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# STRUCTURE, STATUS, REPRODUCTIVE BIOLOGY, MOVEMENT, DISTRIBUTION, AND HABITAT UTILIZATION OF A GRIZZLY BEAR POPULATION

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SUMMARY

Little fieldwork was carried out in 1983; results that were gathered did not change the conclusions reached in previous reports. A manuscript (Appendix A) was prepared for the 6th International Conference on Bear Research and Management in February 1983. This paper, entitled "Grizzly bear population biology in the western Brooks Range, Alaska," should stand as the final report for this job. In addition, tables that include data collected during 1983 are presented in Appendixes B through F.



Key words: Alaska, grizzly bears, litter size, mortality, population structure, reproductive interval, reproductive rate.


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# GRIZZLY BEAR POPULATION BIOLOGY IN THE WESTERN BROOKS RANGE, ALASKA

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Population biology of grizzly bears (Ursus arctos) was studied during 1977-82 in the northern foothills of the western Brooks Range. During this period, 101 bears were captured in the 5,200 $km^2$ study area. A density of 1 bear/41 $km^2$ was calculated from the estimated population of 125 bears in the area. The age structure of the population showed more animals in the 0.5- to 2.5-year age classes than in any others. The sex structure of that portion of the population over 2.5 years of age was 57% females and 42% males. Mortality rates for offspring of marked females was determined. Measures of reproductive biology which were calculated included: mean age of 7.9 years at 1st production of litter, reproductive interval of 4.1 years, mean litter size of 1.98, and a reproductive rate of 0.48 cubs/female/year. Evidence indicated that these parameters are higher than those reported in other portions of the North Slope, probably due to the availability of carrion and prey from calving caribou of the Western Arctic Herd.

Key words: Alaska, grizzly bears, litter size, mortality, population structure, reproductive interval, reproductive rate

The grizzly bear (Ursus arctos) populations inhabiting the mountains and foothills of the Brooks Range are very susceptible to the impacts of increased human population and development and to overexploitation by hunting. In this region, the grizzly is at the northern extent of its range; the period of food availability during summer 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 (Crook 1971; H. V. Reynolds, unpubl. rep., Alaska Dep. Fish and Game, Fed. Aid Proj. W-17-6, W-17-7, W-17-11, and W-21-1, 1974, 1976, 1980, 1981; Reynolds et al. 1976). The exponential rate of increase of exploration and exploitation for oil and mineral

resources can only be expected to continue. Improved access to the area provided by such development will probably be followed by increased bear-human contact and conflict. Confrontations could result in depletion of grizzly populations unless the baseline population information necessary for wise management is gathered.

I thank the biologists of the Alaska Department of Fish and Game (ADF&G) as well as numerous volunteer field assistants who participated in this study. R. Ball, J. Hechtel, P. Reynolds, and E. Follmann were especially helpful. The skill of pilots J. Rood, C. Lofstedt, W. Lentsch, and D. Miller was largely responsible for the safe and efficient conduct of the data collection despite poor weather conditions. J. Coady, W. Regelin, and S. Peterson read and made suggestions on the manuscript.

Financial support was provided by ADF&G. Additional funding or logistical support was provided by the U.S. Fish and Wildlife Service, U.S. Bureau of Land Management, U.S. Office of Naval Research, and the Naval Arctic Research Laboratory of Barrow, Alaska.

## Study Area

The 5,200 $km^2$ study area lies in the mountains and foothills of the western Brooks Range. The approximate boundaries of the study area were: Archimedes Ridge (69°10'N latitude) on the north, the Kokolik River on the west, the crest of the Brooks Range on the south, and a line running from Thunder Mountain to the Utukok River (160°15'W longitude) on the east. The physiography of the southern 1/4 of the area is mountainous with elevations of about 600 m in river or creek valleys to 1,300 m for the highest peaks. The northern 3/4 of the area is characterized by a series of east/west-oriented rolling hills, ridges, and buttes of 600-900 m elevation which are cut through by 2 major north-flowing rivers, the Utukok and Kokolik. The lowest elevation on the northern edge of the area is 400 m.

Tussock tundra characterized by cottongrass (Eriophorum sp.) and sedges (Carex sp.) was the predominant vegetative type on the area. In addition, wet sedge meadow communities were found on poorest drained sites, and Dryas sp. or fellfield communities on ridge slopes and mountains. Patches of willows (Salix sp.) are usually stunted but grow to heights 0.5-2.5 m along broad braided river channels (Spetzman 1959).

## Methods

Intensive capture effort took place between late May and mid-July 1977-80, although a few bears were captured during later periods. Small fixed-wing aircraft (Piper PA-18-150) were used to locate

grizzlies and direct the helicopter (Bell 206B) with the immobilization team to the site. In addition, fixed-wing aircraft were used to conduct surveys or make observations and to locate bears fitted with radio transmitters.

Bears were immobilized from helicopters using Sernylan (phenocyclidine hydrochloride, Bio-Ceutic Laboratories, St. Joseph, Mo.) and acepromazine maleate (Ayerst Labs, New York, N.Y.) injected into the rump using Cap-Chur equipment (Palmer Chemical and Equipment Co., Douglasville, Ga.). All animals were measured, weighed, tattooed for permanent identification, ear tagged, and marked with individually coded visual identification collars or ear flags (H. V. Reynolds, unpubl. rep., Alaska Dep. Fish and Game, Fed. Aid Proj. W-17-6, 1974). In addition, 38 bears were fitted with collars containing radio transmitters. 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).

Because capture effort was most intensive in 1977 and 1978, the direct count method (Pearson 1976; H. V. Reynolds, unpubl. rep., Alaska Dep. Fish and Game, Fed. Aid Proj. W-17-6, 1974) was used to calculate the 1978 population size. Several other methods were considered and rejected because of erratic or less accurate results. The differential efficiency method (Caughley and Goddard 1972) for determining population size was used for grizzly bear populations in the eastern Brooks Range with no success (H. V. Reynolds, unpubl. rep., Alaska Dep. Fish and Game, Fed. Aid Proj. W-17-6, 1974). Inadequate funding and logistical constraints precluded use of the Lincoln Index (Overton in Giles 1969). The feasibility of using random transect lines 2,250 km (1,400 mi) in total length in conjunction with intensively surveyed 2,296 $km^2$ (886 $mi^2$) quadrats was tested during caribou (Rangifer tarandus) survey flights, but the number of bears seen during these surveys was too low to be representative of the areas. Crook (1971) tested a survey technique along river valleys of the central North Slope and found that the results were too erratic to be statistically meaningful. Until a more accurate survey or census method is devised and tested, a direct count after intensive capture effort should give a reliable population estimate, at least in areas of little vegetative cover.

Information on reproductive status 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 all family groups. The condition, size, and coloration of mammae were used as indicators of past production or nonproduction of young (J. W. Lentfer, L. H. Miller, and G. N. Bos, unpubl. rep. Alaska Dep. Fish and Game, Fed. Aid Proj. W-15-R-3 and W-17-1, 1969; L. P. Glenn, unpubl. rep. Alaska Dep. Fish and Game, Fed. Aid Proj. W-17-3 and W-17-4, 1972; H. V. Reynolds, unpubl. rep., Alaska Dep. Fish and

Game, Fed. Aid Proj. W-17-6, 1974). For example, the mammae of a female which has not produced young are typically 10 mm in length, pinkish-grey in color, are unwrinkled, and show no scarring on the areola. Producing females have mammae which are usually about 14 mm long, black, and flaccid, often showing scarring near the areola.

## Results and Discussion

Although 101 bears were captured and marked during the 1977-80 period, the intensity of capture effort was greatest during 1977-78. Capture effort decreased in 1979 and ceased in 1980; therefore, the best year for estimation of population size was in 1979. Similarly, population sex and age structure was calculated for 1978 because the proportion of marked bears in the population was highest then (during 1979 and 1980 fewer young-aged bears were captured and attrition due to mortality was lowest).

## Population Size

During 1977-79, 88 bears were captured and marked in the area of intensive study; an additional 62 unmarked but identifiable individuals were observed in the study area. To account for those bears which did not stay in the study area throughout the year, the proportion of the home range of each bear outside the study area was estimated; the sum of these fractional home ranges of bears (9.45) was subtracted from the study area population. Also, at least 21 mortalities occurred during 1977-79, leaving a minimum total of 119 grizzlies in the study area.

The unmarked identifiable bears included 23 offspring of marked females, 9 unmarked females with 19 young, 1 unmarked female with 2 marked young, and 10 single individuals. All sightings of these unmarked bears were recorded throughout the summer; unmarked females with young could be individually identified with more precision than single bears since those bears were encountered in family groups of varying size, age, and coloration of individuals within the group, and their home ranges were generally smaller than those of single bears. It was more difficult to differentiate between individual solitary bears because of growth and pelage changes during the summer. However, a good minimum estimate of the number of solitary bears was obtained from observations of bears of the same size and coloration which were found repeatedly in the same vicinity, and from separate sightings of bears with similar descriptions which were seen within short periods of time or in widely separated locations. The accuracy of these techniques was illustrated when almost all bears captured in 1978 were previously observed and accounted for in the 1977 estimate. The animals captured in 1978 which were not seen in 1977 were primarily cubs born in 1978. The intensity of effort was reduced in 1979, resulting in the location of fewer bears; however, the results indicate that the population was essentially unchanged.

