bears during the survey period. Because of this problem two sets of observations were used to calculate the "absolute minimum" and the "probable minimum." Only those bears which could be positively identified as individuals were included in the calculation of the absolute minimum census estimate. Determination of the probable minimum included observations which shared some elements of physical description but which strong evidence indicated were different bears.

During the survey period 9 of 11 marked bears present along the survey route were seen out of the total of 25 individual bears observed. Using the equation $N = nM/m$, an "absolute" minimum estimate of 30.6 bears was calculated to include a part of the survey route within their

Table 3. The number of bears observed during survey flights from 27 August to 17 September 1973, eastern Brooks Range, Alaska.

Helicopter Surveys				Fixed-Wing Surveys			
Trial	Date	Number Bears	Number Marked	Trial	Date	Number Bears	Number Marked
1	8/27	8	3	1	9/3	8	3
2	8/30	10	2	2	9/4	2	1
3	8/31	14	3	3	9/5	3	1
4	9/1	4	2	4	9/7	4	1
5	9/2	5	1	5	9/11	5	3
6	9/8	6	3	6	9/12	2	1
7	9/9	11	2	7	9/13	5	1
8	9/15	0	0	8	9/14	2	0
9	9/16	3	0	9	9/17	0	0

home range. The "probable" minimum estimate included an additional 2 bears for a total of 27 individuals observed, giving an estimate of 33.0 bears. Confidence limits at the 95 percent level calculated according to Chapman (1948) for "absolute" and "probable" minimums were 13.6 - 59.7 and 14.7 - 64.4, respectively.

In comparison to the census estimates derived by the differential efficiency method and the Lincoln Index, a minimum direct count of 27 bears (29 "probable" minimum) was observed along the survey route during the survey from late August to mid-September. On the other hand, based on direct count of identifiable bears during the period from May to October, a minimum of 43 individual grizzlies included this area within their home range. This figure included the probable minimum number of individually recognizable unmarked bears, those marked along the survey route, and those marked elsewhere but later observed along the survey route. If only those bears which were alive at the end of the field season are included (by subtracting four hunter-killed bears), a minimum of 39 bears were observed. This figure is probably the best estimate for the number of bears which spend time in the study area. However, with the possible exception of a few bears, the survey area represents only a portion of the home range of any individual grizzly. Until we gain a knowledge of home range size, a good estimate of density cannot be made.

Food Habits

Seasonal food habits described by Murie (1944) for grizzly bears in McKinley National Park, Alaska included chiefly roots (especially *Hedysarum* sp.) and carrion from early May to early June; grasses, horsetail *(Equisetum arvense)* and occasional caribou calves or ground squirrels (*Spermophilus undulatus*) during June and July; and various berries (*Vaccinium uliginosum, Shepherdia canadensis, Arctostaphylos* sp., *Empetrum* sp.) and ground squirrels in August, September and October.

In Glacier National Park, British Columbia, food habits as determined by fecal samples included mostly grasses and sedges from May to November with addition of forbs as the primary supplementary food in May, horsetail (*Equisetum* sp.) and berries (*Vaccinium* sp. and *Sorbus* sp.) in June and July and berries in August - November (Mundy and Flook 1973).

Although the scats collected prior to July were inadvertently destroyed, examinations of scats from captured grizzlies in the eastern Brooks Range (Table 4) generally corroborate the seasonal food habits documented by Murie (1944) and Mundy and Flook (1973). Throughout the season general observations and examination of feeding sites confirmed seasonal food habit patterns. From May to early June, carrion, roots (mostly *Hedysarum* sp.) and grasses were the primary food sources; in June and July, grasses and horsetails (*Equisetum* sp.) provided the bulk of the diet; from August to mid-September, soapberry (*Shepherdia canadensis*) was the major food source and from mid-September to mid-October, roots were the major food item but numerous attempts were made to dig out hibernating ground squirrels. After mid-October the only feeding bears seen were utilizing caribou or moose (*Alces alces*) carcasses.

