ALASKA DEPARTMENT OF FISH AND GAME
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NORTH SLOPE GRIZZLY BEAR STUDIES

By Harry Reynolds

STATE OF ALASKA
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DEPARTMENT OF FISH AND GAME
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Final Report
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FINAL REPORT (RESEARCH)

State: Alaska

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

Project No.: W-17-6 and W-17-7 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, 1975

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. Subsequent revisions included 1974 and 1975 data.

DENNING ECOLOGY OF GRIZZLY BEARS IN NORTHEASTERN ALASKA

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ABSTRACT

Denning activities of grizzly bears (*Ursus arctos* L.) were studied in the eastern Brooks Range, Alaska, during April-November 1972, 1973 and 1974. Active dens were found by tracking bears through snow or by locating bears fitted with radio transmitters. In the fall of 1973, 71 percent of the newly excavated dens were constructed from October 5-12, although some grizzlies were observed foraging and did not den until after November 7; similarly, of 8 dens located which were used in 1974, 6 or 75 percent were excavated from 3-9 October, 1 about 27 September and 1 between 19 October and 1 November. A total of 52 dens were found; 20 of these were located shortly after they had been prepared for use during the oncoming winter and 32 others were found after they had been used. In 39 instances bears dug dens in well-drained areas above the permafrost layer and in 13 cases natural caves were utilized. All dens were located in moderate to steep terrain with the exception of three dens which were dug into river banks on the coastal plain. Mean elevation of den sites was 975m (3200 ft) and 46 or 88 percent were located on southern exposures.

When caves were utilized, in every case a bed was constructed of moss, woody and/or herbaceous material. Most dug dens collapsed 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, with the exception that none were located at the bases of trees.

Two adult males moved 51 and 55km (32 and 34 mi) to reach denning areas; another 10 individuals (2 males, 8 females) denned within their known summer range. No instance of den reuse 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 north and south slopes of the Brooks Range. 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 fall 1976.

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FINAL REPORT (RESEARCH)

State:	Alaska		
Cooperators:	Harry Reynolds and Renewable Resources Consulting Services, Ltd.		
Project Nos.:	W-17-6 and W-17-7	Project Title:	Big Game Investigations
Job Nos.:	4.8R	Job Titles:	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, 1975		

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 80 bears were captured, individually color-marked and released. The sex ratio of captured bears was nearly equal.

Evidence gathered during this study indicated that most females do not produce young until they reach the age of 8.5 or more years, and the mean number of cubs born, calculated from observations of 22 family groups, was 1.8. Population structure was weighted toward older age classes suggesting a declining population.

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. The average home range size was 702 km^2 (271 mi^2) for mature males on the study area, 382 km^2 (147 mi^2) for 3 breeding females and 280 km^2 (108 mi^2) for 5 females accompanied by young. Population density was one bear per 142 km^2 (57 mi^2).

Food habits and mortality are discussed.

Movements were determined from radio-tracking and from resighting marked bears; males traveled greater distances than females. Bears were observed to cross the Brooks Range hydrographic divide to reach denning areas, and they probably cross the divide throughout the season. Population mixing probably occurs between the north and south sides of the range.

CONTENTS

BACKGROUND

The history of brown/grizzly bears (*Ursus arctos*) has been one of continuous reduction of numbers and range coinciding with human population growth and development. Only remnant populations remain in Europe (Curry-Lindahl 1972, Cowan 1972). In North America, where they once ranged throughout the western portion of the continent, populations are now much reduced or nonexistent in most areas south of the Canadian border (Storer and Tevis 1955, Craighead and Craighead 1967, Cowan 1972, Herrero 1972). In the past much of the North American brown/grizzly bear range had been protected by its rugged physiography or inaccessibility, but these obstacles to resource development and access are no longer effective.

The potential for adverse impact of development on grizzly bear populations in Alaska is probably greatest from the Brooks Range north to the Arctic Ocean. Here the grizzly is at the northern extent of its range; the period of food availability during the summer season is short, reproductive potential is low, the area required for individual home ranges is large and the stunted vegetation of the region provides little cover.

In 1971 Brooks et al. pointed out the possible detrimental impact that development of oil and gas resources might have on North Slope grizzlies, including disruption of habitat, increased human habitation and increased access. Since then construction of the Trans-Alaska Oil Pipeline has been partially completed, a road linking Fairbanks with the Arctic Ocean coast has been finished, exploration for additional petrochemical reserves has increased and plans for networks of transportation corridors throughout the area have been made. Hunting pressure in the area has shown a gradual increase during the last 15 years despite more restrictive seasons. This has been partially due to human population growth in the state and improved access to the area.

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 determine 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. 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. In 1973 this study was initiated to determine potential impact of development on the ecology of North Slope grizzly bear populations (Quimby 1974, Quimby and Snarski 1974, Reynolds 1974, Curatolo and Moore 1975, and Reynolds et al. in press). In addition, more comprehensive analyses of data presented here are being prepared for inclusion in separate professional papers on food habits, movement and home range determination and population structure and productivity.

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.

STUDY AREA AND 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 tributary streams from the range. Intensive study was carried out on the north side of the Brooks Range from the continental divide on the south to 69°30' N on the north and from Canning River valley on the east to the Ivishak River valley on the west.

The procedures used to capture, mark, measure and age grizzlies during this study and to determine the food habits, movement and numbers of bears were described by Reynolds (1974). For the purposes of this study, a birth date of February 1 was assumed (Craighead et al. 1969, 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.

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 number of cubs and age structure of all family groups.

Movements and home range size were determined from resightings of marked grizzlies during aerial surveys, from tag returns of hunter-killed bears and by aerial tracking of 12 animals fitted with radio transmitters manufactured by Ocean Applied Research (San Diego, California).

Radio-collared bears were tracked using light, fixed-wing aircraft or helicopters equipped with 12-channel portable receivers (AVM Instrument Co., Champagne, Illinois) and one or two three-element, high-gain yagi antennas mounted to the wing struts or luggage rack. Transmitter signals were received at distances up to 130 km (80 miles) under optimum conditions when the aircraft was at 2500 m above ground level (AGL); more often, especially in mountainous terrain, flight level was 450 m AGL and signals were received from 3-5 km distance.