A density of 1 bear/44 $km^2$ (1 bear/16.9 $mi^2$) was calculated from the observed minimum population of 119 bears in the 5,200 $km^2$ (2,000 $mi^2$) area. Because of the lack of escape cover and extensive aerial surveys conducted for 2 years in the study area, it was felt that at least 95% of all bears in the study area were located. Therefore, an estimated adjusted population mean of 125 bears inhabited the area during the period 1977-79, or a density of 1 bear/42 $km^2$ (1 bear/16.1 $mi^2$).

The best method for determining grizzly bear density or population size in arctic regions has been a direct count in conjunction with an intensive individual marking program over a period of years (H. V. Reynolds, unpubl. rep., Alaska Dep. Fish and Game, Fed. Aid Proj. W-17-6 and W-17-7, 1974, 1976; Pearson 1975, 1976). Other means of estimating the grizzly bear population in areas not under intensive study have not been successful in the past because of grizzlies' low density, sparse distribution, and solitary habits. However, even though the direct count method was felt to give accurate results, its use is limited to areas of intensive study and requires at least 2 years of data.

Sex and Age Composition

Forty-two males (41.6%) and 59 females (58.4%) were captured during this study. These figures probably reflect the proportions in which the 2 sexes exist in nonhunted areas of the Brooks Range; during tagging operations, animals were captured as they were encountered and no effort was made to specifically capture either sex. Sport hunting pressure, a factor which may alter sex ratios, is apparently negligible. For example, only 2 bears have been reported taken from the study area in the last 25 years (ADF&G files 1980).

Of bears younger than 3 years of age, 12 (34.3%) were males and 23 (65.7%) were females; this pattern was the same for each of the 3 age classes (cubs, yearlings, and 2-year-olds). The reason for the departure from an equal sex ratio is unclear. Since the ratio did not shift between successive age classes, such an imbalance suggests that either the ratio is an accurate reflection of sex at birth or that more males than females died prior to their emergence from the maternal den. It is unlikely a substantial shift in the sex ratio occurs between the time offspring emerge from dens and when they are captured; most mortality of young occurs to entire litters and not to only 1 or 2 siblings.

The sex and age distribution of marked and unmarked bears in the study area was calculated for the 1978 year only (Table 1). Sex of marked bears was recorded after direct observation. All bears were assigned the ages they would have reached in 1978 to facilitate analysis for this table, regardless of their year of capture. Similar data were collected in 1979 and 1980, but, since the research effort was not as intense, information

concerning the composition and survival of each age cohort was not as accurate as in 1978. The age distribution does indicate that there are more females than males in adult cohorts; these females appear to have a longer life expectancy that do males.

Reproductive rates for bears depend upon age at 1st production of young, length of productive life of females, length of the reproductive cycle or interval between litters, and average litter size (Craighead et al. 1974; Bunnell and Tait 1980, 1981). In Alaska, the age at sexual maturity for brown/grizzly bears has ranged from 3.5 to 6.5 years on the Alaska Peninsula and Kodiak Island (Hensel et al. 1969, Glenn et al. 1976) and 6.5 to 12.5 years in the eastern Brooks Range (H. V. Reynolds, unpubl. rep., Alaska Dep. Fish and Game, Fed. Aid Proj. W-17-7, 1976). In southwestern Yukon Territory, females are first capable of conception at 6.5 years, but in northern Yukon Territory, age at 1st conception was 7.5 years (Pearson 1975, 1976). In Yellowstone National Park, Craighead et al. (1969) reported females bred at 4.5 to 8.5 years of age and had their 1st cubs the following spring. Moreover, they observed that some 3.5-year-old females copulated, but none bore cubs the following spring.

In this study, the mean age of 14 females when they were first observed with young was 7.9 years. This calculation was based on observations of 5 bears which had their 1st litters at ages 5.5, 6.5, 8.5, 9.5, and 10.5 years. In addition, 4 other bears showed no evidence of previous offspring when they were observed breeding; although they were not observed subsequently, the earliest ages at which they could have been observed with cubs were 7.5, 7.5, 8.5, and 8.5 years, respectively. In 4 other cases, bears which were accompanied by offspring at capture would have been 6.5, 7.5, 8.5, and 8.5 years when the cubs left dens; based on these ages, I assumed that the cubs were products of 1st litters. One female showed evidence of previous offspring at age 6.5; I assumed that she had produced cubs for the 1st time at that age and then lost them in the same year.

Since calculations were based on actual observations and extrapolations, the results represent minimum values. Actually, the point of 1st breeding and production of offspring is probably more closely related to the nutritional status and weight of a female than to age (Bunnell and Tait 1980; H. V. Reynolds, unpubl. rep., Alaska Dep. Fish and Game, Fed. Aid Proj. W-22-1, 1982). Subsequent litters and survival of cubs is also likely tied to nutrition. Adequate data to substantiate this relationship are difficult to obtain in the western Brooks Range because of the high costs of capture operations; however, the relationship has been shown for black bears (Ursus americanus) in Minnesota (Rogers 1976, 1977) and Idaho (Beecham 1980, Reynolds and Beecham 1980).

Most females remained reproductively active until death, while others apparently stopped breeding as they become older. Among relatively old females, 1 bred at age 26.5 but was not seen the

following year, 1 was accompanied by yearlings at age 20.5, 1 by yearlings at age 22.5, and the other by 3-year-olds at age 28.5. One female bred unsuccessfully at age 19.5 and 20.5 but was not observed with males and apparently did not breed at ages 21.5 or 22.5.

Litter sizes ranged from 1 to 3 cubs. The mean size of 57 litters over the 6-year period was 1.98 but ranged from 1.67 to 2.50 among years (Table 2). Such variability has far-reaching management implications because litter size may greatly affect the calculations of productive capacity. For example, using the 1980 litter size of 1.67, calculation of the reproductive rate for the population yields a mean rate of 0.41 cubs/adult female/year. If, on the other hand, the 1981 litter size of 2.50 was used, the mean reproductive rate would be 0.62 cubs/adult female/year, an increase of 51% over the 1980 figures. Further, if reproductive rates were calculated using high litter sizes found during 1 or 2 years, levels of sustained yield would be overestimated, possibly resulting in overharvest of bear populations. These differences illustrate the importance of gathering such information from long-term studies prior to setting appropriate harvest levels.

The reasons for variations in litter size were not determined. Inclusion of cohorts older than cubs-of-the-year in calculations did not result in low litter sizes since older cohorts displayed litter sizes similar to, or larger than, cub cohorts. Since many litters were not observed until early June, prior cub mortality could result in low litter sizes. However, evidence from family groups observed shortly after emergence from winter dens indicates that the great majority of cub mortality results in deaths of entire litters, not a reduction in litter size (H. V. Reynolds, unpubl. rep., Alaska Dep. Fish and Game, Fed. Aid Proj. W-17-11, 1981). The most reasonable explanation for differences in yearly litter size is that cub production is dependent on the nutritional state of females, which may vary according to yearly differences in food availability and quality, or even winter den conditions affected by weather.

The mean litter size of 1.98 found in the western Brooks Range was larger than those found in other studies in northern and interior Alaska or Yukon Territory. In those areas, litter size ranged from 1.60 to 1.83 (H. V. Reynolds, unpubl. rep., Alaska Dep. Fish and Game, Fed. Aid Proj. W-17-7, 1976; Pearson 1975, 1976; Dean 1976). In coastal Alaska, litter sizes ranged from 2.36 to 2.50 (Troyer and Hensel 1964, Glenn et al. 1976). These variations are probably reflections of the availability and nutritional quality of food which grizzlies may secure in the different regions.

The minimum reproductive interval, the period between successive litters of cubs, was 4.1 years. Four females had reproductive intervals of 3 years, 3 of 4 years, 6 of at least 4 years, 2 of 6 years, and 1 of at least 6 years; the minimum figures included productive females which weaned offspring and bred but for which

the outcome of breeding is not known. These calculations did not include incomplete cycles which were interrupted by mortality of offspring.

The reproductive rate of a population is a measure of the potential of a population for growth and is expressed as the number of cubs produced per adult female per year (Craighead et al. 1976). Reproductive rate may also be expressed as the potential production of cubs during the reproductive life of an adult female. The grizzly bear population in the western Brooks Range had a higher reproductive rate than populations in the eastern Brooks Range (H. V. Reynolds, unpubl. rep., Alaska Dep. Fish and Game, Fed. Aid Proj. W-17-7, 1976) but not as high as populations in Yellowstone Park or the Alaska Peninsula (Table 3). Potential production of cubs during the lifetime of an adult female was similar in the western Brooks Range and the Alaska Peninsula, primarily due to longer reproductive longevity of bears in northern Alaska; this difference may be due to a high level of hunting pressure on the Peninsula which results in lower chances of survival to maximum potential age.

## Mortality

During 1977-82, 43 mortalities were recorded in the study area; these included bears which were found dead, those offspring which disappeared from family groups prior to weaning, and those adult, usually old (20-28 yr), bears which had been observed frequently within established home ranges but which could not be located after extensive searches in 2 or more years.

