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Effects of Harvest Rates on Grizzly Bear Population Dynamics in the Northcentral Alaska Range

by
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and
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SUMMARY

Changes in population density and harvest rates for a grizzly bear (*Ursus arctos*) population in the northcentral Alaska Range were estimated during 1986-91 for comparison with similar data for the 1981-85 period. Baseline population status and reproductive biology were determined during 1981-85; the effects of increased harvest on this population were the focus of investigations from 1986 through 1991. Minimum estimated population size, adjusted to account for closure, declined from 71 in 1981 to 52 in 1991. The number of productive adult females in the population at den emergence fluctuated from 20 to 22 during 1981-89 with an average annual harvest rate of 6.5%, but will include only 15 by spring 1992 following a harvest rate of 14.3% during 1989-91. Population numbers and productivity were affected by environmental conditions resulting in the failure of the 1983 cub cohort. Females produced their first litters at mean age 6.3 years and their first surviving litters at mean age 7.3 years. Mean litter size for cubs of the year was 2.15 (n = 41) and 2.0 for offspring weaned as 2- or 3-year-olds (n = 18). In 86% of observations, females that bred in one year produced cubs the next. The mean interval between production of weaned offspring was 4.1 years. Although there were differences in some measures of population productivity between 1981-86 and 1987-91, they could not be ascribed to compensatory production or survival; these differences may have been influenced by the same environmental factors that resulted in the failure of the 1983 cub cohort. Patterns of movement or fidelity to maternal or established home ranges indicated that all females remained in the vicinity of their maternal home ranges and that none emigrated from the study area. All males weaned or captured as 2- or 3-year-olds emigrated from their maternal or established home ranges within 2 years. Males $\geq$4 years of age apparently left their maternal home ranges to immigrate to the study area; none of these later emigrated from the study area although some had home ranges that extended beyond the study area boundaries. Recovery of the bear population to former levels will probably require reductions in harvest and more intensive management of females, since compensatory production or survival, if present, has not been enough to maintain adult female numbers.

Key Words: density estimates, emigration, grizzly bear, harvest rates, immigration, interior Alaska, movement patterns, population dynamics, reproductive biology, *Ursus arctos*.

CONTENTS

BACKGROUND

An understanding of the effects of hunter harvest on grizzly bear (Ursus arctos) population dynamics is necessary for effective management. To accomplish this, we need to determine (1) how differing levels of harvest affect population status, (2) how populations respond to hunter-caused mortality, and (3) whether hunting harvest constitutes additive or compensatory mortality in grizzly bear populations.

During 1981, this study was begun to address these information needs (Reynolds 1982). The background and rationale for this long-term study have been described during previous reports (Reynolds and Hechtel 1983, 1984a, 1985, 1986, 1988; Reynolds et al. 1987; Reynolds 1989, 1990; Reynolds and Boudreau 1990). Other studies have addressed aspects of population biology or density of grizzly bears in interior Alaska (Dean 1976; Murie 1981; Ballard et al. 1982; Miller and Ballard 1982; Miller 1990a,b).

Currently, most management decisions are based on the number, sex, and age of bears killed by hunters in a given area. These parameters may provide a general assessment of the status of grizzly bear populations under certain conditions, but few data are available to use as a basis for estimating rates of harvest (Harris and Metzgar 1987, Miller 1990c).

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 first breeding, litter size, and interval between litters (Craighead et al. 1974, Reynolds 1976, Bunnell and Tait 1980, McLellan 1989a, Miller 1990c, Miller and Miller 1990). The approach I have taken in this study is to monitor these characteristics annually so that harvest can be related to potential population responses.

Abstracts of publications that include analysis of data from this study are included in Appendices A, B, and C.

