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POPULATION STRUCTURE, REPRODUCTIVE BIOLOGY, AND MOVEMENT PATTERNS OF GRIZZLY BEARS IN THE NORTHCENTRAL ALASKA RANGE

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SUMMARY

In 1981-83, the 1st phase of a study was begun to determine the status and reproductive biology of a grizzly bear (Ursus arctos) population in the northcentral Alaska Range. During this period, 56 bears were captured and 45 were radio-collared; captured bears included 26 males and 30 females. Minimum estimated population density for the study area was 1.85 bears/100 km^2. Initial analysis of the structure of the population showed that few mature males were present, possibly the result of hunting pressure. Evidence suggests that females have a potentially long reproductive life span; at least some produce their 1st litters at age 6 and a 25.5-year-old female weaned her 2.5-year-old offspring and bred. Based on 13 litters, including those of both cubs and yearlings, mean litter size was 1.8. All measures of population biology that were calculated should be considered tentative and contingent upon the collection of additional data.

During 1982-83, 21 mortalities were recorded in the study area: 10 hunter kills, 6 offspring of marked females, 2 capture-related deaths, 1 adult female that was killed by an adult male, 1 adult female that died in her den, and an unmarked yearling that was not seen after the capture attempt and was presumed dead. Historical sport hunting records of grizzly bears in the study area during 1961-83 are reported. Analysis of the effects of present harvest on the population will await determination of population structure and reproductive biology.

The extent of movement and size of home range were apparently dependent upon the sex and age of the individual. In general, adult males moved farthest and had the largest home ranges. Home

ranges and movements of breeding females, females with offspring, and young-age animals of both sexes were much smaller than adult males, and there was a lot of individual variation within the sex and age classes.

Key words: grizzly bear, harvest rates, home ranges, Interior Alaska, mortality, population biology, Ursus arctos

CONTENTS

Summary i
Background 1
Objective 2
Procedures 3
Results and Discussion 4
Bears Captured and Radio-collared 4
Population Density 4
Population Structure 5
Reproductive Biology 5
Age at 1st Production of Young 6
Maximum Productive Age 6
Reproductive Interval 6
Litter Size 7
Reproductive Status of Males 7
Mortality 7
Movement and Home Range Size 8
Denning 9
Recommendations 9
Acknowledgments 9
Literature Cited 10
Figures 14
Tables 22
Appendix A. Physical attributes of grizzly bears captured in the northcentral Alaska Range, 1981-83 29

BACKGROUND

As problems concerning the management of Alaska's wildlife become more complex, there is a growing need for specific biological information on wild species. Human populations are rapidly increasing in Alaska; consequently, user demands on wildlife (including hunting) are increasing. Concurrently, the amount of public land available for wildlife habitat and accessible to wildlife consumers has declined due to resource development and changes in land status resulting from Alaskan lands legislation. In Alaska, because of their requirements for large home ranges and their low reproductive potential, grizzly bears (Ursus arctos) are among the most susceptible of the large mammals to these changes.

Few research studies have addressed aspects of grizzly bear biology that are necessary to answer problems of increased exploitation and loss of habitat. Specifically, no population dynamics data are available for Interior Alaska north of the Alaska Range except for 2 studies in Denali National Park (Dean 1976, Valkenburg 1976). Elsewhere in Alaska, baseline biological information has been determined for brown/grizzly bear populations on the south side of the Alaska Range (Ballard et al. 1982, Miller and Ballard In Press), on the Alaska Peninsula (Lentfer et al. 1969, Glenn et al. 1976), and in the Brooks Range (Crook

1971, 1972; Reynolds 1976, 1978, 1981). However, there is no evidence that data from these areas are applicable to the north-central Alaska Range.

Assessment of the impacts of changes in user pressure or changes in availability of habitat requires knowledge of bear population status. Management decisions are based on the number, sex, and age of bears harvested. Other than the use of these parameters and general estimations of the status of grizzly populations, no data are available to use as a basis for regulating harvest rates. Use of these data as a basis for past management has been adequate in many cases, but more detailed information is needed as management becomes more intensive. Management strategies for any area must consider the relative numbers of, and relationships between, wildlife species. Management goals for grizzly bears may require increasing, decreasing, or maintaining populations to reach densities that are compatible with desired population levels of ungulates.

Although safe annual harvest rates of 2-4% of the grizzly population have been proposed for areas of similar habitat in Canada (Lortie 1978), and rates of 2-3% have been used as a basis for harvest in the Brooks Range (Reynolds 1976), additional information is necessary before appropriate harvest rates can be estimated for the Alaska Range. The following baseline information must be known to accurately predict the effects of harvest: population density and structure, movement and home range patterns, mortality rates of age classes, and reproductive potential including age at 1st breeding, litter size, and interval between litters (Craighead et al. 1974, Reynolds 1978, Bunnell and Tait 1980).

In 1981, Phase I of this study was begun in a long-term investigation of the effects of different harvest rates on a grizzly bear population (Reynolds 1982, Reynolds and Hechtel 1983). The emphasis of Phase I is to gather baseline information on the population biology of northcentral Alaska Range grizzly bears. Data collection necessary for an accurate baseline description and population model should be completed during 1984. Harvest level during this period will be low, 3-5%. In Phase II of the study, harvest rates will be calculated and the harvest level increased to about 6-10% through manipulation of seasons and by directing public hunting effort to the area using the news media. Changes in population size and productivity will be monitored and analyzed to determine the effects of increased harvest on population size and reproductive parameters and to determine if population compensatory mechanisms occur as harvest level is increased.

OBJECTIVE

To determine population density, structure, reproductive potential, and movements of grizzly bears in the northcentral Alaska Range.

PROCEDURES

The 3,900-km^2 (1,500-mi^2) study area is located in the mountains and foothills of the northcentral Alaska Range (Fig. 1). Its boundaries are Gold King Creek drainage and Wood River drainage downstream from Virginia Creek to the west, the crest of the Alaska Range to the south, the Delta Creek drainage to the east, and the southern edge of the Tanana Flats (approx. 64°N latitude) to the north. It includes portions of 2 U.S. Army reservations, Ft. Wainwright and Ft. Greely.

Elevations in the area range from 500 to 3,700 m (1,600 to 12,000 ft). Most rivers in the area flow through U-shaped, glacially formed valleys and are fed by active glaciers. Treeline occurs at approximately 900 m (3,000 ft). Dense patches of willow (Salix spp.) or alder (Alnus crispa), which bears use for cover, may be present to about 1,200 m (4,000 ft).

Capture procedures followed standard helicopter immobilization techniques used on grizzly bears in the Brooks Range (Reynolds 1974, 1976, 1978). Bell 206B and Hughes 500D helicopters were used in 1981, and U.S. Army UH-1 (Bell 205) helicopters were used in 1982 and 1983. In the area's precipitous terrain, the Hughes helicopter was preferred due to its maneuverability and climbing power. Although the U.S. Army UH-1 helicopter was not as maneuverable as the smaller helicopters, it surpassed them in power, climbing ability, and hauling capacity. Bears were immobilized with Sernylan (100 mg phencyclidine hydrochloride/ml; Bio-Ceutic Laboratories, St. Joseph, Mo.) and acepromazine maleate (10 mg/ml; Ayerst Labs, New York, N.Y.) injected into the rump using Cap-Chur (Palmer Chemical and Equipment Co., Douglasville, Ga.) or Paxarms equipment (Paxarms Ltd., Box 317, Timaru, New Zealand). During 1983, etorphine (1 mg M99/ml, D-M Pharmaceuticals, Inc., Rockville, Md.) was used to immobilize some bears. All animals were measured, weighed (Appendix A), tattooed for permanent identification, ear-tagged, and marked with individually coded visual ear flags as described by Reynolds (1974). In addition, except those offspring under maternal care, all bears captured were fitted with radio collars (Telonics, Inc., Mesa, Ariz.).

A 1st premolar tooth was extracted for determination of age based on cementum layering (Mundy and Fuller 1964, Stoneburg and Jonkel 1966, Craighead et al. 1970). 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 10-cc Vacutainers (Becton-Dickinson, Rutherford, N.J.). During 1981 and 1982, blood and 1 g muscle samples were collected for blood chemistry and physical condition studies (Brannon 1983). Saliva swabs were collected for identification of aerobic and anaerobic bacteria present in bear mouths to facilitate treatment of bear attacks on humans (Parry et al. 1983). Fecal samples were collected to aid in determining seasonal food habits.

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 the number of cubs and age structure of family groups.

Radio-collared bears were relocated using a Piper PA-18 Super Cub equipped with a radio receiver-scanner and 4-element, high-gain Yagi antennas. Movements and home range sizes were determined from resightings of marked grizzlies during aerial surveys and from relocating animals fitted with radio transmitters. Home ranges were determined using the minimum home range polygon (Craighead and Craighead 1972; Pearson 1975, 1976; Craighead 1976). In this method, the outermost observation sites plotted on maps for each bear are connected to form a convex polygon; the enclosed area is measured to calculate home range.

A tentative population estimate was made using the direct count method (Reynolds 1974, 1976, 1978; Pearson 1976) and will be compared with results from a Lincoln Index estimate (Overton 1971).

RESULTS AND DISCUSSION

Bears Captured and Radio-collared

In the study area, 56 bears were captured: 5 in 1981, 30 in 1982, and 21 in 1983 (Table 1). Radio collars were placed on 45 bears, 11 were placed on young-age males ($\leq$5.5 years), 9 on adult males ($\geq$6.5 years), 9 on young-age females, and 16 on adult females. By fall 1983, 31 of 45 bears still carried functioning radio collars; 7 bears had shed collars (Nos. 1302, 1304, 1315, 1316, 1346, and 1349); 5 bears had died (Nos. 1305, 1314, 1329, 1332, and 1342); and 2 bears could not be located and their collars were presumed to have failed (Nos. 1309 and 1310). In 5 cases, collars were placed on all members of family groups: No. 1305 and her 2, 2-year-olds, Nos. 1306 and 1307; No. 1321 and her 3, 2-year-olds, Nos. 1342, 1343, and 1344; No. 1322 and her single 2-year-old, No. 1336; No. 1329 and her single yearling, No. 1330; and No. 1333 and her 2 yearlings, Nos. 1334 and 1335.