Of the 42 mortalities observed or recorded, 18 occurred to cubs of the year, 7 to cubs or yearlings, 1 to a yearling, 2 to yearlings or 2-year-olds, 4 to 2-year-olds, and 10 to bears 3 years and older. For 9 cases where the exact year of mortality was unknown, deaths occurred between one summer and the next.

In 7 out of 10 cases of observed mortality to cubs-of-the-year litters, mortality occurred from 1 to 5 weeks after emergence from maternal dens; in all but 2 cases mortality occurred to the entire litter. Although the highest number of cubs was lost during 1979, this same degree of cub mortality could have occurred in 1980. Adult females No. 1134, 1100, and 1166 probably bred in 1979 but were not seen with young after 9 June 1980 when observations began. Therefore, during 1980 it may have been possible that these females produced cubs and lost them before observations began. However, observations made during 1981 and 1982 indicate that females seen without offspring in early spring did not lose young after emerging from winter dens; instead, either offspring were not produced or they died in dens during winter. For example, 3 females which bred in 1980 and were presumed pregnant did not have offspring by 7 May 1981 and were not near den sites. This contrasts to 4 other females with cubs or yearlings which were still in or close by dens on the same date. Similarly, 3 females which bred in 1981 neither had

with them nor were near their den sites on 19 May 1982; 6 other females with cubs or yearlings were still at or close to den sites on the same date. Therefore, I assumed the following: (1) females with offspring in early May should have been in or near den sites, and (2) females away from dens had not emerged from winter dormancy with cubs.

Analysis of mortality rates for cubs, yearlings, and 2-year-olds is presented in Table 4. Cubs sustain the highest mortality rate; most mortality in that age class occurs to entire litters. In yearling and 2-year-old age classes, however, mortality rates are lower and usually involve only 1 member of the litter.

In the past, differences in mean litter sizes of cohorts have been used as indicators of survival or mortality rates between successive age classes (Martinka 1974, Dean 1976). Litters in the study area were comprised of from 1 to 3 offspring (Table 5). Over the 6-year period, composite litter sizes of cub, yearling, 2-year-old, and 3-year-old age classes were 1.95, 1.86, 1.70, and 1.70, respectively. Using these figures, survival rate from cub to yearling age class can be calculated as 0.95; from yearling to 2-year-old age class, 0.91; and from 2-year-old to 3-year-old, 1.00. From comparing the observed mortality rates presented in Table 4, with the rates calculated from Table 5, however, it is apparent that using the decline in litter sizes of subsequent age classes greatly underestimates actual mortality rate. The reason for the discrepancy between the differences in mean litter sizes of age classes and observed rates of mortality for those same age classes is that when mortality occurs, it often involves entire litters, rather than partial litters.

The causes of all cub mortality in this study have not been determined. The past experience of producing females may play a role in their successful raising of offspring; 4 of 5 females observed with their 1st litters lost them. Cannibalism by adult males has been documented in the eastern Brooks Range (H. V. Reynolds, unpubl. rep., Alaska Dep. Fish and Game, Fed. Aid Proj. W-17-7, 1976), elsewhere in Alaska (Troyer and Hensel 1962, Glenn et al. 1976), and in Canada (Mundy and Flook 1973; Pearson 1975, 1976). This cannibalism may have sociobiological implications. Females which lost their cubs from early May to late June were later seen breeding during the same season. In 3 cases in the study area, females were apparently in breeding condition 9, 14, and 16 days after their cubs died; in 2 of these cases, adult males were responsible for mortality of the cubs. However, the comparative extent of cannibalism in cub mortality has not been established. Some mortality probably occurs within winter dens. Other cub deaths could result from disease, natural accidents, or sibling rivalry.

To better understand causes of cub mortality, in 1981, 3 females with cubs were placed under intensive observation from early May until mid-June. Two of these family groups were watched by ground-based crews on a 24-hour basis, weather permitting; the 3rd was observed daily from aircraft (H. V. Reynolds and J. H.

Hechtel, unpubl. rep., Alaska Dep. Fish and Game, Fed. Aid Proj. W-22-1, 1982). In 1982, similar observations were made of 4 females with cubs and 2 females with yearlings. Three family groups, 1 comprised of female No. 1169 and her 2 cubs, 1 of an unmarked female with a single cub, the other of female No. 1166 and her single yearling offspring, were watched by ground-based crews; the other 3 (No. 1097 and her 3 yearlings, No. 1102 and her 2 cubs, and No. 1178 and her 2 cubs) were observed daily from aircraft.

Female No. 1178 was still in her den when located on 9 May. By 16 May she had moved with her 2 cubs 2 km east and was observed near that same location on 21, 22, and 23 May. On 24 May when she was located, she appeared very agitated and was not accompanied by her offspring. After an intensive search of the vicinity, a large blond adult male was sighted with the remains of a cub in its mouth. When the aircraft had made 2 passes to observe the male, he dropped the cub and ran. The carcass of the cub was collected and examined: it was a female; the head and most of the groin area had been eaten. When further search for the 2nd cub was unsuccessful, it was presumed dead as well.

It did not appear that the habitat selection by No. 1178 differed from that used by other females with cubs in the same locality. The area which had been used by the family group from 16-24 May was on the east end of a ridge about 240 m above the nearby Utukok River. The slope of the ridge was moderate and provided little escape cover but steeper rock faces and talus slopes were available in the vicinity. Another female, No. 1102, used an area on the same ridge 10 km west where even less escape cover was available and she was able to keep her offspring until at least late June. Female No. 1169 also safely reared 2 cubs until at least mid-June. She used an area of Tupikchak Mountain with little escape cover even though steep southfacing talus slopes were less than 2 miles away. She safely reared 2 cubs until mid-June.

Factors Influencing Population Density and Reproductive Biology

Comparison of the grizzly bear population in the eastern Brooks Range (H. V. Reynolds, unpubl. rep., Alaska Dep. Fish and Game, Fed. Aid Proj. W-17-7, 1976) with that in this study area indicates that both population density and productivity are greater in the western Brooks Range. This may be a localized phenomenon due to the proximity of the traditional caribou calving grounds of the Western Arctic Caribou Herd to the grizzly bear intensive study area. This proximity in turn increases the availability of caribou as a source of carrion and prey which may allow an increase in the productivity and density of the grizzly bear population.

These caribou may provide a protein source unavailable in the same quantities to other grizzly bear populations whose range does not overlap caribou calving grounds. Caribou may be a

particularly important segment of the grizzly bears' diet because they are available during a time in which those portions of vegetation upon which bears feed are of poor nutritive quality; overwintering roots, tubers, and bulbs begin to mobilize their nutrient supply into flower and leaf production during early summer, and most above-ground vegetation favored by bears is just beginning to grow (J. Bryant, pers. commun.). Caribou are available to bears as an abundant source of protein at a time when energy demands by bears are also high because of activity and movement associated with breeding. Since grizzly bear population size and reproductive capacity are probably closely related to food availability, high density and reproductive capacity of bears in an area of high protein availability would be expected.

Although this population appears to be relatively dense and productive for an arctic population, the apparent low rates of survival for some cohorts may serve as a dampening factor for population growth. It is unlikely that further improvements in length of reproductive cycle, length of reproductive life, or litter size would occur even if food supply were to increase. However, changes in the apparent present rates of survival would in turn affect population maintenance or growth. The 2 critical periods of survival are during the 1st month after cubs first leave the maternal winter den and for the 1st 1-2 years following weaning.

## LITERATURE CITED


Beecham, J. J. 1980. Population characteristics, denning and growth patterns of black bears in Idaho. Ph.D. Thesis. Univ. of Montana. 101pp.

Bunnell, F. L., and D. E. N. Tait. 1980. Bears in models and reality--implications to management. Pages 15-23 in C. J. Martinka and K. L. McArthur, eds. Bears--Their biology and management. Bear Biology Assoc. Ser. No. 3. U.S. Gov. Print. Off. Washington, D.C.

_____, and _____. 1981. Population dynamics of bears--implications. Pages 75-98 in C. W. Fowler and T. D. Smith, eds. Dynamics of large mammal populations. J. Wiley and Sons, New York.

Caughley, G., and J. Goddard. 1972. Improving the estimates from inaccurate censuses. J. Wildl. Manage. 36(1):135-140.

Craighead, J. J., F. C. Craighead, Jr., and H. E. McCutchen. 1970. Age determination of grizzly bears from fourth premolar tooth sections. J. Wildl. Manage. 34(3):353-363.

_____, _____, and J. Sumner. 1976. Reproductive cycles and rates in the grizzly bear, Ursus arctos horribilis, of the Yellowstone ecosystem. Pages 337-356 in M. R. Pelton, J. W. Lentfer, and G. E. Folk, eds. Bears--Their biology and management. IUCN New Ser. 40.

_____, M. G. Hornocker, and F. C. Craighead, Jr. 1969. Reproductive biology of young female grizzly bears. J. Reprod. Fert. Suppl. 6:447-475.