OBJECTIVES

To quantitatively relate changes in the harvest rate of grizzly bears to their population dynamics, especially population size, structure, productivity, survival, emigration, and immigration; and more specifically,

1. to determine the size, density, and sex and age structure of the grizzly bear population;

2. to determine measures of reproductive biology, including the age at first production of young, reproductive interval, and mean litter size;

3. to determine natural mortality rates for sex and age classes within the population;

4. to determine harvest rates for sex and age classes within the population; and

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

STUDY AREA

The 3,160-km^2 (1,220-mi^2) study area is located in the mountains and foothills of the northcentral Alaska Range within Game Management Subunit 20A. In past reports, the study area size was calculated as 3,900-km^2 (1,500-mi^2); the difference represents deletion of mountainous portions of rock or glaciers and heavily forested portions of the Tanana Flats where searches were not attempted and where few observations were made. 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° 07'N) to the north. It includes portions of 2 U.S. Army reservations, Fort Wainwright and Fort Greely.

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

METHODS

I continued to use the same methods described in past reports 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 (Kingsley et al. 1988; Appendix D).

Annual population size was estimated by a direct count method that includes marked and hunter-killed bears known or assumed to be present in the study area (Reynolds 1980, Reynolds et al. 1987). During 1986, a mark-recapture estimate was also conducted (Miller et al. 1987; Reynolds et al. 1987; Miller 1990a,b); another is planned during spring 1992.

Direct count estimates of annual minimum population size included the sum of: (1) marked or radio-collared bears that were known or assumed to be alive and present in the area, (2) unmarked offspring of radio-collared females, (3) bears captured in the study area that would have been resident in past years (e.g., a 14-year-old female captured in 1986 was assumed to be a resident of the study area during 1981-85, 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); and (4) unmarked bears killed within the study area, but which would have been resident in past years.

Based on observed patterns of immigration and fidelity to maternal and established home ranges, I assumed that all captured females were present in the study area from the time of their birth and that none emigrated from the area nor immigrated to it. Similarly, using observed patterns, I assumed that all males captured at $\geq$4 years of age immigrated to their established home range (of which at least a portion was included in the study area) as 4-year-olds. And, I assumed that all 2- or 3-year-old males captured in the area during May and June were born in the area but emigrated within 2 years after capture, regardless of whether or not their maternal lineage and home range were known. (See section on Movement Patterns for supporting data.)

When radio-collared bears could not be located during a season of aerial telemetry flights, I assumed that either they were present in the population, but with a shed or failed collar, or that they were no longer a part of the population due to emigration or death. Based on patterns of radiocollar loss and subsequent recapture or known death of specific bears, I also assumed that females remained present in the population for 6 years after they were last observed, males $\geq$4 years of age for 4 years, and 2- or 3-year-old males for 2 years. (See section on Movement Patterns for supporting data.)

By 1986, I had enough baseline data on home range size and movement of Alaska Range grizzly bears 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 maintain home ranges entirely within the study area; this results in an overestimation of population size. Bears living near the center of the study area are 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 and resulted in "adjusted" population estimates (Reynolds 1980). For bears killed by hunters, home range size and proportional inclusion in the study area were assumed to be similar to those of radio-collared grizzly bears 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, since 20% of the home range of bear No. 1336, another 5-year-old female living along the Wood River, also lies outside the study area.

I believe that by 1991 almost all of the bears present in the area were captured and that I can account for most of the bears using the study area. This assumption is justified because capture takes place during the breeding season when any unmarked bear consorting with a radio-collared bear can be captured. Over time, as adult females wean their offspring and breed, they can be captured so that all or almost all of the adult females present in the study area can be radiocollared. The same pattern is true of adult males, although they may have home ranges that extend beyond the study area. In the unlikely event that some adults do not breed, there is an increased likelihood that they could avoid capture; however, if present, they could still be captured because most of the study area is systematically and intensively searched annually. Most 2- to 3-year-old offspring of radio-collared females are also captured before they are weaned so they can be accounted for as well. The sex and age class most likely to be underrepresented in the captured sample is that of 2- to 4-year-old immigrant, nonbreeding males. However, if the number of these young males moving into the study area approximately equals the number moving out, this effect would be minimized and further mitigated by capture of such bears during routine searches. Also likely to be underrepresented in the sample are those bears living at the edges of the study area whose home ranges only include a small portion within the study area. By adjusting population estimates to account for closure, the bias resulting from such edge effect is minimized.