Population Density

Based only on the bears captured or observed in the study area during 1982-83, the minimum spring 1982 population density was 1.85 bears/100 km^2 (2.57 bears/100 mi^2). In early May 1982, the study area contained a minimum of 72 grizzly bears. These included the 55 marked bears that were alive in spring 1982 and 17 unmarked individuals that were either observed during 1982-83 capture operations or later killed by hunters. Nine of the 17 unmarked bears were observed during capture operations, including 5 offspring of marked females, 1 adult female with a yearling, 1

large adult male, and 1 small bear whose sex was not determined. Hunters killed 4 unmarked bears in 1982 (1 in May, 3 in September) and 4 in 1983 (2 in May, 2 in September).

The probable density of bears in the area, however, is 1.89-2.86 bears/100 km^2 (5.89-7.14 bears/100 mi^2). The minimum density is an underestimate because it does not include unmarked bears in the area that were not killed by hunters or observed during the study. Based on the home ranges and distribution of marked bears living in major drainages of the area, the available habitat may support an additional 18-38 bears. Therefore, the probable population of bears in the area is 90-110. This estimate is similar to the density of 1 bear/41 km^2 (2.44/100 km^2) reported south of the Alaska Range in the upper Susitna River (Miller and Ballard In Press).

Population Structure

Of the 64 bears captured in this study or killed by hunters, 29 (45%) were males and 35 (55%) females (Fig. 2). Twelve males were offspring of marked females (0.5-2.5 years of age), 4 were young age (3.5-5.5 years), and 12 were adults (≥6.5 years of age). The female component of the population consisted of 7 offspring, 10 young age, and 17 adults. Additional data are required to determine if this sex and age structure is representative of the population. If it is representative, 3 patterns are evident: there are more male than female offspring, there are more young-age and adult females than males, and few males live beyond age 13.5. This seems to indicate that there is greater production and higher mortality for males, and lower production and lower mortality rate for females. These patterns may change when larger sample sizes are available.

The fact that fewer adult males than females were captured likely reflects their relative presence in the population. Similar ratios of males:females have been recorded in populations subject to little sport hunting in Wyoming (Craighead et al. 1974) and northern Alaska (Reynolds 1980). The Alaska Range population is hunted and most bears harvested are males, so the sex ratio of the adult population should favor females. Males composed 61% of the bear harvest from 1961-83 in Game Management Unit 20, which includes the study area. Large adult males are very vulnerable to sport hunting (Bunnell and Tait 1980, Stringham 1980), so few survive past age 13-15 years. Few young-age males were captured. This could be due to the small sample size or to a high mortality rate within this age class.

Reproductive Biology

Assessment of the reproductive potential of females requires data on ages at 1st and last production of young, interval between litters, and litter size (Craighead et al. 1969, Reynolds 1978, Bunnell and Tait 1980). Preliminary results indicate general patterns that must be corroborated by additional data.

Age at 1st Production of Young:

Eight females aged 3.5-5.5 years showed no evidence of previous offspring. One 6.5-year-old estrous female (No. 1308) captured in late May 1982 had black, enlarged mammaries indicating that she lost a litter as a 5.5-year-old or, more likely, as a 6.5-year-old prior to the onset of estrus. An 8.5-year-old female (No. 1322) that was accompanied by a yearling bred successfully at 6.5 years (Table 2).

These data indicate that age at 1st production of young in the study area will probably be 6 or 7 years of age; this minimum breeding age is slightly older than has been recorded in more southern portions of Alaska, but younger than in northern Alaska. Females produce 1st litters between 4.5 and 7.5 years of age in the Nelchina Basin (Miller and McAllister 1982), Kodiak Island (Hensel et al. 1969), and the Alaska Peninsula (Glenn et al. 1976). The bear populations in these areas are all highly productive. On the other extreme, in the eastern Brooks Range, age at 1st litter ranges from 6.5-12.5 ($\bar{x}$ = 10.1) (Reynolds 1976) and in the western Brooks Range, 5.5 to 11.5 ($\bar{x}$ = 8.0) (Reynolds and Hechtel 1982).

Outside Alaska, Pearson (1975, 1976) concluded that females in southwestern Yukon Territory are first capable of conception at age 6.5, but in the northern part of the Territory the age at 1st conception was 7.5 years. In Yellowstone National Park, Craighead et al. (1969, 1976) observed that some 3.5-year-old females copulated, but none were accompanied by cubs the following spring, and that females first bred successfully at 4.5-8.5 years.

Maximum Productive Age:

All 13 females older than 10 years of age were accompanied by offspring or in breeding condition and showed evidence of previous offspring. The ages at which 12 females produced their most recent litter were 9 years, 1; 11 years, 1; 12 years, 2; 13 years, 3; 15 years, 3; 18 years, 1; and 23 years, 1. One female (No. 1305) produced cubs as a 23-year-old, weaned them as a 25.5-year-old, and then bred the same year. Unfortunately, she was killed by a hunter that fall so the outcome of the breeding could not be determined.

Reproductive Interval:

Reproductive interval is the time between breeding by a mature female and the subsequent weaning of a litter (Reynolds 1980, Reynolds and Hechtel 1982). Years in which a female breeds but fails to conceive or loses her litter are included in a reproductive interval. Therefore, observations of the length of time offspring accompany females before weaning should be viewed as minimum values of reproductive intervals since females may not

always produce young subsequent to breeding efforts (Craighead et al. 1969, 1976; Reynolds 1974, 1980; Glenn et al. 1976). Failure to produce offspring in the spring following breeding was prevalent in studies in the eastern (Reynolds 1974, 1976) and western Brooks Range (Reynolds 1980, 1981; Reynolds and Hechtel 1982).

In the study area, a minimum reproductive interval of 3 years was observed for only 1 female (No. 1305) when she weaned her 2-year-old offspring in 1982. In 1983, 3 family groups of females with 2-year-olds remained together through the summer and entered dens in the fall. These offspring will probably be weaned as 3-year-olds; therefore, their minimum reproductive interval will be 4 years.

In both 1982 and 1983, circumstantial evidence that some females wean 2.5-year-old offspring was observed: no adult females were seen that were accompanied by 2-year-olds during or after the 1982 breeding season; 2, 2-year-olds (Nos. 1303 and 1356) were captured alone during the 1982 and 1983 breeding seasons, respectively, and were presumably weaned that year; and 1, 3-year-old (No. 1302) was captured in early May 1982 prior to the time most offspring are weaned and therefore was probably weaned the previous year as a 2-year-old. Calculation of the mean breeding interval for females in this population will require further data collection.

Litter Size:

Mean litter size was 1.5 for 5 cub litters and 2.0 for 8 yearling litters. Mean cub litter size is small, especially when compared to that of 2.3 found 100 km south in the Nelchina Basin (Miller and McAllister 1982); however, mean yearling litter size is higher than that of 1.6 for the Nelchina Basin. Sample sizes are too small to draw conclusions.

Reproductive Status of Males:

Fifteen adult males were observed during the 1982 or 1983 breeding seasons. All 10 males older than 8.5 years of age displayed breeding behavior or accompanied a female in estrus. In 1982, neither of the 2, 6.5-year-old males displayed breeding behavior, but in 1983 2, 6.5-year-old males did display breeding behavior while 1, 5.5-year-old did not. Young adult males may not breed due to physiological incapability or competition with older males. If young males do not breed, productivity could be adversely affected by exploitation of older males. However, no firm conclusions regarding minimum breeding age in males can be drawn until more data are collected.

Mortality

Confirmed mortality within the study area during 1982 was 11 bears. Hunters killed 3 males and 3 females including 1 marked 25.8-year-old female (No. 1305) and 1 marked 6.8-year-old male

(No. 1314) in 1982. Unknown causes accounted for mortality of 5 offspring of 3 marked females. One of 2 yearlings of female No. 1327 was not observed after it was darted during the capture attempt and was presumed dead. The other yearling was marked on 8 July but not seen with the adult female after 27 August and presumed dead. Two litters of cubs were lost during the summer. Female No. 1318 had 1 cub when captured on 8 June and was observed with the cub on 18 June. On 2 July, she was observed without a cub and accompanied by a large adult male exhibiting courtship behavior. When captured on 26 May, female No. 1311 had 2 cubs that accompanied her until at least 5 August but were not observed on 27 August.

During 1983, known mortality included 4 hunter kills, 1 illegal kill (No. 1342, a 2-year-old male), 2 capture-related deaths (adult males No. 1338 and 1347), and 4 natural mortalities. A yearling offspring of marked female No. 1341 and a cub-of-the-year of female No. 1320 disappeared and were presumed dead. One adult female No. 1329 was accompanied by her 2-year-old when she was killed by an adult male. Another adult female, No. 1332, bred in 1982 but was found dead in her den in mid-May.

The causes of cub and yearling mortality could not be determined. Cub deaths caused by adult males have been documented in Alaska in the Brooks Range (Reynolds 1976, 1980; Reynolds and Hechtel 1982), south of the Alaska Range (Troyer and Hensel 1962, Glenn et al. 1976), and in Canada (Mundy and Flook 1973; Pearson 1975, 1976).