_____, J. R. Varney, and F. C. Craighead, Jr. 1974. A population analysis of Yellowstone grizzly bears. Montana For. and Conserv. Sta. Bull. 40. School of Forestry, Univ. of Montana, Missoula. 20pp.

Crook, J. L. 1971. Determination of abundance and distribution of brown bear (Ursus arctos) north of the Brooks Range, Alaska. M.S. Thesis, Univ. of Alaska, Fairbanks. 78pp.

Dean, F. C. 1976. Aspects of grizzly bear population ecology in Mount McKinley National Park. Pages 111-119 in M. Pelton, J. Lentfer, and G. Folk, eds. Bears--Their biology and management. IUCN New Ser. 40.

Glenn, L. P., J. W. Lentfer, J. B. Faro, and L. H. Miller. 1976. Reproductive biology of female brown bears, Ursus arctos, McNeil River, Alaska. Pages 381-390 in M. Pelton, J. Lentfer, and E. Folk, eds. Bears--Their biology and management. IUCN New Ser. 40.

Hensel, R. J., W. A. Troyer, and A. W. Erickson. 1969. Reproduction in the female brown bear. J. Wildl. Manage. 33(2):357-365.

Martinka, C. J. 1974. Population characteristics of grizzly bears in Glacier National Park, Montana. J. Mammal. 55(1):21-29.

Mundy, K. R. D., and D. R. Flook. 1973. Background for managing grizzly bears in the national parks of Canada. Can. Wildl. Serv. Rep. No. 22. 35pp.

_____, and W. A. Fuller. 1964. Age determination in the grizzly bear. J. Wildl. Manage. 28:863-866.

Overton, W. S. 1969. Estimating the numbers of animals in wildlife populations. Pages 403-455 in R. H. Giles, ed. Wildlife management techniques. Wildl. Soc., Washington, D.C.

_____. 1971. Estimating the numbers of animals in wildlife populations. Pages 403-455 in R. H. Giles, ed. Wildlife management techniques. Wildl. Soc., Washington, D.C.

Pearson, A. M. 1975. The northern interior grizzly bear (Ursus arctos L.) Can. Wildl. Serv. Rep. No. 34. 86pp.

_____. 1976. Population characteristics of the arctic mountain grizzly bear. Pages 240-260 in M. Pelton, J. Lentfer, and E. Folk, eds. Bears--Their biology and management. IUCN New Ser. 40.

Reynolds, D. G., and J. Beecham. 1980. Home range activities and reproduction of black bears in west-central Idaho. Pages 403-409 in C. J. Martinka and K. L. McArthur, eds. Bears--Their biology and management. Bear Biol. Assoc. Conf. Ser. No. 3. U.S. Gov. Print. Off.

Reynolds, H. V., J. A. Curatolo, and R. Quimby. 1976. Denning ecology of grizzly bears in northeastern Alaska. Pages 403-410 in M. Pelton, J. Lentfer, and G. Folk, eds. Bears--Their biology and management. IUCN New Ser. 40.

Rogers, L. L. 1976. Effects of mast and berry crop failures on survival, growth, and reproductive success of black bears. Trans. N. Am. Wildl. Nat. Resour. Conf. 41:431-438.

_____. 1977. Social relationships, movements, and population dynamics of black bears in northeastern Minnesota. Ph.D. Diss. Univ. Minn. Minneapolis. 194pp.

Spetzman, J. 1959. Vegetation of the Arctic Slope of Alaska. U.S. Geol. Surv. Prof. Pap. 302:19-58.

Stoneburg, R. P., and C. J. Jonkel. 1966. Age determination of black bears by cementum layers. J. Wildl. Manage. 30(2):411-414.

Troyer, W. A., and R. J. Hensel. 1962. Cannibalism in brown bear. Anim. Behav. 10:231.

_____, and _____. 1964. Structure and distribution of a Kodiak bear population. J. Wildl. Manage. 28(4):769-772.

Appendix A. Table 1. Age and sex structure of the grizzly bear population in the study area in the western Brooks Range, 1978.

| Age by cementum (yr) | Males | Females | Unmarked, sex unknown | Total known in age class[a] |
|---|---|---|---|---|
| 0.5 | 3 | 1 | 15 | 19 |
| 1.5 | 2 | 5 | 6 | 13 |
| 2.5 | 6 | 7 | 5 | 18 |
| 3.5 | 2 | 2 | 2 | 6 |
| 4.5 | 1 | 2 | | 3 |
| 5.5 | 5 | 2 | | 7 |
| 6.5 | 4 | 3 | | 7 |
| 7.5 | 0 | 4 | | 4 |
| 8.5 | 3 | 2 | | 5 |
| 9.5 | 2 | 3 | | 5 |
| 10.5 | 1 | 1 | | 2 |
| 11.5 | 1 | 1 | | 2 |
| 12.5 | 0 | 3 | | 3 |
| 13.5 | 0 | 0 | | 0 |
| 14.5 | 2 | 2 | | 4 |
| 15.5 | 0 | 1 | | 1 |
| 16.5 | 0 | 0 | | 0 |
| 17.5 | 2 | 1 | | 3 |
| 18.5 | 1 | 1 | | 2 |
| 19.5 | 0 | 1 | | 1 |
| 20.5 | 2 | 1 | | 3 |
| 21.5 | 0 | 1 | | 1 |
| 22.5 | 0 | 0 | | 0 |
| 23.5 | 0 | 0 | | 0 |
| 24.5 | 0 | 1 | | 1 |
| 25.5 | 0 | 1 | | 1 |
| 26.5 | 0 | 0 | | 0 |
| 27.5 | 0 | 1 | | 1 |

[a] Ages were either assigned after observation of individuals as cubs, yearlings, or 2-year-olds when they were accompanied by adult females or established from premolar tooth cementum annuli. In addition, the sexes and ages of 19 unmarked bears observed in the study area were estimated but not included in this table. Based on size, pairing during the breeding season or accompaniment by offspring, the sex and age of these unmarked bears were as follows: 2 of unknown sex were 2.5-3.5 years of age, 4 from 4.5-6.5 years of age, and 10 females and 3 males were estimated older than 6.5 years of age.

Appendix A. Table 2. Litter sizes for grizzly bears in the western Brooks Range, 1977-81.

| | Age of offspring when first observed or captured | | | | | Litter |
|---|---|---|---|---|---|---|
| Year | Cubs/litters | Ylgs/litters | 2-yr/litters | 3-yr/litters | Total | size |
| 1977 | 15/8 | 16/7 | 2/1 | 2/1 | 35/17 | 2.06 |
| 1978 | 17/8 | 0 | 0 | 0 | 17/8 | 2.13 |
| 1979 | 15/8 | 2/1 | 0 | 0 | 17/9 | 1.89 |
| 1980 | 14/8 | 0 | 1/1 | 0 | 15/9 | 1.67 |
| 1981 | 15/6 | 0 | 4/3 | 0 | 15/6 | 2.50 |
| 1982 | 10/6 | 3/1 | 1/1 | 0 | 14/8 | 1.75 |
| | 86/44 | 21/9 | 4/3 | 2/1 | 113/57 | |
| Mean litter size | 1.95 | 2.33 | 1.3 | 2 | 1.98 | |

Appendix A, Table 3. Reproductive rates of grizzly bear populations.

| Area | Mean age at 1st breeding to maximum age of breeding (yr) | Potential reproductive life ÷ reproductive interval | | Litter size | | Potential production of cubs | $\bar{x}$ reproductive rate (no. cubs/ female/year) |
|---|---|---|---|---|---|---|---|
| Yellowstone Park (Craighead et al. 1976) | 6.3-25.5 | 19.2 years / 3.40 | x | 2.24 | = | 12.65 | 0.658 |
| Alaska Peninsula (Glenn et al. 1976)[a] | 6.3-22.5[b] | 16.2 years / 3.8 | x | 2.50 | = | 10.66 | 0.66 |
| Eastern Brooks Range (Reynolds 1976)[a] | 10.1-24.5 | 14.4 years / 4.2 | x | 1.78 | = | 6.10 | 0.42 |
| Western Brooks Range (this study) | 7.9-26.5 | 18.6 years / 4.1 | x | 1.98 | = | 8.98 | 0.483 |

[a] My analysis of data presented by others.

[b] Data presented by these researchers designated greatest longevity of females as age 18.5; since that time new records have been observed (J. Faro, pers. commun.).

Appendix A, Table 4. Mortality rates for age classes of offspring accompanied by marked female grizzlies, 1977-81.

| Age class | Young/litters in early spring | Young/litters in fall | Mortality rate of age class |
|---|---|---|---|
| Cubs[a] (1st year) | 59/31 | 33/19 | 44.1% |
| Yearlings[a] (2nd year) | 33/16 | 30/16 | 9.1% |
| 2-year-olds[b] | 14/8 | 12/7 | 14.3% |

[a] When it was unknown whether a mortality occurred between age classes (i.e., between cub and yearling), it was assigned to the younger age class. This included 7 deaths of cubs or yearlings and 2 of yearlings or 2-year-olds.

[b] Of the 3 young accompanying female No. 1138 at capture, Nos. 1151 and 1152 were 2-year-olds and No. 1153 was a yearling. This "mixed" litter was presumably the result of an adoption by No. 1138, but which offspring were adopted is unknown. For purposes of this table, the 2 oldest were placed in the 2-year-old category, but the youngest was not included in the yearling cohort.