Table 4. Results of food analysis from scats collected from marked grizzly bears in the eastern Brooks Range, 1973.

Bear Number	Date	Scat Analysis Estimated Percent by Volume
1018	7/6/73	*Salix reticulata*, 80%; *Carex* sp., 15%; *Equisetum* sp., 5%
1019	7/12/73	*Equisetum* sp., 99%; moss, T; *Juncus* sp., T
1020	7/13/73	*Equisetum* sp., 95%; grass, 2%; *Juncus*, sp., T
1021	7/18/73	*Salix reticulata*, 80%; *Carex* sp., 15%; *Equisetum* sp., 5%
1022	7/23/73	Grasses and sedges, 60%; *Equisetum* sp., 39%; small rodent, T
1023	7/28/73	Root material, 95%; moss, 2%; *Arctostaphylos rubra*, 1%; *Salix* sp., 1%
1024	8/7/73	*Shepherdia canadensis*, 99%; *Vaccinium* sp., T
1026	8/9/73	*Shepherdia canadensis*, 100%
1027	9/3/73	*Shepherdia canadensis*, 98%; *Salix* sp. 2%
1028	9/3/73	*Shepherdia canadensis*, 98%; *Salix* sp. 2%
1029	9/6/73	*Shepherdia canadensis*, 100%
1030	9/6/73	*Shepherdia canadensis*, 100%
1031	9/6/73	*Shepherdia canadensis*, 100%
1032	9/7/73	*Shepherdia canadensis*, 99%; *Salix* sp., T
1033	9/14/73	*Shepherdia canadensis*, 99%; *Salix* sp., T; *Hedysarum* sp., T
1034	9/15/73	*Shepherdia canadensis*, 100%
1003	9/27/73	*Hedysarum* sp., 95%; Arctic ground squirrel (*Spermophilus undulatus*), 5%
1037	10/2/73	Grasses and sedges (root material), 100%
1038	10/7/73	Grasses and sedges (root material), 100%

Movement

Movement was determined by repeat observations of 29 of the 39 bears marked during the 1973 field season (Table 5). In addition to the initial sighting recorded when the animals were marked, 19 males were observed a total of 63 times or an average of 3.3 repeat observations per bear; 11 females were seen on 32 different occasions or an average of 2.9 repeat observations per bear. The mean greatest distance between the locations of any two observations was 20.2 miles for males and 9.4 miles for females; the longest movement for a male, no. 1008, was 48 miles and for a female, no. 1003, was 17 miles. Ten bears were not located again after they were marked; however, one was a drug-induced mortality and three were marked during September when the opportunity for subsequent observations was slight.

Some bears spent more time in the study area than others. The number of months which 16 marked bears spent in the area was as follows: 4 months, 2; 3 months, 3; 2 months, 8; and 1 month, 2. Some observations were separated by periods of three months so it was not known whether the animals moved from the area or were present but not observed. Of the recognizable unmarked bears, most were observed only during the period of the survey or within 10 days of its completion.

Crook (1971) reported two patterns of seasonal movement within home ranges on the central North Slope: one in which bears spent most of the season in a relatively small area from 6 - 15 miles in radius and the other in which bears spent the spring and fall in the mountains and moved to the foothills during the summer. In southwestern Yukon Territory, Pearson (1972) found that the mean range of 8 sows was 27 mi^2 and for an unspecified number of boars was 114 mi^2. Limited evidence collected during 1973 in the eastern Brooks Range supports findings of each of these studies. After marking, three adult females without young were observed within relatively confined areas (7-12 miles). Nine adult males were seen only in the spring and/or fall but not from mid-June and late August, the period which Crook (1971) reported movement from the mountains to the foothills. One adult male, number 1015, was seen in the mountains in the spring, in the foothills north of the study area in July and in the mountains again in the fall.

