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Population Dynamics of a Hunted Grizzly Bear Population in the Northcentral Alaska Range

by
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SUMMARY

Population densities and harvest rates for a grizzly bear (Ursus arctos) population in the northcentral Alaska Range were estimated during the years 1981 through 1989; baseline population status and reproductive biology were also determined for the period 1981 to 1985. The effects of increased harvests on this population have been the focus of investigations since 1986, continuing through 1991.

In 1989 I observed only minor changes from past production and survival rate patterns. All population estimates calculated during 1989 were adjusted for population closure. The estimated harvest rate for the minimum study area population was 21.6% in 1989, compared with the mean rate of 10.1% (1981-88). Although minimum population size of grizzlies ≥2 years of age declined from estimates of 54 in 1981 to 42 in 1989, preliminary analysis of some aspects of reproductive biology were apparently stable; i.e., the age at 1st production of young was 5-7 years, observed reproductive interval was 4.3 years, and mean litter size was 2.1.

Key Words: density estimates, grizzly bear, Ursus arctos, harvest rates, Interior Alaska, population dynamics, reproductive biology.

CONTENTS

BACKGROUND

An understanding of the effects of hunter harvests on grizzly bear (Ursus arctos) population dynamics is necessary for effective management. To accomplish this we need to determine (1) the effects of differing levels of harvest on population status, (2) how populations respond to hunter-caused mortality, and (3) whether hunter harvests constitute additive or compensatory mortality in grizzly bear populations. This study was begun in 1981 to address these informational needs (Reynolds 1982). The background and rationale for this long-term study has been described previously (Reynolds and Hechtel 1983, 1984a, 1985, 1986; Reynolds et al. 1987; Reynolds and Hechtel 1988; Reynolds 1989).

Before the effects of various harvest rates can be assessed, the following information should be available: (1) population density or size, (2) population structure, (3) movement patterns, (4) home range size, (5) mortality and survival rates, and (6) reproductive potential including age at 1st breeding, litter size, and interval between litters (Craighead et al. 1974, Reynolds 1976, Bunnell and Tait 1980). The approach I have taken in this study is to monitor these characteristics annually so that harvest can be related to potential population responses.

OBJECTIVES

To quantitatively relate changes in the harvest rates of grizzly bears to their population dynamics, especially population size, structure, productivity, survival, emigration, and immigration.

To determine the size, density, and sex and age structure of the grizzly bear population.

To determine reproductive potential, including the age at 1st production of young, reproductive interval, and mean litter size.

To determine natural mortality rates for sex and age classes within the population.

To determine harvest rates for sex and age classes within the population.

To determine movement patterns and home range sizes for grizzly bears of various sex and age classes within the population.

STUDY AREA

The 3,900-km^2 (1,500-mi^2) study area is located in the mountains and foothills of the northcentral Alaska Range within Subunit 20A. The boundaries are the Gold King Creek and Wood River drainages 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) to the north. It includes portions of 2 U.S. Army reservations, Forts Wainwright and Greely.

Elevation in the area ranges from 500 to 3,700 m (1,500 to 12,000 ft). Most rivers flow through U-shaped, glacially formed valleys 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 up to an elevation of approximately 1,200 m (4,000 ft).

METHODS

I continued to use the same methods to capture bears and measure population variables (Reynolds 1982, Reynolds and Hechtel 1983, 1984a, 1985, 1986, 1988; Reynolds et al. 1987). Standardized weight and measurement data were collected (Appendix A). Estimates of minimum population size included the sum of (1) those bears captured within the boundaries of the study area that would have been alive in past years (e.g., a 14-year-old female captured in 1986 was assumed to be a resident of the study area during the years 1981 through 1985, but a 2-year-old male captured in 1986 was only counted as a member of the population from 1984 to 1986 [those known to have emigrated were not included]), (2) bears killed within the study area that would have been alive in past years, and (3) bears that were observed in the area but could not be accounted for as captured or killed. In using this method, I assumed that the rates of unobserved emigration by young-aged bears equaled the rates of immigration; an assessment of this assumption was discussed previously (Reynolds and Hechtel 1986).

Based on observed fidelity to their home ranges, I assumed that females did not emigrate or abandon their established home ranges. Similarly, adult males (≥6 years of age) were also faithful to their home ranges; however, because adult males can be reliably located with radio-collared estrous females during the breeding season, I assumed they were dead or at least not present in the population when unobserved in the study area for 4 years. Because of observed dispersal patterns of this group, I assumed that 2- to 5-year-old males had emigrated or were dead if they had not been observed in the study area for more than 2 years. The degree to which these assumptions are valid will become more evident as capture efforts continue.

In addition to the method for calculating minimum population size, I derived "probable" population sizes by estimating that the 3,900-km^2 area included an additional 10-15 bears that had not been captured, killed, or observed. This estimate was based on the availability of habitat in the area, the known home range sizes and distribution of marked bears living in major drainages, and vegetative cover and rugged terrain that allow resident bears to escape detection for several years.

By 1986 I had sufficient baseline data on home range size and movement of Alaska Range grizzlies to "adjust" my estimates to more accurately account for lack of population closure (Reynolds et al. 1987). Not all bears captured, killed, or observed within the boundaries of the study area maintained home ranges entirely within the study area, resulting in an overestimation of population size. Bears living near the center of the study area were far more likely to remain entirely within the area than those living near the boundaries. To account for this bias, the approximate proportion of each home range lying outside the study area was estimated. The fractional home ranges were subtracted from total population estimates to more accurately reflect numbers

of bears in the study area, resulting in "adjusted" population estimates (Reynolds 1980). For bears killed by hunters, home range size and locations were assumed to be similar to those of radio-collared grizzlies of similar sex and age living in the same area. For example, if an unmarked 5-year-old female was killed near the Wood River at Mystic Creek, I would assume that 20% of her home range would lie outside the study area, because 20% of the home range of bear No. 1336 (i.e., another 5-year-old female living along the Wood River) also lies outside the study area.

I believe I can account for most of the bears using the study area. During the period 1986 to 1989, only eight of 34 bears captured in the study area had not been previously marked or were not offspring of marked bears; six of the eight were captured near the edge of the study area. Similarly, of 34 bears killed in the study area by humans during 1985-89 (excluding 2 capture mortalities), only 14 were unmarked: three were very likely the 2- or 3-year-old offspring of marked bears, nine were 2- or 3-year-old males that had probably immigrated, and the other two were taken on the edge of the study area.

I used a modified capture-recapture method during early June 1986 to estimate the density of bears in a portion of the northcentral Alaska Range study area (Reynolds et al. 1987). The modified capture-recapture technique (Miller et al. 1987) appeared to be a promising method of addressing geographic closure and providing a statistical variance for a bear population estimate. I tested the technique in our area under different conditions than where it had been developed (i.e., in Southcentral Alaska) and compared density-estimated recapture techniques with those based on direct counts.

RESULTS AND DISCUSSION

Immobilization and Drug Use

During 1986-87, I began immobilizing grizzly bears with a 50:50 mixture of tiletamine hydrochloride and zolazepam hydrochloride (Telazol, A. H. Robins, Richmond, VA) (Reynolds 1989, Taylor et al. 1989). I have used it exclusively since 1988; bears have been immobilized 53 times during the study area with no mortalities (Table 1). Unlike etorphine hydrochloride (M99, Lemon Co., Sellersville, PA), Telazol has a wider margin of safety and a mortality rate of <0.5%. It has induction and recovery times from moderate doses of approximately 4-5 and beginning at about 50-70 minutes, respectively. In comparison, similar dosages of phencyclidine hydrochloride (Sernylan, Bio-Ceutic Lab., St. Joseph, MO) have induction and recovery times of 10-15 beginning at about 90-120 minutes, respectively.

Bears Captured and Radio-collared

One hundred and one individual bears were captured in the study area from 1981 to 1989 (Table 1). In addition, 65 bears were recaptured to replace radio collars. During the period 1981 to 1983, initial captures included bears of all sex and age classes. Since then, most initial captures targeted offspring of previously captured bears (Appendix B). Radio collars have been placed on 89 bears: 31 on young-age males ($\leq$5 years), 17 on adult males ($\geq$6 years), 20 on young-age females, and 21 on adult females. By the fall of 1989, 30 bears carried functioning radio collars, 13 bears had shed collars, 50 bears were dead, one was presumed dead, and 7 bears could not be located, presumably because of long-range movements or collar failures (Appendixes C and D).

Twenty-six bears were captured during May and June 1989: 3 previously unmarked adult males, 1 female with two 2-year-olds, seven 2-year-old offsprings of marked females, and 13 that had been previously marked. At least 1-2 of the adult males had been observed but not captured during previous years; the female with two 2-year-olds lives on the eastern edge of the study area and had not been previously observed as an adult.

Population Size and Density

Estimates Based on Population Closure:

Annual population size estimates were calculated both as minimum values and as minimum values adjusted for population closure (Table 2). In addition, "probable adjusted" population size was estimated to account for those bears believed to reside in the area that have not been killed by hunters or captured during the study. Based on the home range size of marked bears and available habitat, the study area supports an additional 10-15 bears; therefore, the 1989 "probable adjusted" population size of bears in the area is 61-66, a decline from that (i.e., 80-95) for 1982. Based on the mean proportions of cubs and yearlings in the 1988-89 population, I think that 9 to 11 of these undetected bears are $\leq$2 years of age. As the study continues, these estimated values will continue to converge as unmarked, resident, and breeding adults are captured while associating with radio-collared bears.

Monitoring of young-age bears born and weaned in the study area will also continue to improve our understanding of dispersal and mortality rates. The 1989 minimum adjusted spring population was 51 grizzly bears, a density of 1.31 bears/100 km^2 (3.40 bears/100 mi^2). This included 43 marked bears adjusted from a total marked population of 51 bears whose home ranges included the study area, 9 unmarked offspring of marked females adjusted from a total of 9 bears, and 5 unmarked bears killed by hunters adjusted from a total of 6 bears.

A more useful measure of population size or density would include only those members of the population $\geq$2 years of age for 2

reasons: (1) because cub and yearling cohorts constitute a relatively high percentage of the population (a mean of 28% in the 1981-87 adjusted population estimates; Reynolds and Hechtel 1986), these proportions can fluctuate widely and point estimates may not be representative of the population trend or reproductive potential and (2) because regulations do not allow legal harvest of cubs or yearlings, calculation of harvest rates is more accurate and useful if the population base only includes those bears ≥2 years of age.

The 1989 adjusted population estimate of grizzly bears ≥2 years of age in the study area was 42 bears, or 1.08 bears/100 km^2 (3.20 bears/100 mi^2). This represents a 22% decline from the adjusted 1981 population estimate of 54 bears, or 1.38 bears ≥2 years old/100 km^2 (3.60 bears/100 mi^2).

Population Structure

The 1989 population, sex, and age structure indicate approximately equal proportions of females and males (Fig. 1); however, there were more females (20) than males (9) present in adult age classes (≥6 years) and more males (22) than females (15) in subadult age classes. The high 1989 mortality rate because of hunting resulted in shifts within the sex and age structure (Fig. 2). By fall 1989, there were still more females (18) than males (6) in the adult age classes; in subadult age classes, there were 13 males and 12 females (Fig. 2).

For comparison, in 1982 the population structure was weighted more heavily toward females for bears ≥3 years of age (Fig. 3), because males are more heavily harvested in the study area than females. The mean sex ratio of the bear harvest since 1979 is 71 males:29 females. During this period, the harvest included 40 males and 14 females in the 1- to 5-year-old age class and 25 males and 12 females in the ≥6-years-old age classes. Males have larger home ranges and travel more widely than females (see Movement section p. 11) and thus are more likely to encounter hunters (Bunnell and Tait 1980, 1981). In addition, because regulations prohibit the taking of cubs (including yearlings) or females accompanied by cubs, productive females are less vulnerable to hunters. For example, from 1981 to 1986, a mean of only 22% and 51% of adult females with known reproductive status were vulnerable to hunters during spring and fall hunting seasons, respectively. In contrast, all adult males were vulnerable during both seasons.

Offspring observed as cubs had an even sex ratio, 14 males:13 females:3 unknown sex, but I am hesitant to conclude that the sex ratio at birth is even. I rarely attempted to capture cubs, so our sample size was low. The sex ratios I observed in older juvenile age classes tended to be male dominant, but none were significantly different from the male:female ratio I observed for cubs. Yearlings had a sex ratio of 19 males:14 females:3 unknown sex; 2-year-olds, 20 males:14 females:2 unknown sex; and 3-year-olds, 8 males:5 females. Of those 2- and 3-year-olds that were

observed at weaning, 23 were males, 15 were females, and one was of unknown sex. If there is a tendency toward greater male recruitment in the population, it may be the result of initial production, rather than a lower survival rate for females in litters. Of 18 litters, five were composed of all males, two were composed of all females, 15 were composed of mixed-sex litters, and three were composed of a male or a female with an unknown-sex litter mate. Similar sex ratios have been recorded in Yellowstone National Park. Craighead et al. (1974) found 57% of 74 cubs captured during the years 1959 through 1970 were males, and Knight and Eberhardt (1985) reported that 67% of 24 cubs captured during the years 1974 through 1982 were males.

Reproductive Biology

Age at 1st Production of Young:

During 1989 female No. 1379 bred for the 1st time as a 4-year-old and female No. 1398, accompanied by two 2-year-olds, was an estimated 8 years of age, indicating that she produced a surviving litter when she was 6 years old.

The age at which females first produce cubs in this area ranged from 5 to 7 years, but the age at which females produce cubs which are successfully reared may be 5 to 9 years (Table 3). Only 2 of ten 5-year-old females were observed with cubs or showed evidence of suckling, although eight had been observed consorting with males the previous year. Of nine 6-year-old females, two produced cubs that survived, two had cubs that did not survive, three bred and produced cubs as 7-year-olds, one was not observed as a 6- or 7-year-old but produced surviving offspring at age 8 years, and one did not breed.

Reproductive Interval:

Reproductive interval, or reproductive cycle, is the period between weaning of 1 litter by an adult female and the successful rearing and weaning of her subsequent litter. For females producing cubs for the 1st time, intervals begin at the 1st breeding that results in offspring. The years in which a female breeds but fails to conceive or loses her litter are included in this definition of reproductive interval. Therefore, observations of the length of time offspring accompany females before weaning should be viewed as minimum values of reproductive intervals, because females may not always produce young subsequent to breeding efforts following weaning (Craighead et al. 1969, 1976; Reynolds 1974, 1976, 1978, 1980; Glenn et al. 1976; Reynolds and Hechtel 1982). This definition differs from that used by others; Craighead et al. (1976) define a cycle as the interval from pregnancy to pregnancy.

During 1989, 4 females completed 3-year reproductive intervals, two kept their 2-year-olds and will have 4-year intervals in 1990, one completed a 5-year interval, and 4 others lost offspring and

will have projected intervals of from 5 to 10 years. Offspring were weaned as 2-year-olds (n = 13 litters) or 3-year-olds (n = 8 litters). Mean minimum reproductive interval, however, was 4.3 years (n = 36), based on those cycles that we observed plus those that were projected by assuming weaning of offspring as 2-year-olds (Table 4). Alternately, if we project minimum cycle length based upon observed proportions of those litters weaned as 2- and 3-year-olds, then the mean reproductive interval was 4.4 years. All 13 intervals greater than 4 years resulted from interruption of the breeding cycle because of mortality of litters or to breeding that did not produce cubs the following year.

Factors that result in females weaning their young as 2-year-olds or keeping them another year to wean as 3-year-olds have not been identified. Weight or nutritional status in mid- to late May at the time when offspring are usually weaned and the estrus cycle begins may be important, but with our small sample sizes we were unable to detect any patterns. Nevertheless, conditions present in the summer of 1982 or the winter of 1982-83 appear to have prolonged reproductive intervals. Not only were no surviving cubs produced during 1983, but 3 females accompanied by 2-year-olds in 1983 all weaned their litters as 3-year-olds. Similarly, of 3 females with yearlings in 1983, one weaned her litter as 2-year-olds and the other two weaned their litters as 3-year-olds. In contrast, of 6 litters produced in 1984 or 1985, 5 were weaned as 2-year-olds, and only 1 litter of 3-year-olds was weaned. Models of the effects of harvest on population dynamics should recognize such variability.