Appendix A. Table 5. Observed litter size and number of offspring in cub, yearling, 2-year-old, and 3-year-old age classes, 1977-82.

| Age class | No. offspring in litter/no. of litters 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | Total litters | No. of offspring | $\bar{x}$ litter size |
|---|---|---|---|---|---|---|---|---|---|
| Cub | 1/2 | 1/1 | 1/3 | 1/2 | 1/0 | 1/3 | 11 | 11 | |
| | 2/5 | 2/5 | 2/3 | 2/6 | 2/3 | 2/2 | 24 | 48 | |
| | 3/1 | 3/2 | 3/2 | 3/0 | 3/3 | 3/1 | 9 | 27 | |
| No. offspring | 15 | 17 | 15 | 14 | 15 | 10 | | 86 | 1.95 |
| Yearling | 1/2 | 1/3 | 1/2 | 1/1 | 1/1 | 1/1 | 10 | 10 | |
| | 2/2 | 2/4 | 2/5 | 2/0 | 2/1 | 2/0 | 12 | 24 | |
| | 3/3 | 3/0 | 3/0 | 3/0 | 3/0 | 3/3 | 6 | 18 | |
| No. offspring | 15 | 11 | 12 | 1 | 3 | 10 | | 52 | 1.86 |
| 2-year-old | 1/0 | 1/1 | 1/2 | 1/2 | 1/1 | 1/1 | 7 | 7 | |
| | 2/2 | 2/3 | 2/3 | 2/3 | 2/0 | 2/1 | 12 | 24 | |
| | 3/0 | 3/1 | 3/0 | 3/0 | 3/0 | 3/0 | 1 | 3 | |
| No. offspring | 4 | 10 | 8 | 8 | 1 | 3 | | 34 | 1.70 |
| 3-year-old | 1/0 | 1/0 | 1/1 | 1/1 | 1/1 | 1/1 | 4 | 4 | |
| | 2/1 | 2/0 | 2/2 | 2/0 | 2/1 | 2/0 | 4 | 8 | |
| | 3/0 | 3/0 | 3/1 | 3/0 | 3/0 | 3/0 | 1 | 3 | |
| No. offspring | 2 | 0 | 8 | 1 | 3 | 1 | | 15 | 1.70 |

Appendix B. Capture and marking characteristics of 105 bears in the western Brooks Range, 1977-83.

| Bear No. and sex | Cem. age (yr) | Date of capture | Bear wt. (lb) | Location | Drug dosage[a] | Ear tags (left/right) | Marking[b] |
|---|---|---|---|---|---|---|---|
| 1081M | 5.5 | 5/24/77 | 175 | Utukok R. | 2.6/H | 889/890 | P/O |
| | 7.5 | 9/17/79 | 430 | N. Meat Mtn. | A/M | 17827/17826 | P/O |
| | 8.5 | 7/7/80 | 380 | Disappointment Cr. | 2.8 | 504/503 | P/O |
| | | 8/15/80 | 400 | Utukok R. | 3.0/L | 504/503 | P/O |
| 1082M | 13.5 | 5/25/77 | 370 | Kokolik R. | 2.0/M | 892/893 | O/G/O (removed) |
| | | 6/13/77 | 365 | Kokolik R. | 2.3/M | 892/893 | -- |
| | | 6/25/77 | 380 | Kokolik R. | 2.7/M | 892/893 | -- |
| | | 8/10/77 | -- | Kokolik R. | 2.7/L | 892/893 | -- |
| | 14.5 | 6/27/78 | 425 | Kokolik R. | 2.8/L | 892/893 | Bk -- |
| | 15.5 | 6/28/79 | 480 | Kokolik R. | A/M | 313/312 | -- |
| | 16.5 | 8/17/80 | 520 | Kokolik R. | 5.0/L | 538/539 | dB/P |
| 1083M | 7.5 | 5/25/77 | 265 | Utukok R. | 2.0/M | 894/895 | plaque |
| | | 6/2/77 | -- | Utukok R. | 2.6/L | 894/895 | Bk |
| | 8.5 | 7/2/78 | 360 | Utukok R. | 2.7/M | 894/895 | Bk |
| | 9.5 | 6/30/79 | 355 | Utukok R. | 3.4/H | 894/ | -- |
| 1084M | 7.5 | 5/26/77 | 220 | Utukok R. | A/L | 897/896 | P/P |
| | | 6/2/77 | -- | Driftwood Cr. | 2.2/L | 897/896 | Bk/W |
| 1085F | 19.5 | 5/27/77 | 280 | Meat Mtn. | A/L | 899/898 | -- |
| 1086F | 16.5 | 5/29/77 | 205 | Meat Mtn. | 2.0/L | 205/206 | -- |
| | | 6/24/77 | 235 | Meat Mtn. | 1.3/L | 205/206 | -- |
| | | 8/8/77 | 265 | Driftwood Cr. | 1.9/M | 205/206 | -- |
| | 18.5 | 9/16/79 | 400[c] | N. Meat Mtn. | A/L | 205/206 | -- |
| 1087F | 1.5 | 5/29/77 | 31 | Meat Mtn. | 0.13/M | 207/208 | /G |
| | 3.5 | 6/30/79 | 170 | Meat Mtn. | 1.1/M | 314/208 | Bk/ |
| | 4.5 | 7/7/80 | 205 | Meat Mtn. | A/M | 506/505 | 1B/Bk |
| 1088M | 4.5 | 5/31/77 | 270 | Eskimo Hill | 2.0/M | 210/209 | -- |
| 1089F | 4.5 | 6/1/77 | 122 | Adventure Cr. | A/M | 214/213 | -- |
| | | 6/10/77 | 126 | Adventure Cr. | 1.7/M | 243/240 | W/W |
| 1090F | 18.5 | 6/1/77 | 220 | Utukok R. | A/H | 215/216 | -- |
| 1091M | 19.5 | 6/4/77 | 350 | Utukok R. | 3.0/H | 217/218 | -- |
| 1092F | 8.5 | 6/4/77 | 220 | Ilingnorak Ridge | 2.2/M | 227/226 | -- |
| | 11.5 | 8/19/80 | 320 | Ilingnorak Ridge | 4.0 | 549/548 | O/G |
| | 14.5 | 6/21/83 | -- | Ilingnorak Ridge | 3.8M99/M | 3389/3466 | O/G |
| 1093F | 0.5 | 6/4/77 | 38 | Ilingnorak Ridge | 0.1/M | 228/229 | 1B/ |
| 1094M | 4.5 | 6/5/77 | 175 | Meat Mtn. | 2.0/H | 225/230 | 1B/dB |
| 1095F | 6.5 | 6/5/77 | 200 | N. Meat Mtn. | 1.5/M | 231/233 | O/W |
| 1096M | 7.5 | 6/5/77 | 325 | Meat Mtn. | 2.6/M | 236/237 | -- |
| | 8.5 | 6/28/78 | 395 | Utukok R. | 2.8/M | 774/775 | 1B -- |
| | 9.5 | 6/28/79 | -- | N. Meat Mtn. | A/H | 774/775 & 893 | /1B |
| | 10.5 | 8/17/80 | 505 | Meat Mtn. | 4.2/L | 536/537 | O/1B |

Appendix B. Continued.