Sport hunting is a major source of mortality in this population. Annual harvest has ranged from 1 to 15 during 1961-83 (Table 3). The high reported kill of 14 occurred in 1981. Prior to that year, the mean annual take was 4.6. Females composed 33% of the total annual kill during 1961-81, but females composed only 11% of the bears harvested in the spring. If the population has remained relatively stable during the 1961-83 period and future research confirms a density estimate of 2.5 bears/100 km^2, the overall harvest rate has been between 4.5-5.0% of the population. However, before a sustained harvest rate can be calculated, sex- and age-specific mortality and population structure, productivity, and survival must be determined (Bunnell and Tait 1980, 1981).

Movement and Home Range Size

Movements and home range during 1982 and 1983 were determined for 35 bears equipped with radio collars. The time between sightings varied from 4 days to 5 weeks due to weather, sighting conditions, or available flight time. On this basis, general patterns of movement were identified but more specific measures, such as daily movement patterns, could not be calculated. Preliminary data on movements and home range for each bear were calculated (Table 4).

Only adult male bears moved outside the study area, and they all returned after traveling to the north of the study area. Females and young-age bears generally stayed within the drainage where they were captured.

Home range sizes varied by sex and age of bears (Table 5), but additional data must be collected before these data can be compared with home ranges from other areas. Home ranges of adult males were large, included variable habitat from glacial moraine to muskeg of the Tanana Flats, and traversed several river drainages (Fig. 3). Females with offspring had relatively small home ranges that tended to stay within a single river drainage (Fig. 4). These females were usually observed close to escape cover, possibly a reflection of the propensity for adult males to stalk or kill offspring of adult females (Reynolds 1980, Reynolds and Hechtel 1982). One breeding female (No. 1318) had a much larger home range than 5 others (Fig. 5). Subadult female home ranges were variable (Fig. 6). One 5.5-year-old had the 2nd largest female home range. Subadult male home ranges were small compared to adult males (Fig. 7).

Denning

Forty-two dens of radio-collared bears were located during 1981-83, 3 in 1981, 17 in 1982, and 22 in 1983 (Fig. 8). These bears denned in a variety of terrain ranging from creek banks at 900 m elevation to precipitous mountain slopes above glaciers in the Alaska Range at 1,600 m. No special denning areas or concentration sites were found and dens were distributed throughout the study area; bears tended to den within their home ranges. During 1982 and 1983, grizzlies in the Alaska Range denned a mean distance of 6 km (range 2-17 km) from the dens they used the previous year. No reuse of dens was documented. Physiographic characteristics of den sites including slope, aspect, and den measurements will be collected after bears leave their dens in 1984, funds permitting.

RECOMMENDATIONS

Research should continue to focus on learning the status and structure of this population so that accurate models of sustained yield can be calculated and tested.

ACKNOWLEDGMENTS

Because the study area included portions of military land on Ft. Wainwright and Ft. Greely, we were fortunate to be involved in a cooperative effort between the U.S. Army 172D Infantry Brigade (Alaska) and the Department of Fish and Game. Army units from Ft. Wainwright that provided support included the 222nd Aviation

Battalion, the Veterinary Activity, and the Natural Resources Office of the Facilities Engineers. The interest, skill, and willingness to help exhibited by the many individuals who were involved greatly contributed to the study.

Locating and capturing bears in this area was a particularly arduous task due to vegetative cover and precipitous terrain. The success we enjoyed was due in large part to the skill and abilities of UH-1 helicopter pilot-in-command CW3 Bruce Watson and crews of the 222nd Aviation Battalion. Every individual from this unit who participated did so in a competent and professional manner. Super Cub pilot Bill Lentsch and observer Ed Crain again demonstrated their unequaled capabilities to spot bears in alder patches, glacial moraines, and fog banks. Bob Brannon, University of Alaska, did an excellent job as a field assistant and instructor in field surgical techniques.

Ft. Wainwright U.S. Army personnel provided welcome and able assistance in all aspects of field research. Capt. Michael Terry, Ret., VETACT, originally proposed the cooperative aspects of the study. He instructed us in veterinary procedures for collecting samples; Capt. William E Clymer, VETACT, continued to provide veterinary expertise for the project. Junior Kerns, Jim Clark, and Steve Harrington, Natural Resources Office, Ft. Wainwright as well as Alan Bennett, 172nd Infantry Brigade, Ft. Richardson assisted in data collection, observation, and handling of bears; Junior Kerns and Alan Bennett helped coordinate the project.

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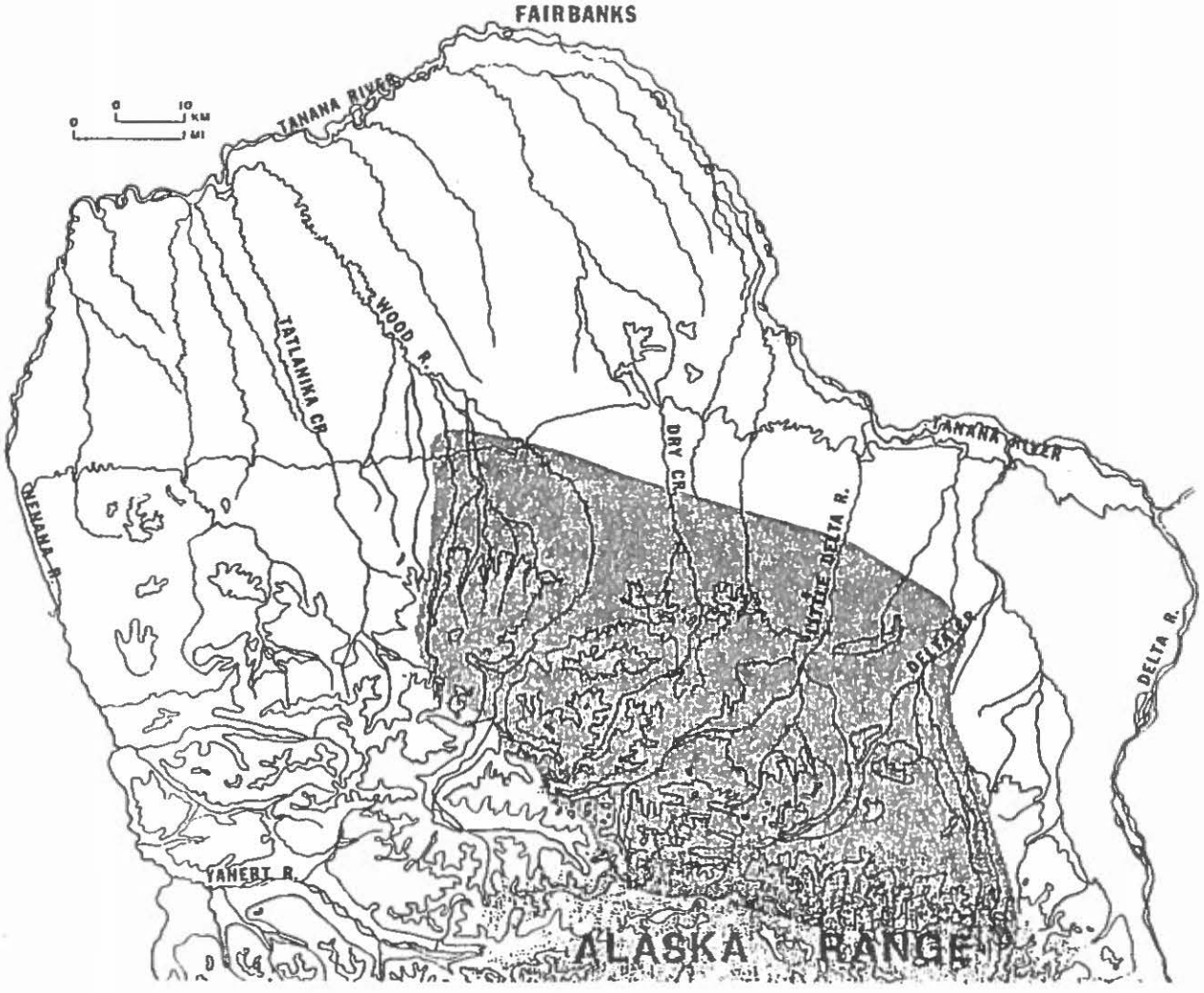
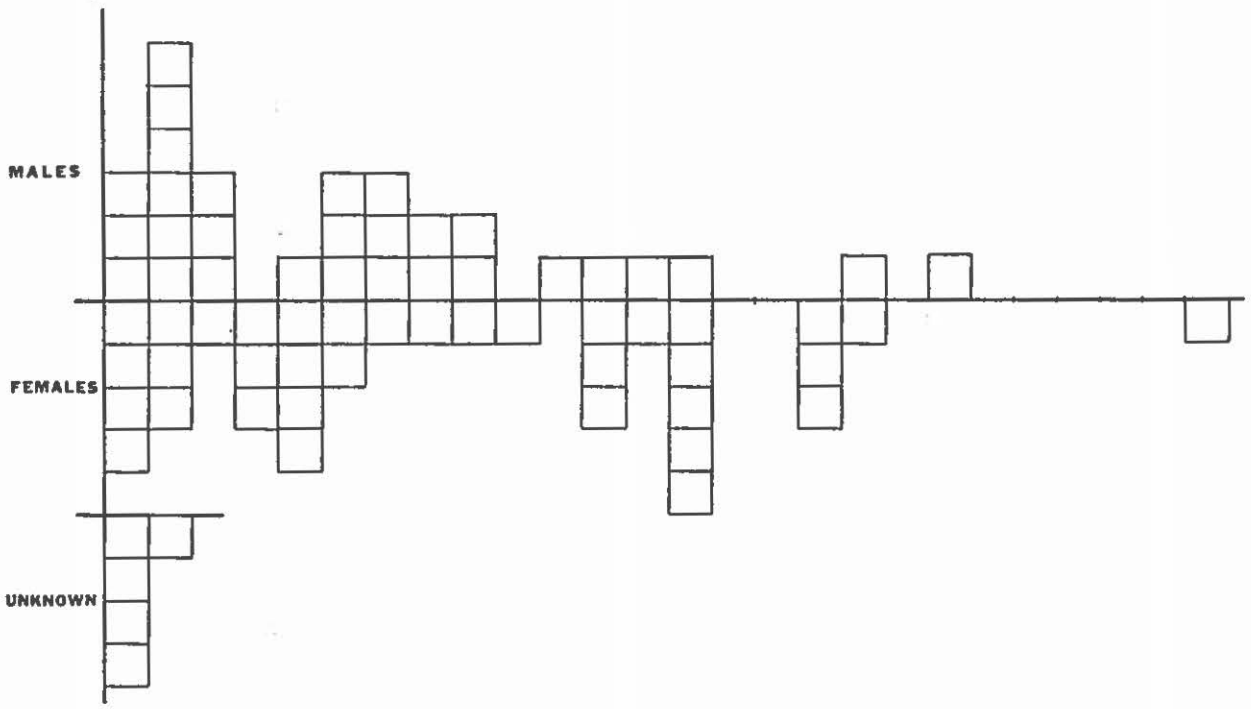


Fig. 1. Grizzly bear study area in northcentral Alaska Range.