Reproductive Success:

At least 4 females bred during 1988, and three produced litters in 1989. Reproductive success, or the proportion of breeding activity by adult females that results in the production of cubs, was 77%. This rate was based on the outcome of 31 observations of breeding activity by 13 individual females $\geq$6 years of age during the years 1982 through 1989. In addition, 2 females bred at ages 4 and 5 years before producing young as 6-year-olds.

Successful reproduction is probably dependent upon an individual female reaching a critical weight, rather than a critical age, prior to ovulation or implantation (Rogers 1976). Weight gain and maintenance, in turn, must depend on weather conditions, food availability, or other unknown factors either in the year that breeding occurs or during the winter/spring following breeding.

Reproductive failure occurred in the study area population during 1983; only 1 cub was observed, and it died shortly after it emerged from its den. Only 1 of 3 adult females observed breeding in 1982 produced cubs in 1983. In addition, at least 3 other females that were later either captured or killed in the study area may have bred in 1982 but were not accompanied by surviving offspring in spring 1983. In comparison, 86% of females that bred

during 1983-87 produced cubs the following year (n = 28) (Table 3).

Litter Size:

Mean litter size was 2.1 for 30 litters first observed as cubs, 1.9 for 15 litters first observed as yearlings, and 2.0 for 31 litters observed as yearlings, regardless of when they were first observed. For comparison, in the Nelchina Basin on the south side of the Alaska Range, Miller (1987) found the same mean cub litter size (2.1) but a mean yearling litter size of only 1.7. In this study the number of females producing cubs varied from year to year, ranging from 1 female producing 1 cub in 1983 to 7 females producing 14 cubs in 1982 (Table 5). In 1989 cub production was low; only 5 cubs were produced by 3 females. Poor cub production in 1983 may have been due to failure of berry crops in 1982 (Miller 1984) or to the weather patterns of the winter of 1982-83, in which little snow fell and temperatures fluctuated widely.

Although the difference in mean litter size between cubs and yearlings is small, it is primarily due to the mortality of entire litters, rather than an indication of high survival rates. Similar patterns of litter mortality have been recorded in northwestern Alaska (ADF&G files).

The mean size of 18 litters weaned as 2- or 3-year-olds was 2.0. The annual number of adult females in the population since 1982 has ranged from 18 to 21 (Tables 3, 6), and the observed annual numbers of litters produced were 7, 1, 6, 5, 2, 9, and 5 during the years 1982 through 1988, respectively. From 1982 to 1989, the observed annual numbers of weaned litters, however, were only 1-2, 0-1, 4, 2, 4, 1, 2, and 5, respectively. This pattern also reflects mortality of entire litters, mostly in cub or yearling age classes.

Recruitment:

Population recruitment is dependent upon cub production, survival of offspring to productive age, and movement patterns, including emigration and immigration. Although recruitment has been adequate to maintain the number of productive females in the population, the number of female offspring available to serve as replacements has declined (Table 6). This will likely result in a future decline in the number of productive females, unless the production or survival of young-aged females improves or additional young females move into the area. The number of cubs produced that survive and remain in an area after 5 years illustrates the effects of grizzly bears' low survival rates: of a minimum of 37 cubs produced during 1981-84, 22 survived until weaning, but only four (2 males, 2 females) remained in the area as 5-year-olds (Table 7). Data collected in subsequent years show that this pattern will apparently persist. The effect of emigration on recruitment will be addressed in future reports.

Mortality

During 1989 the harvest by hunters was 8 grizzly bears; two additional bears each were either killed illegally or in defense of life or property (DLP), and 1 missing offspring was presumed dead. In addition, 3 marked bears were killed by hunters outside the study area; two of these were recently weaned 2-year-old males, and the other was an adult male whose home range had been primarily within the study area.

From 1981 through 1989 at least 109 bears died in the study area: 14 in 1981, 11 in 1982, 11 in 1983, 18 in 1984, 11 in 1985, 9 in 1986, 10 in 1987, 12 in 1988, and 13 in 1989. Fifty-seven grizzly bears were killed by hunters, 33 offspring were missing from family groups and presumed dead, eight were killed during capture, five were killed in defense of life or property, four were harvested illegally, and two were natural mortalities for which carcasses were found (Table 8, Appendix E).

The causes of mortality for cubs, yearlings, and 2-year-olds that disappeared while accompanying their mothers could not be determined. Cannibalism by adult males was suspected as the major cause; it has been documented in Alaska in the Brooks Range (Reynolds 1976, 1980, 1981 ; Reynolds and Hechtel 1982, 1984b), Alaska Range (Dean et al. 1986), south of the Alaska Range (Troyer and Hensel 1962, Glenn et al. 1976, Miller 1984), and Canada (Mundy and Flook 1973; Pearson 1975, 1976). Natural mortality rates (i.e., excluding those caused by humans) for offspring under maternal care were 29% for cubs (n = 52), 7% for yearlings (n = 45), and 7% for 2-year-olds (n = 29).

The mortality rates for 31 radio-collared females aged 2 to 25 years that were monitored for 103 bear-years were caused by the following: 8%, sport hunting; 2%, natural, and 3%, capture-related. Only 2 of the deaths were due to natural causes; 1 female was killed and eaten by an adult male, presumably as a result of defense of her single 2-year-old, and the other was found dead in her den.

Sport hunting is a major source of mortality in this population. Prior to 1981 the mean annual harvest ranged from 1 to 14 grizzly bears; the mean was 5.0 (Table 9). If the population remained relatively stable during the period 1961-80 and future research confirms a pre-1981 adjusted density estimate of 2.2 bears/100 km^2 (5.7/100 mi^2), the mean annual harvest rate was approximately 5.6-5.8% of the population, with a range of 1.1-16.5%. By comparison, during the years 1981 through 1989, the mean harvest rate for the minimum population, including all human-caused mortalities, was 11% (Table 10). If these rates are based on adjusted population size to account for those bears estimated living in the study area but not yet captured, the mean mortality rate for the years 1981 through 1989 was 8-9%. Alternately, if harvest rates are calculated for only those bears $\geq$2 years of age and based on probable population size (adjusted to account for lack of

population closure and those bears living in the area that have not been detected), then the mean mortality rate for the years 1981 through 1989 was 11-12%.

More than a simple calculation of harvest rate is necessary to evaluate the effects of the harvest or to correlate harvest rates with population trend. Both Craighead et al. (1974) and Knight and Eberhardt (1984) emphasized that the number of productive females within a population is the most important factor in the rate of growth or decline in grizzly bear populations. These data also indicate the importance of adult females to population dynamics. Since 1982 the harvest has not resulted in a decline in the number of adult females; there was only minor change from 21 females in 1982 to a projected total of 18 in 1990 (Table 6). However, the number of females in the 3- to 5-year-old age class, which acts as replacements when adults die, has declined from 10 in 1982 to 4 in 1989. At the same time, the population within the study area has declined from an adjusted minimum of 70 in 1981 to 51 in 1987, and this trend is expected to continue. Based on only those bears $\geq$2 years of age, the trend is similar, but apparently more severe; minimum adjusted estimates were 52 bears in 1981 and 42 bears in 1989 (Table 9). Although compensatory changes in production or survival rates may occur in reduced populations, as suggested by Stringham (1983) and McCullough (1981), such mechanisms have yet to be documented. Evidence for compensatory mechanisms at the present level of exploitation in the study area will not be analyzed until more data are collected.

Movement

In this study, no emigration or abandonment of established home ranges by adult bears was documented. Some adult males moved outside the study area and returned after traveling as far as 40 km (25 mi) to the north; however, their movement was confined to their apparent home ranges. In 2 instances, we lost contact with adult males for more than 4 years. Because we have monitored breeding females annually to locate marked adult males whose radio collars have been shed or have malfunctioned, these bears should also have been located to determine if they were alive and present in the area. Consequently, after 4 years of not being observed, adult males were no longer considered to be present in the population. Similarly, adult females were faithful to the home ranges within which they were captured (Reynolds and Hechtel 1986), and none were observed to emigrate or abandon their home ranges. It is more difficult to relocate breeding females that have lost their radio collars in the same way we do for males, because they may only breed once every 3 or 4 years. Contact was lost with 5 adult females for 4 to 6 years; two were subsequently recaptured or killed within their home ranges, and observations indicate at least one other is still alive. The other 2 females had home ranges on the periphery of the study area in locations not easily searched, so I assume they are still alive. Intensive searches of their home ranges are planned during 1990 to substantiate their presence or absence in the population.

The fidelity of young-aged bears to their maternal home ranges varied (Table 11). Based on limited observations, most females remain close to their maternal home ranges following weaning, but less than half of the males remain. Of 22 males followed during the 1st year after weaning, four moved from 44 to 98 km (27 to 61 mi) outside their maternal home ranges. Of those followed during the 2nd year after weaning, four more moved from their maternal home ranges, while 4 others remained. Of those that stayed within their maternal home range for 1 to 3 years after weaning, only one was observed and seven were killed during the 1st year, one stayed for 2 years, and three stayed for 3 years. Because of this pattern of emigration from their maternal home ranges, when telemetry contact of 2- to 5-year-old males was lost for more than 2 years, I assumed that they had dispersed from the study area.

All 14 females monitored stayed within their maternal home ranges; seven remained for at least 1 year (3 killed, 4 recently weaned), four remained for at least 2 years, and three remained for $\geq$3 years. Four other 2- to 4-year-old females were captured after they had been weaned, so their maternal home ranges were not known; however, all four stayed within their established home ranges for 3 to 9 years.

Siblings do not necessarily display similar patterns of movement. Of 8 sets of weaned offspring, 6 sets remained within their maternal home ranges for at least 1 year; in 2 sets, 1 sibling emigrated while the other did not.

CONCLUSIONS AND RECOMMENDATIONS

1. Probable adjusted population size was 78-83 in 1982 but declined to 62-67 by 1989. These estimates were based on the minimum numbers observed as well as the probable number that were present but not observed, and the overall estimate was adjusted to account for lack of a closed population. The reduction in numbers resulted in fewer females in the 3- to 5-year-old age class.

2. Mean natural mortality rates observed during the years 1982 through 1989 were 29% for cubs-of-the-year, 7% for yearlings, 7% for 2-year-olds, and 2% for adult females.

3. Human-caused mortality (including hunting, DLP, illegal, and capture-related) was 11-12% during the period, ranging from 4% to 17% based on probable adjusted population estimates. Harvest rates of 8% were observed for adult radio-collared females. During the period these harvest rates were observed (i.e., 1981-1989), the grizzly bear population in the area declined.

4. Based on a limited number of observations, most young, recently weaned females remained within their maternal home ranges, in contrast to less than a third of the young males.

5. No change in trends of reproductive capacity, cub survival, or movement patterns were detected from 1982 through 1989.

Continuation of this study should enable us to answer the following questions: (1) Will continued harvest at current levels result in a further decline in population size and will we exceed a threshold beyond which the population will abruptly and precipitously decline? (2) Will changes in litter size, reproductive interval, or the age at which females first successfully produce cubs follow population reduction; and if changes do occur, how will they affect population productivity? (3) Will declines in the population size reduce natural mortality rates of adult females or their offspring? (4) Will patterns of immigration and emigration of young-age bears affect population trend, or will population trend affect emigration and immigration? The answers to these questions should allow managers to better predict the effects of increased bear harvest and to assess the impacts of various levels of harvest on grizzly populations.

I therefore recommend that the increase in harvest rates that began during the early 1980's be allowed to continue until at least 1991. Concurrently, research efforts should continue to monitor the dynamics of this population to document any compensatory changes in production or survival of offspring. Emphasis should be directed toward determining the response by individual members of the population to high harvest levels and how individual responses affect the population as a whole. Further attention should be directed toward constructing and testing population dynamics models based on measurable productivity and harvest variables.

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Toby Boudreau very ably acted as a field biologist, logistics coordinator, and data compiler. His ability to learn quickly and work efficiently helped make the project successful.

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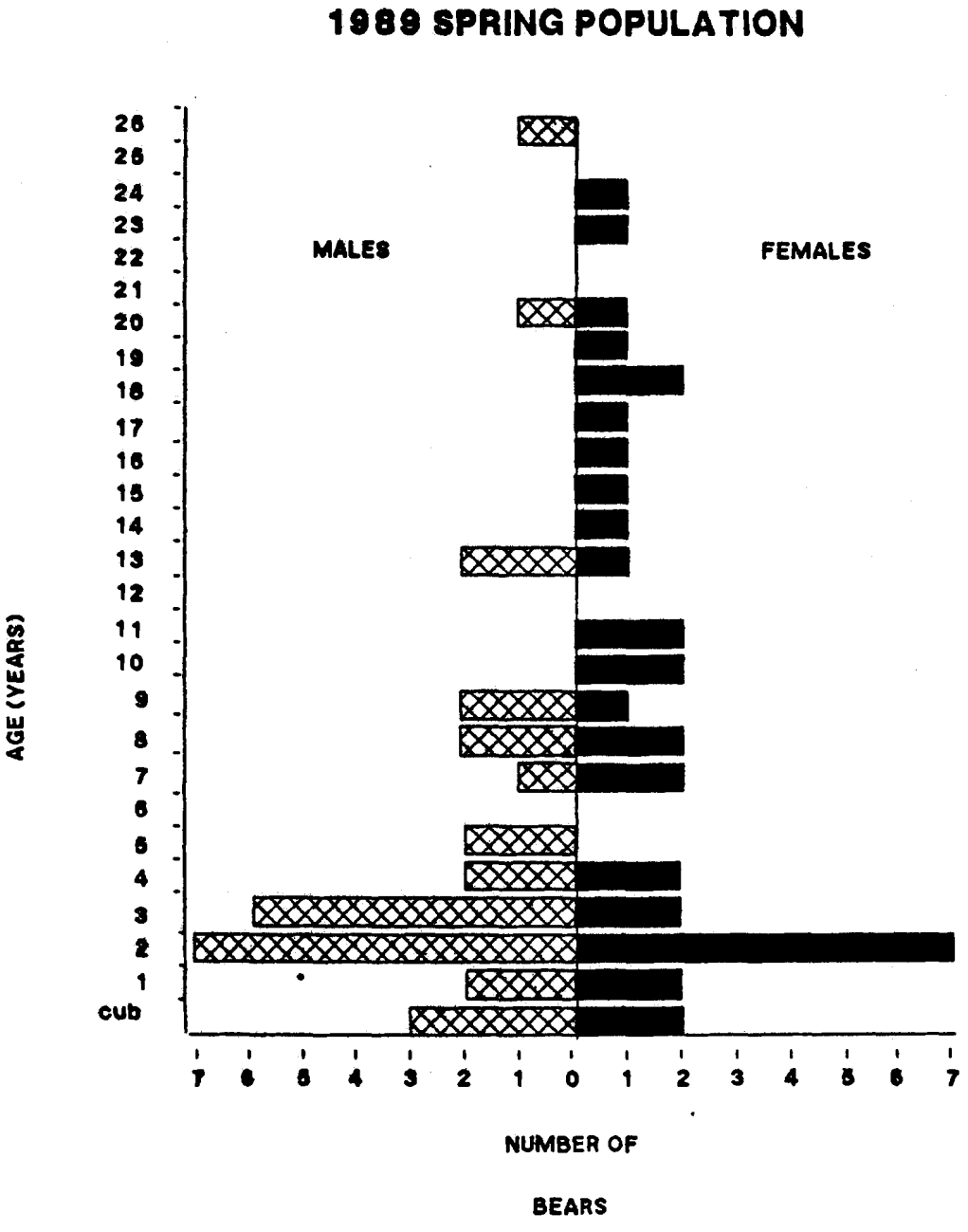

Fig. 1. Population sex and age structure of grizzly bears known alive and assumed present in the northcentral Alaska Range study area, spring 1989.