Locations were plotted on 1:250,000-scale topographic maps and relevant information was recorded on data sheets (Fig. 1). Locations were determined visually every 3 or 4 days when possible. When radio-collared bears were not visually located during flights because of adverse weather, cover or terrain, "fixes" were determined by triangulation or by abrupt changes in radio signal strength.

Home ranges were determined using the modified "exclusive boundary strip" method (Stickel 1954, Berns and Hensel 1972). The method was modified by using grid squares 4.83 km (3 mi) on a side or 23.3 km^2 (9 mi^2) in area. Grid square size was based on daily bear movements. All squares, including actual locations, were connected by the shortest distance to other squares containing actual locations; this was done because no observations were made during a bear's travel between location sites (Fig. 2).

FINDINGS

Measurements

The cementum age, sex, weight and measurements of bears captured in 1974 are presented in Appendix I; those for bears captured in 1973 were previously reported (Reynolds 1974). Eastern Brooks Range bears are generally small. The mean weight of 18 females over 7.5 years of age captured in 1974 was 109 kg (241 lb; range 195-310 lb); 10 females 7.5 years of age or less weighed an average of 74 kg (163 lb), ranging from 41 kg (90 lb) for a yearling to 125 kg (275 lb) for a 7.5-year-old. The mean weight of males over 7.5 years was 180 kg (397 lb; range 300-590 lb). Like young-age females, young males weighed an average of 74 kg (164 lb), ranging from 48 kg (105 lb) for a yearling to 107 kg (235 lb) for a 3.5-year-old. When multiple weights were obtained the measurement with the earliest date was used in the calculations.

Fig. 1. GRIZZLY BEAR MOVEMENT DATA FORM

Bear No. _____ Sex _____
Date _____ Time _____
Circle 2: Fix Sighting Unmarked Radio-collar Marked-type: _____
Location Description: _____
_____
Coordinates: _____ Map no: _____
Elevation _____ Exposure _____ Vegetation type _____
Slope _____ Topography _____
Weather: cloud cover (x 1/10) _____ Temperature _____ Wind direction _____
Rain _____ Fog _____ Snow _____ None _____ Wind speed _____
Phenology: _____
Time in immediate vicinity before sighting: _____
Bear's activity when sighted: _____
Other bears present: _____
Distance from first signal to bear: _____ Distance from last location: _____
Date of last location: _____ Direction from last location: _____
Description of last location: _____
_____
Remarks: _____
_____
_____
_____

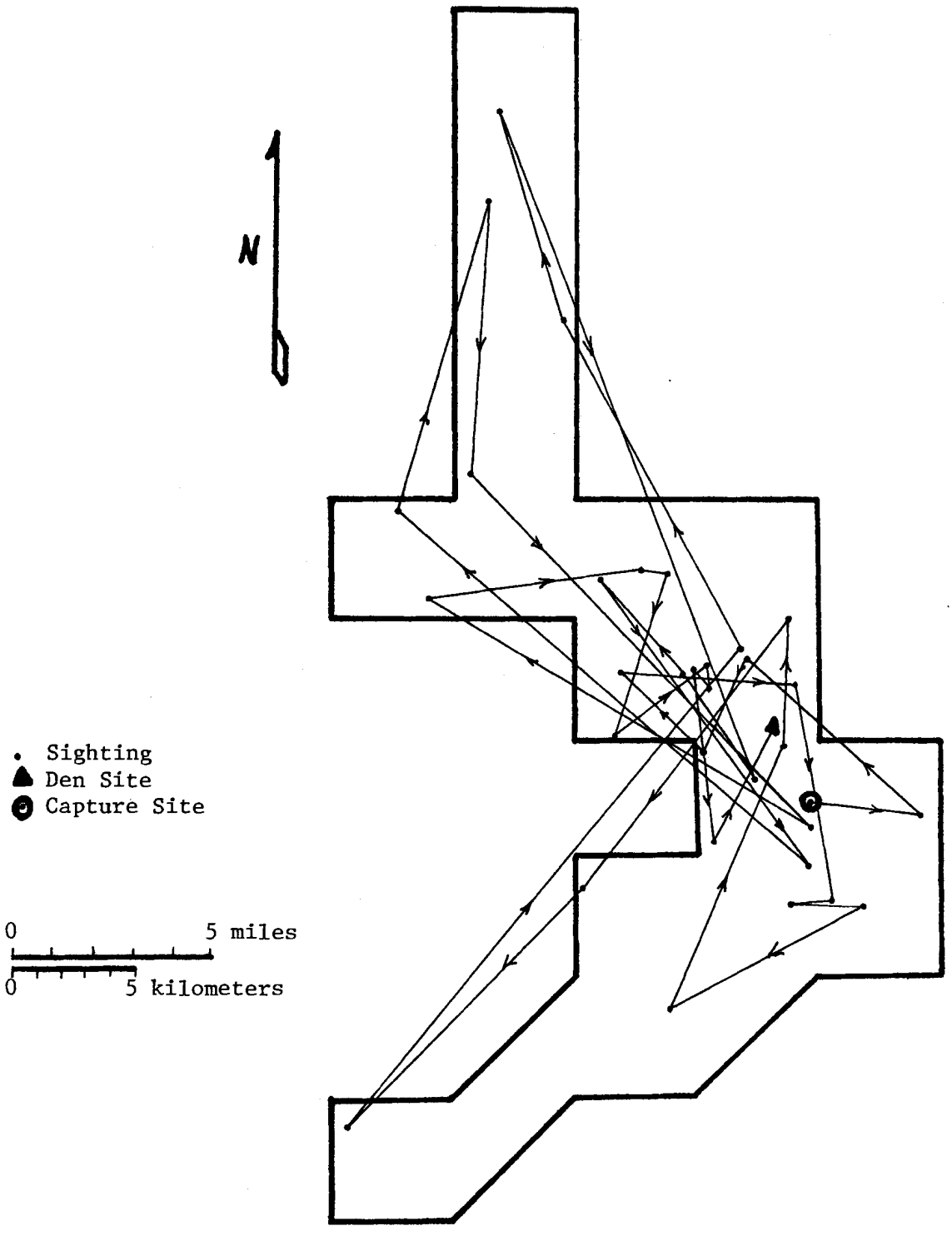

Fig. 2. Movement and home range of adult female grizzly no. 1042, based on modification of the "exclusive boundary strip" method.