AGE	0.5	1.5	2.5	3.5	4.5	5.5	6.5	7.5	8.5	9.5	10.5	11.5	12.5	13.5	14.5	15.5	16.5	17.5	18.5	19.5	20.5	21.5	22.5	23.5	24.5	25.5	ALL
MALES	3	6	3	0	1	3	3	2	2	0	1	1	1	1	0	0	0	1	0	1	0	0	0	0	0	0	29
FEMALES	4	3	1	3	4	2	1	1	1	1	0	3	1	5	0	0	3	1	0	0	0	0	0	0	0	1	35
UNKNOWN	4	1																									5
TOTAL	11	10	4	3	5	5	4	3	3	1	1	4	2	6	0	0	3	2	0	1	0	0	0	0	0	1	69

Fig. 2. Sex and age structure of a grizzly bear population in the northcentral Alaska Range during 1982 based on capture and hunter kill data.

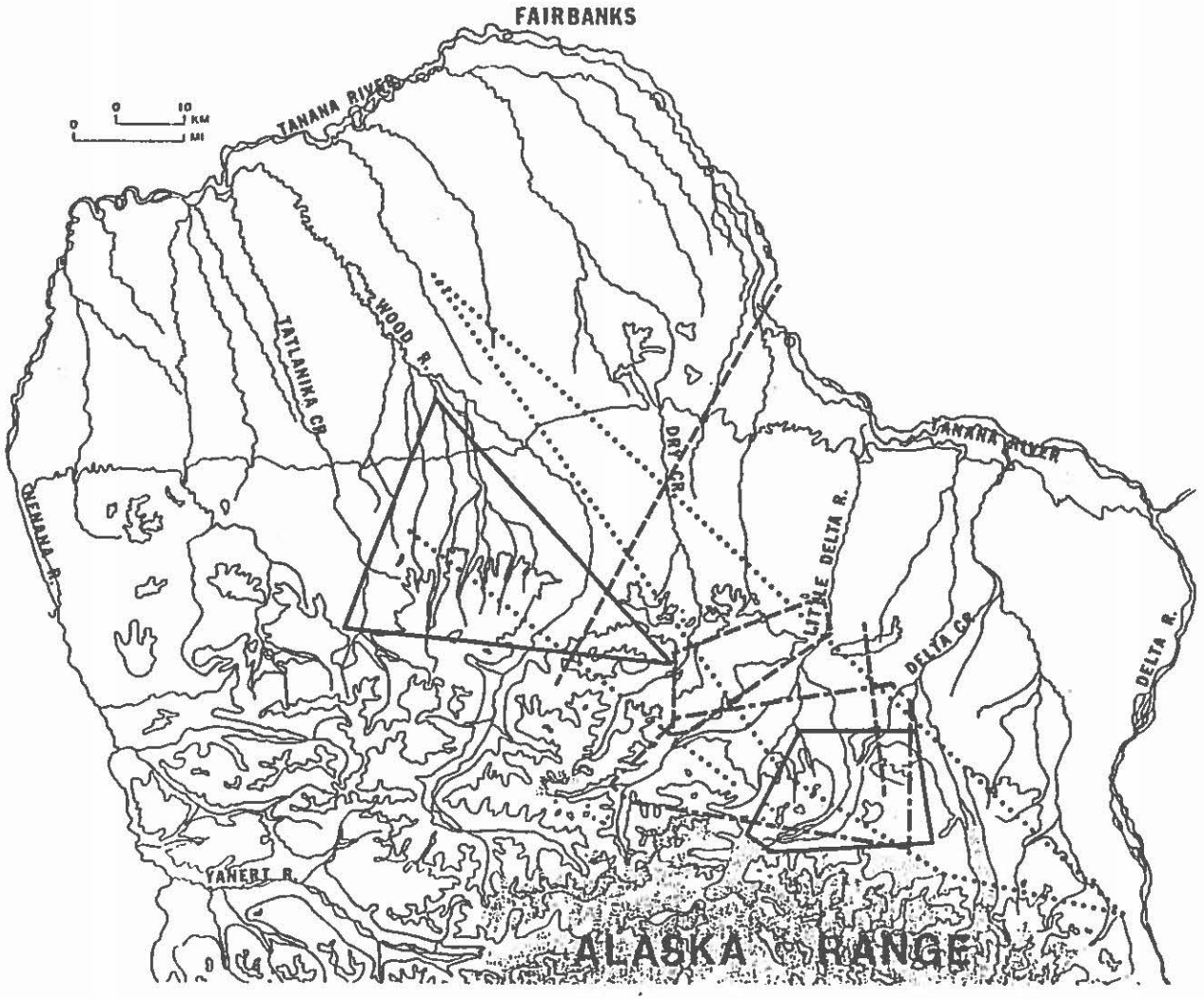


Fig. 3. Home ranges of 8 adult male grizzly bears, 1983.

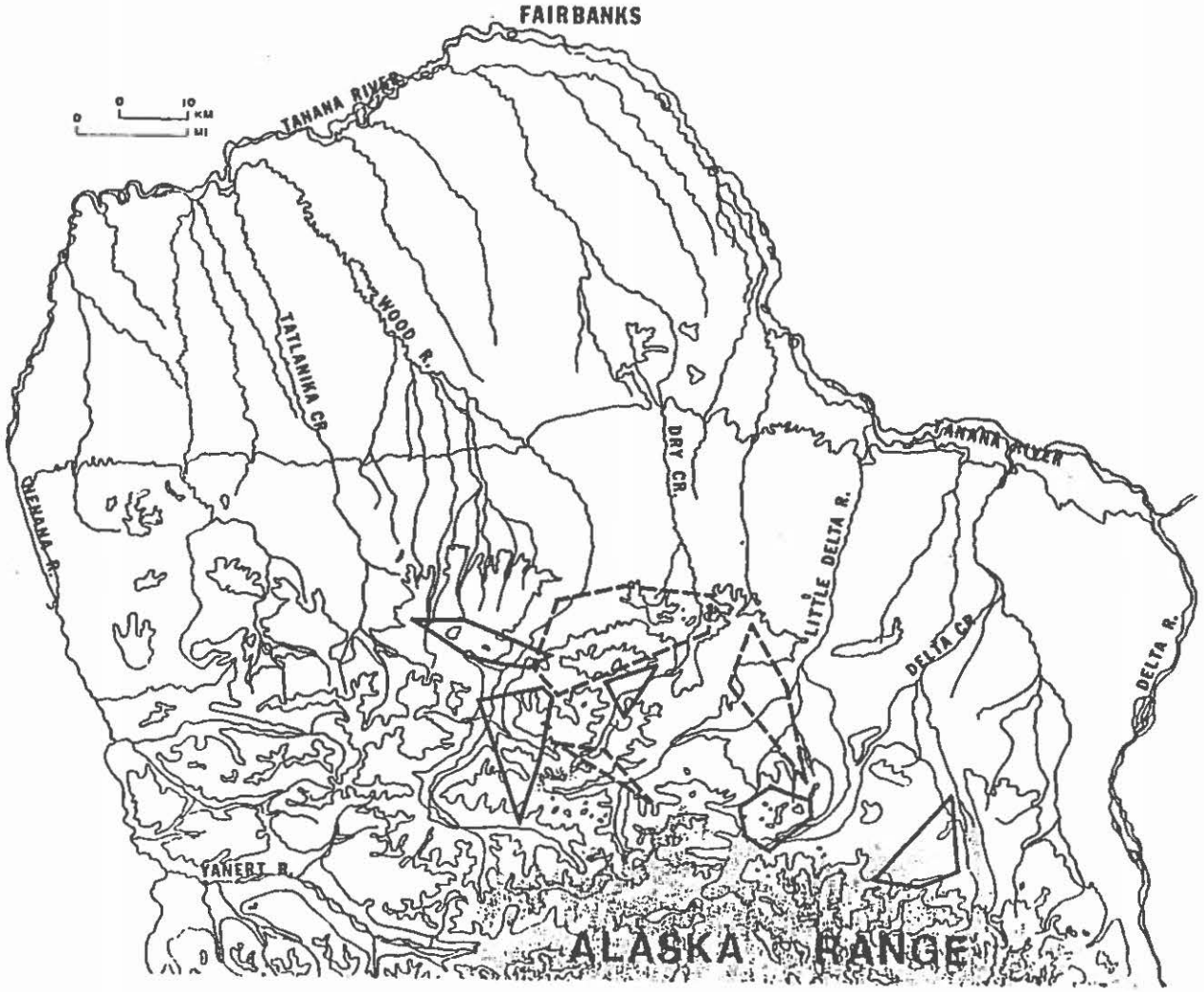


Fig. 4. Home ranges of 8 female grizzly bears with offspring, 1983.