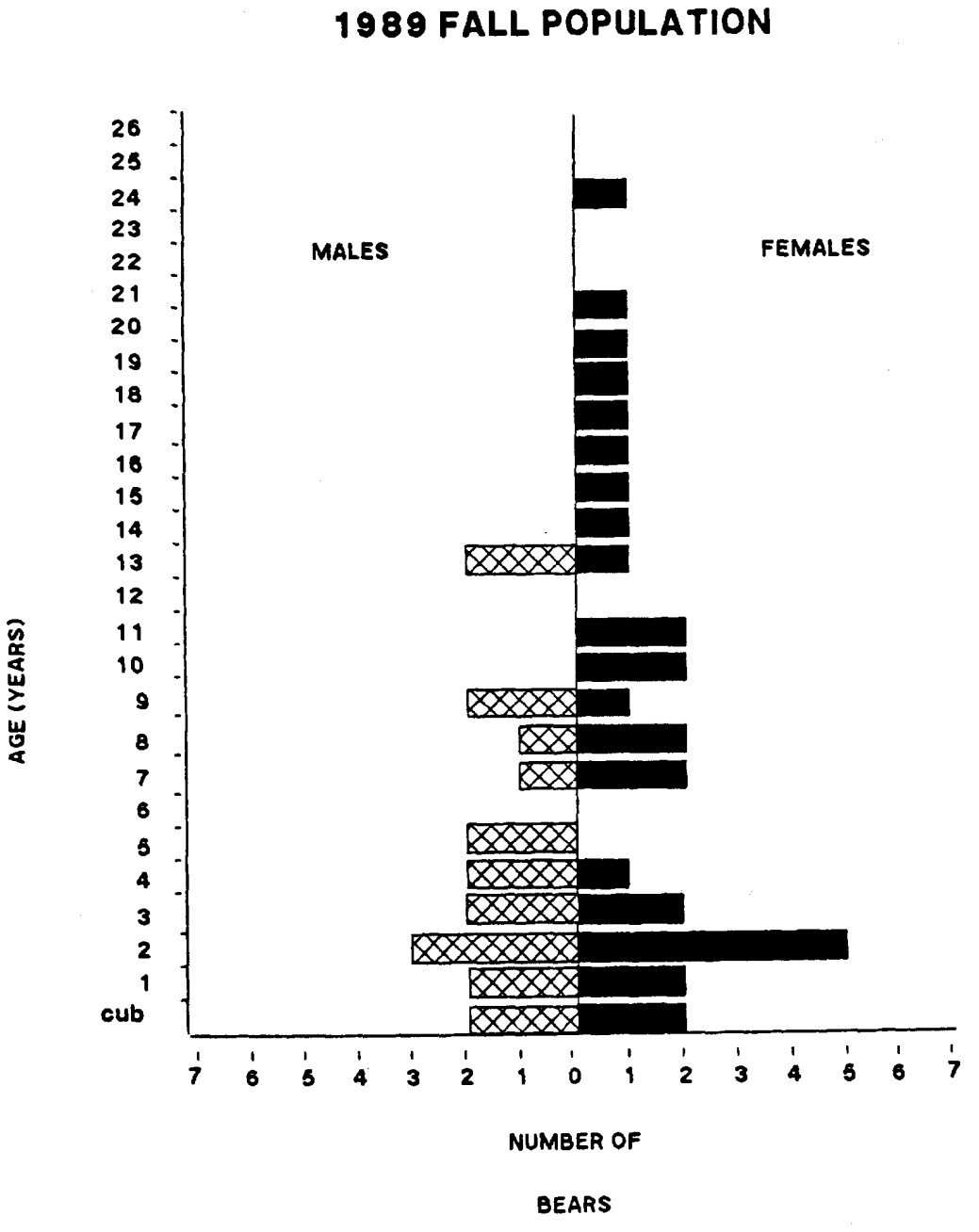

Fig. 2. Population sex and age structure of grizzly bears known alive and assumed present in the northcentral Alaska Range study area after the hunting season, fall 1989.

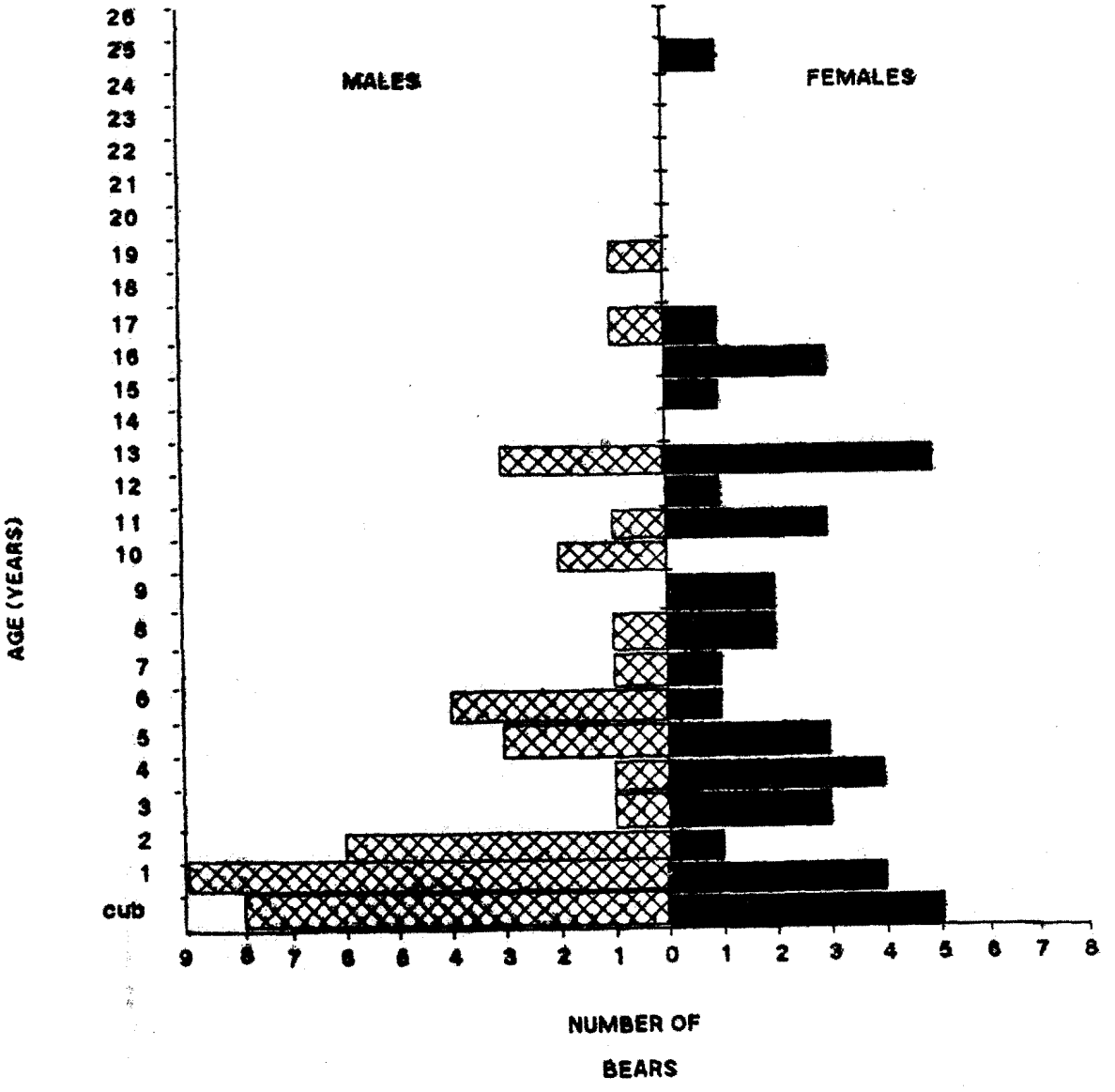

Fig. 3. Population sex and age structure of grizzly bears known alive and assumed present in the northcentral Alaska Range study area, spring 1982.

Table 1. Capture and marking characteristics of 101 bears captured in the northcentral Alaska Range, 1981-89.

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	5/18/81	120(265)	Buchanan Creek	1.8/1.2 H	373/374	G/G
1302 F	3	5/19/81	75(165)	East Fork Delta	1.0/1.0 M	368/367	R/
	8	6/12/86	114(250)	East Fork Delta	2.2 TEL M	280/281	O/1B
	11	5/12/89	109(241)	Buchanan Creek	4.5 TEL M	339/340	O/1B
1303 F	2	6/17/81	57(125)	Mystic Mountain	1.4/1.4 M	524/523	R/R
	4	6/27/83	82(180)	Hearst Creek	5.0 M99 M	3227/3214	R/R
	6	6/14/85	73(160)	Upper Gold King	2.0/2.0 M	486/487	R/R
1304 M	5	6/19/81	136(300)	West Fork Delta	2.4/2.0 M	451/452	1B/R
	11	5/21/87	255(560)	Threemile Creek	8.1 TEL M	430/431	W/mG
	13	6/7/89	245(540)	Slate Creek	7.0 TEL M	778/--	W/--
1305 F	24	6/19/81	114(250)	Slate Creek	A M	453/454	O/R
1306 M	2	5/24/82	44(97)	West Fork Delta	1.0/1.0 L	3151/3086	G/1B
1307 M	2	5/24/82	44(98)	West Fork Delta	1.0/1.0 H	3087/3152	1B/G
	5	6/17/85	114(250)[d]	Sheep Creek	2.4/2.6 L	3087/3152	1B/G
1308 F	6	5/25/82	111(245)	Dry Creek	-[e]	3001/3154	O/Pp
	8	6/20/84	120(265)	Dry Creek	5.0 M99 M	3001/471	O/Pp
	11	6/8/87	123(270)	Dry Creek	3.3 TEL M	528/529	O/Pp
1309 M	8	5/25/82	318(700)[d]	Dry Creek	A L	3153/3101	dB/Bk
1310 M	13	5/25/82	250(550)[d]	Buchanan Creek	2.0/2.0 M	No tags	
	15	6/20/84	241(530)	Molybdenum Ridge	4.0/2.0 M	467/473	O/W
	18	5/21/87	264(580)	Buchanan Creek	9.0 TEL M	414/413	Y/W
1311 F	12	5/26/82	120(265)	Molybdenum Ridge	1.9/2.1 M	3106/3107	W/W
	14	6/21/84	116(255)	Molybdenum Ridge	2.0/2.2 M	466/455	W/W
	17	6/8/87	123(270)[d]	Molybdenum Ridge	3.4 TEL M	571/570	W/W
1312 F	cub	5/26/82	12(26)	Molybdenum Ridge	0.1/0.1	3104/3155	O/W[f]
1313 F	cub	5/26/82	12(27)	Molybdenum Ridge	0.08/0.13	3156/3105	W/O[f]
1314 M	6	5/27/82	116(255)	Iowa Ridge	2.1/1.9 H	3088/3002	dB/1B
1315 M	13	6/4/82	272(600)	Buchanan Creek	1.9/2.1 L	3102/3157	Bk/O
	15	5/17/84	295(650)	Hayes Creek	A H	3322/none	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]
1316 M	11	6/7/82	236(520)	West Fork Delta	3.8/0.0 H	3089/3090	O/1B
1317 F	3	6/8/82	36(80)	Forgotten Creek	1.2/1.8 L	3091/3003	1B/O
	5	5/16/84	55(122)	Upper West Fork	A L	3486/3239	1B/O
	6	5/23/85	59(130)	Upper Wood River	7.0 M99	497/498	1B/O
1318 F	13	6/8/82	104(230)	Buchanan Creek	A L	3004/3103	W/G
	15	6/22/84	118(260)[d]	Slate Creek	A M	458/472	W/G
	18	6/2/87	105(230)[d]	Slate Creek	3.3 TEL M	--	--
1319 M	cub	6/8/82	12(26)	Buchanan Creek	0.15/0 L	3005/3092	R/Y[f]
1320 F	17	6/8/82	102(225)	Trident Glacier	A M	3158/3093	G/B
	19	6/25/84	139(305)	East Hayes Creek	5.0 M99 M	463/461	G/B
	22	6/12/87	114(250)	Hayes Glacier	4.0 TEL M	517/518	mG/dB
1321 F	16	6/9/82	141(310)	Snow Mtn. Gulch	2.1/1.9 M	3028/3108	G/W
	17	5/17/83	127(280)	Dry Creek	1.8/2.2 M	3028/3427	G/W
	19	7/22/85	218(480)	North VABM Wood	2.6/1.0 L	399/398	G/W
	23	6/6/89	170(375)	Dry Creek	-- TEL M	788/789	1G/W
1322 F	8	6/9/82	91(200)	Sheep Creek	1.9/2.1 M	3051/3159	W/1B
1323 F	11	6/10/82	95(210)	Mystic Mountain	1.9/2.1 M	3160/3030	G/G
	13	6/29/84	132(290)	VABM Wood	A M	579/582	G/G
1324 F	cub	6/10/82	12(26)	Mystic Mountain	0.12/0 M	3027/3162	R/W[f]
	6	5/26/88	111(245)	Coal Creek	3.6 TEL L	159/160	Bk/W
1325 M	cub	6/10/82	12(27)	Mystic Mountain	0.10/0 M	3161/3031	W/R[f]
	2	5/15/84	67(148)	Mystic Creek	1.0 M99 M	3233/3394	R/W
1326 F	4	6/18/82	93(205)	Buchanan Creek	2.2/1.8 M	3008/3163	W/R
	6	6/21/84	109(240)	Buchanan Creek	1.8/2.2 M	468/462	W/R
	7	6/27/85	111(245)	Slate Creek	2.4/1.6 L	426/427	W/W
1327 F	16	7/8/82	127(280)	Whistler Creek	2.2/1.8 M	3134/3192	G/R
	18	6/23/84	125(275)	Whistler Creek	A H	458/192	G/R
1328 F	1	7/8/82	43(95)	Whistler Creek	0.9/1.1 M	3115/3014	dB/G
1329 F	13	7/9/82	120(265)	Buchanan Creek	2.4/1.6 M	3026/3111	W/R
1330 M	1	7/9/82	48(106)	Buchanan Creek	-- M	--/--	R/W
	3	6/28/84	102(225)	East Fork Delta	2.6/3.0 M	597/598	R/W

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]
1331 F	4	7/10/82	77(170)	Trident Glacier	2.4/1.6 M	3120/3194	Bk/O
	9	5/20/87	114(250)[d]	East Hayes Creek	3.0 TEL M	519/520	Bk/Y
1332 F	5	7/12/82	104(230)	Gillam Glacier	2.4/1.6 M	394/190	R/dB
1333 F	16	7/13/82	141(310)	Buchanan Creek	A M	474/469	G/R
1334 M	1	7/13/82	49(108)	Buchanan Creek	1.0/1.0 M	395/392	Y/G
	3	6/27/84	107(235)	McGinnis Creek	A M	585/583	O/G
1335 F	1	7/13/82	38(84)	Buchanan Creek	1.0/1.0 M	32/456	G/Y
	3	6/25/84	80(175)	Gilliam Glacier	1.5/3.0 M	465/464	dB/G
1336 F	2	5/16/83	48(105)	Kansas Creek	1.0/1.0 M	3201/3204	Bk/mG
	3	6/26/84	89(195)	Copper Creek	2.0/3.0 M	470/595	Bk/mG
	4	6/17/85	102(224)	Wood River	A L	470/595	Bk/mG
	6	5/15/87	109(240)	Rogers Creek	2.2/2.0 M	521/522	Bk/mG
	8	5/17/89	145(320)	Upper Wood River	4.5 TEL M	330/329	Bk/mG
1337 M	20	5/18/83	293(645)	Sheep Creek	3.5/3.5	3209/3205	R/O
	25	6/15/88	277(610)	Sheep Creek	A TEL H	364/363	O/R
1338 M	6	5/20/83	111(245)	Molybdenum Ridge	A M	3203/3202	O/Bk
1339 M	6	5/23/83	120(265)	Trident Glacier	-- M	3286/3351	1B/W
	7	5/17/84	168(370)	East Fork Delta	6.0 M99 H	3254/3398	1B/W
1340 F	3	5/23/83	71(157)	Hayes Creek	1.2/0.8 H	3277/3208	G/O
	4	5/19/84	91(200)[d]	Molybdenum Ridge	4.0 M99 M	3277/3208	mG/O
	5	6/27/85	100(220)	West Hayes Creek	2.4/1.6 L	590/596	mG/mG
1341 F	10	5/23/83	107(235)	NE Portage	1.5/1.5 H	3210/3428	R/dB
	12	6/13/85	107(235)[d]	East Fork Delta	2.0/2.0 M	442/none	O/-
	15	6/14/88	164(360)	East Fork Delta	7.0 TEL M	356/355	dkB/Y
1342 M	2	5/24/83	49(108)	Threemile Creek	0.6/1.2 M	3354/3207	W/dB
1343 M	2	5/24/83	43(95)	Threemile Creek	0.6/1.2 M	3426/3285	R/Bk
1344 M	2	5/24/83	56(123)	Threemile Creek	0.6/1.2M	3361/3433	1B/Bk
	3	6/23/84	123(270)	Hayes Creek	2.2/3.2 M	475/460	1B/Bk
1345 F	8	5/24/83	--	Upper West Fork	1.2/1.8 L	3206/3352	O/O
	10	5/23/85	105(230)[d]	Upper West Fork	7.0 M99	499/500	O/O
	14	5/13/89	118(260)	Upper Wood River	4.5 TEL M	445/446	O/O