Movement within a home range by brown or grizzly bears is usually made in response to food sources, reproductive condition of the animals or seasonal habits including winter denning (Erickson 1965, Lentfer et al. 1966, 1967, Craighead and Craighead 1967, Glenn 1972, 1973). Evidence of movement to a food source was recorded in the study area when as many as 17 bears were seen feeding on *Shepherdia canadensis* berries in the upper Canning River drainage during late August and early September. These grizzlies had not been observed in the area prior to that time and most were not seen after the berries dropped from the shrubs. Also, the pattern of Arctic Slope grizzly bear movement from the mountain river valleys in the spring to the foothills in the summer which was recorded by Crook (1971) may well have been in response to the greater availability of preferred foods such as *Equisetum* sp. and sedges in the more moist foothill areas.

Table 5. Movement recorded from marked bears in the eastern Brooks Range, 1973.

Bear Number	Sex	Cem. Age	Date	Location	Distance From Initial Capture (miles)	Greatest Distance From My Previous Observation (miles)
1000	M	23.5	4/24/73	69°17'N 146°10'W	Initial Capture	
			5/4/73	69°24'N 146°02'W	8	8
			5/5/73	69°27'N 145°53'W	13	13
			5/10/73	69°22'N 146°02'W	6	7
			5/11/73	69°22'N 146°01'W	6	7
			5/12/73	69°24'N 146°05'W	8	8
			5/17/73	69°07'N 145°58'W	20	23
1001	M	14.5	4/25/73	69°02'N 147°23'W	Initial Capture	
			5/2/73	69°02'N 147°23'W	0	0
			5/4/73	69°02'N 147°22'W	0	0
			5/10/73	69°02'N 147°22'W	0	0
			9/3/73	69°06'N 146°00'W	35	35
1002	M	14.5	4/27/73	69°02'N 146°04'W	Initial Capture	
			5/3/73	68°48'N 146°18'W	17	17 (recapture)
			5/30/73	68°41'N 146°05'W	11	11 (study mortality)
1003	F	5.5	4/29/73	68°24'N 145°11'W	Initial Capture	
			5/24/73	68°25'N 145°12'W	4	4
			6/29/73	68°20'N 145°44'W	17	17
			9/27/73	68°19'N 145°23'W	11	11
1004	M	9.5	5/3/73	68°48'N 145°42'W	Initial Capture	
			9/7/73	68°42'N 146°23'W	19	19
			9/8/73	68°59'N 145°40'W	12	27
1005	M	11.5	5/6/73	68°47'N 146°28'W	--	-- (study mortality)
1006	F	5.5	5/10/73	68°48'N 145°43'W	0	--
			5/10/73	68°48'N 145°43'W	Initial Capture	0
			9/1/73	68°45'N 146°06'W	10	10
1007	M	14.5	5/10/73	69°02'N 145°41'W	10	--
			5/10/73	68°53'N 145°44'W	Initial Capture	10
			5/17/73	69°07'N 145°42'W	17	17
			5/24/73	69°00'N 145°41'W	9	9
			6/16/73	68°58'N 145°43'W	6	10
			6/18/73	68°59'N 145°40'W	7	9
1008	M	19.5	5/10/73	69°25'N 146°34'W	0	--
			5/11/73	69°25'N 146"34'W	Initial Capture	0
			5/14/73	69°25'N 146°35'W	0	0
			5/23/73	69°34'N 146°40'W	10	10
			5/24/73	69°34'N 146°40'W	10	10
			5/26/73	69°23'N 146°06'W	12	19
			6/17/73	68°58'N 145°43'W	38	48

Table 5. Continued.