In comparison, Crook (1971) reported a mean weight for 12 adult males from the central North Slope of the Brooks Range of 217 kg (479 lb; range 240-690 lb) and a mean weight for 11 females of 147 kg (325 lb; range 205-460 lb).

Sex and Age Composition

Rausch (pers. comm.) reported that 102 or 59.7 percent of 171 grizzlies killed by natives from 1948-1972 within a radius of 60 miles from Anaktuvuk Pass in the central Brooks Range 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 spring and fall, when the more mobile males are likely to be traveling. However, Crook (1971) captured an almost equal number of both sexes of grizzlies in the foothills and coastal plain north of Anaktuvuk Pass.

The sex ratio of the 80 bears captured in the study area was closely balanced; 37 (46.3%) males and 43 (53.7%) females. The ratio of 67 adult bears (over 7.5 years of age) was nearly equal, with 50.7 percent females and 49.3 percent males. The true adult sex ratio may be more biased toward females since they are more likely to remain in inaccessible locations where capture would be difficult and hazardous. Also, 72 percent of the hunter-killed grizzlies in GMU 26 during the last 14 years has been males, a factor which should influence the sex ratio in favor of females.

The mean age of male grizzlies captured, as determined by cementum annuli, was 12.1 years and ranged from 1.5 to 24.5 years. Females had a lower average age (10.3 years) and ranged from 1.5 to 23.5 years. Using the same aging technique, Crook (1971) found the mean age of 11 males was 11.6 years and the mean age of 12 females was 11.3 years.

Bears captured during both years of study and accompanying offspring (cubs, yearlings, 2-year-olds) were assigned ages which they would have reached in 1974 and placed in cohort groups (Table 1). The age structure suggests a declining population, since there are more bears in the 12.5 to 14.5 and 15.5 and 17.5 year age classes than in the younger cohort groups from 3.5 to 11.5 years.

Table 1. Age structure of the grizzly bear population in the study area, eastern Brooks Range, 1974.

Ages of cohorts	0.5-2.5	3.5-5.5	6.5-8.5	9.5-11.5	12.5-14.5	15.5-17.5	18.5-20.5	21.5-24.5
Number in cohort group	27	9	9	11	20	14	6	3

Productivity

The minimum age at sexual maturity, defined as the earliest age of successful conception, was tentatively established at 6.5 years for bears in the study area. Although no females younger than 8.5 years

were confirmed as having young, one female captured as a 6-year-old in 1973 was recaptured in 1974 and showed strong evidence of having recently suckled. Although this animal was not accompanied by young she was in estrous condition and was accompanied by an adult male when captured. A 4.5-year-old female was observed breeding on several occasions in 1973 but was not accompanied by young when captured in 1974. While the minimum age of sexual maturity may be 6.5 years, most evidence indicates that grizzlies in the study area do not successfully conceive until age 8.5 to 9.5 years. Indeed, observations of females in estrous condition at least 2 years prior to the first successful production of young have been reported in Wyoming (Craighead et al. 1969) and in Alaska (Glenn et al. in press).

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, Glenn et al. in press). 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. (1969) reported that females bred at 4.5 to 8.5 years of age and had their first cubs the following spring. Moreover, they observed that some 3.5-year-old females copulated but none bore cubs the following spring.

The ages at which female grizzlies 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 cubs between the ages of 4 and 9 years, although some bears were observed copulating during several seasons without producing viable young. Pearson (1972) observed that female grizzlies in southwestern Yukon Territory did not give birth until their seventh year. On the Alaska Peninsula, where the summer season and period of food availability are longer than in the Brooks Range, Glenn et al. (in press) reported that the mean breeding age of 8 female brown bears was 6 years (range 5-8 years).

During this study 14 females accompanied by young were captured; one female had cubs at 9 years, 5 at 10 years and 8 between 12 and 22 years. Lentfer et al. (1969), Glenn (1973) and Glenn et al. (in press) used the size, coloration and condition of mammae as an indicator of past production of cubs. Applying these criteria to 23 females over 4 years of age, which were not accompanied by young when captured, 9 had produced young in the past and 14 had not produced young. If these nine females had, in fact, successfully reared young, weaned them as 2-year-olds and were captured during the same summer in which weaning occurred, their ages at production of young would have been: 8.0 years, 1; 9.0 years, 3; 10.0 years, 2; 12.0 years, 2; and 17.0 years, 1. Bears whose mammae did not display evidence of rearing young included females of the following ages: 4.5 years, 1; 5.5 years, 4; 6.5 years, 1; 7.5 years, 1; 8.5 years, 2; 9.5 years, 3; 12.5 years, 1 (Bear number 1016 was included in the previous category since she showed no evidence of rearing young as a 6.5-year-old; she apparently gave birth, but did not successfully rear young and bred again as a 7.5-year-old.).

More data are necessary before the age at which females produce young can be accurately established, however, evidence presented above indicates that most females do not produce young until they reach 8.5 or more years of age.

If we assume that: (1) all the females over age 7.5 years which showed no previous evidence of rearing young conceived during the year of calculation; (2) those females which showed previous evidence of having young were captured during the year in which their young were weaned as 2-year-olds; and (3) young accompanied by females of ages 8.5, 9.5 or 10.5 were the product of their first successful birth, then an average age of 10.1 years at first successful production of cubs can be calculated from 19 individuals.