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]
1346 M	5	5/25/83	114(250)	Hayes Glacier	A M	3359/3356	1B/1B
1347 M	6	5/31/83	189(415)	Coal Creek	3.5 M99	None	Dead
1348 F	12	5/31/83	123(270)[d]	Mystic Mountain	A M	3363/3372	W/O
	15	5/16/86	116(255)	Wood River	2.4/1.6 M	235/236	W/O
1349 M	18	6/2/83	264(580)	O'Brien Creek	3.8/1.2L	3364/3292	R/1B
1350 M	8	6/2/83	202(445)	Ptarmigan Creek	3.0/2.0L	3432/3430	dB/R
	11	6/12/86	205(450)[d]	East Fork Delta	3.5 TEL L	273/272	dB/R
1351 F	14	6/23/83	114(250)[d]	Dry Creek	4.0 M99 M	3217/3390	dB/W
	16	6/10/85	111(245)	Little Delta River	2.0/2.0 M	477/436	dB/W
	18	5/19/87	130(285)	Dry Creek	A M	503/504	dB/W
1352 F	14	6/27/83	111(245)	West Fork Delta	--	3215/3316	O/W
1353 M	1	6/27/83	27(60)	West Fork Delta	--	3310/none	O/-
1354 F	1	6/27/83	12(27)	West Fork Delta	--	None/3314	-/O
1355 M	3	6/30/83	60(133)	East Fork Delta	4.0 M99 H	3232/3473	O/Bk
	5	6/3/85	70(155)	Whistler Creek	2.2/1.8 H	586/587	O/Bk
1356 M	2	6/30/83	50(110)	Little Delta River	2.0 M99 H	3234/3392	Bk/O
1357 M	2	5/15/84	63(138)	Dry Creek	1.1 M99 M	3323/3235	W/Bk
	3	6/24/85	93(205)	Dry Creek	1.5/1.5 M	447/448	W/Bk
1358 M	13	5/18/84	205(450)	Hayes Creek	A L	3318/3447	1B/dB
	15	5/20/86	236(520)	Trident Glacier	3.4/2.0 L	297/296	1B/dB
1359 M	3	5/28/85	61(134)	Snow Mt. Gulch	4.0 M99 M	489/488	dB/O
1360 F	10	5/28/85	95(210)	Snow Mt. Gulch	7.0 M99 H	None	None
1361 F	3	5/28/85	63(138)	Dry Creek	4.0 M99 M	482/483	mG/R
	4	5/19/86	100(220)	Rogers Creek	1.7/2.0 L	274/275	G/Bk
1362 F	6	6/5/85	--	Glacier Creek	2.0/2.0 L	None	None
	6	6/24/85	114(250)	Threemile Creek	2.2/1.8 L	443/490	dB/dB
	9	5/15/88	--	Sheep Creek	5.0 TEL H	197/198	O/Y
1363 M	3	6/5/85	55(120)	Slide Creek	1.0/2.0 M	592/593	dB/1B
1364 M	cub	6/14/85	7(15)	Gold King Creek	0.7/- M	None	None
1365 M	5	6/19/85	118(260)	Wood River	A M	476/441	1B/G
1366 M	8	7/22/85	234(515)	Tatlanika River	3.2/1.0 M	390/391	mG/R

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]
1367 M	2	5/19/86	61(134)	Threemile Creek	1.4/2.0 M	400/241	1B/W
1368 F	2	5/19/86	48(106)	Threemile Creek	1.4/2.0 M	257/256	1B/1B
1369 M	2	5/19/86	68(150)	Threemile Creek	1.4/2.0 L	247/246	W/dB
1370 F	2	5/20/86	47(103)	Buchanan Creek	1.4/2.0 H	253/252	dB/Bk
	3	5/20/87	69(151)	Buchanan Creek	1.5/1.5	--	--
1371 M	2	5/20/86	57(126)	Buchanan Creek	1.4/2.0 M	269/268	Bk/dB
1372 M	2	5/20/86	72(158)	Ptarmigan Creek	1.4/2.0 M	387/386	1B/O
	5	5/17/89	186(410)	Chute Creek	7.0 TEL M	310/309	1B/O
1373 M	7	5/21/86	193(425)	Delta Creek	4.0/2.0 M	295/294	1B/R
1374 F	6	5/21/86	106(233)	Delta Creek	2.0/2.0 M	249/248	R/G
	9	6/9/89	147(325)	Delta River	6.0 TEL M	320/319	1G/1B
1375 M	6	6/13/86	186(410)	Sheep Creek	4.5 TEL L	276/277	Y/W
	9	5/13/89	281(620)	Mystic Creek	6.0 TEL L[h]	439/440	O/W
1376 F	14	6/13/86	130(285)	Hayes Creek	3.0 TEL M	279/278	G/O
1377 M	2	8/28/86	132(290)	Iowa Ridge	4.0 TEL L	505/507	Bk/R
1378 F[g]	2	5/20/86	59(130)[d]	Ptarmigan Creek	--	None	None
1379 F	2	5/15/87	67(148)	Sheep Creek	2.2/2.0 L	334/335	W/W
	4	6/6/89	102(225)	Dry Creek	3.5 TEL L	777/776	W/W
1380 M	2	5/18/87	65(142)	West Fork Delta	2.2 TEL H	513/514	W/R
	3	5/17/88	109(240)	Buchanan Creek	3.2 TEL	175/174	W/R
1381 M	2	5/21/87	73(160)	Dry Creek	3.0 TEL M	481/480	1B/Bk
1382 F	3	5/15/88	68(150)	West Fork Delta	3.2 TEL M	169/170	R/Y
	4	6/7/89	84(185)	Buchanan Creek	4.0 TEL M	169/170	R/Y
1383 M	2[d]	6/12/87	77(170)	Coal Creek	AM	389/390	mG/dB
1384 M	7[d]	5/15/88	191(420)	Chute Creek	7.0 TEL M	960/959	W/Y
1385 F	2	5/15/88	68(150)	Upper Wood River	2.2 TEL H	168/167	1B/Y
	3	5/13/89	82(180)	Wood River	3.4 TEL M	--	1B/Y
1386 M	2	5/15/88	73(160)	Upper Wood River	2.2 TEL M	181/180	Bk/Y
	3	5/13/89	91(200)	Upper Wood River	3.4 TEL M	181/180	Bk/Y
1387 F	2	5/23/88	55(120)	Dry Creek	A TEL M	179/178	Y/R
	3	5/12/89	77(170)	Roger Creek	3.4 TEL M	337/338	Y/R

Table 1. Continued.

Bear No. and sex	Cem. age (yr)	Date of capture	Weight kg (lb)	Location	Drug dosage[a]	Ear tags[b]	Marker[c]
1388 M	2	5/25/88	68(150)	Dry Creek	2.5 TEL M	153/154	Y/lB
1389 M	3	5/13/89	84(185)	Mystic Creek	4.5 TEL H	343/344	W/dB
1390 F	3	5/13/89	77(170)	Mystic Creek	3.4 TEL H	345/346	Y/Y
1391 F	2	5/13/89	68(150)	Dry Creek	2.8 TEL L	333/334	O/mG
1392 M	2	5/13/89	89(195)	Dry Creek	2.8 TEL M	341/342	lG/O
1393 M	2	5/17/89	66(145)	Moly Ridge	3.5 TEL H	326/325	Bk/lB
1394 F	2	5/17/89	59(130)	Moly Ridge	3.5 TEL -	331/332	lBl/Bk
1395 M	2	5/17/89	86(190)	Moly Ridge	3.1 TEL M	302/301	dkB/W
1396 M	13[d]	5/18/89	295(650)	Moly Ridge	7.0 TEL M[h]	327/328	Y/O
1397 F	2	5/18/89	61(135)	Delta Creek	3.2 TEL M	314/313	O/O
1398 F	8[d]	5/18/89	127(280)	Delta Creek	4.5 TEL M	315/316	W/Y
1399 M	2	5/18/89	66(145)	Delta Creek	3.2 TEL M	303/304	R/R
1400 M	8[d]	6/8/89	239(525)	Trident Glacier	7.0 TEL M[h]	425/426	R/lB
1601 M	7[d]	6/9/89	193(425)	Whistler Creek	6.5 TEL M[h]	782/785	Gr/Y

[a] Dosage in ml of phencyclidine hydrochloride/acepromazine maleate; use of M-99 is designated M99; use of Telezol is designated TEL; A denotes multiple injections with unknown effective dosage. Drug effects were as follows: L = light, M = optimum, H = heavy.

[b] Ear tag numbers, left/right.

[c] Marking designations:
Colors: R, red; G, light green; mG, medium green; Gr, gray; O, orange; lB, 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] Data collected but not recorded.

Table 1. Continued.

[f] 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.

[g] Bear No. 1378, an offspring of No. 1311, was darted but not immobilized on 20 May 1986. We left her with her mother to recover from the darting chase, but she was killed by hunters before we returned. We include her in this table for ease of data analysis.

[h] Dosages of Telezol administered at a concentration of 300 mg/ml, instead of the usual 200 mg/ml.

Table 2. Estimate of the minimum spring grizzly bear population in northcentral Alaska Range study area, 1981-89.[a]

Bears alive during spring of year[b]	1982			1983			1984			1985			1986			1987			1988			1989		
	N	Adj	≥2	N	Adj	≥2	N	Adj	≥2	N	Adj	≥2	N	Adj	≥2	N	Adj	≥2	N	Adj	≥2	N	Adj	≥2
Marked bears	68	59	40	62	52	45	65	55	37	53	45	36	48	41	41	41	34	31	41	36	34	43	37	37
Unmarked young with marked mothers	2	2	0	3	3	0	6	6	0	13	13	0	9	9	0	21	20	0	24	22	0	9	9	0
Unmarked bears killed by hunters	12	9	7	9	6	6	5	3	3	3	1	1	5	3	1	12	6	1	7	5	3	6	5	5
Minimum observed population	82	70	47	74	61	51	76	64	40	69	59	37	62	53	42	74	60	33	72	63	37	58	51	42

[a] Minimum populations are presented as: N, total number present; Adj, or adjusted N, which accounts for those bears which range outside the study area; and ≥2, or Adjusted N ≥2 years of age. To account for those bears whose home ranges extend beyond the study area boundaries, the proportion of each home range or estimated home range outside the study area was estimated. These individual fractional home ranges were subtracted from appropriate population figures to more accurately reflect the numbers of bears present. Fractional figures were rounded to the nearest whole number.

[b] Number of bears alive during spring of year, N, includes bears that were later captured or killed by hunters but presumed to be present in preceding years.

Table 3. Reproductive status and litter sizes of potentially mature females in the northcentral Alaska Range, 1981-89.

Bear No.	Age in 1989[a] (yr)	Offspring No.	Reproductive status[b] 1981	1982	1983	1984	1985	1986	1987	1988	1989	Reproductive history
1302	11	3UM	NB	UN	UN	UN	UN	B	B	3cb	3ylg	No offspring prior 1986
1303	10	1364, 1UM	NB	NB	B?	B	2cb/B	UN	UN	UN	UN	No offspring prior 1981; lost 2 cubs 1985
1305	25	1306, 1307	2ylg	2 2yr/B D								Hunter kill fall 1982
1308	13	2UM, 1391, 1392		?/B	B	2cb	2ylg	1 2yr/B	2cb	2ylg	2 2yr/B	Offspring 1982 or before; lost 1 ylg 1985
1311	19	1312, 1313, 1372, 1378, 1UM, 1395	UN/B	2cb	B	2cb	2ylg	2 2yr/B	2cb	2ylg	2 2yr/B	Lost cubs August 1982 Lost UM 2yr?, spring 1989
1317	6			NB	NB?	NB	NB/D					Illegal kill 1985
1318	20	1319, 1380, 1382, 2UM	UN/B	1cb/B	B	B	2cb	2ylg	2 2yr	2 3yr/B	2cb	Lost cub 1982
1320	24	1UM, 3UM, 2UM		?/B	1cb/B?	B	3cb	B	2cb	1ylg	B	Weaned or lost offspring 1982; lost cub 1983; lost 3 cubs 1985, lost 1 cub 1987; lost 1 ylg 1988
1321	23	1342, 1343, 1344, 1UM, 1379,[c] 1381[c] 3UM	UN/ 3+cb	3ylg	3 2yr	2 3yr/B	3cb	3ylg	2 2yr/B	3 cb	B/Dead	1342 killed illegally fall 1983; lost 1 ylg 1983; lost 3 cubs 1988
1322	15	1336	UN/1+cb	1ylg	1 2yr	1 3yr/B	UN	UN	UN	UN	UN	
1323	18	1324, 1325 2UM	UN/B	2cb	2ylg	2 2yr/B	UN	UN	2+cb	2+ylg	2 2yr/D	DLP kill[b] fall 1989
1324	7	1389, 1390		NB	NB	NB	UN/NB?	UN/B	2+cb	2ylg	2 2yr/B	
1326	8	1UM		NB	B	B	1cb	B/Dead				No offspring prior 1982; lost cub 1985; hunter kill 1986
1327	18	1328, UM, 3UM	UN/2+cb	2ylg	B	3cb/D						1UM ylg capture mortality; lost 1328 in 1982; 1327 capture mortality? 1984

Table 3. Continued.

Bear No.	Age in 1989[a] (yr)	Offspring No.	Reproductive status[b] 1981	1982	1983	1984	1985	1986	1987	1988	1989	Reproductive history
1329	14	1330	UN/1+cb	1ylg	1 2yr/D							Killed by male May 1983
1331	11	1UM		NB	B	UN/B	UN/B	UN/1+cb	1ylg/B	1+cb	1ylg	No offspring prior 1982; lost ylg 1987
1332	6			NB?	D							No offspring prior 1982; died in den 1983
1333	18	1334, 1335	UN/2+cb	2ylg	2 2yr 2 3yr/B D							Hunter kill 1984
1336	8	2UM			NB	NB	B	B	2cb	2ylg	B	No offspring prior 1983 lost 2 ylg 1988
1340	9				NB	NB	B	UN	UN	UN	UN	No offspring prior 1983
1341	16	1UM, 1370, 1371, 2UM, 2UM		UN/1+cb	1ylg/B	2cb	2ylg	2 2yr/B	B	2cb/B	2cb	Lost ylg 1983; lost 2 cubs 1988
1345	14	2UM, 1385, 1386			B	2cb	1ylg/B	2cb	2ylg	2 2yr	2 3yr/B	Lost 1 cub 1984; lost 1 ylg 1985
1348	18	1367, 1368, 1369, 2UM, 1UM			?/B	3cb	3ylg	3 2yr/B	2cb	2ylg/B	1 cb/B	Probably weaned or lost offspring 1983; lost 2 ylg 1988; lost 1 cub 1989
1351	19	1357, 1361, 1UM, 3UM	UN/B	UN/3+cb	3ylg	3 2yr	2 3yr/B	UN/3+cb	3ylg/D			Lost 1UM offspring 1984; hunter kill 1987, 3UM ylg orphaned?
1352	16	1353, 1354	UN/B	UN/2+cb	2ylg	2 2yr/D						Hunter kill 1984; 1353, hunter kill 1984
1360	11	1359, 1363	UN/B	UN/2+cb	UN/2+ ylg	UN/2+ 2yr	2 3yr/D					Capture mortality 1985
1361	7					NB	NB	NB	UN	UN	UN	No offspring prior 1985
1362	10	1387, 1388				UN	B	2cb	2ylg	2 2yr/B	B	No offspring prior 1985
1374	9	2UM, 2UM				UN/B	UN/2+cb	2ylg	?/B	2+cb	2ylg	
1376	17	1393, 1394					UN	?/B	2cb	2ylg	2 2yr	Offspring prior 1986
1379	4									NB	B	
1398	8	1397, 1399						?/B	2+cb	2+ylg	2 2yr/B	

Table 3. Continued.