Bear Number	Sex	Cem. Age	Date	Location	Distance From Initial Capture (miles)	Greatest Distance From My Previous Observation (miles)
1009	M	16.5	5/11/73	69°15'N 147°20'W	Initial Capture	
1010	M	13.5	5/11/73	69°15'N 147°20'W	Initial Capture	
			6/3/73	69°03'N 147°40'W	18	18 (hunter kill)
1011	M	19.5	5/12/73	69°24'N 146°05'W	Initial Capture	
			5/17/73	69°24'N 146°05'W	0	0
			5/26/73	69°23'N 146°05'W	0	0
			6/8/73	69°07'N 145°56'W	20	20
			6/9/73	69°07'N 145°56'W	20	20 (hunter kill)
1012	M	11.5	5/17/73	68°51'N 146°03'W	Initial Capture	
			5/18/73	68°51'N 146°03'W	0	0
			8/27/73	68°52'N 146°07'W	1	1
			8/31/73	69°10'N 145°48'W	23	23
			9/2/73	69°06'N 145°41'W	20	20
			9/8/73	69°06'N 145°42'W	20	20
1013	F	11.5	5/30/73	68°51'N 146°05'W	Initial Capture	
			7/1/73	68°57'N 146°06'W	7	7
			8/10/73	68°56'N 146°06'W	5	5
			9/28/73	68°47'N 146°13'W	6	12 (natural mortality)
1014	F	4.5	6/1/73	68°55'N 145°44'W	Initial Capture	
			6/16/73	68°58'N 145°43'W	4	4
			6/17/73	68°58'N 145°43'W	4	4
			8/27/73	69°02'N 145°42'W	9	9
1015	M	16.5	6/1/73	69°18'N 146°04'W	Initial Capture	
			7/9/73	69°35'N 144°55'W	20	20
			10/6/73	69°23'N 146°03'W	6	14
			10/9/73	69°24'N 146°01'W	7	12
1016	F	6.5	6/3/73	68°15'N 146°47'W	Initial Capture	
1017	M	11.5	6/3/73	68°51'N 146°47'W	Initial Capture	
			8/25/73	69°01'N 146°04'W	21	21
			8/30/73	69°03'N 145°40'W	31	31
			9/5/73	69°00'N 145°40'W	30	30
			*9/11/73	68°54'N 145°44'W	--	--
				68°49'N 146°08'W	--	--
			9/12/73	68°54'N 146°06'W	18	18
			9/28/73	69°03'N 146°00'W	25	25
			10/6/73	69°05'N 145°58'W	26	26
			10/9/73	69°04'N 145°59'W	26	26
			10/16/73	69°06'N 145°58'W	26	26

Table 5. Continued.

Bear Number	Sex	Cem. Age	Date	Location	Distance From Initial Capture (miles)	Greatest Distance From My Previous Observation (miles)
1018	F	7.5	7/6/73	68°21'N 145°47'W	Initial Capture	
			9/14/73	68°31'N 145°35'W	12	12
1019	F	16.5	7/12/73	68°17'N 144°52'W	Initial Capture	
			7/29/73	68°19'N 145°06'W	7	7
1020	F	11.5	7/13/73	68°21'N 145°04'W	Initial Capture	
1021	F	19.5	7/18/73	68°04'N 146°38'W	Initial Capture	
1022	M	14.5	7/23/73	68°45'N 146°19'W	Initial Capture	
			9/10/73	68°43'N 146°39'W	9	9
			*9/11/73	68°49'N 146°08'W	--	--
				68°54'N 145°44'W	--	--
			10/1/73	68°32'N 146°05'W	16	19
			10/8/73	68°18'N 146°11'W	32	32
1023	F	8.5	7/28/73	68°42'N 146°47'W	Initial Capture	
1024	M	2.5	8/7/73	68°58'N 145°41'W	Initial Capture	
			9/23/73	68°51'N 145°44'W	8	8
1025	F	--	8/8/73	68°17'N 145°42'W	Initial Capture	
			8/16/73	68°21'N 145°38'W	5	5
			10/2/73	68°19'N 145°53'W	6	7
			10/8/73	68°17'N 145°36'W	3	7
			10/11/73	68°16'N 145°39'W	1	7 (den)
1026	F	11.5	8/9/73	68°44'N 146°12'W	Initial Capture	
			8/27/73	68°44'N 146°11'W	0	0
			8/30/73	68°43'N 146°11'W	1	1
			8/31/73	68°43'N 146°11'W	1	1
			9/1/73	68°43'N 146°11'W	1	1
			9/3/73	68°43'N 146°13'W	0	1
			9/4/73	68°43'N 146°10'W	1	1
			9/9/73	68°42'N 146°19'W	3	4
			9/11/73	68°43'N 146°14'W	1	2
			9/12/73	68°45'N 146°05'W	3	7
			9/28/73	68°40'N 146°05'W	5	7
			9/29/73	68°36'N 146°10'W	9	10
1027	M	9.5	9/3/73	68°45'N 145°11'W	Initial Capture	
1028	M	10.5	9/3/73	68°42'N 145°02'W	Initial Capture	
			9/7/73	68°45'N 145°16'W	6	6
			9/23/73	68°45'N 145°12'W	5	5
			10/7/73	68°48'N 145°00'W	7	7
			10/13/73	68°46'N 145°03'W	5	6