Most females with cubs had one or two young, although reliable reports were received of females with three. In the study area, 22 marked or identifiable females were accompanied by 40 young (13 females with 23 cubs-of-the-year, 7 females with 14 yearlings, 1 female with 2 2 year olds and 1 female with a single 3-year-old). Average number of cubs in the study area was 1.8, compared with 2.1 on the Alaska Peninsula (Glenn et al. in press), 2.2 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 1.6 in southwestern Yukon Territory (Pearson 1972). Crook (1972) found the number of cubs to be 1.8 and 2.1 during 1970 and 1971, respectively, in the central North Slope of the Brooks Range. However, these figures may be biased since no attempt was made to eliminate duplicate sightings. Young were not weaned until at least 2.5 years of age, and one was not weaned until at least age 4.5.

Mortality

Hunting was the greatest known source of mortality to grizzly bears on the study area and accounted for the deaths of 12 animals (9 on the north side of the divide and 3 on the south). In addition, one was killed in defense of life and property and four were killed as a result of the study; two drowned while under the effects of drugging and two from other drug-related causes.

Three natural mortalities were recorded in the study area and two outside the area. In 1973 the remains of a 2-year-old bear were found at the base of a winter den, and an adult female was killed by adult male during the fall (Reynolds 1974). A helicopter pilot reported observing a large bear feeding on a small bear at the mouth of a den southwest of the study area in spring 1974; examination of the den site revealed the remains of an adult female and at least one yearling. It could not be determined if the animals died during winter and were dragged from the den or were killed by another bear. The other mortality was assumed on the basis of indirect evidence when a female entered hibernation with two cubs and was observed with only one cub the following spring.

Census Methods

Accurate census estimates for brown/grizzly bears are difficult to obtain because of the species' generally low densities and extensive movement patterns. To overcome these problems most census estimates of bear populations have been conducted in areas where bears congregate at food sources (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, aerial censuses were conducted during late August and early September when bears appeared to be feeding primarily on soapberries (*Shepherdia canadensis*) growing on gravel bars in river valleys.

As reported in a previous report (Reynolds 1974), census estimates were calculated by using the differential efficiency method (Caughley and Goddard 1972), the Lincoln Index (as reported in Overton and Davis in Giles 1969) and a minimum direct count. The use of the differential efficiency method resulted in a gross underestimation of bears. Both the Lincoln Index and the minimum direct count probably overestimated the number of bears in the area since the survey routes and areas of search were restricted to prime grizzly bear habitat and because the relationship of home range size to habitat use was unknown.

To determine population density and the accuracy of census methods in the study area, all bears sighted were captured and marked when conditions permitted. During 1973 and 1974 a total of 63 marked or recognizable bears were observed in the 9,324 km^2 (3600 mi^2) area of intensive study. Fifty of these bears were captured in 1974 (including recaptures of bears marked in 1973), 3 were captured in 1973 and observed in 1974, and 10 were recognizable young accompanying marked adults. This density of 1 bear/148 km^2 (57 mi^2) was calculated only in the area of intensive study where habitat quality was comparatively high; if the coastal plain to the north of the study area is included where surveys indicate density to be very low, the region-wide density would be approximately 1 bear/260 km^2 (100 mi^2).

Movement and Home Range Size

Characteristics of movement and home range size are presented in Table 2. Home ranges of five breeding males had a mean size of 702 km^2 (271 mi^2), while three breeding females had a mean home range size of 382 km^2 (147 mi^2) and five females accompanied by cubs had a mean home range size of 280 km^2 (108 mi^2). As expected, those bears with greater maximum distance between sightings had larger home range sizes. However, the mean daily movement of some bears with large home ranges was similar to that of bears with small home ranges. The larger home range of males versus females probably reflects the tendency of males to forage more widely than females.

Table 2. Movement and home range size of 13 grizzly bears in the eastern Brooks Range, Alaska, 1974.

Individual				Sightings		Distance traveled/day in km (mi)/day		Maximum distance between sightings in kilometers(miles)	Home Range Size
No.	Sex	Age	Repro Status	No.	Period	Mean	Range		km^2 (mi^2)
1001	M	15.5	Adult breeding	31	May 9-Sept 12	3.3(2.1)	.8-44.8 (.5-28.0)	45.9(28.5)	699(270)
1007	M	15.5	Adult breeding	22	May 21-Aug 30	2.3(1.4)	1.6-34.4 (1.0-21.5)	37.0(23.0)	699(270)
1015	M	17.5	Adult breeding	29	May 21-Nov 1	1.7(1.1)	0-46.4 (0-29.0)	47.5(29.5)	712(275)
1036	M	13.5	Adult breeding	25	May 26-Oct 10	2.4(1.5)	.8-32.8 (.5-20.5)	65.2(40.5)	757(293)
1051	M	12.5	Adult breeding	15	June 30-Sept 6	3.2(2.0)	1.6-43.2 (1.0-27.0)	51.5(32.0)	642(248)
1014	F	5.5	Adult breeding	32	May 26-Oct 10	1.8(1.1)	0-32.8 (0-20.5)	29.0(18.0)	456(176)
1043	F	14.5	Adult breeding	24	June 9-Sept 7	1.6(1.0)	0-20.0 (0-12.5)	25.8(16.0)	256(99)
1044	F	12.5	Adult breeding	35	June 11-Oct 6	2.7(1.7)	0-23.2 (0-14.5)	43.5(27.0)	433(167)
1045	F	12.5	With two 2 yr olds	10	June 11-Oct 6	1.4(0.9)	4.8-27.2 (3.0-17.0)	34.6(21.5)	326(126)
1042	F	10.5	With two yearlings	35	May 24-Oct 10	2.4(1.5)	.8-28.8 (.5-18.0)	41.0(25.5)	409(158)
1041	F	23.5	With two yearlings	23	May 23-Sept 12	1.0(0.6)	.8-10.4 (.5-6.5)	16.1(10.0)	210(81)
1026	F	12.5	With two cubs	21	June 6-Oct 5	1.3(0.8)	.8-16.8 (.5-10.5)	29.0(18.0)	256(99)
1070	F	14.5	With two cubs	7	Sept 5-Sept 30	1.6(1.0)	1.6-15.2 (1.0-9.5)	20.1(12.5)	199(77)