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[a] Age in 1989 or last year in which bear was alive.

[b] Designations: NB, not observed in breeding condition; UN, not observed in that year; B, observed in breeding condition; ?, status unknown; UM, unmarked; cb, cub of year; ylg, yearling; 2-yr, 2-year-old; +, offspring first observed in subsequent year and therefore litter size may have been larger; D, dead; DLP, killed in defense of life or property.

[c] Siblings 1379 and 1381 were captured separately after weaning within 1321's home range and were sighted together once during the summer. We assume that the siblings were those recently weaned by 1321.

Table 4. Observed and projected minimum reproductive intervals for adult female grizzly bears in the northern Alaska Range, 1981-89.

Bear No.	Age when interval began	Minimum cycle length[a]	Annual reproductive status for adult females[b]										
			Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11
1302	7	5	B?	B	B	C	Y	2/B					
1303	5	5	B	C/B	B	C	Y	2/B					
1305	22	3	W/B	C	Y	2/B/D							
1308	6	4,3	C?/B	B	C	Y	2/B	C	Y	2/B			
1311	10	5,3	W/B	C	B	C	Y	2/B	C	Y	2/B		
1318	12	7,3	W/B	C/B	B	B	C	Y	2	3/B	C	Y	2/B
1320	17	10	W/B	C/B?	B	C	B	C	Y/B?	B	C		
1321	14	4,3,5	W/B	C	Y	2	3/B	C	Y	2/B	C	B/D	C
1322	6	4	B	C	Y	2	3/B						
1323	11	3,6	W/B	C	Y	2/B	?	?/B	C	Y	2/B/D	3	
1324	5	3	B	C	Y	2/B							
1326	6	5	B	C/B?	B/D	C	Y	2/B					
1329	11	3	W/B	C	Y	2/D							
1331	7	5	B	C	Y/B	C	Y	2/B					
1333	14	4	W/B	C	Y	2	3/B/D						
1336	5	6	B	C	Y	B	C	Y	2/B				
1341	10	5,5	W/B	C	Y/B	C	Y	2/B	B	C/B	C	Y	2/B
1345	8	5	B	C	Y/B	C	Y	2	3/B				
1348	12	3,6	W/B	C	Y	2/B	C	Y/B	C/B	C	Y	2/B	
1351	12	4,3	W/B	C	Y	2	3/B	C	Y/D	2/B			
1352	13	3	W/B	C	Y	2/D							
1360	6	4	W/B	C	Y	2	3/D						
1362	6	3,4	B	C	Y	2/B	B	C	Y	2/B			
1374	4	3	B	C	Y	2/B	C	Y	2/B				
1376	14	4	W/B	C	Y	2	3/B						
1398	5	3	B	C	Y	2/B							

Table 4. Continued.

[a] All reproductive cycles or intervals were minimum values because they were partially based on projections prior to or after years when actual observations were made. In addition, all projected calculations assume weaning of young as 2-year-olds; however, in weanings which were observed, 5 of 11 females weaned offspring as 3-year-olds.

[b] Underlining indicates reproductive status was projected to allow minimum cycle length calculation; status which was observed is not underlined. Designations are: B, bred; W/B, weaned offspring, then bred; C/B, lost cubs, then bred; Y/B, lost yearling, then bred; C, with cubs; Y, with yearlings; 2, with 2-year-olds; 3, with 3-year-olds; D, died.

Table 5. Observed litter size and number of offspring in cub, yearling, 2-year-old, and 3-year-old age classes, Alaska Range, 1982-89.

Age class	Observed no. of litters								Total		Mean litter size
	1982	1983	1984	1985	1986	1987	1988	1989	No. of litters	No. of offspring	
Cub											
litter size 1	1	1	0	1	0	0	0	1	3	4	
litter size 2	2	0	4	2	2	7	1	2	18	40	
litter size 3	0	0	2	2	0	0	2	0	6	18	
total	3	1	6	5	2	7	3	3	30	62	2.07
Yearling											
litter size 1	2	1	0	1	0	1	1	1	7	7	
litter size 2	2	2	0	3	2	2	5	1	18[a]	36[a]	
litter size 3	1	1	0	1	1	1	0	1	6	18	
total	5	4	0	5	3	4	6	2	31[a]	61[a]	1.97[a]
2-year-old											
litter size 1	0	2	0	0	1	0	0	0	3	3	
litter size 2	1	1	2	0	2	2	2	5	10	30	
litter size 3	0	1	1	0	1	0	0	0	3	9	
total	1	4	3	0	4	2	2	5	21	42	2.00
3-year-old											
litter size 1	0	0	1	0	0	0	0	0	1	1	
litter size 2	0	0	2	1	0	0	1	1	4	10	
litter size 3	0	0	0	1	0	0	0	0	1	3	
total	0	0	3	2	0	0	1	0	6	14	2.00

[a] One litter with 2 yearling offspring was first observed in 1981 and is included in these calculations.

Table 6. Minimum number of female grizzly bears present in the study population in northcentral Alaska, 1981-89.

	Minimum number of females in population								
		3-5 yrs old				≥6 yrs old			
			Change from previous year				Change from previous year		
Year	No. ≤2 yrs old[a]	No.	+	-	Net	No.	+	-	Net
1981	-[b]	-[c]	-[c]	4	-[c]	20[d]	2	0	+2
1982	9-12	10	-[c]	5	-[c]	21	1	1	0
1983	6-8	9	1	2	-1	19	0	2	-2
1984	9-12	6	2	5	-3	20	3	2	+1
1985	8-11[e]	5	3	4	-1	19	3	4	-1
1986	7-8[e]	4	0	1	-1	18	1	2	-1
1987	12-14[e]	3	1	1	0	19	2	1	+1
1988	13-15[e]	2	2	3	-1	20	2	1	-1
1989	10-12[e]	4	2	0	+2	20	0	0	0
1990	-[b]	7	4	1	+3	18	0	2	-2

[a] No special effort was made to capture offspring of females until just prior to weaning; therefore, these figures are estimates based on sex ratios of captured offspring.

[b] Because cub production is so variable, no estimates were projected for years when observations were not made.

[c] Prior to 1982, production or survival was not observed; therefore, for bears less than 6 years of age, only known losses in these age categories are listed.

[d] Calculations of the number of adult females was based on those bears killed by hunters or captured during the study; therefore, figures for 1980-81 are likely underestimates because natural mortality is not accounted for. The probable number of adult females present during 1980-81 was more likely 21-24.

[e] These are minimum figures because not all marked and reproductively active females were observed every year due to radio collar loss or failure. We assumed that these females remained in the study area and continued to produce offspring. There were 2 reproductively mature females which were not observed in 1985 and 4 in 1986-89. But since the number and age of offspring were not known, their estimated numbers are not included here.

Table 7. Annual number of breeding females, cubs produced, cub survival to weaning, and subsequent presence of offspring in the Alaska Range study area, 1981-1990 (+ indicates minimum figures).

No. during given year	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Females bred during the previous year[a]	5+	6+	3+	9	9	5+	11+	4	4	9
Cubs produced	9	13+	1	14+	11	8+	18+	9	5	--
Cubs survived to weaning	6[b,c]	8[c]	0	8[b]	4	4[b]	10[c]	--	--	--
Cubs still in area 3 yr later	6	2	0	3	3	3-4	--	--	--	--
Cubs still in area 5 yr later	1	1	0	2	--	--	--	--	--	--
Offspring weaned during year	--	2+	1[c]	9[c]	4	8	2	4	12[c]	--

[a] If the reproductive status of females could not be established for the year subsequent to breeding, they were not included here.

[b] In 3 instances, mortality of offspring was human-caused. During 1981, an unmarked yearling of female no. 1327 was not observed after a capture attempt and was assumed dead. During 1984, no. 1327 died from capture-related causes or was killed by another bear while recovering from immobilization; her 3 cubs were assumed dead as well. During September 1986 a hunter killed bear no. 1351; subsequent survival of her 3 yearlings is unlikely.

[c] The survival of 3 litters of 2-year-olds to weaning age was assumed, since most offspring are weaned at that age. During 1983, female no. 1329 was killed by an adult male prior to the time her 2-year-old, no. 1330, would normally have been weaned. Similarly, female no. 1352 was killed by a hunter during May 1984 before it was determined whether she had weaned her offspring. Bear no. 1323 was shot in self-defense during August, 1989; her 2 accompanying offspring would have been weaned as 3-year-olds.

Table 8. Mortality of grizzly bears in Alaska Range study area, 1981-89.

Bear No.[a]	Sex[b]	Age[c]	Date of initial capture	Date of death	Location	Cause of death
UM	F	3	--	5/16/81	Dry Creek	Hunter kill
UM	M	6	--	5/18/81	Buchanan Creek	Hunter kill
1301	M	6	5/18/81	5/18/81	Buchanan Creek	Capture mortality
UM	M	2	--	5/23/81	Wood River	Hunter kill
UM	M	3	--	5/25/81	West Fork Little Delta	Hunter kill
UM	M	2	--	9/4/81	Wood River	Hunter kill
UM	F	2	--	9/6/81	Iowa Ridge	Hunter kill
UM	M	12	--	9/7/81	Wood River[d]	Hunter kill
UM	M	2	--	9/12/81	West Fork Little Delta	Hunter kill
UM	F	3	--	9/28/81	Wood River[d]	Hunter kill
UM	M	7	--	10/2/81	East Fork Little Delta	Hunter kill
UM	M	Unk	--	10/8/81	Wood River	Hunter kill
UM	F	5	--	10/9/81	Wood River[d]	Hunter kill
UM	M	8	--	10/17/81	Gold King	Hunter kill
UM	M	10	--	5/22/82	Gold King	Hunter kill
1319	M	Cub	6/8/82	6/18-7/2/82	West Fork Little Delta	Unk, offspring of 1318
UM	Unk	1	7/8/82	7/8/82	East Fork Little Delta	Capture mortality, offspring of 1327
1312	F	Cub	5/26/82	8/5-27/82	Molybdenum Ridge	Unk, offspring of 1311
1313	F	Cub	5/26/82	8/5-27/82	Molybdenum Ridge	Unk, offspring of 1311
1328	F	1	7/8/82	8/27-9/23/82	East Fork Little Delta	Unk, offspring of 1327
UM	F	5	--	9/15/82	West Fork Little Delta	Hunter kill
UM	M	2	--	9/15/82	Dry Creek	Hunter kill
1305	F	25	6/19/81	9/15/82	Dry Creek	Hunter kill
1314	M	6	5/27/82	9/15/82	Little Delta River	Hunter kill
UM	F	11	--	9/17/82	East Fork Little Delta	Hunter kill
1332	F	6	7/12/82	Winter 82/83	Buchanan Creek	Unk, den mortality
UM	F	4	--	5/1/83	Trident Glacier	Hunter kill
1329	F	14	7/9/82	5/15/83	Buchanan Creek	Killed and eaten by 1315M

Table 8. Continued.

Bear No.[a]	Sex[b]	Age[c]	Date of initial capture	Date of death	Location	Cause of death
1338	M	6	5/20/83	5/20/83	Molybdenum Ridge	Capture mortality
UM	F	5	--	5/24/83	West Fork Little Delta	Hunter kill
1347	M	6	5/31/83	5/31/83	Wood River	Capture mortality
UM	Unk	Cub	--	6/83	Delta Creek	Unk, offspring 1320
UM	Unk	1	--	5/23-8/21/83	Little Delta River	Unk, offspring 1341
UM	F	14	--	9/16/83	Kansas Creek	Hunter kill
UM	M	7	--	9/19/83	Little Delta River/ Tenmile Creek	Hunter kill
1342	M	2	5/24/83	10/83	Wood River	Nonsport illegal kill
1315	M	15	6/4/82	5/17/84	Delta Creek	Capture mortality
1306	M	4	5/24/82	5/20/84	West Fork Little Delta	Hunter kill
1356[e]	M	3	6/30/83	5/20/84	Gerstle River	Hunter kill
1333	F	18	7/12/82	5/22/84	East Fork Little Delta	Hunter kill
1352	F	15	6/27/83	5/30/84	West Fork Little Delta	Hunter kill
1327	F	18	7/8/82	6/23/84	East Fork Little Delta	Capture mortality?
3UM	Unk	Cub	--	6/23/84	East Fork Little Delta	Unk, offspring of 1327
UM	Unk	Cub	--	6/84	Wood River	Unk, offspring of 1345
UM	Unk	2	--	8-9/84	Dry Creek	Unk, offspring of 1351
UM	F	Unk	--	9/2/84	Delta Creek	Hunter kill
1353	M	2	6/27/83	9/4/84	West Fork Little Delta	Hunter kill
UM	M	3	--	9/6/84	Dry Creek	Hunter kill
1344	M	3	5/24/83	9/7/84	Dry Creek	Hunter kill
1325	M	2	6/10/82	9/9/84	Gold King Creek	Defense of life and property kill
1335	F	3	7/13/82	9/14/84	East Fork Little Delta	Hunter kill
1309	M	10	5/25/82	9/15/84	Gold King	Hunter kill
UM	F	17	--	10/7/84	West Fork Little Delta	Hunter kill
3UM	Unk	Cub	--	5/85	Hayes Glacier	Unk, offspring of 1320
UM	Unk	1	--	5/12/85-5/15/86	Dry Creek	Unk, offspring of 1308
1360	F	10	5/28/85	5/28/85	Snow Mountain Gulch	Capture mortality

Table 8. Continued.

Bear No.[a]	Sex[b]	Age[c]	Date of initial capture	Date of death	Location	Cause of death
UM	Unk	Cub	--	5/23-6/5/85	Mystic Creek	Unk, offspring of 1303
UM	Unk	1	--	5/23-7/22/85	Upper Wood River	Unk, offspring of 1345
1364	M	Cub	--	6/14-24/85	Mystic Creek	Unk, offspring of 1303
UM	Unk	Cub	--	6/18-27/85	Buchanan Creek	Unk, offspring of 1326
1317	F	6	6/8/82	9/85	Wood River/Yanert River	Illegal kill?[g]
1355	M	5	6/30/83	9/13/85	Iowa Ridge	Hunter kill
1378	F	2	--	5/25/86	Delta Creek	Hunter kill, offspring of 1311
1326	F	8	6/18/82	5/27/86	O'Brien Creek	Hunter kill
1358	M	15	5/18/84	5/31/86	Delta Creek	Hunter kill
1368	F	2	5/19/86	5/31/86	Bonnifield Creek	Defense of life or property kill, offspring of 1348
1367	M	2	5/19/86	6/28/86	Bonnifield Creek	Defense of life or property kill, offspring of 1348
UM	M	3[f]	--	9/2/86	Wood River	Hunter kill
1373[e]	M	7	5/20/86	9/2/86	McGinnis Creek	Hunter kill
UM	M	2[f]	--	9/3/86	West Fork Little Delta	Hunter kill, offspring of 1308?
1371	M	2	5/20/86	9/7/86	Little Delta River	Hunter kill, offspring of 1341
1357[e]	M	4	5/15/84	9/23/86	Tatlanika River	Hunter kill, offspring of 1351
UM	Unk	1	--	fall 1986	Dry Creek	Unk, offspring of 1321
UM	Unk	1	--	5/20/87-7/3/87	East Hayes Creek	Unk, offspring of 1331
UM	Unk	Cub	--	7/3/87-8/30/87	Hayes Glacier	Unk, offspring of 1320
UM	M	3[f]	--	5/9/87	Slate Creek	Hunter kill, offspring of 1308?