| Bear No. and sex | Cem. age (yr) | Date of capture | Bear wt. (lb) | Location | Drug dosage[a] | Ear tags (left/right) | Marking[b] |
|---|---|---|---|---|---|---|---|
| 1097F | 8.5 | 6/5/77 | 225 | Meat Mtn. | 1.8/M | 235/234 | -- |
| | | 6/19/77 | -- | Utukok R. | 1.4/M | 235/234 | -- |
| | 11.5 | 7/6/80 | 300 | Utukok R. | 1.8/M | 510/511 | Pp/P |
| | | 8/16/80 | 270 | Utukok R. | A/L | 510/511 | Pp/P |
| | 14.5 | 9/19/83 | 305 | Utukok R. | 5.0M99/M | 3236/3480 | Bk/P |
| 1098M | 3.5 | 6/8/77 | 108 | Utukok R. | 1.2/H | 238/239 | O/1B |
| 1099M | 10.5 | 6/11/77 | 365 | Utukok R. | 3.2/M | 245/244 | -- |
| | 11.5 | 6/27/78 | 450[c] | Kokolik R. | 2.8/M | 773/772 | -- |
| | 12.5 | 6/26/79 | 450 | Utukok R. | 3.0/M | 773/772 | -- |
| | 16.5 | 9/20/83 | 495 | Utukok R. | 6.0M99/H | 3238/3485 | R/R |
| 1100F | 6.5 | 6/11/77 | 200 | Meat Mtn. | 2.4/M | 247/246 | -- |
| | 7.5 | 6/9/78 | 240[c] | Utukok R. | 2.5/H | 247/246 | P |
| | 8.5 | 7/1/79 | 220 | Driftwood Cr. | 1.9/M | 247/246 | P |
| 1101M | 2.5 | 6/12/77 | 145 | Utukok R. | 1.2/L | 249/248 | G/W |
| 1102F | 2.5 | 6/12/77 | 125 | Utukok R. | 1.2/L | 251/250 | W/G |
| | 3.5 | 6/18/78 | 140 | Utukok R. | 1.4/M | 251/250 | -- |
| | 5.5 | 8/18/80 | 210 | Kokolik R. | 3.0 | 544/545 | W/G |
| 1103M | 8.5 | 6/12/77 | 320 | Utukok R. | 2.6/H | 253/252 | -- |
| | 9.5 | 6/12/78 | -- | Utukok R. | A/H | 253/252 | -- |
| 1104F | 9.5 | 6/12/77 | 215 | Utukok R. | 1.6/M | 255/254 | -- |
| | | 6/17/77 | -- | Utukok R. | 1.2/L | 255/254 | -- |
| | 12.5 | 7/10/80 | 250 | Nimwutik Cr. | 1.5/L | 517/518 | P/G |
| | 15.5 | 6/22/83 | 190 | Nimwutik Cr. | 3.8M99/M | 3468/3471 | G/G |
| 1105F | 7.5 | 6/13/77 | 225 | Kokolik R. | 1.5/M | 257/256 | -- |
| | | 6/26/77 | 245 | Tupikchak Mtn. | 1.5/L | 257/256 | -- |
| | 8.5 | 6/28/78 | 285 | Kokolik R. | 1.7/L | 257/301 | -- |
| | 10.5 | 7/10/80 | 260 | Iligluruk Cr. | 1.8/M | 522/521 | W/O |
| | 13.5 | 9/18/83 | 310 | Tupikchak Mtn. | 6.0M99/H | 3309/3258 | W/O |
| 1106F | 11.5 | 6/14/77 | 210 | Adventure Cr. | 1.5/H | 258/259 | -- |
| 1107F | 0.5 | 6/14/77 | 7 | Adventure Cr. | None | None | None |
| 1108F | 0.5 | 6/14/77 | 20 | Adventure Cr. | None | /260 | /W |
| 1109F | 0.5 | 6/14/77 | 18 | Adventure Cr. | None | 261/ | W/ |
| 1110F | 24.5 | 6/15/77 | 245 | Ilingnorak Ridge | A/H | 262/263 | 1B/P/1B |
| | 25.5 | 7/1/78 | -- | Ilingnorak Ridge | 1.9/L | 262/263 | dB |
| | 26.5 | 6/30/79 | 235 | Ilingnorak Ridge | 1.7/H | 262/263 | -- |
| 1111F | 14.5 | 6/18/77 | 240 | Colville R. | 1.7/M | 269/268 | -- |
| 1112M | 4.5 | 6/18/77 | 250 | Colville R. | 1.7/M | 267/266 | dB/G |
| 1113F | 4.5 | 6/18/77 | 150[c] | Colville R. | 1.5/M | 270/271 | G/dB |
| 1114M | 16.5 | 6/19/77 | 450 | Utukok R. | 1.7/L | 273/272 | O/G/O |
| 1115M | 5.5 | 6/22/77 | 175 | Meat Mtn. | 1.5/H | 275/274 | dB/O |
| 1116M | 5.5 | 6/23/77 | 175 | Utukok R. | 1.5/M | 276/277 | O/dB |
| 1117M | 19.5 | 6/23/77 | 315 | Driftwood Cr. | A/M | 279/278 | Pp/W/Pp |
| 1118F | 17.5 | 6/23/77 | 185 | Driftwood Cr. | 1.3/H | 281/280 | W/Pp |
| 1119F | 6.5 | 6/24/77 | 190 | N. Meat Mtn. | 1.7/L | 282/283 | O/P |
| 1120M | 16.5 | 6/24/77 | 390 | N. Meat Mtn. | 2.6/M | 284/285 | Pp/1B/Pp |

Appendix B. Continued.

| Bear No. and sex | Cem. age (yr) | Date of capture | Bear wt. (lb) | Location | Drug dosage[a] | Ear tags (left/right) | Marking[b] |
|---|---|---|---|---|---|---|---|
| 1121F | 11.5 | 6/25/77 | 245 | Kokolik R. | A/H | 287/286 | -- |
| 1122M | 0.5 | 6/25/77 | 30 | Kokolik R. | 0.12/M | /288 | /G |
| 1123F | 0.5 | 6/25/77 | 27 | Kokolik R. | 0.12/M | 289/ | G/ |
| 1124M | 17.5 | 6/26/77 | 360 | Tupikchak Mtn. | 2.6/M | 291/290 | dB/W/dB |
| 1125F | 3.5 | 6/27/77 | 145 | Utukok R. | 1.4/H | /292 | /W |
| 1126M | 13.5 | 6/28/77 | 345 | Kokolik R. | 2.7/M | 293/294 | O/W/O |
| 1127F | 26.5 | 6/28/77 | 295 | Kokolik R. | 1.5/L | 295/ | P/W/P |
| 1128F | 7.5 | 6/30/77 | 240[c] | Tupikchak Mtn. | 1.8/M | 297/296 | P/P/P |
| 1129F | 1.5 | 6/30/77 | 90 | Tupikchak Mtn. | 0.5/M | 299/298 | P/P |
| 1130F | 21.5 | 6/30/77 | 255 | Elbow Cr. | 1.9/M | 300/900 | O/O/O |
| 1131M | 8.5 | 7/1/77 | 235 | Driftwood Cr. | 2.5/H | 3085/3086 | G/O |
| 1132F | 2.5 | 7/2/77 | 67 | Archimedes Ridge | -- | 1498/3082 | 1B/P |
| 1133M | 2.5 | 7/2/77 | 80 | Archimedes Ridge | -- | 3088/1499 | P/1B |
| | 3.5 | 6/27/79 | 150 | Utukok R. | 1.4/M | 310/309 | P/1B |
| 1134F | 14.5[c] | 7/5/77 | 230[c] | Utukok R. | 2.0/L | 3089/3090 | O |
| | 17.5[c] | 7/12/80 | 285 | Utukok R. | 2.8/H | 526/527? | Bk/G |
| | 20.5[c] | 6/83 | 165 | Utukok R. | A/H | -- | -- |
| 1135M | 1.5 | 7/5/77 | 57 | Utukok R. | -- | 3091/3092 | O/O |
| 1136F | 1.5 | 7/5/77 | 48 | Utukok R. | -- | 3093/ | O/ |
| 1137F | 1.5 | 7/5/77 | 58 | Utukok R. | -- | /3094 | /O |
| 1138F | 23.5 | 8/10/77 | 250 | Kantangnak Cr. | 1.9/M | None | O |
| | 24.5 | 6/16/78 | 265 | Kantangnak Cr. | A/L | 759/758 | dB/dB/dB |
| 1139F | 11.5 | 6/7/78 | 200[c] | Utukok R. | 1.3/M | 651/654 | W |
| | 16.5 | 6/22/83 | 180 | Utukok R. | 3.6M99/M | 3226/3229 | mG/G |
| 1140M | 0.5 | 6/7/78 | 21 | Utukok R. | None | /655 | /O |
| 1141F | 0.5 | 6/7/78 | 16 | Utukok R. | None | 656/ | O/ |
| | 2.5 | 7/13/80 | 165 | Utukok R. | 2.1 | 532/533 | W/O |
| 1142F | 14.5 | 6/9/78 | 250[c] | Utukok R. | A/H | 658/657 | Bk |
| 1143F | 9.5 | 6/9/78 | 210[c] | Utukok R. | 1.8/H | 704/705 | 1B/W |
| 1144F | 1.5 | 6/9/78 | 38 | Utukok R. | 0.4/H | 717/718 | Pp/G |
| 1145F | 2.5 | 6/10/78 | 95 | Elbow Cr. | 1.7/H | 720/719 | 1B/G |
| 1146F | 14.5 | 6/10/78 | 230[c] | Elbow Cr. | 2.5/H | 721/722 | G/1B |
| 1147M | 3.5 | 6/10/78 | 205 | Utukok R. | 1.3/M | 723/724 | P/G |
| | 5.5 | 7/10/80 | 305 | Tupikchak Cr. | 2.8/H | 516/515 | P/dB |
| 1148M | 6.5 | 6/10/78 | 205 | Utukok R. | 1.3/M | 725/728 | dB/W |
| 1149F | 4.5 | 6/11/78 | 180 | Utukok R. | 1.3/M | 736/733 | W/dB |
| 1150M | 5.5 | 6/16/78 | 185 | Utukok R. | 1.2/M | 751/747 | Bk/P |
| 1151F | 3.5 | 6/16/78 | 112 | Kantangnak Cr. | -- | 752/753 | Bk/Bk |
| | 8.5 | 6/22/83 | 165 | Plunge Cr. | 3.8M99/M | 3469/ | Bk/ |
| 1152M | 3.5 | 6/16/78 | 142 | Kantangnak Cr. | -- | 754/755 | O/Bk |
| 1153F | 2.5 | 6/16/78 | 70 | Kantangnak Cr. | -- | 756/757 | Bk/O |
| 1154F | 12.5 | 6/21/78 | 220 | Tupik Cr. | 1.8/M | 760/761 | W/O/W |
| 1155M | 1.5 | 6/21/78 | 75 | Tupik Cr. | 0.50/M | 763/762 | G/W |
| 1156F | 6.5 | 6/21/78 | 205 | Kogruk Cr. | 2.0/M | 765/764 | P/Bk |
| 1157M | 5.5 | 6/24/78 | 210 | Driftwood Cr. | A/H | 766/767 | P/G/P |
| | 6.5 | 6/30/79 | 275 | Driftwood Cr. | 2.4/H | 766/767 | Bk/P |