These home ranges are considerably larger than those reported for bears in other areas. In Wyoming, Craighead and Craighead (1965) found a home range of 39 km^2 (15 mi^2) for a female. In Mt. McKinley National Park, Alaska, Dean (in press) estimated the home range of a female to be 16-25 km^2 (6-10 mi^2). Eight female grizzlies in the southern Yukon Territory had a mean home range size of 70 km^2 (27 mi^2), and an unspecified number of males ranged over a mean area of 295 km^2 (114 mi^2) (Pearson 1972). Differences in home range size between bears on Alaska's North Slope and other areas of North America likely reflect the low quality and short period of availability of forage on the North Slope of the Brooks Range.

Population Discreteness

Because of the grizzly bear's mobility and ability to forage in, and to cross, rugged terrain it is unlikely that the Brooks Range is a barrier between breeding populations.

In 1973 movement by marked bears across the physiographic divide of the Brooks Range was recorded during late September and early October when they were moving to denning areas (Reynolds 1974). Two of these bears crossed to the south side of the range and another moved north after she was disturbed by aircraft at a den site near the crest of the divide. In 1974 no interchange of marked animals across the range was noted. However, the large size of home ranges and freedom with which bears travel across precipitous terrain suggest that such movement freely occurs.

Food Habits

Observations of bears and examination of feeding sites confirmed seasonal food habit indicated by scat analysis. From May to early June 1974, 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 was the major food source in 1973 and bearberry (*Ardostaphylos rubra*) was in 1974. Between mid-September and mid-October roots were the major food item, although numerous attempts were made to dig out hibernating ground squirrels (*Spermophilus undulatus*). After mid-October the only feeding bears seen were utilizing caribou (*Rangifer tarandus*) or moose (*Alces alces*) carcasses.

Seasonal food habits described by Murie (1944) for grizzly bears in Mt. McKinley National Park, Alaska included roots (especially *Hedysarum* sp.) and carrion from early May to early June; grasses and horsetail 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 determined by fecal samples, included mostly grasses, horsetail and sedges from May to November with forbs as a supplementary food in May and berries (*Vaccinium* sp. and *Sorbus* sp.) supplemental from June through November (Mundy and Flook 1973). Our observations and scat analyses (Reynolds 1974) on grizzlies in the eastern Brooks Range generally corroborate the seasonal food habits documented by Murie (1944) and Mundy and Flook (1973).

RECOMMENDATIONS

Because of the accelerating rate of resource development and human access, monitoring of human impact on the grizzly bear population in the Brooks Range and Arctic Slope should be continued. The sub-population in the study area should be observed periodically to further determine parameters of productivity and survival rates of marked bears.

Additional research of a similar nature should be conducted in the western Brooks Range and Arctic Slope to compare population structure, productivity, home range size and habitat utilization of grizzly bear populations throughout northern Alaska.

In view of the low density, poor population production and apparently declining population structure, annual hunter harvest should be limited to no more than three percent of the total population.

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Appendix I. Weights and measurements of grizzly bears captured in northeastern Alaska, 1974.

Bear	Sex	Age cem+ (yrs)	Measured Weight**	Total Length*	Shoulder Height*	Hind Foot*	Neck*	Girth*	Body Length*	Head Width*	Head Length*	Left Upper Canine*	Left Lower Canine*
1000	M	24.5	159(350)	193	119	28	68	-	121	21.6	36.4	-	-
1001a	M	15.5	181(400)	198	100	25	77.7	122	120	23.2	38.2	3.4	3.0
b			-	180	109	28	80	-	129	22.5	34.0	3.5	3.5
c			211(465)	211	116	31	79	-	115	23.0	36.2	3.3	3.1
1004	M	10.5	154(340)	171	107	22	72	-	109	20.5	34.5	3.9	3.2
1007	M	15.5	150(330)	188	85.5	21	78	126	105	28.0	46.0	3.3	3.0
1014	F	5.5	77(170)	158	99	20.6	62	-	101	17.5	31.5	3.3	3.0
1015a	M	17.5	268(590)	215	106	39.8	82	-	132	25.0	37.0	4.2	3.5
b			227(500)	200	133	30	75	129	126	24.0	38.2	4.1	3.7
1016	F	7.5	86(190)	167	93	24	85	116	99	18.1	31.0	3.1	3.0
1017	M	12.5	213(470)	196	111	30	76	131	112	23.0	34.9	3.4	3.2
1024	M	3.5	107(235)	160	100	21.9	63	105	97	17.6	32.4	3.2	3.0
1026	F	12.5	91(200)	165	94	24.5	63	106	97	18.3	30.0	2.9	2.5
1036a	M	13.5	179(395)	207	114	25.5	73.8	-	125	23.6	37.6	4.3	3.6
b			211(465)	189	107	36	75	-	118	23.9	36.8	4.4	3.9
1039	M	12.5	191(420)est	179	114	28	72	118	96	21.4	35.7	3.7	3.2
1040	M	12.5	136(300)	160	120	29	75	123	100	21.8	33.2	3.5	3.4
1041a	F	22.5	88(195)	153	71	25.2	56	-	97	18.8	31.2	3.5	3.0
b			100(220)	158	93	23	58	-	93	17.9	-	3.4	3.0
1042a	F	10.5	109(240)	178	78	25.9	56	-	97	19.0	32.8	2.6	2.6
b			113(250)	171	97	20	60	131	115	18.8	32.0	2.7	2.5
1043	F	14.5	95(210)	99	94	24	57	105	82	18.8	27.3	2.8	2.5
1044a	F	12.5	100(220)	167	95	25	55	101	95	19.2	31.9	3.0	2.3
b		12.5	141(310)	-	-	-	-	-	-	-	-	-	-
1045	F	12.5	102(225)	189	95	27	61	124	95	20.0	35.0	3.5	3.0
1046	M	2.5	75(165)	165	79	28	53	120	87	16.7	30.4	3.0	3.1
1047	F	14.5	91(200)	153	87	25	58	103	96	18.5est	28.8est	3.5	2.8
1048	F	10.5	109(240)	190	93	22.1	66	122	110	29.0est	48.0est	3.2	2.7
1049	M	2.5	64(140)	156	97	26	52	93	74	16.6	29.0	2.6	3.1
1050	M	28.5	145(320)	195	102	26	73	131	118	24.2	35.6	4.0	3.0

Appendix I. (cont.)