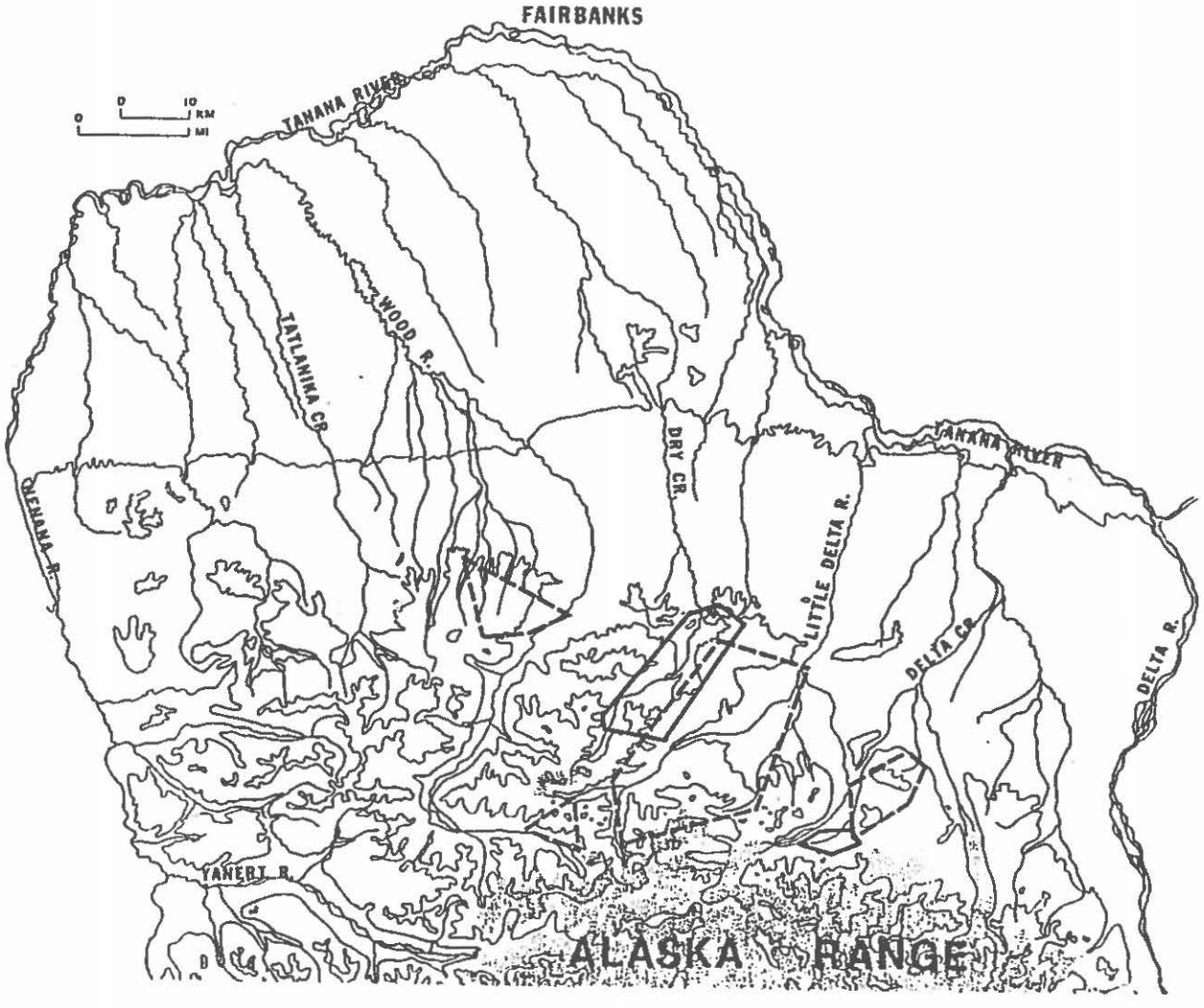


Fig. 5. Home ranges of 6 breeding female grizzly bears, 1983.

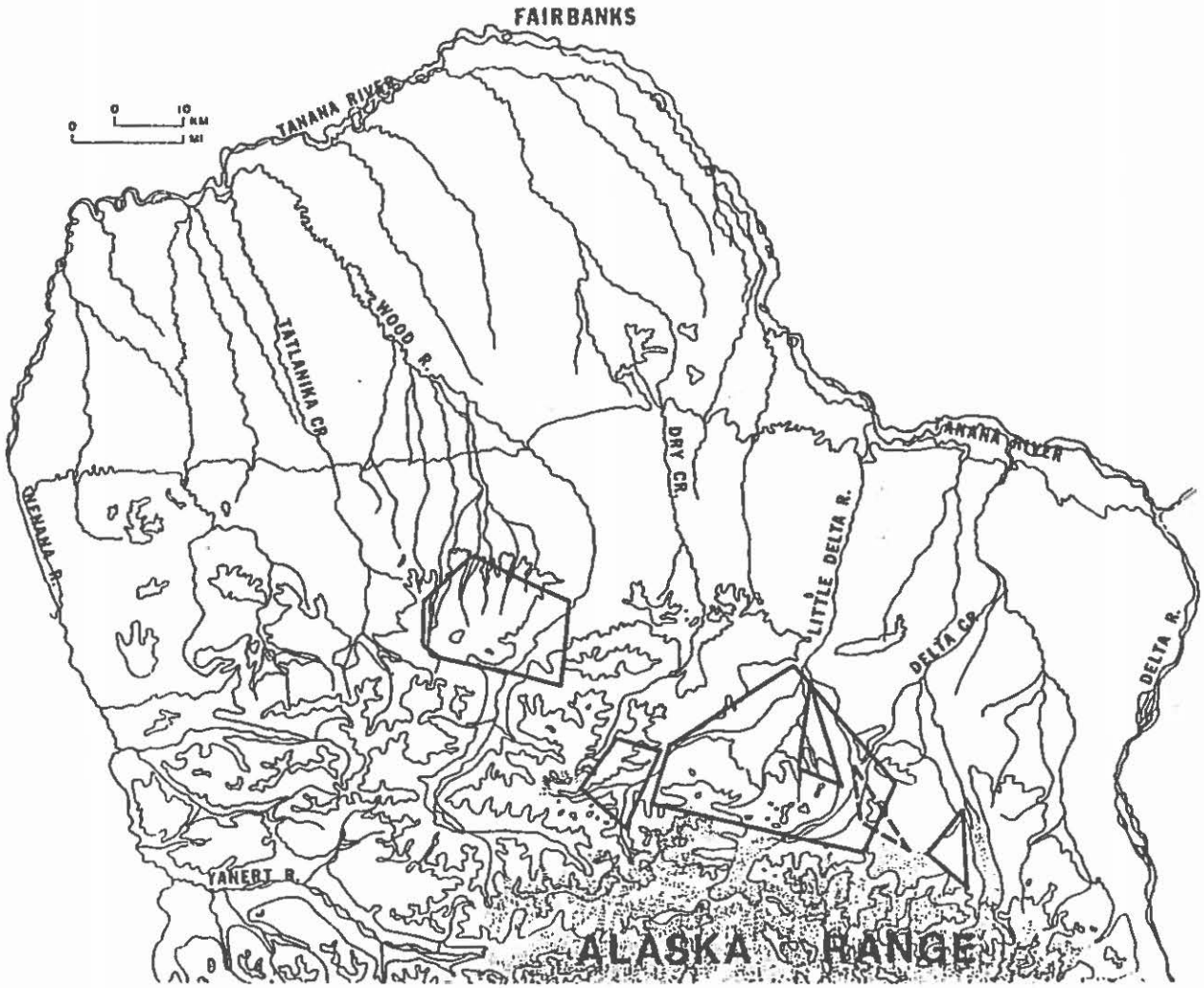


Fig. 6. Home ranges of 6 subadult female grizzly bears, 1983.