Appendix B. Continued.

| Bear No. and sex | Cem. age (yr) | Date of capture | Bear wt. (lb) | Location | Drug dosage[a] | Ear tags (left/right) | Marking[b] |
|---|---|---|---|---|---|---|---|
| 1158F | 7.5 | 6/24/78 | 180 | Elbow Cr. | 1.4/M | 769/768 | P/W |
| 1159M | 10.5 | 6/24/78 | 295 | Driftwood Cr. | 1.7/M | 770/771 | G/P |
| | 12.5 | 8/16/80 | -- | Utukok R. | A/L | 535/534 | G/P |
| | 15.5 | 9/16/83 | -- | Utukok R. | -- | -- | -- |
| 1160M | 0.5 | 7/1/78 | 25 | Ilingnorak Ridge | None | 303/ | dB/ |
| 1161M | 0.5 | 7/1/78 | 21 | Ilingnorak Ridge | None | /302 | /dB |
| 1162M | 2.5 | 7/1/78 | 95 | Iligluruk Cr. | 1.1/M | 304/305 | lB/Bk |
| 1163M | 2.5 | 7/3/78 | 92 | Iligluruk Cr. | A/H | 306/307 | Bk/lB |
| 1164M | 3.5 | 5/7/79 | 185 | Meat Mtn. | 1.3/M | 308/311 | G/Bk |
| | 4.5 | 7/6/80 | 270 | Meat Mtn. | 1.9/M | 512/311 | Bk/G |
| 1165M | 3.5 | 9/17/79 | 200[c] | N. Meat Mtn. | A/H | 318/319 | G/dB |
| 1166F | 10.5 | 9/18/79 | 390 | N. Meat Mtn. | A/L | 284/317 | dB/O |
| | 11.5 | 7/7/80 | 265 | Utukok R. | 2.1/H | 502/317 | lB/O |
| | 14.5 | 6/22/83 | -- | Utukok R. | 3.6M99/H | 3221/3228 | mG/lB |
| 1167F | 7.5 | 9/18/79 | 235 | N. Meat Mtn. | 2.8/H | 271/315 | O/dB |
| 1168F | 0.5 | 9/18/79 | 55 | N. Meat Mtn. | 0.60/M | 274/296 | None |
| 1169F | 11.5 | 7/5/80 | 290 | Kokolik R. | 2.2/L | 513/514 | Bk/dB |
| | 14.5 | 6/21/83 | -- | Plunge Cr. | 3.8M99/M | 3467/3465 | mG/Bk |
| 1170F | 0.5 | 7/5/80 | 34 | Kokolik R. | 0.10 | 114/112 | dB/ |
| 1171M | 0.5 | 7/5/80 | 32 | Kokolik R. | 0.10 | 115/113 | Bk/ |
| 1172M | 11.5 | 7/6/80 | 360 | Utukok R. | 3.2/H | 509/508 | W/lB |
| 1173M | 0.5 | 7/10/80 | 32 | Kokolik R. | 0.14 | 525/101 | /O |
| 1174F | 0.5 | 7/10/80 | 28 | Kokolik R. | 0.14 | 501/507 | O/ |
| 1175M | 7.5 | 7/12/80 | 400 | Iligluruk Cr. | 2.6 | 528/529 | lB/lB |
| 1176F | 18.5 | 7/13/80 | 345 | Utukok R. | 2.0/M | 531/530 | G/G |
| 1177F | 1.5 | 7/13/80 | 91 | Nimwutik Cr. | 0.38/L | 520/519 | G/G |
| | 4.5 | 9/18/83 | 195 | Utukok R. | 4.0M99/M | 3262/ | O |
| 1178F | 13.5 | 8/18/80 | 250 | Utukok R. | 3.0 | 540/541 | lB/Bk |
| 1179F | 2.5 | 8/18/80 | 135 | Utukok R. | 1.4/L | 542/543 | lB/O |
| | 5.5 | 6/22/83 | -- | -- | 3.8M99/L | 3230/3231 | dB/mG |
| 1180F | 0.5 | 8/18/80 | 31 | Kokolik R. | 0.30/L | /547 | /lB |
| 1181F | 0.5 | 8/18/80 | 34 | Kokolik R. | 0.40/M | 546/ | lB/ |
| | 3.5 | 9/15/83 | 225 | Utukok R. | A/H | -- | lB/dB |
| 1232M | 4.5[c] | 9/18/83 | 190 | Utukok R. | 6.0M99/M | 3399/3317 | W/R |
| 1233M | 11.5[c] | 9/18/83 | 430 | Kokolik R. | 6.0M99/M | 3261/3395 | dB/O |
| 1234F | 5.5[c] | 9/18/83 | 280 | Utukok R. | 6.0M99/M | 3253/3400 | O/W |
| 1261M | 10.5 | 6/22/83 | 345 | Utukok R. | 5.0M99/M | 3457/3470 | mG/dB |

Appendix B. Continued.

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[a] Dosage in cc of phencyclidine hydrochloride or M99; A denotes multiple injections with unknown effective dosage. Drug effects were as follows: L = light, M = optimum, H = heavy.

[b] Marker designations:
Colors: P, pink; W, white; G, light green; mG, medium green; O, orange; dB, dark blue; lB, light blue; Bk, black; Pp, purple.
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. Three flag combinations were used in nylon rope collars; e.g., OOW is 2 identical clusters of OOW flags on opposite sides of the collar.

[c] Estimate after close examination.

Appendix C. Reproductive history and litter size for female grizzlies in the western Brooks Range, 1977-83.[a]

| Bear No. | Age[b] in 1983 | Offspring No. | Reproductive history and litter size[c] 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 |
|---|---|---|---|---|---|---|---|---|---|
| 1085 | 23.5 | | B | B | NB? | NB | Pdead | -- | -- |
| 1086 | 20.5 | 1087, 1164; 2UM | 2ylg | 2 2yr | 2 3yr/B | 2cb/Pdead | -- | -- | -- |
| 1087 | 7.5 | None | | | | NB | B | B | UN |
| 1089 | 10.5 | 2UM | NB | B | 2cb | UN | UN | 1cb? | UN |
| 1090 | 21.5 | 3UM | 3ylg | 3 2yr | 3 3yr/?B | UN/Pdead | -- | -- | -- |
| 1092 | 14.5 | 1093 | 1cb | 1ylg | 1 2yr | B | B | B | B |
| 1095 | 12.5 | None | ?B | ?B | UN | UN | UN | UN | UN |
| 1097 | 14.5 | 2UM | B | B | 2cb/B | 2cb/B | 3cb | 3ylg | 3 2yr |
| 1100 | 12.5 | 2UM | NB | B | 2cb/B | B | UN | UN | UN |
| 1102 | 8.5 | 1180, 1181 | NB | NB | B | 2cb | B | 1cb | UN |
| 1104 | 15.5 | 1101?, 1102? | 2 2yr/B | 1cb/B | 1cb | 1ylg | 1 2yr/B | B | B |
| 1105 | 13.5 | 1UM; 1173, 1174 | B | B | 1cb/B | 2cb | 2ylg | 2 2yr | 2 3yr |
| 1106 | 14.5 | 1107, 1108, 1109 | 3cb | 2ylg | 2 2yr/dead | | | | |
| 1110 | 28.5 | 1160, 1161 | B | 2cb | 2ylg | 2 2yr | 2 3yr/Pdead | -- | -- |
| 1111 | 19.5 | 1112, 1113; 3UM | 2 4yr/B | B | 3cb/B | UN | UN | UN | UN |
| 1118 | 22.5 | 2UM | B | 2cb | 2ylg | UN | UN | UN | UN |
| 1119 | 11.5 | None | B | B | UN | UN | UN | UN | UN |
| 1121 | 16.5 | 1122, 1123 | 2cb | 2ylg | 2yr/B | 2cb | UN | UN | UN |
| 1127 | 27.5 | None | B | UN/Pdead | -- | -- | -- | -- | -- |
| 1128 | 12.5 | 1129; 3UM | 1ylg/B | 3cb | UN | UN | UN | UN | UN |
| 1130 | 26.5 | 2UM | 2cb | 1ylg | UN | UN | UN | UN/Pdead | -- |
| 1134 | 20.5 | 1135, 1136, 1137 | 3ylg | 2 2yr | 2 3yr/B? | cb?/B? | B | 3cb | B? |
| 1138 | 25.5 | 1151, 1152, 1153 | 2 2yr, 1ylg | 2 3yr, 1 2yr | UN/Pdead | -- | -- | -- | -- |
| 1139 | 16.5 | 1140, 1141 | UN/B | 2cb | 2ykg | 2 2yr/B | 3cb | 3ylg | 2 2yr |
| 1141 | 5.5 | None | | | | | NB | B | UN |
| 1142 | 19.5 | | PO | B | UN | UN | UN | 1 2yr? | UN |
| 1143 | 14.5 | 1144, 1UM | 2cb | 2ylg | 2 2yr | UN | UN | UN | UN |
| 1146 | 19.5 | 1145, 1UM | 1-2ylg | 1 2yr | 1 3yr/B | UN | UN | UN | UN |
| 1154 | 17.5 | 1155 | 1cb | 1ylg | 1 2yr | 1 3yr/B | 2cb | UN | UN |
| 1156 | 11.5 | None | | B | UN | UN | UN | UN | UN |
| 1158 | 12.5 | None | | B | UN | UN | UN | UN | UN |