One measure of the validity of using the direct count method to estimate population size is the presence of unmarked bears in the study area. This is indicated by the proportion of unmarked bears that are captured or are killed by hunters. During 1986-91, only 14 of 46 bears captured in the study area were previously unmarked bears that were not offspring of marked bears. Of the 14, 6 were adult males captured on the edge of the study area, 1 was a young adult male captured in the core of the area, 3 were 2- or 3-year-old males prone to emigrate, 3 were adult females living on the edge of the study area, and 1 was an adult female living in the core of the study area. Similarly, of 39 bears killed in the study area by humans during 1986-91 (not including 1 capture mortality), only 16 were not previously marked; 1 was the 2-year-old offspring of a marked bear, 3 were likely the 2- or 3-year-old offspring of marked bears, 10 were 2- or 3-year-old males that were probably fall immigrants, and 2 were taken at the edges of the study area. It must be emphasized that the completeness of the sample improved as the study progressed. By 1991, of 22 grizzly bears captured, the 3 that were not previously marked or offspring of previously marked females were all young males living on the edge of the study area. Similarly, of 5 hunter-killed bears taken in 1991, only 1 3-year-old male on the edge of the study area was not marked or with a marked female.

During early June 1986, I used a modified capture-recapture method to estimate the density of bears in a portion of the northcentral Alaska Range study area (Reynolds et al. 1987). Miller et al. (1987) developed this method in southcentral Alaska in 1985, and then improved it (Miller 1990<u>b</u>). It 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 this study area under different conditions than those occurring in southcentral Alaska and was able to compare densities with those based on direct counts.

Using the direct count method provides the advantage of monitoring the status of individual animals annually to assess the mechanisms of population change. Also, annual and cumulative effects of harvest on the population can be tracked to address population response. However, the method also has the disadvantages of not providing estimates with statistical bounds, requiring long-term effort, and being expensive. To provide a statistically defensible estimate and test the validity of estimated changes in population density and numbers (Miller 1990b, Ballard et al. 1991), a mark-recapture effort will be conducted during 1992. Some analyses of grizzly bear population response to human-caused mortality will not be conducted until the density estimate has been made.

RESULTS AND DISCUSSION

Although population numbers and response to harvest have been estimated using available data, a more complete analysis will be developed after a statistically defensible capture-recapture density estimate (Miller et al. 1987) is completed during 1992.

The results of this study are being published in scientific journals. Use of the immobilizing drug tiletamine HCL/zolazepam HCL was published in the Journal of Wildlife Management in 1989 (Taylor et al.; Appendix A). Results from characteristics of population biology and movement patterns in the study area will be published in the Proceedings of the Ninth International Conference on Bear Research and Management; the abstracts are included in this report as Appendices B and C, respectively.

Immobilization and Drug Use

During 1986, 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; a total of 89 immobilizations were made in the study area with no mortalities (Table 1). This compares with 3 drug-related mortalities of 21 bears immobilized with etorphine and 3 drug-related mortalities of 96 immobilizations of grizzly bears made with phencyclidine hydrochloride. Telazol has been an excellent drug for immobilizing bears and has important advantages over the use of previously used drugs. Unlike etorphine, it has a wide margin of safe use and mortality rate of $\leq$0.5%. It has an induction time of approximately 4-5 minutes with recovery from moderate doses beginning at about 50-70 minutes. In comparison, similar dosages of phencyclidine hydrochloride have an induction time of 10-15 minutes, with a normal recovery beginning at about 90-120 minutes; in isolated instances in other studies, mobility was not regained for 24 hours (H. Reynolds, unpubl. data). While Telazol can be used in concentrations of 100-550 mg/ml, to reduce the volume of drug injected I now use concentrations of 400 mg/ml for large adult males (>230 kg) and 200 mg/ml for all other bears.

Further experience with using Telazol for immobilization of grizzly bears indicates that dosages of 9-10 mg/kg are preferable to dosages of <9 mg/kg. The possible exception for use of higher dosages would be on bears recently emerged from dens, for females with cubs of the year during May-early June, or in areas of high bear density where free-roaming bears would be more likely to encounter and injure an immobilized bear. Use of higher dosages results in shorter induction times, and thus less stress on the bear, without substantially increasing the length of time that a bear is under the effects of the drug. Body temperature is usually less elevated as well because bears do not appear to run as far prior to induction. Heavier dosages only seem to increase down time from approximately 50 minutes to 60-65 minutes. No other side effects of the heavier dosages were observed.