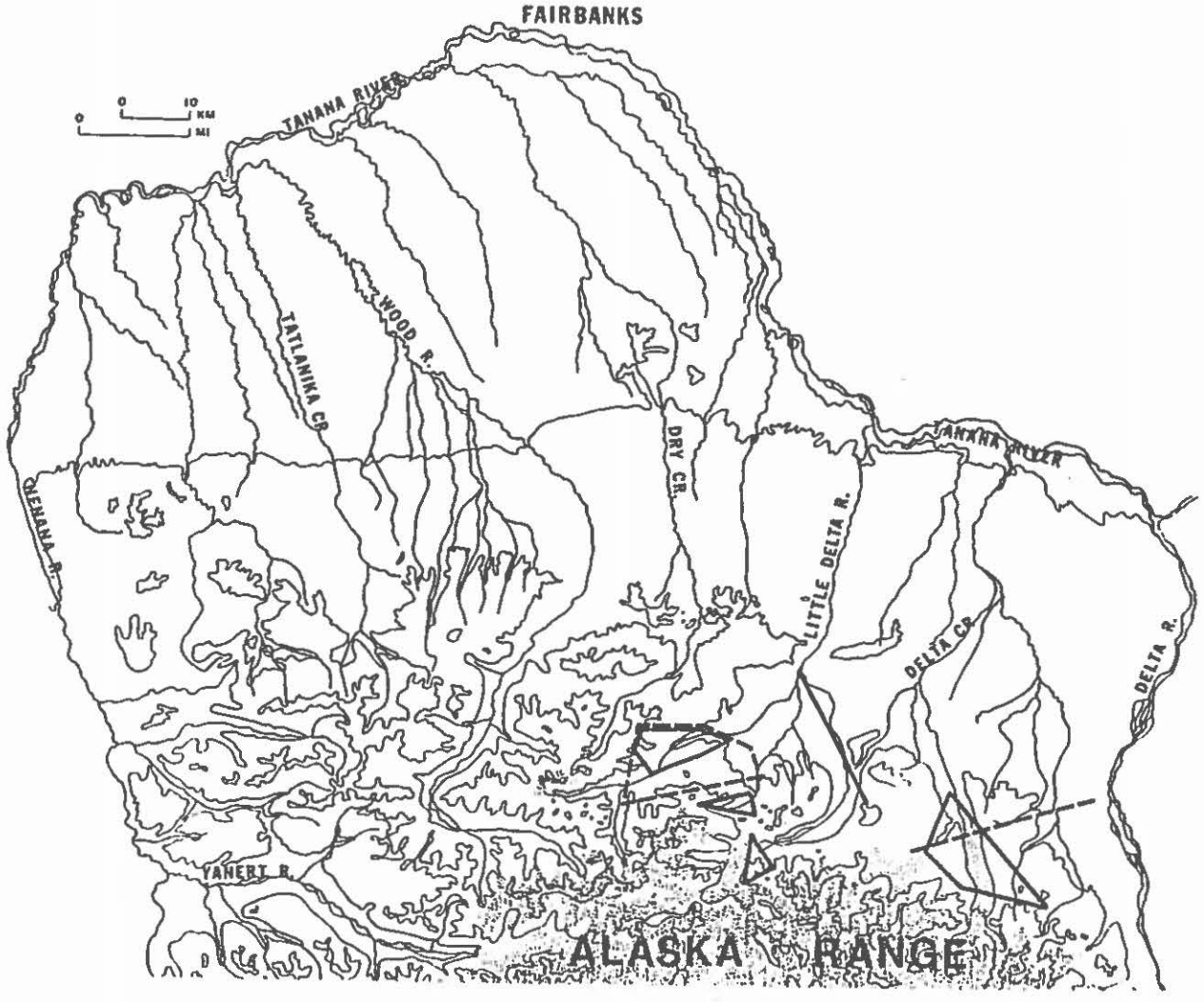


Fig. 7. Home ranges of 7 subadult male grizzly bears, 1983.

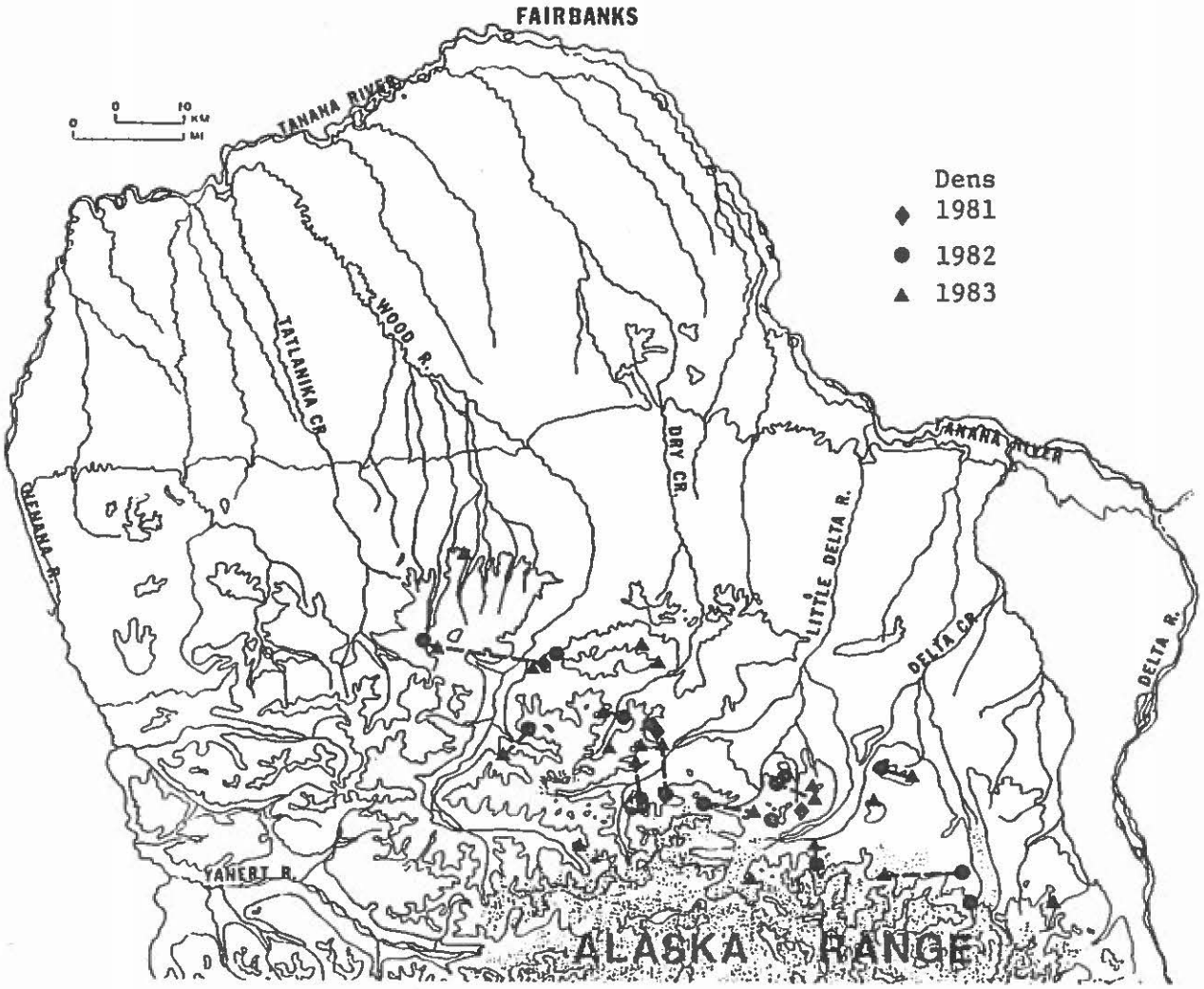


Fig. 8. Dens of radio-collared grizzly bears, northcentral Alaska Range, 1981-83. Den sites connected by dashed lines indicate dens used in different years by the same individual grizzly.

Table 1. Capture and marking characteristics of 56 bears captured in the northcentral Alaska Range, 1981-83.

Bear No. and sex	Cem. age (yr)	Date of capture	Weight kg (lb)	Location	Drug dosage[a]	Ear tags[b]	Markers[c]
1301 M	6.5	5/18/81	120(265)	Buchanan Cr.	1.8/1.2 H	373/374	G/G dead
1302 F	3.5	5/19/81	75(165)	E. Fork Delta	1.0/1.0 M	368/367	R/G
1303 F	2.5	6/17/81	57(125)	Mystic Mtn.	1.4/1.4 M	524/523	R/R
	4.5	6/27/83	82(180)	Herst Cr.	5.0[d] M	--	--
1304 M	5.5	6/19/81	136(300)	W. Fork Delta	2.4/2.0 M	451/452	lB/R
1305 F	24.5	6/19/81	114(250)	Slate Cr.	AM	453/454	O/R
1306 M	2.5	5/24/82	44(97)	W. Fork Delta	1.0/1.0 L	3151/3086	G/lB
1307 M	2.5	5/24/82	44(98)	W. Fork Delta	1.0/1.0 H	3087/3152	lB/G
1308 F	6.5	5/25/82	111(245)	Dry Cr.	--	3001/3154	O/Pp
1309 M	8.5	5/25/82	318(700[d])	Dry Cr.	AL	3153/3101	dB/Bk
1310 M	12[d]	5/25/82	250(550[d])	Buchanan Cr.	2.0/2.0 M	No tags	--
1311 F	12.5	5/26/82	120(265)	Molybdenum Rg.	1.9/2.1 M	3106/3107	W/W[e]
1312 F	0.5	5/26/82	12(26)	Molybdenum Rg.	0.1/0.1	3104/3155	O/W[e]
1313 F	0.5	5/26/82	12(27)	Molybdenum Rg.	0.08/0.13	3156/3105	W/O[e]
1314 M	6.5	5/27/82	116(255)	Iowa Rg.	2.1/1.9 H	3088/3002	dB/lB
1315 M	13.5	6/4/82	272(600)	Buchanan Cr.	1.9/2.1 L	3102/3157	Bk/O
1316 M	11.5	6/7/82	236(520)	W. Fork Delta	3.8/0.0 H	3089/3090	O/lB
1317 F	3.5	6/8/82	36(80)	Forgotten Cr.	1.2/1.8 L	3091/3003	lB/O
1318 F	13.5	6/8/82	104(230)	Buchanan Cr.	AL	3004/3103	W/G[e]
1319 M	0.5	6/8/82	12(26)	Buchanan Cr.	0.15/0 L	3005/3092	R/Y[e]
1320 F	17.5	6/8/82	102(225)	Trident Gl.	AM	3158/3093	G/B
1321 F	16.5	6/9/82	141(310)	Snow Mt. Glch.	2.1/1.9 M	3028/3108	G/W
	17.5	5/17/83	127(280)	Dry Cr.	1.8/2.2 M	3028/3427	G/W
1322 F	8.5	6/9/82	91(200)	Sheep Cr.	1.9/2.1 M	3051/3159	W/lB
1323 F	11.5	6/10/82	95(210)	Mystic Mt.	1.9/2.1 M	3160/3030	G/G[e]
1324 F	0.5	6/10/82	12(26)	Mystic Mt.	0.12/0 M	3027/3162	R/W[e]
1325 M	0.5	6/10/82	12(27)	Mystic Mt.	0.10/0 M	3161/3031	W/R[e]
1326 F	4.5	6/18/82	93(205)	Buchanan Cr.	2.2/1.8 M	3008/3163	W/R
1327 F	16.5	7/8/82	127(280)	Whistler Cr.	2.2/1.8 M	3134/3192	G/R
1328 F	1.5	7/8/82	43(95)	Whistler Cr.	0.9/1.1 M	3115/3014	dB/G
1329 F	13.5	7/9/82	120(265)	Buchanan Cr.	2.4/1.6 M	3026/3111	W/R
1330 M	1.5	7/9/82	48(106)	Buchanan Cr.	M	--	R/W
1331 F	4.5	7/10/82	77(170)	Trident Gl.	2.4/1.6 M	3120/3194	Bk/O
1332 F	5.5	7/12/82	104(230)	Gillam Gl.	2.4/1.6 M	394/190	R/dB
1333 F	16.5	7/13/82	141(310)	Buchanan Cr.	AM	474/469	G/R
1334 M	1.5	7/13/82	49(108)	Buchanan Cr.	1.0/1.0 M	395/392	Y/G
1335 F	1.5	7/13/82	38(84)	Buchanan Cr.	1.0/1.0 M	32/456	G/Y
1336 F	2.5	5/16/83	47(104)	Kansas Cr.	1.0/1.0 M	3201/3204	Bk/mG
1337 M	20.5	5/18/83	289(635)	Sheep Cr.	3.5/3.5	3209/3205	R/O
1338 M	6.5	5/20/83	111(245)	Molybdenum Rg.	AM	3203/3202	O/Bk dead
1339 M	6.5	5/23/83	120(265)	Trident Gl.	M	3286/3351	lB/W
1340 F	3.5	5/23/83	71(157)	Hayes Cr.	1.2/0.8 H	3277/3208	G/O
1341 F	10.5	5/23/83	107(235)	NE Portage	1.5/1.5 H	3210/3428	R/dB
1342 M	2.5	5/24/83	49(108)	Threemile Cr.	0.6/1.2 M	3354/3207	W/dB
1343 M	2.5	5/24/83	43(95)	Threemile Cr.	0.6/1.2 M	3426/3285	R/Bk