Appendix C. Continued.

| Bear No. | Age[b] in 1983 | Offspring No. | Reproductive history and litter size[c] | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 |
| 1166 | 13.5 | 3UM | | NPO | B? | B | 3cb | 1y1g | 1 2yr/B |
| 1167 | 14.5 | 1168 | | UN/B | 1cb | B | B | B | UN |
| 1169 | 14.5 | 1170, 1171; 2UM | | UN | B | 2cb | B | 2cb | 2y1g |
| 1176 | 21.5 | 2UM | | | | UN/B | 2cb | 1y1g | UN |
| 1178 | 16.5 | 1179; 2UM | | | | 1 2yr | 1 3yr/B | 2cb/B | UN |
| UM | | 2UM | 2cb | 2y1g | | | | | |
| UM | | 3UM | | 3cb | | | | | |
| UM | | 2UM | | 2cb | 2y1g | | | | |
| UM | | 2UM | | 2cb | 1-2y1g | 1 2yr | | | |
| UM | | 2UM | 2cb | | | | | | |
| UM | | 1162, 1163 | 2y1g | 2 2yr/?B | | | | | |
| UM | | 3UM | 3y1g | | | | | | |
| UM | | 2UM | 2 2yr | | | | | | |
| UM | | 3UM | | | 3cb | | | | |
| UM | | 2UM | | 2cb | 2y1g | 2 2yr | | | |
| UM | | 1UM | | | 1cb | | | | |
| UM | | 1UM | | | | | | 1cb | |
| UM | | | | | | | | 3y1g | |

[a] Designations are as follows: PO, evidence of previous offspring; NPO, no evidence of previous offspring; UM, unmarked; UN, unobserved; B, bred during that season; NB, did not breed; Pdead, presumed dead; cb, y1g, 2yr, 3yr, female accompanied by cub, yearling, 2-year-old, 3-year-old young; cb/B, cubs lost prior to breeding season, subsequent breeding by female; y1g/B, 2yr/B, etc., offspring weaned, then subsequent breeding by female.

[b] These ages were determined from cementum annuli during the year of capture, but the ages reported here include years subsequent to the bear's capture. However, in cases of bears known or presumed dead, the data listed represent their ages when last known to be alive.

[c] Litter sizes should be viewed as minimum since mortality to other offspring may have occurred prior to observation.

Appendix D. Known mortality of the offspring of female grizzly bears in the western Brooks Range, 1977-83.

| Adult female bear | Number of offspring in litter | Number of offspring lost | Age of offspring lost[a] | Last date young observed | 1st date young observed missing | Comments |
|---|---|---|---|---|---|---|
| 1086 | 2 | 2 | cub | 7/19/80 | 8/14/80 | Entire family group not resighted |
| 1097 | 2 | 2 | cub | 5/9/79 | 5/15/79 | 1097 observed breeding 6/7/79 |
| 1097 | 2 | 2 | cub | 5/3/80 | 6/18/80 | 1097 observed breeding 6/18/80 |
| 1100 | 2 | 2 | cub | 5/5/79 | 6/29/79 | 1100 observed breeding 6/29/79 |
| 1104 | 1 | 1 | cub | 5/28/78 | 6/8/78 | Male 1099 25 yd away on 6/8; 1104 bred again in 1978 |
| 1105 | 1 | 1 | cub | 5/22/79 | 5/31/79 | 1105 observed breeding 5/31/79 |
| 1111 | 3 | 3 | cub | 5/5/79 | 7/11/79 | 1111 not resighted again |
| UM[a] | 3 | 1 | cub | 8/11/78 | 9/12/78 | Wolf seen harassing UM/3 cubs; UM/2 cubs later seen in same vicinity |
| 1166 | 3 | 1 | cub | 6/4/81 | 6/5/81 | |
| | 2 | 1 | cub | 7/9/81 | 9/19/81 | Female lost 1 cub earlier in summer |
| 1178 | 2 | 2 | cub | 5/23/82 | 5/24/82 | Male observed feeding on 1 cub; 1178 observed breeding 6/7/82 |
| 1102 | 2 | 2 | cub or y1g | 8/20/80 | 5/12/81 | |
| 1130 | 2 | 1 | cub or y1g | 6/30/77 | 8/2/78 | |
| 1134 | 3 | 3 | cub or y1g | 6/12/82 | 6/18/83 | 1134 emaciated when captured 6/83 |
| 1167 | 1 | 1 | cub or y1g | 9/18/79 | 6/10/80 | 1167 observed breeding 6/22/80 |
| 1169 | 2 | 2 | cub or y1g | 7/18/80 | 5/7/81 | |
| 1176 | 2 | 1 | cub or y1g | 9/19/81 | 5/25/82 | |
| 1106 | 3 | 1 | y1g | 4/20/78 | 5/20/78 | Runt yearling found dead at den site |
| 1169 | 2 | 1 | y1g | 5/4/83 | 6/18/83 | |
| 1134 | 3 | 1 | y1g or 2yr | 9/16/77 | 5/18/78 | |
| 1139 | 3 | 1 | y1g or 2yr | 6/3/82 | 6/22/83 | |
| 1146 | 2 | 1 | y1g or 2yr | 7/21/77 | 6/6/78 | |
| 1106 | 2 | 2 | 2yr | 10/10/78 | 5/4/79 | 1106 probably killed by male 1099; young not sighted again, presumed dead |

[a] Designations are: UM, unmarked female; cub, cub of the year; y1g, yearling; 2-yr, 2-year-old.

Appendix E. Mortality rates for age classes of offspring accompanied by marked female grizzlies, 1977-83.

| Age class | Young/litters in early spring | Young/litters in fall | Mortality rate of age class (%) |
|---|---|---|---|
| Cubs[a] (1st year) | 62/32 | 33/19 | 47 |
| Yearlings[a] (2nd year) | 41/19 | 36/19 | 12 |
| 2-year-olds[b] | 16/9 | 14/8 | 13 |

[a] When it was unknown whether a mortality occurred between age classes (i.e., between cub and yearling), it was assigned to the younger age class. This included 7 deaths of cubs or yearlings and 2 of yearlings or 2-year-olds.

[b] Of the 3 young accompanying female No. 1138 at capture, Nos. 1151 and 1152 were 2-year-olds and No. 1153 was a yearling. This "mixed" litter was presumably the result of an adoption by No. 1138, but which offspring were adopted is unknown. For purposes of this table, the 2 oldest were placed in the 2-year-old category, but the youngest was not included in the yearling cohort.

Appendix F. Observed litter size and number of offspring in cub, yearling, 2-year-old, and 3-year-old age classes, 1977-83.

| Age class | Litter size | No. of Litters 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | Total litters | No. of offspring | $\bar{x}$ litter size |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Cub | 1 | 2 | 1 | 3 | 2 | 0 | 3 | 0 | 11 | 11 | |
| | 2 | 5 | 5 | 3 | 6 | 3 | 2 | 0 | 24 | 48 | |
| | 3 | 1 | 2 | 2 | 0 | 3 | 1 | 0 | 9 | 27 | |
| | | | | | | | | | 44 | | |
| No. offspring | | 15 | 17 | 15 | 14 | 15 | 10 | 0 | | 86 | 1.95 |
| Yearling | 1 | 2 | 3 | 2 | 1 | 1 | 1 | 1 | 11 | 11 | |
| | 2 | 2 | 4 | 5 | 0 | 1 | 0 | 0 | 12 | 24 | |
| | 3 | 3 | 0 | 0 | 0 | 0 | 3 | 0 | 6 | 18 | |
| | | | | | | | | | 29 | | |
| No. offspring | | 15 | 11 | 12 | 1 | 3 | 10 | 1 | | 53 | 1.83 |
| 2-year-old | 1 | 0 | 1 | 2 | 2 | 1 | 1 | 0 | 7 | 7 | |
| | 2 | 2 | 3 | 3 | 3 | 0 | 1 | 1 | 13 | 26 | |
| | 3 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 2 | 6 | |
| | | | | | | | | | 22 | | |
| No. offspring | | 4 | 10 | 8 | 8 | 1 | 3 | 5 | | 39 | 1.77 |
| 3-year-old | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 4 | 4 | |
| | 2 | 1 | 0 | 2 | 0 | 1 | 0 | 1 | 5 | 10 | |
| | 3 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 3 | |
| | | | | | | | | | 10 | | |
| No. offspring | | 2 | 0 | 8 | 1 | 3 | 1 | 2 | | 17 | 1.70 |