Bears Captured and Radio-collared

One hundred and fifteen individual bears were captured in the study area during 1981-91 (Table 1). In addition, 89 bears were recaptured to replace radiocollars. During 1981-83, initial captures were made of bears of all sex and age classes. Since 1983, most initial captures were of offspring of previously captured bears (Appendix E). Radiocollars have been placed on 103 bears; 36 on young-age males (≤5 years), 19 on adult males (≥6 years), 25 on young-age females, and 23 on adult females. By fall 1991, 30 bears carried functioning radiocollars; 16 bears had shed collars; 58 bears were dead; 1 was presumed dead; and 10 bears could not be located, presumably because of long-range movements or collar failure (Appendices F, G).

Movement Patterns

A knowledge of movement patterns by grizzly bears of all sex and ages is crucial to understanding how emigration, immigration, and fidelity to home range affect population dynamics. Analyses of size, density, and demography of grizzly bear populations usually assume population closure or attempt to account for it. In this study, determining movement patterns was especially important because annual presence or absence in the study area affected some calculations of population size, density, and dynamics. Approximately 20-30 radiocollars were functional on bears during any one season. Although some bears were tracked by radiocollars for up to 10 years, contact with others was lost due to radiocollar loss or failure or due to movement beyond areas where we conducted aerial radio-tracking flights (emigration). Many of these bears were recaptured or killed within the study area or killed by hunters outside it. Patterns of movement by sex and age classes provided a basis for assignment of presence or absence in the population to individuals for which radio contact was lost.

No movement from the vicinity of their home range or area of initial capture was documented for the 23 females captured in the study area as adults ($\geq$6 years), or for the 21 females captured either as offspring (2- or 3-year-olds) of marked adults (Appendix H) or as young females (2- to 5-year-olds) of unknown family history. Of the females initially captured as 2- to 5-year-olds, 9 shed their radiocollars and were not subsequently observed for 1 to 6 years (Table 2). Four of these were later recaptured or killed by hunters in the study area after periods of 3, 4, 4, and 5 years; the 5 that have not been recaptured have been missing for 1, 2, 2, 2, and 6 years. Based on these patterns, I assumed that no young females emigrated from the area or immigrated to it. Similarly, of females initially captured as adults, 6 had collars that malfunctioned or were shed so that they were not relocated for 1, 1, 1, 3, 4, and 5 years. All were subsequently recaptured or killed within their established home ranges. In addition, 1 adult has not been located for 2 years. On this basis, I assumed that no females left their maternal or established home ranges in the study area and that all females present were born in, or immediately adjacent to, the study area. I further assumed that females remained alive in the area for 6 years following their last observation.

Utilizing the same approach, I found that most 2- to 3-year-old males captured either emigrated from their home ranges in the study area, could not be located, or were killed by hunters within 2 years after weaning (Table 2; Appendix H). Exceptions to this pattern included 2 bears that were killed in the study area within 3 years of initial capture and 2 others that emigrated from their maternal home ranges but remained in the study area. Twenty-four male offspring were weaned as 2- or 3-year-olds, and their maternal home ranges were known; 6 were captured at the same age but their maternal home range was unknown. During the year in which these bears were weaned or captured, 20 remained in the area, 7 were killed by hunters within the study area, 2 were killed outside the study area, and 1 emigrated (Table 2). Of the 19 observed during the year following capture or weaning, 10 were observed in the study area, 2 were killed outside the area, 1 emigrated, and 6 could not be located. During the second year, none remained in the area for the entire year, 2 were killed in the area during spring, 2 were killed outside the area, 1 emigrated, and 5 could not be located. No males born in the area remained there as 4-year-olds except for 2 that emigrated from their maternal home ranges but not from the study area. Of the 11 that could not be located 1 or 2 years following capture or weaning, 3 were later killed by hunters outside the study area, 2 were later located in the study area but outside their maternal home ranges, and the status of 6 remains unknown. Based on these patterns, I assumed that, for this exploited population, all 2- or 3-year-old males emigrated from their maternal home ranges by summer of the year that they reached age 4. I further assumed that the 6 2- or 3-year-olds of unknown maternal lineage that were captured in the area were either born in the area or, if they were immigrants, that others of the same age emigrated at the same rate.