Table 8. Continued.

Bear No.[a]	Sex[b]	Age[c]	Date of initial capture	Date of death	Location	Cause of death
1370	F	3	5/20/86	5/20/87	Buchanan Creek	Capture mortality, offspring of 1341
1349[e]	M	22	6/2/83	5/22/87	Coal Creek (Healy)	Hunter kill
1369[e]	M	3	5/19/86	6/26/87	Lignite	Defense of life or property kill, offspring of 1348
UM	F	2	--	9/2/87	Delta Creek	Hunter kill, offspring of 1374?
UM	M	2	--	9/2/87	Wood River	Hunter kill
UM	M	8	--	9/2/87	Wood River	Hunter kill
UM	M	17	--	9/7/87	Virginia Creek	Hunter kill
1381	M	2	5/21/87	9/8/87	Dry Creek	Hunter kill
1351	F	18	6/23/83	9/11/87	Slide Creek	Hunter kill
1334[e]	M	7	7/13/82	4/14/88	Tangle Lakes	Hunter kill
UM	Unk	1	--	Spring 1988	Hayes Glacier	Unk, offspring of 1320
UM	Unk	Cub	--	Spring 1988	Sheep Creek	Unk, offspring of 1321
UM	Unk	Cub	--	Spring 1988	East Fork Delta River	Unk, offspring of 1345
UM	Unk	Cub	--	Spring 1988	East Fork Delta River	Unk, offspring of 1345
UM	Unk	Cub	--	June 1988	Wood River	Unk, offspring of 1348
UM	Unk	Cub	--	June 1988	Wood River	Unk, offspring of 1348
UM	M	3[f]	--	9/7/88	South of Gold King	Hunter kill
1350	M	13	6/2/83	9/14/88	Dry Creek	Hunter kill
UM	Unk	Cub-ylg	--	8/30/88-5/12/89	Glacier Creek	Unk, offspring of 1321
UM	Unk	Cub-ylg	--	8/30/88-5/12/89	Glacier Creek	Unk, offspring of 1321
UM	Unk	Cub-ylg	--	8/30/88-5/10/89	Upper Wood River	Unk, offspring of 1336
UM	Unk	Cub-ylg	--	8/30/88-5/10/89	Upper Wood River	Unk, offspring of 1336
1384	M	7	5/15/88	4/23/89	Wood River	Hunter kill
UM	Unk	Cub	--	5/18/89-6/7/89	Wood River	Unk, offspring of 1348
1389	M	3	5/13/89	7/89	St. George Creek	Illegal kill
UM	Unk	2[f]	--	7/89	St. George Creek	Illegal kill
UM	M	3[f]	--	8/16/89	Gillam Glacier	Defense of life or property kill

Table 8. Continued.

Bear No.[a]	Sex[b]	Age[c]	Date of initial capture	Date of death	Location	Cause of death
1323	F	18	6/10/82	8/18/89	Gold King Creek	Defense of life or property kill
1321	F	23	6/9/82	9/1/89	Dry Creek	Hunter kill
1310[e]	M	20	5/25/82	9/1/89	Tangle Lakes, GMU 13	Hunter kill
UM	M	2[f]	--	9/1/89	West Fork Little Delta	Hunter kill
UM	M	3[f]	--	9/1/89	West Fork Little Delta	Hunter kill
1382	F	4	5/15/88	9/9/89	West Fork Little Delta	Hunter kill
1395[e]	M	2	5/17/89	9/9/89	Jumbo Dome	Hunter kill
1399[e]	M	2	5/18/89	9/9/89	Ruby Creek/Delta River	Hunter kill
UM	M	3[f]	--	9/15/89	Trident Glacier	Hunter kill
1337	M	26	5/18/83	9/16/89	Blair Lakes	Hunter kill
UM	M	4[f]	--	9/19/89	Coal Creek	Hunter kill

[a] UM designates an unmarked bear.
[b] M, male; F, female; Unk, unknown sex.
[c] Age at death; Unk denotes unknown age.
[d] Hunter kills with location only listed as Wood River were counted in the study area.
[e] Killed outside study area.
[f] Estimate.
[g] Bear killed in September 1985, but not reported or sealed.

Table 9. Grizzly bear harvest[a] within the study area, 1961-89.

Year	Drainage of reported harvest: Delta Creek	Little Delta River	Dry Creek	Wood River[b]	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	1	7	13
1982	0	3[c]	2[c]	1	6
1983	2	2	0	2[d]	6
1984	1	6[e]	2[e]	1[e]	11
1985	0	1[f]	0	1[f]	2
1986	2[g]	3[g]	0	3[g]	8
1987	1	1	2[h]	3	7
1988	0	0	1[i]	1	2
1989	1	4[j]	2[j]	5[j]	12
Totals	21	52	26	67	166

[a] Includes hunter harvest, bears killed in defense of life or property, and bears killed illegally by hunters.

[b] 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.

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

Table 9. Continued.

[d] One marked bear was killed illegally in the Wood River drainage in 1983.

[e] Seven marked bears (5 in drainages of the Little Delta River, 1 in Dry Creek, and 1 in Wood River) were killed by hunters in the study area during 1984; 1 was killed in defense of life or property along Gold King Creek.

[f] Both bears killed in 1985 were marked; one may have been taken illegally, either on the upper Wood River or Yanert River drainages.

[g] Six marked bears were killed in 1986; 4 marked bears were taken by hunters (2 in Delta Creek and 2 in the Little Delta River) and 2 were taken in defense of life or property in the Wood River drainage.

[h] Two marked bears were killed by hunters in Dry Creek during 1987.

[i] One marked bear was killed by a hunter in Dry Creek during 1988.

[j] Six marked bears were killed in the study area during 1989: 4 were killed by hunters (1 each in Wood River, Dry Creek, Little Delta River, and Blair Lake drainages); 1 was killed on Gold King Creek in defense of life and 1 was killed illegally on St. George Creek.

Table 10. Human-caused mortality[a] and mortality rates for a grizzly bear population[b] in the northcentral Alaska Range, 1981-89.

Year	Human-caused mortalities	Minimum population of all age classes		Minimum population ≥2 yrs of age		Adult females ≥6 yrs of age[c]		
		n	Mortality rate (%)	n	Mortality rate (%)	n	Deaths	Mortality rate (%)
1981	11	68	16	52	21	19	0	0
1982	5	70	7	47	11	20	2	10
1983	6	61	10	51	12	19	2	15
1984	12	64	20	40	30	19	4	21
1985	3	59	5	37	8	17	2	11
1986	6	53	12	42	14	16	1	6
1987	6	60	10	33	18	19	1	6
1988	2	63	3	37	8	17	0	0
1989	11	51	22	42	26	20	2	10
$\bar{x}$	6	61	11	42	16	18	2	8

[a] Human-caused mortality includes deaths from hunter harvest, defense of life or property, capture-related causes, and illegal take.

To account for those bears whose home ranges extend beyond the study area boundaries, the proportion of each home range or estimated home range outside the study area was estimated. These individual fractional home ranges were subtracted from appropriate mortality and population figures to more accurately reflect the numbers of bears included in each category. Fractional figures were rounded to the nearest whole number. Note that mortality rates are based upon observed minimum populations, which do not include the 10-15 bears we estimate as present in the population but not captured or killed.

[b] All population and mortality figures were adjusted to account for lack of population closure.

[c] Mortality of adult females is included here to provide perspective with changes in mortality rates and minimum population size. The only 2 cases of natural mortality of adult females were observed in 1983 and are included in calculations of adult female mortality rates for 1983 but not in human-caused mortality rates.

Table 11. Movement of young-age bears from their maternal home ranges (MHR) subsequent to weaning, Alaska Range, 1983-89.

Maternal female No.	Offspring No. and sex	Age when weaned	Age/year during movement	Movement pattern
1305	1306 M	2	2/1982	Within maternal home range (MHR)
			3/1983	Within MHR
			4/1984	Killed by hunter 5/20/84 in MHR
1305	1307 M	2	2/1982	Within MHR
			3/1983	Within MHR
			4/1984	Sighted once within 15 km of MHR
			5/1985	Moved 12 km NW of MHR
			6/1986	Home range includes MHR
			7/1987	Status unknown
			8/1988	Status unknown
			9/1989	Status unknown
1308	1391 F	2	2/1989	Within MHR
1308	1392 M	2	2/1989	Within MHR
1311	1372 M	2	2/1986	Within MHR
			3/1987	Moved 40 km WNW of MHR, shed collar?
			4/1988	Status unknown
			5/1989	Moved 70 km WNW of MHR
1311	1378 F	2	2/1986	Killed by hunter 5/25/86 prior to weaning
1311	1395 M	2	3/1989	Killed by hunter 9/9/89 98 km W of MHR
1318	1380 M	3	3/1988	Within MHR
			4/1989	Status unknown, shed collar
1318	1382 F	3	1988	Within MHR
			4/1989	Killed by hunter 9/9/89 in MHR
1321	1344 M	3	3/1984	Moved 44 km SE of MHR between 5/15 and 6/4/84, remained there through 6/23; killed in MHR by hunter 9/7/84
1321	1379 F	2	2/1987	Within MHR
			3/1988	Within MHR
			4/1989	Within MHR
1321	1381 M	2	2/1987	Killed by hunter 9/8/87 in MHR

Table 11. Continued.

Maternal female No.	Offspring No. and sex	Age when weaned	Age/year during movement	Movement pattern
1322	1336 F	3	3/1984	Within MHR
			4/1985	Within MHR; bred
			5/1986	Within MHR; collar nonfunctional
			6/1987	Within MHR; with 2 cubs
			7/1988	Within MHR; with 2 yearlings
			8/1989	Within MHR; bred
1323	1324 F	2	2/1984	Within MHR; not radio-collared
			3/1985	Not sighted
			4/1986	Not sighted
			5/1987	Not sighted
			6/1988	Within MHR; with 2 yearlings
			7/1989	Within MHR; bred
1322	1325 M	2	2/1984	Within MHR; killed in defense of life or property 9/9/84
1329	1330 M	2[a]	2/1983	Within MHR
			3/1984	Moved outside MHR?; no radio contact
			4/1985	Status unknown
			5/1986	Status unknown
			6/1987	Status unknown
			7/1988	Status unknown
			8/1989	Status unknown
1333	1334 M	3	3/1984	Moved 48 km to SE between 6/4 and 6/25/84
			4/1985	Status unknown
			5/1986	Status unknown
			6/1987	Status unknown
			7/1988	Killed by hunter 4/14/88 at den 82 km SE of MHR
1333	1335 F	3	3/1984	Killed by hunter 9/14/84 in MHR
1341	1370 F	2	2/1986	Within MHR
			3/1987	Within MHR; capture mortality
1341	1371 M	2	2/1986	Killed by hunter 9/7/86 in MHR
1345	1385 F	3	3/1989	Within MHR
1345	1386 M	3	3/1989	Within MHR

Table 11. Continued.

Maternal female No.	Offspring No. and sex	Age when weaned	Age/year during movement	Movement pattern
1348	1367 M	2	2/1986	Killed in defense of life or property 6/28/86 in MHR
1348	1368 F	2	2/1986	Killed in defense of life or property 5/31/86 in MHR
1348	1369 M	2	2/1986	Within MHR
			3/1987	Killed in defense of life or property 6/26/87 48 km WSW of MHR
1351	1357 M	3	3/1985	Moved 44 km NNW of MHR by 12/3/85
			4/1986	Killed by hunter 9/23/86 46 km WNW MHR
1351	1361 F	3	3/1985	Within MHR
			4/1986	Within MHR
			5/1987	Shed collar in den
			6/1988	Status unknown
			7/1989	Status unknown
1352	1353 M	2[b]	2/1984	Killed by hunter 9/4/84 in MHR
1352	1354 F	2[b]	2/1984	Not radio-collared, status unknown, assumed dead
1360	1359 M	3[c]	3/1985	Within MHR
			4/1986	Moved 62 km SE of MHR, shed collar
			5/1987	Status unknown
			6/1987	Status unknown
			7/1989	Status unknown
1360	1363 M	3[c]	3/1985	Within MHR
			4/1986	Shed collar between 4/28 and 5/16/86 within MHR
			5/1987	Status unknown
			6/1987	Status unknown
			7/1988	Status unknown
1362	1387 F	2	2/1988	Within MHR
			3/1989	Within MHR
1362	1388 M	2	1988	Within MHR
			3/1989	Status unknown, shed collar

Table 11. Continued.

Maternal female No.	Offspring No. and sex	Age when weaned	Age/year during movement	Movement pattern
1398	1397 F	2	2/1989	Within MHR
	1399 M	2	2/1989	Killed by hunter 16 km W of MHR
Unk	1302 F	2-3[d]	3/1981	Within established home range
			4-7	Shed collar 8/81, no contact until 1986 recapture
			8/1986	Within established home range
			9/1987	Within established home range
			10/1988	Within established home range; with 3 cubs
			11/1989	Within established home range; with yearlings
Unk	1355 M	Unk	3/1983	Within established home range
			4/1984	Within established home range
			5/1985	Killed by hunter 9/13/85 12 km N of home range
Unk	1356 M	Unk	3/1984	Moved 74 km ESE of den area between 4/27 and 5/20/84 when killed by hunter

[a] Orphaned when 1329 was killed and eaten by No. 1315, adult male.

[b] Orphaned when 1352 was killed by hunter 5/30/84.

[c] Orphaned when 1360 died during capture.

[d] Captured as 3-year-old in 1981.

Appendix A. Physical attributes[a] of grizzly bears captured in the northcentral Alaska Range, 1981-89.