1051	M	20.5	181(400)est	202	116	27	72	125	119	24.8	34.8	3.5	3.5
1052	F	12.5	118(260)	171	95	24	60	114	99	18.5	31.7	2.9	2.6
1053	M	15.5	195(430)	175	113	28	79	-	117	23.2	35.8	4.0	3.4
1054a	F	7.5	125(275)	164	102	26	69	132	109	20.2	33.2	3.0	2.8
b			141(310)	183	99	26	66	-	106	20.3	32.8	3.0	2.8
1055	F	2.5	54(120)	135	78	22	44	82	79	13.6	25.8	2.9	2.9
1056	M	15.5	200(440)	178	124	30	75	134	110	22.8	34.0	4.2	3.2
1057	F	10.5	104(230)	159	98	20.2	-	-	94	19.6	30.8	-	-
1058	M	21.5	175(385)	200	109	29	73	-	112	20.8	34.1	3.9	3.4
1059	M	4.5	104(230)	164	100	27	55	104	137	17.1	31.8	3.5	3.1
1060	M	10.5	188(415)	211	111	31.5	82	140	117	22.1	37.0	3.4	3.1
1061	F	13.5	104(230)	158	97	27	-	109	91	17.9	32.5	3.1	2.9
1062	F	11.5	120(265)	155	96	23	59	104	96	19.5	32.6	3.1	2.8
1063	F	1.5	59(130)	137	67	23	55	77	76	13.8	25.1	2.1	2.4
1064	F	5.5	86(190)	145	87	24	54.5	91	93	16.4	29.8	2.9	2.9
1065	F	19.5	118(260)	191	102	26.5	59	113	93	18.6	34.1	2.7	2.5
1066	F	20.5	138(305)	157	92	26	74	143	103	19.9	32.0	3.1	2.9
1067	F	18.5	118(260)	155	88	20	60	113	99	19.6	32.8	3.0	2.6
1068	F	4.5	91(200)	168	101	28	59	104	94	16.5	30.5	1.1	1.1
1069	M	8.5	136(300)	196	103	27	70	-	112	19.2	33.7	3.2	2.9
1070	F	14.5	122(270)	181	99	24	60	113	100	19.4	31.3	3.1	2.8
1071	M	2.5	70(155)	119	76	17	51	102	81	15.0	26.5	3.1	2.9
1072	M	1.5	79(175)	135	71	20	43	76	79	14.2	24.5	1.6	1.9
1073	F	1.5	45(100)	116	70	20	40	76	70	13.5	23.2	1.9	2.1
1074	F	2.5	76(160)	152	78	23	47	90	86	15.4	26.7	2.6	2.6
1075	F	13.5	134(295)	179	98	21	73	114	107	20.0	33.0	2.7	2.3
1076	M	16.5	211(465)	214	112	26	79	-	103	24.0	37.4	4.4	3.5
1077	M	1.5	48(105)	124	64	16	44	96	81	13.5	24.5	1.9	1.8
1078	F	1.5	41(90)	124	67.5	15.5	46.5	100	80	14.3	22.5	2.0	1.8
1079	F	12.5	107(235)	181	100	25	62	120	97	19.6	32.1	3.5	3.0

+ cementum
* cm
**kilograms (pounds)

Appendix II. Cementum age, sex, weight, drug dosage and tag numbers of bears marked in the eastern Brooks Range, Alaska, 1973-1974.