Twenty males, initially captured at ≥4 years of age, maintained home ranges that included the study area. Radio contact with 13 of these was lost; 6 were later located within the study area after lapses of 1, 1, 1, 2, 4, and 6 years. Another was killed outside the study area but within a distance that could reasonably include the study area in his home range. One of the adult males that maintained a presence in the study area was observed from May to September every year from 1982 to 1989, but we were never able to locate his den; he was killed outside the study area by a hunter, presumably during movement to his denning area. The 6 bears for which present status is not known have been missing for 1, 2, 2, 5, 7, and 9 years. Based on these patterns, I assumed that all males ≥4 years of age were present in the study area unless they had not been observed for 4 years. In addition, based on these observed patterns and those of 2- to 3-year-old males, I assumed that all adults had been present in the study area since they were 4 years of age.

The effect of biases on the annual population estimates resulting from acceptance of these assumptions should be minimal. Based on the previous record of recaptures of females whose collars were shed or nonfunctional, it appears unlikely that females either died or emigrated from the study area. Presently, only the status of female No. 1340 has been unknown for more than 2 years. The fact that no young males of known status, initially captured as 2- or 3-year-olds, remained in the study area 2 years after capture or weaning is a sound argument against the possibility that any of the 6 with which radio contact was lost still remain in the study area. The assumption that all of the 6 young males of unknown maternal lineage which were captured in the study area were also born in the study area is not as strong. However, the productive status of 4 females was unknown during the period when these bears were captured and could have accounted for their presence in the population. Further, because it is reasonable to assume that rates of emigration and immigration are equal for this area, the total effects of any biases should also be near zero. The result of accepting assumptions that are not true are less straightforward for adult males. It is usually difficult to maintain telemetry contact with large males because they readily shed or damage their radiocollars and they have wide-ranging movement patterns and large home ranges. Some adult males moved outside the study area and returned after traveling as far as 40 km (25 mi) out of the study area, but their movement was confined to their apparent home ranges. However, once their radiocollars have been shed or have malfunctioned, they can be recaptured after they are observed accompanying radio-collared females in breeding condition. Accepting the assumption that a male is lost to the population after not being observed for 4 years would have resulted in counting 3 males as present in the population that had been missing for 1 or 2 years. It would have excluded 3 others missing for 5, 7, and 9 years as well as 1 that lived in the study area but was not recaptured for 6 years. A measure of the size and direction of the bias resulting from accepting this assumption may result from the mark-recapture density estimate which will take place during 1992. In addition, a positive bias may result from accepting the assumption that males immigrate to, and establish residency in, an area when they are 4 years of age.

Population Size and Density

Estimates Based on Population Closure:

Annual estimates were calculated for minimum population size, for minimum population size adjusted for population closure, and for minimum population ≥2 years of age that was adjusted for population closure (Table 3). All estimates represented size and density of the population in the spring after emergence from dens and before any harvest occurred. The minimum population estimates included all bears present in the study area regardless of how much of their estimated home ranges were included in the area; in other words, not adjusted for population closure. Estimated minimum population size for 1991 was 64, compared with 83 for 1981. Estimated minimum population density was 2.03 bears/100 km^2 (5.25 bears/100 mi^2) during 1991 compared with 2.63 bears/100 km^2 (6.80 bears/100 mi^2) during 1981.

The estimated minimum 1991 spring population, adjusted for closure, was 52 grizzly bears, a density of 1.65 bears/100 km^2 (4.26 bears/100 mi^2). This included 34 marked bears, adjusted from a total marked population of 42 bears whose home ranges included the study area; 16 unmarked offspring of marked females, adjusted from a total of 20 bears; and 2 unmarked bears killed by hunters, adjusted from a total of 2 bears. This compares with an estimated minimum adjusted population of 71 bears in 1981, a density of 2.25 bears/100 km^2 (5.82 bears/100 mi^2).