Table 5. Continued.

Bear Number	Sex	Cem. Age	Date	Location	Distance From Initial Capture (miles)	Greatest Distance From My Previous Observation (miles)
1029	M	15.5	9/6/73	68°31'N 145°37'W	Initial Capture	
			9/23/73	68°29'N 145°08'W	12	12
1030	F	9.5	9/6/73	68°34'N 145°43'W	Initial Capture	
			10/7/73	68°38'N 145°46'W	5	5 (aband. den)
			10/8/73	68°41'N 145°54'W	5	9 (aband. den)
1031	F	9.5	9/6/73	68°34'N 145°43'W	Initial Capture	
			9/14/73	68°34'N 145°44'W	0	0
1032	F	6.5	9/7/73	68°45'N 145°14'W	Initial Capture	
			9/20/73	68°37'N 145°13'W	10	10
1033	F	11.5	9/14/73	68°37'N 144°34'W	Initial Capture	
1034	F	5.5	9/15/73	68°39'N 145°36'W	Initial Capture	
1035	M	4.5	9/17/73	68°15'N 145°39'W	Initial Capture	
			10/7/73	68°29'N 145°37'W	16	16
1036	M	12.5	9/28/73	68°47'N 146°18'W	3	--
			9/29/73	68°45'N 146°19'W	Initial Capture	3
1037	F	11.5	10/2/73	68°18'N 145°59'W	Initial Capture	
1038	M	6.5	10/6/73	68°11'N 145°31'W	3	--
			10/7/73	68°13'N 145°37'W	Initial Capture	3
			10/8/73	68°13'N 145°43'W	3	5
			10/11/73	68°09'N 145°46'W	6	7 (aband. den)

* Note: Two observations of bears marked with green and white flagging were obtained during the same survey flight; no positive identification could be made at either location of which individual was sighted but this color combination eliminated all bears except numbers 1017 and 1022.

Although no direct evidence was obtained to link movement to reproductive status, the greatest movement by both males and females was recorded when the animals were in breeding condition. Number 1008, a 19.5-year-old male, was observed six times within a relatively restricted area and then moved south 39 miles where he was observed to copulate with a 4.5-year-old female, number 1014. Number 1003, a 5.5-year-old female, was observed 17 miles southwest from the point of her capture in the company of two adult males.

Short-range movement associated with winter denning was documented in four cases on the East Fork of the Chandalar drainage; these animals were all females which were not followed throughout the summer so the extent of earlier movements was not known. On the other hand, some animals moved long distances to reach denning areas; two males traveled at least 42 and 36 miles.

Population Discreteness

Because of the grizzly bear's mobility and ability to forage in and cross rugged terrain there is no reason that the Brooks Range should present a barrier between breeding populations.