No.	Sex	Age	Wt.[1]	Capture Date	Location (River drainage or area)	Visual Markers[2]	Ear Tags L.	Ear Tags R.	Drug Dosage[3]	Repro Status
1000	M	23.5	295	4/24/73	Canning-3 Lakes	R/R	601	602	3.0(S)o	Ad. breeding
		24.5	350	4/30/74	Pogopuk Creek	RRW	776	602	2.4(M)m	Ad. breeding
1001	M	14.5	400e	4/25/73	Ivishak-Low Pass	G/G	603	604	2.6(S)o	Ad. breeding
		15.5	400	5/9/74	Ivishak-Low Pass	Radio	603	604	1.9(S)o	Ad. breeding
		15.5	-	7/17/74	E. trib. Saviuviayak	Radio	603	604	3.2(S)o	Ad. breeding
		15.5	465	9/12/74	W. trib. Ivishak	Bk r.	603	868	5.4(S)h	Ad. breeding
1002	M	14.5	350e	4/27/73	Marsh Fork	W/R	605	606	2.8(M)1	Ad. breeding
		14.5	375e	5/3/73	Porcupine Creek	WWRW	605	606	3.6(M)1	Ad. breeding
		14.5	-	5/30/73	Marsh Fork	-	605	606	-	Ad. breeding
1003	F	5.5	250e	4/29/73	E. Fork Chandalar	R/G	611	607	2.8(M)m	SubAd. breeding
		5.5	258	927/73	E. Fork Chandalar	WWB1	611	607	-	SubAd. breeding
1004	M	9.5	220	5/3/73	S. Fork Canning	GRG	613	612	2.6(S)h	Ad. breeding
		10.5	340	9/8/74	Canning	BdBdW	859	858	4.5?(S)1	Ad. breeding
1005	M	11.5	300	5/6/73	Porcupine Lake	Radio	614	615	2.2+(M)1	Ad. breeding
1006	F	5.5	150	5/10/73	S. Fork Canning	WWRW	617	616	1.5(S)o	SubAdult
1007	M	14.5	400e	5/10/73	S. Fork Canning	Radio	621	618	2.0(S)1	Ad. breeding
		14.5	300e	6/16/73	Pass S. Canning	RWR	621	618	2.2(S)o	Ad. breeding
		15.5	330	5/21/74	Canning	Radio	621	784	1.5(S)m	Ad. breeding
1008	M	19.5	350e	5/11/73	Kavik	R/B1	622	623	1.9(S)h	Ad. breeding
1009	M	16.5	275	5/11/73	Echooka	RRBGR	625	624	2.0(S)o	Ad. breeding
1010	M	13.5	450	5/11/73	Echooka	R/S	631	641	2.8(M)1	Ad. breeding
1011	M	19.5	325e	5/12/73	Canning	G/W	644	643	1.7(S)m	Ad. breeding
1012	M	11.5	250	5/17/73	Marsh Fork	G/B1	652	651	2.6(M)1	Ad. breeding
1013	F	11.5	225	5/30/73	Marsh Fork	G/R	656	655	1.1(S)1	Ad. breeding
1014	F	4.5	175	6/1/73	Canning	W/W	653	654	-	SubAd. breeding
		5.5	170	5/26/74	Canning	Radio	653	654	1.4(S)o	SubAd. breeding
1015	M	16.5	500	6/1/73	Canning-3 Lakes	W/R	657	658	1.7(S)1	Ad. breeding
		17.5	590	5/24/74	Canning-3 Lakes	Radio	789	790	2.6(S)1	Ad. breeding
		17.5	500	8/16/74	Canning	Radio	789	790	4.1(S)m	Ad. breeding
		18.5	500e	5/25/75	Canning	none	789	790	-	Ad. breeding
1016	F	6.5	175	6/3/73	Ivishak	BkWBk	659	661	1.3(S)o	SubAd. breeding
		7.5	190	6/29/74	Ivishak-Porcupine	BkWBk	659	661	1.5(S)o	SubAd. breeding
1017	M	11.5	350e	6/3/73	Ivishak	GWG	663	662	1.9(S)h	Ad. breeding
		12.5	470	8/22/74	Ivishak	GWG	844	845	3.0(S)1	Ad. breeding

1018	f	7.5	150e	7/6/73	Deadman Creek	BkWBk(r)	3025,26	1.1(S)1	SubAd. breeding
1019	F	16.5	200e	7/12/73	Spoonfish Lake	WRW	3028,29	1.4(S)m	With 2 yrlgs
1020	F	11.5	240e	7/13/73	E. of E. Fork Chandalar	W/G	3045,46	1.8(M)1	With 2 yrlgs
1021	F	19.5	225e	7/18/73	Upper Porcupine Lake	BdBdBd	3047,48	1.6(S)o	With 2 cubs
1022	M	14.5	225e	7/23/73	Porcupine Lake-MF	GGW	3049,50	2.0(S)1	Ad. breeding
1023	F	8.5	205	7/28/73	Upper Ivishak	BkBkBk(c)	3052,53	1.4(S)o	SubAd. breeding
1024	M	2.5	-	8/7/73	Canning	WWWW	3055,54	1.7(M)1	SubAdult
		3.5	235	9/27/74	Upper Canning	O r. ear	3055,821	2.2(S)o	SubAdult
1025	F	-	275e	8/8/73	Deadman Creek	RR/RR	3057,56	-(M)-	Ad. breeding
1026	F	11.5	225e	8/9/73	Marsh Fork	GBkG	3058,59	3.0(M)1	Ad. breeding
		11.5	-	9/29/73	Carter Pass	Radio	3058,59	-(M)m	Ad. breeding
		12.5	200	6/29/74	Porcupine area	Radio	3058,59	1.7(S)o+	With 2 cubs
		13.5	200e	5/29/75	Marsh Fork	-	3058,59	-	With 1 yrlg
1027	M	9.5	-	9/3/73	Cane Creek	GGR	3075,76	3.7(S)o	Ad. breeding
1028	M	10.5	-	9/3/73	Cane Creek	RRG	3074,73	3.6(M)o+	Ad. breeding
1029	M	15.5	450	9/6/73	Water Creek	WWR(L)	3072,1,0	2.6(S)o	Ad. breeding
1030	F	9.5	275	9/6/73	Water Creek	WWBd	3069,68	2.6(S)o	Adult
1031	F	9.5	200	9/6/73	Water Creek	BdWBd	3066,67	3.6(M)1	Adult
1032	F	6.5	200e	9/7/73	Cane Creek	BOB	3065,64	3.5(M)1	SubAdult
1033	F	11.5	-	9/14/73	Water Creek	RBdR	3063,62	-	-
1034	F	5.5	180e	9/15/73	Water Creek	B1B1c	3060,61	1.9(S)o	SubAdult
1035	M	4.5	190e	9/17/73	Deadman	OOOOOc	3077,51	1.7(M)o	SubAdult
1036	M	12.5	600e	9/29/73	Porcupine area	R/G	3078,79	-(M)1	Ad. breeding
		13.5	395	5/26/74	Canning	Radio	798,3079	2.2(S)o	Ad. breeding
			465	8/28/74	Echooka	GGG	798,3079	4.9(M)1	Ad. breeding
			-	9/2/74	Ivishak	Radio	798,3079	4.9(S)h	Ad. breeding
		14.5	-	5/75	Canning	-	798,3079	-	Ad. breeding
1037	F	11.5	220e	10/2/73	Deadman Creek	S/B	3080,81	3.0(M)h	With 2 yrlgs
1038	M	6.5	175e	10/7/73	Deadman Creek	GBGBc	3082,83	-	SubAdult
1039	M	10.5	420e	5/6/74	Gilead Creek	plaque	777,779	2.7(M)h	Ad. breeding
1040	M	15.5	300	5/15/74	Echooka	plaque	783,782	1.5(S)h	Ad. breeding
1041	F	23.5	195	5/23/74	Wahoo Lake	radio	785,786	1.2(S)1	With yrlgs
			220	9/12/74	Echooka	none	785,786	2.2(S)h	With yrlgs
1042	F	10.5	240	5/24/74	Canning-3 Lakes	radio	787,788	1.3(S)o	With 2 yrlgs
			250	9/25/74	Headwaters E. Kavik	radio	787,788	2.0(S)o	With 2 yrlgs
			220e	5/24/75	Canning-3 Lakes	-	787,788	-	With 2, 2 year olds
1043	F	14.5	210	6/9/74	Marsh Fork	radio	792,791	1.5(S)o	Ad. breeding
1044	F	12.5	220	6/11/74	Ivishak	radio	793,794	1.3(S)h	Ad. breeding
			310	10/1/74	Ivishak	none	793,794	2.6(S)1	Ad. breeding