A more useful measure of population size or density would include those members of the population ≥2 years of age, for 2 reasons. First, cub and yearling cohorts constitute a relatively high percentage of the population--a mean of 28% in the 1982-91 adjusted population estimates. These proportions can fluctuate widely and point estimates may not be representative of the population trend or reproductive potential. Second, 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 adjusted minimum population estimate of grizzly bears ≥2 years of age in the study area in 1991 was 33 bears, or 1.04 bears/100 km^2 (2.70 bears/100 mi^2). This represents a decline from the adjusted 1981 population estimate of 53 or 1.68 bears/100 km^2 (4.34 bears/100 mi^2) for bears ≥2 years old.

During 1986, a modified capture-recapture density estimate (Miller et al. 1987) was conducted in a 950-km^2 (367-mi^2) portion of the study area, resulting in a point estimate of 10.67 bears ≥2 years old (var. = 3.67) (Reynolds et al. 1987). Based on our sample size and the proportion of marked bears in our sample, we used the binomial approach to calculate confidence intervals (CI) (Seber 1973:64). Statistical tables (Rohlf and Sokol 1969:208) showed that our 95% CI was 7.59-25.44 for our point estimate of 10.67 bears ≥2 years of age. This resulted in a density estimate of 1.12 bears (≥2 years of age)/100 km^2 (2.91 bears/100 mi^2) (Reynolds et al. 1987). This is within the range estimated by the adjusted minimum population ≥2 years of age during the study period. To confirm the trend of adjusted population estimates calculated in this study (Table 3), another modified capture-recapture density estimate is necessary and will be conducted during 1992.

Population Structure

The sex and age structure of the population for 1991 was more heavily weighted toward females than males (Fig. 1). There were more females (25%, *n* = 16) than males (14%, *n* = 9) present in adult age classes (≥6 years) and approximately equal numbers of males (15%, *n* = 10) and females (14%, *n* = 9) in the subadult age classes (2-5 years). The proportions of males and females in the cub and yearling age classes (32%, *n* = 21 total) was unknown because I did not capture offspring until they were 2-year-olds but I assumed an equal sex ratio to construct this figure. The unequal sizes of the cub, yearling, and 2-year-old cohorts are related to a higher number of females producing cubs during 1990 and lower numbers during 1989 and 1991 rather than variations in litter sizes. Low representation in the structure of the 1983 cohort (8-year-olds in 1991) was due to a cub production failure, probably related to a berry crop failure during 1982. Low representation from other cohorts are mostly due to hunting pressure, or a combination of hunting pressure and lower survival rates.

For comparison, in 1982 the structure was also more heavily weighted toward females for bears ≥3 years of age (Fig. 2). Such a population structure should be expected, since males are more heavily harvested in the study area than females. The sex ratio of the bear harvest since 1979 is 74 males:37 females. Of 102 bears for which ages were determined during this period, the harvest included 43 males and 16 females in the 1- to 5-year-old age class and 25 males and 18 females for age classes ≥6 years old. Males have larger home ranges and travel more widely than females (see Movement Patterns section) 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. During 1981-86, for those adult females whose reproductive status was known (29), only 22% were vulnerable to hunters during spring hunting seasons and 46% were vulnerable during fall; all adult males were vulnerable during both seasons.

Offspring observed as cubs had an approximately even sex ratio, 16 males:18 females:3 unknown sex. I rarely attempted to capture cubs, so our sample size was low. The sex ratios I observed in older juvenile age classes tend to be male dominant, but none are significantly different from the male:female ratio I observed for cubs. Yearlings had a sex ratio of 21 males:19 females:3 unknown sex; 2-year-olds, 23 males:19 females:2 unknown sex; and 3-year-olds, 8 males:5 females. Of those 2- and 3-year-olds that were observed at weaning, 26 (56%) were males, 20 (44%) were females, and 1 was of unknown sex. Of 18 litters, 5 were composed of all males, 2 were composed of all females, 15 were composed of mixed-sex litters, and 3 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. (1969, 1976) found 57% of 74 cubs captured during 1959-70 were males, and Knight and Eberhardt (1985) reported that 67% of 24 cubs captured during 1974-82 were males.