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	120	180	119	31	61	114	101	21.0	36.8	3.4	3.0
1302	5/19/81	F	3	75	165	102	26	55	100	90	16.7	30.5	3.0	2.7
	6/12/86	F	8	114	180	--	--	61	106	--	19.2	33.1	--	--
	5/12/89	F	11	109	161	--	--	59	103	--	19.1	33.5	--	--
1303	6/17/81	F	2	57	122	87	23	53	89	78	15.1	27.7	2.5	2.7
	6/27/83	F	4	82	159	97	26	55	91	79	18.4	32.3	3.0	2.9
	6/14/85	F	6	73	--	--	--	47	85	--	18.8	32.2	--	--
1304	6/19/81	M	5	136	196	121	30	63	108	109	20.0	36.0	3.9	3.5
	5/21/87	M	11	255	205	--	--	80	132	--	24.0	39.7	--	--
	6/7/89	M	13	245	217	--	--	77	147	--	26.0	39.2	--	--
1305	6/19/81	F	24	114	174	103	28	60	100	96	20.1	32.6	3.0b	3.3b
1306	5/24/82	M	2	44	131	85	26	44	73	76	15.1	29.6	2.7	2.8
1307	5/24/82	M	2	44	148	84	28	46	74	83	15.4	27.3	2.6	2.5
	6/17/85	M	5	114[d]	--	--	--	55	94	--	19.2	34.8	--	--
1308	5/25/82	F	6	111	186	103	32	63	100	101	20.2	33.1	3.0	2.2b
	6/20/84	F	8	120	--	--	--	64	116	--	20.8	34.1	--	--
	6/8/87	F	11	123	183	--	--	56	106	--	21.5	34.9	--	--
1309	5/25/82	M	8	318[d]	238	150	36	89	152	128	25.0	39.1	4.0	3.5
1310	5/25/82	M	13	250[d]	--	--	--	--	--	--	--	--	b	--
	6/20/84	M	15	255	--	--	--	74	129	--	24.6	39.3	--	--
	5/21/87	M	18	264	212	--	--	80	143	--	25.5	39.1	--	--
1311	5/26/82	F	12	120	190	107	30	63	113	105	21.8	33.8	3.0	2.6
	6/21/84	F	14	116	--	--	--	59	100	--	20.0	34.2	--	--
	6/8/87	F	17	123[d]	188	--	--	62	115	--	21.2	34.1	--	--
1312	5/26/82	F	cb	12	81	48	15	28	43	42	10.2	16.5	m	m
1313	5/26/82	F	cb	12	76	50	15	30	48	45	11.1	16.8	m	m
1314	5/27/82	M	6	116	191	114	33	61	105	99	18.5	34.8	3.6	3.3
1315	6/4/82	M	13	273	197	126	36	96	154	122	26.4	38.2	3.5	3.3
	5/17/84	M	15	295	--	--	--	97	139	--	26.8	37.5	--	--

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]
1316	6/7/82	M	11	236	211	133	33	81	133	135	24.0	40.7	3.8	3.7
1317	6/8/82	F	3	36	142	91	24	38	62	72	14.2	27.9	2.9	2.9
	5/16/84	F	5	55	--	--	--	45	89	--	16.2	29.7	--	--
	5/23/85	F	6	59	--	--	--	43	77	--	16.4	30.3	--	--
1318	6/8/82	F	13	104	188	113	31	57		113	19.5	33.5	3.1	2.8
	6/22/84	F	15	118[d]	--	--	--	59	105	--	19.8	33.5	--	--
	6/2/87	F	18	105[d]	--	--	--	--	--	--	--	--	--	--
1319	6/8/82	M	cb	12	85	52	14	26	34	44	10.8	17.2	d	d
1320	6/8/82	F	17	102	181	110	29	65	103	100	21.0	33.1	2.9w	2.7w
	6/25/84	F	19	139	--	--	--	62	106	--	21.0	33.0	--	--
	6/12/87	F	22	114	173	--	--	58	106	--	21.7	33.4	--	--
1321	6/9/82	F	16	141	199	107	34	69	105	115	22.1	35.8	3.5	3.1
	5/17/83	F	17	127	178	91	30	69	109	112	21.9	36.0	2.4b	3.2
	7/22/85	F	19	218	--	--	--	63	121	--	22.1	35.6	--	--
	6/6/89	F	23	170	199	--	--	71	125	--	22.0	35.9	--	--
1322	6/9/82	F	8	91	169	100	29	62	97	97	18.9	32.8	3.2	3.0
1323	6/10/82	F	11	95	171	106	32	57	98	93	20.0	33.5	3.2	2.9
	6/29/84	F	13	132	--	--	--	61	109	--	20.9	33.6	--	--
1324	6/10/82	F	cb	12	77	49	16	29	47	39	10.6	17.5	m	m
	5/26/88	F	6	111	158	--	--	63	109	--	18.8	34.0	--	--
1325	6/10/82	M	cb	12	86	54	15	26	48	42	11.5	18.0	m	m
	5/15/84	M	2	67	--	--	--	46	80	--	16.5	30.1	--	--
1326	6/18/82	F	4	93	172	102	27	54	88	98	17.9	31.4	3.1	2.9
	6/21/84	F	6	109	--	--	--	58	92	--	18.9	32.8	--	--
	6/27/85	F	7	111	--	--	--	52	95	--	20.1	33.3	--	--
1327	7/8/82	F	16	127	175	106	29	62	100	117	20.9	32.9	2.3	2.8
	6/23/84	F	18	125	--	--	--	61	109	--	21.0	33.5	--	--
1328	7/8/82	F	1	43	122	83	26	41	75	68	14.5	25.7	2.0	1.7
1329	7/9/82	F	13	120	186	112	30	59	106	104	19.8	34.2	3.3	3.0

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]
1330	7/9/82	M	1	48	130	83	27	45	75	67	14.4	26.2	1.4	1.8
	6/28/84	M	3	102	--	--	--	50	99	--	17.5	32.9	--	--
1331	7/10/82	F	4	77	161	102	28	50	96	98	17.0	30.5	--	--
	5/20/87	F	9	114[d]	175	--	--	56	104	--	19.8	33.4	--	--
1332	7/12/82	F	5	104	173	100	32	54	92	97	18.0	33.4	3.1	2.9
1333	7/13/82	F	16	141	175	112	33	65	117	124	21.0	34.0	3.1	2.6
1334	7/13/82	M	1	49	129	86	27	42	87	72	14.4	24.9	1.3	1.6
	6/27/84	M	3	107	--	--	--	52	104	--	18.1	31.3	--	--
1335	7/13/82	F	1	38	127	77	24	40	76	73	13.5	24.0	1.6	1.8
	6/25/84	F	3	80	--	--	--	47	90	--	16.8	30.0	--	--
1336	5/16/83	F	2	47	141	86	27	56	90	86	14.9	28.2	2.6	2.4
	6/26/84	F	3	89	--	--	--	49	101	--	16.9	31.7	--	--
	6/17/85	F	4	102	--	--	--	61	102	--	18.3	33.3	--	--
	5/15/87	F	6	109	160	--	--	67	103	--	18.8	34.6	--	--
	5/17/89	F	8	145	175	--	--	67	133	--	21.2	33.2	--	--
1337	5/18/83	M	20	289	210	122	36	98	151	135	26.6	39.8	4.0b	b
	6/15/88	M	25	277	210	--	--	84	135	--	26.6	39.4	--	--
1338	5/20/83	M	6	111	175	89	29	35	107	101	19.9	34.8	3.5	3.4
1339	5/20/83	M	6	120	174	103	29	37	109	100	19.7	34.4	3.6	3.1
	5/17/84	M	7	168	--	--	--	60	102	--	20.0	35.0	--	--
1340	5/23/83	F	3	71	159	86	27	58	95	91	15.7	30.2	3.2	3.2
	5/19/84	F	4	91[d]	--	--	--	51	95	--	17.3	31.8	--	--
	6/27/85	F	5	100	--	--	--	54	94	--	18.5	33.6	--	--
1341	5/23/83	F	10	107	171	110	31	63	125	110	20.7	33.2	3.2	3.1
	6/13/85	F	12	107	--	--	--	57	104	--	--	--	--	--
	6/14/88	F	15	164	185	--	--	59	114	--	21.8	34.1	--	--
1342	5/24/83	M	2	49	133	85	27	52	91	67	15.6	27.2	2.5	2.8
1343	5/24/83	M	2	43	139	85	26	48	88	69	15.5	27.1	3.0	3.0

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]
1344	5/24/83	M	2	56	151	79	--	49	93	--	14.9	28.5	2.5	2.5
	6/23/84	M	3	123	--	--	--	55	105	--	18.5	33.2	--	--
1345	5/24/83	F	8	--	175	99	30	65	110	98	18.3	33.0	3.1	2.8
	5/23/85	F	10	105[d]	--	--	--	56	103	--	18.6	33.6	--	--
	5/13/89	F	14	118	165	--	--	65	105	--	19.6	33.2	--	--
1346	5/25/83	M	5	114	145	98	30	71	110	94	19.7	25.1	3.2	3.0
1347	5/31/83	M	6	189	188	119	23	71	144	114	22.0	37.5	3.7	3.4
1348	5/31/83	F	12	--	175	107	20	72	123	110	20.0	37.6	3.2	2.9
	5/16/86	F	15	116	180	--	--	58	100	--	20.2	32.8	--	--
1349	6/2/83	M	18	264	217	124	33	93	145	125	25.6	35.5	4.0b	3.4
1350	6/2/83	M	8	202	201	119	30	77	118	118	22.5	--	3.7	3.1
	6/12/86	M	11	205	207	--	--	76	--	--	23.7	38.2	--	--
1351	6/23/83	F	14	114[d]	181	91	23	69	114	116	21.0	38.0	3.3	3.2
	6/10/85	F	16	111	--	--	--	56	98	--	21.3	35.5	--	--
	5/19/87	F	18	130	178	--	--	64	110	--	22.0	35.5	--	--
1352	6/27/83	F	14	111	175	102	29	59	103	108	19.5	34.1	3.1	2.8
1353	6/27/83	M	1	27	107	75	20	34	54	56	12.4	21.9	r	r
1354	6/27/83	F	1	12	87	60	17	24	41	43	11.0	18.4	r	r
1355	6/30/83	M	3	60	138	98	27	45	77	77	15.2	27.5	--	--
	6/3/85	M	5	70	--	--	--	49	84	--	17.4	31.6	--	--
1356	6/30/83	M	2	50	--	--	24	46	69	--	14.9	25.2	--	--
1357	5/15/84	M	2	63	--	--	--	53	90	--	14.7	27.5	--	--
	6/24/85	M	3	93	--	--	--	50	88	--	18.5	31.1	--	--
1358	5/18/84	M	13	205[d]	--	--	--	86	--	--	--	38.4	--	--
	5/20/86	M	15	236	216	--	--	79	143	--	24.2	38.5	--	--
1359	5/28/85	M	3	61	--	--	--	44	--	--	14.4	29.1	--	--
1360	5/28/85	F	10	95	--	--	--	--	89	--	19.5	34.4	--	--
1361	5/28/85	F	3	63	--	--	--	44	81	--	17.3	30.0	--	--
	5/19/86	F	4	100	155	--	--	51	100	--	18.6	32.1	--	--

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]
1362	6/5/85	F	6	--	--	--	--	--	--	--	--	--	--	--
	6/24/85	F	6	114	--	--	--	55	98	--	19.2	33.1	--	--
	5/15/88	F	9	--	181	--	--	56	102	--	20.0	34.0	--	--
1363	6/5/85	M	3	55	128	--	--	50	86	--	16.0	28.3	--	--
1364	6/14/85	M	cb	7	69	--	--	20	37	--	9.8	15.6	--	--
1365	6/19/85	M	5	118	--	--	--	57	97	--	18.9	34.9	--	--
1366	7/22/85	M	8	234	--	--	--	83	130	--	23.2	36.3	--	--
1367	5/19/86	M	2	61	138	--	--	48	91	--	15.5	28.8	--	--
1368	5/19/86	F	2	48	140	--	--	51	82	--	15.0	27.0	--	--
1369	5/19/86	M	2	68	158	--	--	56	98	--	16.4	30.2	--	--
1370	5/20/86	F	2	47	136	--	--	41	81	--	14.9	25.5	--	--
	5/20/87	F	3	69	136	--	--	46	92	--	16.3	29.0	--	--
1371	5/20/86	M	2	57	150	--	--	51	83	--	16.5	28.2	--	--
1372	5/20/86	M	2	72	--	--	--	--	--	--	--	--	--	--
	5/17/89	M	5	186	186	--	--	84	118	--	23.3	37.5	--	--
1373	5/21/86	M	7	193	190	--	--	69	119	--	22.6	37.1	--	--
1374	5/21/86	F	6	106	171	--	--	64	99	--	19.8	35.2	--	--
	6/9/89	F	9	148	178	--	--	68	109	--	21.8	35.7	--	--
1375	6/13/86	M	6	186	208	--	--	67	117	--	21.0	36.6	--	--
	5/13/89	M	9	281	211	--	--	87	141	--	25.2	39.5	--	--
1376	6/13/86	F	14	130	171	--	--	64	103	--	21.8	34.2	--	--
1377	8/28/86	M	3[d]	132	174	--	--	58	98	--	17.3	31.6	--	--
1378	5/20/86	F	2	130[d]	--	--	--	--	--	--	--	--	--	--
1379	5/15/87	F	2	67	--	--	--	52	96	--	15.4	27.3	--	--
	6/6/89	F	4	105	156	--	--	63	99	--	19.4	33.5	--	--
1380	5/18/87	M	2	65	153	--	--	49	84	--	16.6	30.3	--	--
	5/17/88	M	3	109	178	--	--	50	92	--	17.5	33.5	--	--
1381	5/21/87	M	2	73	158	--	--	45	83	--	16.3	29.6	--	--
1382	5/14/88	F	3	68	154	--	--	46	83	--	16.2	30.3	--	--
	6/7/89	F	4[e]	84	174	--	--	49	89	--	17.8	31.9	--	--

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]
1383	6/12/87	M	2[d]	77	146	--	--	52	88	--	17.4	30.9	--	--
1384	5/15/88	M	7[d]	191	198	--	--	83	116	--	24.5	39.8	--	--
1385	5/15/88	F	2	68	142	--	--	50	76	--	15.5	27.4	--	--
	5/13/89	F	3	82	140	--	--	50	92	--	17.2	30.8	--	--
1386	5/15/88	M	2	73	146	--	--	45	75	--	16.0	29.1	--	--
	5/13/89	M	3	91	162	--	--	49	88	--	17.7	32.5	--	--
1387	5/23/88	F	2	55	129	--	--	58	79	--	15.8	27.5	--	--
	5/12/89	F	3	77	137	--	--	49	83	--	16.5	28.8	--	--
1388	5/25/88	M	2	68	148	--	--	50	93	--	16.3	29.0	--	--
1389	5/13/89	M	3	84	157	--	--	53	88	--	17.6	33.1	--	--
1390	5/13/89	F	3	77	148	--	--	50	83	--	16.2	30.0	--	--
1391	5/13/89	F	2	68	139	--	--	50	83	--	16.1	29.4	--	--
1392	5/13/89	M	2	89	145	--	--	55	86	--	17.1	31.0	--	--
1393	5/17/89	M	2	66	150	--	--	51	85	--	17.0	28.7	--	--
1394	5/17/89	F	2	59	144	--	--	49	83	--	16.1	26.2	--	--
1395	5/17/89	M	2	86	159	--	--	63	103	--	18.5	30.7	--	--
1396	5/18/89	M	13[d]	295	206	--	--	91	163	--	25.0	38.1	--	--
1397	5/18/89	F	2	61	142	--	--	45	76	--	15.4	26.8	--	--
1398	5/18/89	F	8[d]	127	188	--	--	67	104	--	20.2	33.1	--	--
1399	5/18/89	M	2	66	157	--	--	50	78	--	15.3	27.0	--	--
1400	6/8/89	M	8[d]	239	208	--	--	88	--	--	23.8	39.5	--	--
1601	6/9/89	M	7[d]	193	193	--	--	88	135	--	23.2	38.2	--	--

[a] Weights in kg and measurements in cm; head measurements made using calipers, all others were with a steel tape.
[b] Age determined by cementum layering; cubs of the year are designated as cb.
[c] Designations of tooth characteristics: b=broken, w=heavily worn; r=erupting; m=deciduous milk teeth.
[d] Estimate after close examination.

Appendix B. Grizzly bear captures, recaptures, and capture-related mortalities, Alaska Range, 1981-89.

Year	Bear No.		Total no. captured during year	Cumulative no. total captures	Capture mortalities			
	New captures	Recaptures			Yearly total	Bear No.	Percentage Year	Percentage Cumulative
1981	1301-1305		5	5	1	1301	20	20
1982	1306-1335		31a	36a	1	UM yrlg[a]	3	6
1983	1336-1356	1303, 1321	23	59	2	1338, 1347	9	7
1984	1357, 1358	1308, 1310, 1311, 1315, 1317, 1318, 1320, 1323, 1325, 1326, 1327, 1330, 1334, 1335, 1336, 1339, 1340, 1344	20	79	2(5)	1315, 1327[b], 3UM[b]	10	8
1985	1359-1366	1303, 1307, 1317, 1321, 1326, 1336, 1340, 1341, 1345, 1351, 1355, 1357	20	99	1	1360	5	7
1986	1367-1378	1302, 1348, 1350, 1358, 1361	16	115	0	--	0	6

Appendix B. Continued.