Table 1. Continued.

Bear No. and sex	Cem. age (yr)	Date of capture	Weight kg (lb)	Location	Drug dosage[a]	Ear tags[b]	Markers[c]
1344 M	2.5	5/24/83	56(123)	Threemile Cr.	0.6/1.2M	3361/3433	1B/Bk
1345 F	8.5	5/24/83	--	Upper W. Fork	1.2/1.8L	3206/3352	O/O
1346 M	5.5	5/25/83	114(250)	Hayes Gl.	AM	3359/3356	1B/1B
1347 M	12[d]	5/31/83	189(415)	Coal Cr.	--	--	dead
1348 F	12.5	5/31/83	--	Mystic Mtn.	AM	3363/3372	W/O
1349 M	18.5	6/2/83	264(580)	O'Brien Cr.	3.8/1.2L	3364/3292	R/1B
1350 M	8.5	6/2/83	202(445)	Ptarmigan Cr.	3.0/2.0L	3432/3430	dB/R
1351 F	14.5	6/23/83	114(250)[d]	Dry Cr.	4.0M99M	3217/3390	dB/W
1352 F	14.5	6/27/83	111(245)	W. Fork Delta	--	3215/3316	O/W
1353 M	1.5	6/27/83	27(60)	W. Fork Delta	--	3310/-	O/-
1354 F	1.5	6/27/83	12(27)	W. Fork Delta	--	-/3314	-/O
1355 M	3.5	6/30/83	60(133)	E. Fork Delta	4.0M99H	3232/3473	O/Bk
1356 M	3.5	6/30/83	50(110)	Little Delta R.	2.0M99H	3234/3392	Bk/O

[a] Dosage in ml of phencyclidine hydrochloride/acepromazine maleate; use of M99 is designated M99; A denotes multiple injections with unknown effective dosage. Drug effects were as follows: L = light, O = optimum, H = heavy.

[b] Ear tag numbers, left/right.

[c] Marking designations:
Colors: R, red; G, light green; mG, medium green; O, orange; 1B, light blue; dB, dark blue; W, white; Bk, black; Pp, purple; Y, yellow.
Marker types:
One or 2 color combinations were used for ear flags, e.g., O/W is orange in left ear, white in right ear; -/G is no flag, left; green, right.

[d] Estimated.

[e] Ear tags only and not ear flagging material were used to mark cubs of the year; therefore, for these bears only, marker colors indicate ear tags and not ear flags.

Table 2. Reproductive status and litter sizes of potentially mature females in the northcentral Alaska Range, 1981-83.

Bear No.	Age in 1983 (yr)	Offspring No.	1981[a]	1982	1983	Reproductive history
1302	5		NB	UN	UN	No offspring prior 1981
1303	4		NB	NB	B?	No offspring prior 1981
1305	25[b]	1306, 1307	2 ylg	2 2 yr/B	Dead	Hunter kill, fall 1982
1308	7			?/B	B?	Offspring prior 1982
1311	13	1312, 1313	UN/B	2 cubs	B	Lost cubs August 1982
1317	4			NB	NB?	No offspring prior 1982
1318	14	1319	UN/B	1 cub/B	B	Lost cub 1982
1320	18			?/B	1 cub	Weaned or lost offspring 1982, lost cub in 1983
1321	17	1342, 1343, 1344	3 cubs	3 ylg	3 2-yr	1342 illegally killed, fall 1983
1322	9	1336	UN/1+cubs	1 ylg	1 2-yr	
1323	12	1324, 1325	UN/B	2 cubs	2 ylg	
1326	5			NB	B	No offspring prior 1982
1327	17	1328, 1UM	UN/2+cubs	2 ylg	B	1UM capture mortality/1327 dead?
1329	14	1330	UN/1+cubs	1 ylg	Dead	Killed by male, May 1983
1331	5			NB	B	No offspring prior 1982
1332	6			NB	B	No offspring prior 1982, died in den 1983
1333	17	1334, 1335	UN/2+cubs	2 ylg	2 2-yr	
1340	3				NB	No offspring prior 1983
1341	10	1UM		1+cubs	1 ylg	Lost ylg 1983
1345	8				NB?	
1348	12			B	?/B	Probably weaned or lost offspring 1983
1351	14	3UM	UN/B	3+cubs	3 ylg	
1352	14	1353, 1354	UN/B	2+cubs	2 ylg	

[a] Designations: NB, not observed in breeding condition; UN, not observed in that year; B, observed in breeding condition; ?, status unknown; UM, unmarked; ylg, yearling; 2-yr, 2-year-old.

[b] Age in 1982.

Table 3. Historic grizzly bear harvest within the study area, 1961-83.

Year	Drainage of reported harvest				
	Delta Creek	Little Delta River	Dry Creek	Wood River[a]	Total
1961	0	2	2	3	7
1962	0	2	1	1	4
1963	0	1	1	5	7
1964	3	3	1	2	9
1965	0	0	1	1	2
1966	3	5	3	3	14
1967	0	1	0	0	1
1968	1	1	1	1	4
1969	0	1	0	1	2
1970	1	0	0	1	2
1971	0	1	0	1	2
1972	0	1	0	0	1
1973	1	1	1	5	8
1974	1	0	1	4	6
1975	1	0	0	1	2
1976	0	0	0	1	1
1977	1	1	2	1	5
1978	0	0	1	2	3
1979	1	3	0	6	10
1980	1	4	1	3	9
1981	0	5[b]	1[b]	9	15[b]
1982	0	3	2	1	6
1983	1	2	0	1	4
Totals	15	37	19	53	124

[a] The study area does not include the entire Wood River drainage. However, because many harvest records do not record specific portions of the drainage, all harvest records that designated Wood River as the location of kill are included.

[b] Single, marked bears were killed by hunters in the Little Delta River and Dry Creek drainages.

Table 4. Movement and home range sizes of radio-collared grizzly bears, northcentral Alaska Range, 1981-83.

Individual				Locations		Maximum distance between locations	Home range size	
No.	Sex	Age in 1983 (yr)	Reproductive[a] status	N	Period	(km)	(km^2)	Comments
1302	F	5.5	UN	4	5/9/81-3/29/82	13	36	Shed collar
1303	F	4.5	B?	13	6/17/81-10/15/83	22	243	
1304	M	7.5	UN	14	6/19/81-10/31/82	45	768	Shed collar
1306	M	3.5	NB	9	5/24/82-10/14/83	12	52	
1307	M	3.5	NB	12	5/24/82-10/14/83	20	144	
1308	F	7.5	B?	18	5/25/82-10/27/83	25	182	
1309	M	9.5	B	13	5/25/82-6/27/83	52	874	
1310	M	13.5[b]	B	14	5/25/82-8/19/83	27	357	
1311	F	13.5	B	17	5/26/82-10/14/83	15	65	Lost cubs fall 1982
1315	M	14.5	B	11	6/4/82-6/30/83	139	1726	Shed collar between 5/23 and 6/30
1316	M	12.5	UN	5	6/7/82-8/4/82	29	201	Shed collar
1317	F	4.5	NB?	11	6/8/82-10/14/83	13	73	
1318	F	14.5	B	20	6/8/82-10/15/83	37	556	
1320	F	18.5	w/cub	14	6/8/82-10/14/83	17	85	Lost cub in June
1321	F	17.5	w/2-yr	16	6/9/82-10/14/83	27	245	
1322	F	9.5	w/2-yr	13	6/9/82-10/14/83	20	133	
1323	F	12.5	w/ylg	13	6/10/82-10/14/83	21	55	
1326	F	5.5	B?	14	6/18/82-10/14/83	35	549	
1327	F	17.5	B	13	7/8/82-10/27/83	9	29	
1330	M	2.5	NB	3	3/15/83-10/14/83	9	10	Orphaned 2-year-old
1331	F	5.5	B?	11	7/10/82-10/14/83	12	39	
1333	F	17.5	w/2-yr	11	7/13/82-10/14/83	11	62	
1337	M	20.5	B	2	5/18/83-9/2/83	68	--	Radio collar nonfunctional
1339	M	6.5	B	5	5/20/83-10/27/83	22	121	
1340	F	3.5	NB	3	5/23/83-8/19/83	13	15	Not including den site
1341	F	10.5	w/ylg	5	5/23/83-8/15/83	25	103	
1345	F	8.5	B	3	5/24/83-8/15/83	8	29	
1346	M	5.5	UN	2	5/25/83-8/19/83	24	--	Shed collar
1348	F	12.5	B	6	5/31/83-10/15/83	17	88	

Table 4. Continued.