Travel across the physiographic divide of the Brooks Range by marked bears was recorded during late September and early October when bears were moving to denning areas. Two of these bears, numbers 1022 and 1026, crossed to the south side of the range and another, number 1030, moved north after she was disturbed by aircraft at a den site near the crest of the divide. Although no other interchange between the north and south sides by marked bears was observed, there is no evidence that such movement does not freely occur.

RECOMMENDATIONS

The research program should continue for one additional season; its primary focus should be the determination of home range size and movement within home ranges. This information would allow interpretation of census estimates of specific areas and interpolation of densities for grizzly bears in the eastern Brooks Range. To accomplish this objective, a number of bears should be fitted with radio transmitters and aerially tracked throughout their active season.

Other aspects of life history which require supplementary data include sex and age structure of the population, litter size and sex ratio of cubs, determination of the age at which females bear young and estimation of the number of bears in the study area. Data collected in conjunction with the marking program would enable better description of some basic parameters of population dynamics of the grizzly bear on the Arctic Slope.

Estimation of bear numbers by use of the differential efficiency method should be used with caution until further evaluation can be made. The best means of establishing the number in a population is a direct count of all bears in the area under study; since this is not feasible,

calculation of census estimates by the Lincoln Index can be used with some reliability.

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Spencer Linderman of the Alaska Department of Fish and Game prepared the research proposal and assembled equipment prior to the time I began this assignment. Other Department personnel who participated in aspects of this study included Lee Miller, Leland Glenn and Bill Griffin.

Our success in immobilizing grizzlies was to a great extent due to the skill of the following helicopter pilots: Steven Lindsey, R. Fredericks, Robert McAfee, James Ackels and David Binisch. These men, especially Steve Lindsey, also provided on-the-ground assistance in marking and handling bears.

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JOB PROGRESS REPORT (RESEARCH)

State: Alaska

Cooperators: Harry Reynolds, Alaska Department of Fish and Game; Roland Quimby, Renewable Resources Consulting Services, Ltd.

Project No.: W-17-6 Project Title: Big Game Investigations

Job No.: 4.9R Job Title: Denning Ecology of North Slope Grizzly Bears

Period Covered: July 1, 1973 through June 30, 1974

SUMMARY

The following is the abstract of a paper summarizing results of this job as presented by Harry Reynolds at the Third International Conference on Bear Research and Management, May 31-June 1, 1974, held in conjunction with the 54th Annual Meeting, American Society of Mammalogists.

CHARACTERISTICS OF GRIZZLY BEAR DENS IN NORTHEASTERN ALASKA

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Denning activities of grizzly bears were studied in the eastern Brooks Range, Alaska during April-November 1972 and 1973. Most dens were found by tracking bears through the snow. In the fall of 1973, 71 percent of the located dens were excavated from 5-12 October although some grizzlies were observed foraging until 7 November. A total of 31 dens were found; in 21 instances bears dug dens in well-drained areas with no permafrost and in 10 cases natural caves were utilized. All dens were located in moderate to steep terrain with the exception of two dens which were dug into river banks on the coastal plain. Mean elevation of den sites was 3,400 feet, and 27, or 87 percent, were located on southern exposures.

When caves were utilized, in every case a bed was constructed of moss, woody and/or herbaceous material and was located a mean distance of 5.8 feet from the mouth of the cave and 9.6 feet from the cave's end. Most dug dens collapsed soon after the bear's departure; the few intact dens which were measured closely followed the descriptions given by Craighead and Craighead (1972) for Yellowstone grizzlies but none were located at the bases of trees.

Two adult males moved 42 and 36 miles to reach denning areas; on the other hand, two individually marked females denned within their summer range. No instance of reuse of a den was recorded. The remains

of a two-year-old bear were found in a cave den; the cave was quite small and the bed was poorly constructed.

Denning took place over a relatively wide area on the south slopes of the Brooks Range and evidence indicates that good denning habitat is present on the north side of the divide as well. It does not appear at this time that denning habitat is a limiting factor on grizzly bear population dynamics in northeastern Alaska.

The paper will be published in proceedings of the conference and will be available in early 1975.

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