Year	Bear No.		Total no. captured during year	Cumulative no. total captures	Capture mortalities			
	New captures	Recaptures			Yearly total	Bear No.	Percentage Year	Percentage Cumulative
1987	1379-1383	1304, 1308, 1310, 1311, 1318, 1320, 1331, 1336, 1351	13	128	1	1370	8	6
1988	1382, 1384-1388	1324, 1337, 1341, 1362, 1380	11	139	0	--	0	6
1989	1389-1400, 1601	1302, 1304, 1321, 1336, 1345, 1372, 1374, 1375, 1379, 1382, 1385, 1386, 1387	26	165	0	--	0	5

[a] One unmarked (UM) yearling of female No. 1327 was not located after it was darted during a capture attempt and was assumed to have died.

[b] No. 1327 was found dead at the capture site and may have been killed by another bear before she recovered from immobilization drugs. We assume that her 3 cubs died without her care.

Appendix C. Current status of marked bears in the northcentral Alaska Range, 1989.

Bear No.	Sex	Initial capture Age	Initial capture Date	Date last location	Status as of fall 1989
1301	M	6	5/18/81	5/18/81	Dead, capture mortality
1302	F	3	5/19/81	8/30/89	Alive, functional collar; with 3 yearlings
1303	F	2	6/17/81	7/22/85	Unk, shed collar by 12/3/85
1304	M	5	6/19/81	6/7/89	Alive, removed collar
1305	F	24	6/19/81	9/15/82	Dead, hunter kill
1306	M	2	5/24/82	5/20/84	Dead, hunter kill
1307	M	2	5/24/82	6/13/86	Unk, probably alive, shed collar?
1308	F	6	5/25/82	6/7/89	Alive, functional collar; bred
1309	M	8	5/25/82	9/15/84	Dead, hunter kill
1310	M	13	5/25/82	9/1/89	Dead, hunter kill
1311	F	12	5/26/82	8/30/89	Alive, functional collar; bred
1312	F	Cub	5/26/82	8/5/82	Dead, disappeared between 8/5 and 8/27/82
1313	F	Cub	5/26/82	8/5/82	Dead, disappeared between 8/5 and 8/27/82
1314	M	6	5/27/82	9/15/82	Dead, hunter kill
1315	M	13	6/4/82	5/17/84	Dead, capture mortality
1316	M	11	6/7/82	7/12/82	Unk, shed collar between 7/12 and 8/4/82
1317	F	3	6/8/82	7/22/85	Probable illegal kill
1318	F	13	6/8/82	8/10/89	Alive, collar functional; with cubs
1319	M	Cub	6/8/82	6/18/82	Dead, disappeared between 6/18 and 7/2/82
1320	F	17	6/8/82	8/30/89	Alive, collar functional
1321	F	16	6/8/82	9/1/89	Dead, hunter kill
1322	F	8	6/9/82	4/27/84	Unk, probably alive, collar nonfunctional
1323	F	11	6/10/82	8/18/89	Dead, killed in defense of life or property
1324	F	Cub	6/10/82	8/10/89	Alive, collar functional; bred
1325	M	Cub	6/10/82	9/9/84	Dead, killed in defense of life or property
1326	F	4	6/18/82	5/27/86	Dead, hunter kill
1327	F	16	7/8/82	6/23/84	Dead, capture-related mortality
1328	F	1	7/8/82	8/27/82	Dead, disappeared between 8/27 and 9/23/82
1329	F	13	7/9/82	5/15/83	Dead, killed and eaten by bear No. 1315M
1330	M	1	7/9/82	8/14/84	Unk, probably emigrated
1331	F	4	7/10/82	8/30/89	Alive, collar functional; with 1 yearling
1332	F	5	7/12/82	10/31/82	Dead, died in den, winter 82/83
1333	F	16	7/12/82	5/22/84	Dead, hunter kill
1334	M	1	7/13/82	4/14/88	Dead, hunter kill
1335	F	1	7/13/82	9/14/84	Dead, hunter kill
1336	F	2	5/16/83	8/30/89	Alive, functional collar
1337	M	20	5/18/83	9/1/89	Dead, hunter kill
1338	M	6	5/20/83	5/20/83	5/20/83 Dead, capture mortality
1339	M	6	5/20/83	6/4/84	Unk, shed collar between 6/4 and 9/10/84
1340	F	3	5/23/83	6/27/85	Unk, collar shed between 6/27/85 and 4/28/86
1341	F	10	5/23/83	8/30/89	Alive, functional collar; with 2 cubs
1342	M	2	5/24/83	6/27/83	Dead, illegal kill, snared fall 1983
1343	M	2	5/24/83	5/15/84	Unk, collar nonfunctional or emigrated?

Appendix C. Continued.

Bear No.	Sex	Initial capture Age	Initial capture Date	Date last location	Status as of fall 1989
1344	M	2	5/24/83	9/7/84	Dead, hunter kill
1345	F	8	5/24/83	8/30/89	Alive, functional collar
1346	M	5	5/25/83	8/19/83	Unk, shed collar? between 5/25/83 and 8/19/83
1347	M	6	5/31/83	5/31/83	Dead, capture mortality
1348	F	12	5/31/83	8/30/89	Alive, functional collar; bred
1349	M	18	6/2/83	5/22/87	Dead, hunter kill
1350	M	8	6/2/83	9/14/88	Dead, hunter kill
1351	F	14	6/23/83	9/11/87	Dead, hunter kill
1352	F	14	6/27/83	5/30/84	Dead, hunter kill
1353	M	1	6/27/83	9/4/84	Dead, hunter kill
1354	F	1	6/27/83	5/18/84	Unk, never radio-collared, assumed dead
1355	M	3	6/30/83	9/13/85	Dead, hunter kill
1356	M	2	6/30/83	5/20/84	Dead, hunter kill
1357	M	2	5/15/84	9/23/86	Dead, hunter kill
1358	M	12	5/18/84	5/31/86	Dead, hunter kill
1359	M	3	5/28/85	11/6/86	Unk, shed collar between 4/28/86 and 11/6/86
1360	F	10	5/28/85	5/28/85	Dead, capture mortality
1361	F	3	5/28/85	11/6/86	Unk, shed collar in den
1362	F	6	6/5/85	5/18/89	Alive, functional collar
1363	M	3	6/5/85	4/28/86	Unk, shed collar between 4/28/86 and 5/16/86
1364	M	Cub	6/14/85	6/14/85	Dead, disappeared between 6/14/85 and 6/24/85
1365	M	5	6/19/85	7/28/86	Unk, not located in 1988-89
1366	M	8	7/22/85	12/3/85	Unk, shed collar
1367	M	2	5/19/86	6/28/86	Dead, killed in defense of life or property
1368	F	2	5/19/86	5/31/86	Dead, killed in defense of life or property
1369	M	2	5/19/86	6/26/87	Dead, killed in defense of life or property
1370	F	2	5/20/86	5/20/87	Dead, capture mortality
1371	M	2	5/20/86	9/7/86	Dead, hunter kill
1372	M	2	5/20/86	6/8/89	Alive, functional collar
1373	M	7	5/21/86	9/2/86	Dead, hunter kill
1374	F	6	5/21/86	8/30/89	Alive, functional collar
1375	M	6	6/13/86	8/10/89	Alive, functional collar
1376	F	14	6/13/86	8/10/88	Alive, functional collar; with 2 2-year-olds
1377	M	3[a]	8/28/86	3/25/87	Unk, shed collar between 3/25/87 and 8/30/87
1378	F	2	6/20/86	6/20/86	Dead, hunter kill
1379	F	2	5/15/87	8/30/89	Alive, functional collar
1380	M	2	5/18/87	8/30/88	Unk, shed collar
1381	M	2	5/21/87	9/8/87	Dead, hunter kill
1382	F	3	5/15/88	9/9/89	Dead, hunter kill
1383	M	2	6/12/87	9/19/87	Unk, shed collar between 9/19/87 and 4/18/88
1384	M	7[a]	5/15/88	4/23/89	Dead, hunter kill
1385	F	2	5/15/88	8/10/89	Alive, functional collar
1386	M	2	5/15/88	6/6/89	Alive, functional collar

Appendix C. Continued.

Bear No.	Sex	Initial capture Age	Initial capture Date	Date last location	Status as of fall 1989
1387	F	2	5/23/88	8/30/89	Alive, functional collar
1388	M	2	5/25/88	8/30/88	Unk, shed collar
1389	M	3	5/13/89	7/89	Dead, illegal kill
1390	F	3	5/13/89	8/30/89	Alive, functional collar
1391	F	2	5/13/89	5/13/89	Alive, functional collar
1392	M	2	5/13/89	8/10/89	Alive, functional collar
1393	M	2	5/17/89	8/10/89	Alive, functional collar
1394	F	2	5/17/89	8/10/89	With mother and siblings; nonfunctional collar
1395	M	2	5/17/89	9/9/89	Dead, hunter kill
1396	M	13[a]	5/18/89	8/30/89	Alive, functional collar
1397	F	2	5/18/89	8/30/89	Alive, functional collar
1398	F	8[a]	5/18/89	8/30/89	Alive, functional collar
1399	M	2	5/18/89	9/9/89	Dead, hunter kill
1400	M	8[a]	6/8/89	8/30/89	Alive, functional collar
1601	M	7[a]	6/9/89	6/9/89	Alive, functional collar

[a] Estimate.

Appendix D. Status summary of marked bears in the northcentral Alaska Range, fall 1989.

Dead		Alive, active collar	Shed or nonfunctional collar unknown status: Alive in the area?	Shed or nonfunctional collar unknown status: Dispersed? or dead?	Never collared, dead?
1301	1371	1302	1303	1316	1354
1305	1373	1308	1304	1330	
1306	1378	1311	1307	1339	
1309	1381	1318	1322	1343	
1310	1382	1320	1340	1346	
1312	1384	1324	1361	1359	
1313	1389	1331	1377	1363	
1314	1395	1336	1380	1365	
1315	1399	1341	1383	1366[a]	
1317		1345	1388		
1319		1348			
1321		1362			
1323		1372			
1325		1374[a]			
1326		1375			
1327		1376			
1328		1379			
1329		1385			
1332		1386			
1333		1387			
1334		1390			
1335		1391			
1337		1392			
1338		1393			
1342		1394			
1344		1396			
1347		1397			
1349		1398			
1350		1400			
1351		1601			
1352					
1353					
1355					
1356					
1357					
1358					
1360					
1364					
1367					
1368					
1369					
1370					

[a] Captured outside study area.

Appendix E. Status of maternal grizzly bears and their offspring in the northcentral Alaska Range, 1981-89.

Maternal female			Offspring			
Bear No.	Age at capture (yrs)	Present status	Bear No. and sex	Year of birth	Age at weaning (yrs)	Present status
1302	3	Alive	UM[a]	1988	--	With mother 1989
			UM	1988	--	With mother 1989
			UM	1988	--	With mother 1989
1303	2	Last observed 1985	1364 M	1985	--	Assumed dead 1985
			UM	1985	--	Assumed dead 1985
1305	24	Hunter kill 1982	1306 M	1980	2	Hunter kill 1984
			1307 M	1980	2	Last observed 1986
1308	6	Alive	UM	1984	--	Assumed dead 1985
			UM	1984	2	Probable hunter kill 1986
			1391 F	1987	2	Weaned 1989
			1392 M	1987	2	Weaned 1989
1311	12	Alive	1312 F	1982	--	Assumed dead 1982
			1313 F	1982	--	Assumed dead 1982
			1372 M	1984	2	Alive 1989
			1378 F	1984	2	Hunter kill 1986
			UM	1987	2	Hunter kill 1989?
			1395	1987	2	Hunter kill 1989
1318	13	Alive	1319 M	1982	--	Assumed dead 1982
			1380 M	1985	--	Weaned 1988
			1382 F	1985	--	Hunter kill 1989
1320	17	Alive	UM	1983	--	Assumed dead 1983
			UM	1985	--	Assumed dead 1985
			UM	1985	--	Assumed dead 1985
			UM	1985	--	Assumed dead 1985
			UM	1987	--	Assumed dead 1987
			UM	1987	--	Assumed dead 1987
1321	16	Alive	1342 M	1981	--	Illegal kill 1983
			1343 M	1981	3	Last observed 1984
			1344 M	1981	3	Hunter kill 1984
			UM	1985	--	Assumed dead 1986
			1379 F	1985	2	Alive 1989
			1381 M	1985	2	Hunter kill 1987
			UM	1988	--	Assumed dead 1988
			UM	1988	--	Assumed dead 1988-89
			UM	1988	--	Assumed dead 1988-89
1322	8	Last observed 1984	1336 F	1981	3	Had cubs 1987
1323	11	Hunter kill 1989	1324 F	1982	2	Had cubs 1987
			1325 M	1982	2	Killed DLP[b] 1984
			UM	1987	--	With mother 1989
			UM	1987	--	With mother 1989
1324	0	Alive	?1389 M	1987	2	Weaned 1989?
			?1390 F	1987	2	Weaned 1989?
1326	4	Hunter kill 1986	UM	1985	--	Assumed dead 1985

Appendix E. Continued.

Maternal female			Offspring			
Bear No.	Age at capture (yrs)	Present status	Bear No. and sex	Year of birth	Age at weaning (yrs)	Present status
1327	16	Dead 1984	1328 F	1981	--	Assumed dead 1982
			UM	1981	--	Capture death 1982
			UM	1984	--	Assumed dead 1984
			UM	1984	--	Assumed dead 1984
			UM	1984	--	Assumed dead 1984
1329	13	Dead 1983	1330 M	1981	2[c]	Last observed 1984
1331	4	Alive	UM	1986	--	Assumed dead 1987
			UM	1988	--	With mother 1989
1333	16	Hunter kill 1984	1334 M	1981	3	Hunter kill 1988
			1335 F	1981	3	Hunter kill 1984
1336	2	Alive	UM	1987	--	Assumed dead 1988
			UM	1987	--	Assumed dead 1988
1341	10	Alive	UM	1982	--	Assumed dead 1983
			1370 F	1984	2	Capture death 1987
			1371 M	1984	2	Hunter kill 1986
			UM	1988	--	Assumed dead 1988
			UM	1988	--	Assumed dead 1988
			UM	1989	--	With mother
			UM	1989	--	With mother
1345	8	Alive	UM	1984	--	Assumed dead 1984
			UM	1984	--	Assumed dead 1985
			1385 F	1986	3	Weaned 1989
			1386 M	1986	3	Weaned 1989
1348	12	Alive	1367 M	1984	2	Killed DLP 1986
			1368 F	1984	2	Killed DLP 1986
			1369 M	1984	2	Killed DLP 1987
			UM	1987	--	Assumed dead 1988
			UM	1987	--	Assumed dead 1988
			UM	1989	--	Assumed dead 1989
1351	14	Hunter kill 1987	UM	1982	--	Assumed dead 1984
			1357 M	1982	3	Hunter kill 1986
			1361 F	1982	3	Last observed 1986
			UM	1986	1[d]	Unk, 1987[d]
			UM	1986	1[d]	Unk, 1987[d]
			UM	1986	1[d]	Unk, 1987[d]
1352	14	Hunter kill 1984	1353 M	1982	--	Hunter kill 1984
			1354 F	1982	--	Assumed dead 1984
1360	11	Dead 1985	1359 M	1982	--	Last observed 1986
			1363 M	1982	--	Last observed 1986
1362	6	Alive	1387 F	1986	2	Alive 1989
			1388 M	1986	2	Last observed 1988

Appendix E. Continued.

Maternal female			Offspring			
Bear No.	Age at capture (yrs)	Present status	Bear No. and sex	Year of birth	Age at weaning (yrs)	Present status
1374	6	Alive	UM	1985	2?	Weaned 1987?
			UM	1985	2?	Weaned 1987?
			UM	1988	--	With mother 1989
			UM	1988	--	With mother 1989
1376	23[e]	Alive	UM	1987	--	With mother 1989
			UM	1987	--	With mother 1989
1398	8[e]	Alive	1397 F	1987	2	Weaned 1989
			1399 M	1987	2	Hunter kill 1989

[a] UM denotes Unmarked.

[b] Killed legally in defense of life or property.

[c] Orphaned when 1329 was killed and eaten by adult male 1315.

[d] Unknown, orphaned when 1351 was killed by hunter, fall 1987.

[e] Estimate.