Individual No.	Sex	Age in 1983 (yr)	Reproductive status[a]	Locations N	Locations Period	Maximum distance between locations (km)	Home range size (km^2)	Comments
1349	M	18.5	B	2	6/2/83-10/15/83	57	--	Shed collar
1350	M	8.5	B	2	6/3/83-8/21/83	24	--	
1351	F	14.5	w/ylg	3	6/23/83-10/14/83	10	26	
1352	F	14.5	w/ylg	3	6/27/83-10/15/83	16	28	
1355	M	3.5	NB	3	6/30/83-10/15/83	8	14	
1356	M	2.5	NB	3	6/30/83-10/14/83	22	10	

[a] Designations: NB, nonbreeding; B, breeding; w/cub, w/ylg, w/2-yr, with cubs, yearling, or 2-year-old offspring.

[b] Estimated.

Table 5. Home range sizes of grizzly bears of different sex and age groups, northcentral Alaska Range, 1981-83.

Age/sex category	Bear No.	Home range size km^2	$\bar{x}$ km^2	SD km^2
Adult males				
(6.5 yr+)	1304	768		
	1309	874		
	1310	357		
	1315	1726		
	1316	201		
			785	595
Young-age males				
(2.5 yr)	1306	52		
	1307	144		
	1330	10		
	1339	121		
	1355	14		
	1356	10		
			59	60
Females w/offspring				
(8.5 yr+)	1320	85		
	1321	245		
	1322	133		
	1323	55		
	1333	62		
	1341	103		
	1351	26		
	1352	28		
			92	72
Breeding females				
(6.5 yr+)	1308	26		
	1311	65		
	1318	556		
	1327	29		
	1345	29		
	1348	88	132	209
Young-age females				
(2.5-5.5 yr)	1302	36		
	1303	243		
	1317	73		
	1326	549		
	1331	39		
	1340	15		
			159	208

Appendix A. Physical attributes[a] of grizzly bears captured in the northcentral Alaska Range, 1981-83.

Bear No.	Date	Sex	Age (yr)[b]	Measured weight	Total length	Shoulder height	Hind foot	Neck	Girth	Body length	Head width	Head length	Left upper canine[c]	Left lower canine[c]
1301	5/18/81	M	6.5	120	180	119	31	61	114	101	21.0	36.8	3.4	3.0
1302	5/19/81	F	3.5	75	165	102	26	55	100	90	16.7	30.5	3.0	2.7
1303	6/17/81	F	2.5	57	122	87	23	53	89	78	15.1	27.7	2.5	2.7
1303	6/27/83	F	4.5	82	159	97	26	55	91	79	18.4	32.3	3.0	2.9
1304	6/19/81	M	5.5	136	196	121	30	63	108	109	20.0	36.0	3.9	3.5
1305	6/19/81	F	24.5	114	174	103	28	60	100	96	20.1	32.6	3.0b	3.3b
1306	5/24/82	M	2.5	44	131	85	26	44	73	76	15.1	29.6	2.7	2.8
1307	5/24/82	M	2.5	44	148	84	28	46	74	83	15.4	27.3	2.5	2.5
1308	5/25/82	F	6.5	111	186	103	32	63	100	101	20.2	33.1	3.0	2.2b
1309	5/25/82	M	8.5[d]	318[d]	238	150	36	89	152	128	25.0	39.1	4.0	3.5
1310	5/25/82	M	12.0[d]	250[d]									b	b
1311	5/26/82	F	12.5	120	190	107	30	63	113	105	21.8	33.8	3.0	2.6
1312	5/26/82	F	0.5	12	81	48	15	28	43	42	10.2	16.5	m	m
1313	5/26/82	F	0.5	12	76	50	15	30	48	45	11.1	16.8	m	m
1314	5/27/82	M	6.5	116	191	114	33	61	105	99	18.5	34.8	3.6	3.3
1315	6/4/82	M	13.5	272	197	126	36	96	154	122	26.4	38.2	3.5	3.3
1316	6/7/82	M	11.5	236	211	133	33	81	133	135	24.0	40.7	3.8	3.7
1317	6/8/82	F	3.5	36	142	91	24	38	62	72	27.9		2.9	2.9
1318	6/8/82	F	13.5	104	188	113	31	57		113	19.5	33.5	3.1	2.8
1319	6/8/82	M	0.5	12	85	52	14	26	34	44	10.8	17.2	d	d
1320	6/8/82	F	17.5	102	181	110	29	65	103	100	21.0	33.1	2.9w	2.7w
1321	6/9/82	F	16.5	141	199	107	34	69	105	115	22.1	35.8	3.5	3.1
1321	5/17/83	F	17.5	127	178	91	30	69	109	112	21.9	36.0	2.4b	3.2
1322	6/9/82	F	8.5	91	169	100	29	62	97	97	18.9	32.8	3.2	3.0
1323	6/10/82	F	11.5	95	171	106	32	57	98	93	20.0	33.5	3.2	2.9
1324	6/10/82	F	0.5	12	77	49	16	29	47	39	10.6	17.5	m	m
1325	6/10/82	M	0.5	12	86	54	15	26	48	42	11.5	18.0	m	m
1326	6/18/82	F	4.5	93	172	102	27	54	88	98	17.9	31.4	3.1	2.9
1327	7/8/82	F	16.5	127	175	106	29	62	100	117	20.9	32.9	2.3	2.8
1328	7/8/82	F	1.5	43	122	83	26	41	75	68	14.5	25.7	2.0	1.7
1329	7/9/82	F	13.5	120	186	112	30	59	106	104	19.8	34.2	3.3	3.0
1330	7/9/82	M	1.5	48	130	83	27	45	75	67	14.4	26.2	1.4	1.8

Appendix A. Continued.

Bear No.	Date	Sex	Age (yr)[b]	Measured weight	Total length	Shoulder height	Hind foot	Neck	Girth	Body length	Head width	Head length	Left upper canine[c]	Left lower canine[c]
1331	7/10/82	F	4.5	77	161	102	28	50	96	98	17.0	30.5		
1332	7/12/82	F	5.5	104	173	100	32	54	92	97	18.0	33.4	3.1	2.9
1333	7/12/82	F	16.5	141	175	112	33	65	117	124	21.0	34.0	3.1	2.6
1334	7/13/82	M	1.5	49	129	86	26	42	87	72	14.4	24.9	1.3	1.6
1335	7/13/82	F	1.5	38	127	77	24	40	76	73	13.5	24.0	1.6	1.8
1336	5/16/83	F	2.5	47	141	86	27	56	90	86	14.9	28.2	2.6	2.4
1337	5/18/83	M	20.5	289	210	122	36	98	151	135	26.6	39.8	4.0b	b
1338	5/20/83	M	6.5	111	175	89	29	35	107	101	19.9	34.8	3.5	3.4
1339	5/20/83	M	6.5	120	174	103	29	37	109	100	19.7	34.4	3.6	3.1
1340	5/23/83	F	3.5	71	159	86	27	58	95	91	15.7	30.2	3.2	3.2
1341	5/23/83	F	10.5	107	171	110	31	63	125	110	20.7	33.2	3.2	3.1
1342	5/24/83	M	2.5	49	133	85	--	52	91	67	15.6	27.2	2.5	2.8
1343	5/24/83	M	2.5	43	139	85	26	48	88	69	15.5	27.1	3.0	3.0
1344	5/24/83	M	2.5	56	151	79	--	49	93	--	14.9	28.5	2.5	2.5
1345	5/24/83	F	8.5	--	175	99	30	65	110	98	18.3	33.0	3.1	2.8
1346	5/25/83	M	5.5	114	145	98	30	71	110	94	19.7	25.1	3.2	3.0
1347	5/31/83	M	5e	189	188	119	23	71	144	114	22.0	37.5	3.7	3.4
1348	5/31/83	F	12.5	--	175	107	20	72	123	110	20.0	37.6	3.2	2.9
1349	6/2/83	M	18.5	264	217	124	33	93	145	125	25.6	35.5	4.0b	3.4
1350	6/2/83	M	8.5	202	201	119	30	77	118	118	22.5	47.4	3.7	3.1
1351	6/23/83	F	14.5	114	181	91	23	69	114	116	21.0	38.0	3.3	3.2
1352	6/27/83	F	14.5	111	175	102	29	59	103	108	19.5	34.1	3.1	2.8
1353	6/27/83	M	1.5	27	107	75	20	34	54	56	12.4	21.9	e	e
1354	6/27/83	F	1.5	12	87	60	17	24	41	43	11.0	18.4	e	e
1355	6/30/83	M	3.5	60	138	98	27	45	77	77	15.2	27.5	--	--
1356	6/30/83	M	2.5	50	--	--	24	46	69	--	14.9	25.2	--	--

[a] Weights in kg; measurements in cm.
[b] Age determined by cementum layering.
[c] Designations of tooth characteristics: b=broken; w=heavily worn; e=erupting; m=deciduous milk teeth.
[d] Estimate after close examination.