1045	F	12.5	225	6/11/74	Ivishak W.	plaque	796,795	2.0(M)o	With 2, 2 year olds
1046	M	2.5	165	6/11/74	Ivishak W.	lost	797,799	1.1(S)o	Two year old
1047	F	14.5	200	6/13/74	Ivishak	plaque	801,800	1.7(S)o	Ad. breeding
1048	F	10.5	240	6/14/74	Canning	plaque	802,803	1.7(S)o	Ad. breeding
1049	M	4.5	140	6/21/74	Sagavanirktok	Bk 1. ear	804,526	1.3(S)o	SubAdult
1050	M	24.5	320	6/21/74	Echooka	plaque	805,806	2.2(S)h	Old Adult
1051	M	12.5	400	6/30/74	Canning-3 Lakes	radio	807,808	2.6(S)o	Ad. breeding
1052	F	12.5	260	6/30/74	Pogapuk Creek	plaque	810,809	1.7(S)o	Ad. breeding
1053	M	15.5	430	7/1/74	East of Ivishak	plaque	811,812	2.4(S)o	Ad. breeding
1054	F	7.5	275	7/1/74	Echooka-Wahoo Creek	plaque	813,814	1.5(S)o	Ad. breeding
			310	9/4/74	Echooka-Wahoo Creek	GGG	813,814	3.9(M)1	Ad. breeding
1055	F	2.5	120	7/11/74	Juniper Creek	G 1. ear	815,816	1.0(S)h	SubAdult
1056	M	15.5	440	7/11/74	Upper Ignek Creek	none	none	3.0(S)o	Ad. breeding
1057	F	10.5	230e	7/12/74	Flood Creek	RRR	820,819	3.0(M)1	With 2 cubs
1058	M	17.5	385	7/28/74	Gilead Creek	plaque	828,829	9.8(M)1	Ad. breeding
1059	M	5.5	230	7/28/74	W. Ivishak	Bd both	826,827	1.9(S)1	SubAdult
1060	M	15.5	415	7/29/74	W. of Gilead	WRR	830,831	3.4(M)h	Ad. breeding
1061	F	13.5	230	7/31/74	Ivishak-Sagavanirktok	BdBdG	832,833	2.0(M)h	With 2 yrlgs
1062	F	11.5	265	8/8/74	Canning	WWG	835,834	1.9(S)1	With 1 yrlg
1063	F	2.5	130	8/8/74	Canning	W 1. ear	837,836	1.4(M)1	Yearling
1064	F	5.5	190	8/20/74	Trib. Ivishak	O both	1039,838	3.0(M)o	SubAdult
1065	F	18.5	260	8/20/74	Ivishak	WWW	841,840	2.2(S)o	With 2 year old
1066	F	20.5	305	8/20/74	Ivishak	GGG	842,843	8.5(M)o	Adult
1067	F	18.5	260	8/29/74	Upper Ivishak	GOG	847,846	4.9(M)o	With 2 yrlgs
1068	F	4.5	200	8/31/74	Ivishak	R 1. ear	848,849	2.9(M)o	Two year old
1069	M	8.5	300	9/4/74	Echooka-Wahoo Creek	W r. ear	850,1,2	3.7(S)o	Ad. breeding
1070	F	14.5	270	9/5/74	Wahoo Creek	radio	853,854	2.8(S)1	With 2 cubs
1071	M	3.5	155	9/8/74	Marsh Fork	P r. ear	856,857	-	SubAdult
1072	M	1.5	115	9/12/74	Echooka	O 1. ear	861,862	1.3(S)o	Yearling
1073	F	1.5	100	9/12/74	Echooka	O r. ear	863,864	1.8(M)o	Yearling
1074	F	3.5	160	9/13/74	Ivishak	Wl,Rr	869,871	1.7(S)o	SubAdult
1075	F	13.5	295	9/16/74	Ivishak	WRW	873,872	3.4(M)o	With 2 cubs
1076	M	16.5	465	9/24/74	Ivishak-Gilead Creek	BdBdW	877,876	5.6(M)o	Ad. breeding
1077	M	1.5	105	9/25/74	Headwaters E. Kavik	Bd 1.	878,880	-(S)o	Yearling
1078	F	1.5	90	9/25/74	Headwaters E. Kavik	Bd r.	881,879	-(S)o	Yearling
1079	F	12.5	235	10/1/74	Ivishak-Sagavanirktok	OWO	882,883	-(M)m	Ad. breeding

1. Weight in lb.
2. Marking designations:
   Colors: R, red; W, white; G, green; O, orange; Bd, dark blue; Bl, light blue; Bk, black; S, silver; P, pink
   Collar types (with examples): R/W - nylon web, red collar, white flags
   RRG - nylon rope, two identical clusters of RRG flags on opposite sides
   RWRWRW - cotton rope, red and white alternating flags
   R r. ear - red flag in right ear
   Plaque - red and white fiberglass plaque with design
3. The figures represent drug dosage in cc; the letter in parentheses indicates single (S) or multiple (M) injections; and the small letter indicates the effect of the drug - n, none; l, light; o, optimum; h, heavy; m, maximum