Reproductive Biology

Age at First Production of Young:

The mean age at first production of cubs was 6.3 years (n = 10), but the mean age at which females produced cubs that survived was 7.3 years (n = 13). The range of age at which females first produced cubs in this area was from 5 to 7 years, but the age at which females first produced cubs that were successfully reared was 5-10 years (Table 4). Only 2 of 10 5-year-old females were observed with cubs or showed evidence of suckling, although 6 had been observed consorting with males the previous year. Of 10 6-year-old females, 2 produced cubs that survived until fall, 2 had cubs that did not survive, 4 bred and produced cubs as 7-year-olds, 1 was not observed as a 6- or 7-year-old but produced surviving offspring at age 8 years, and 1 did not breed.

Reproductive Interval:

I defined reproductive interval, or reproductive cycle, as the period between weaning of 1 litter by an adult female and the successful rearing and weaning of her subsequent litter (Reynolds and Hechtel 1983, Schwartz and Franzmann 1991). For females producing cubs for the first time, intervals began at the first breeding that resulted in offspring. Years in which a female bred but failed to conceive or lost 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 <u>minimum</u> values of reproductive intervals since 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) defined a cycle as the interval from pregnancy to pregnancy, and Alt (1989) defined it as the interval between births.

Offspring were weaned as 2-year-olds (n = 18 litters) or 3-year-olds (n = 10 litters). Mean minimum reproductive interval, however, was 4.1 years (n = 48), based on those cycles that we observed plus those that were projected by assuming weaning of offspring as 2-year-olds (Table 5). Alternately, a projected minimum cycle length based upon observed proportions of those litters weaned as 2- and 3-year-olds would result in an estimated mean reproductive interval of 4.2 years. All 15 intervals greater than 4 years resulted from interruption of the breeding cycle due to 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 weaning or at the onset of estrus may be important, but with our small sample sizes we were unable to detect any patterns. Nevertheless, conditions present in summer 1982 or winter 1982-83 appear to have prolonged reproductive intervals. Not only were no surviving cubs produced during 1983, but females that were accompanied by 2-year-olds during 1983 tended not to wean those offspring until they were 3 years of age. Of 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, 1 weaned her litter as 2-year-olds but the other 2 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 account for such stochastic events.

Production Success:

Reproductive success, or the proportion of breeding activity by adult females that results in the production of cubs, was 86%. This rate was based on the outcome of 56 observations of breeding activity by 26 individual females ≥6 years of age during 1982-91. In addition, of 8 observations of females that bred at ages 4 and 5 years, 5 produced cubs and 3 did not. Successful reproduction is probably dependent upon an individual female reaching a critical weight or body condition, rather than a critical age, prior to ovulation or implantation (Rogers 1976, Schwartz and Franzmann 1991). 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. There was little difference between 83% reproductive success (n = 24) observed during 1981-85 and 88% observed (n = 24) during 1986-91.

Litter Size:

Mean litter size was 2.14 for 41 litters first observed as cubs, 1.88 for 16 litters first observed as yearlings, and 2.05 for 38 litters observed as yearlings regardless of when they were first observed (Table 6). For comparison, in the Nelchina Basin on the south side of the Alaska Range, Miller (1987, 1990a) found the same mean cub litter size (2.1) but a mean yearling litter size of only 1.7. In the northcentral Alaska Range, the number of females producing cubs varied from year to year, ranging from 1 female producing 1 cub in 1983 to 11 females producing 18 cubs in 1987 (Table 7). Annual cub production was lowest during 1983 and 1986. The poor cub production I observed in 1983 may have been due to failure of berry crops in 1982 as it was in the southcentral Alaska Range (Miller 1984) or to the weather patterns of winter 1982-83, in which little snow fell and temperatures fluctuated widely. Low production was also observed during 1986, when only 8 cubs were produced by the 5 adult females that bred the previous year, but the cause of low production was not known.

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 (H. Reynolds, unpubl. data).

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 16 to 22 (Fig. 3; Tables 4, 7), and the observed annual numbers of cub litters ranged from 1 to 9. From 1982 to 1991, the observed annual number of weaned litters ranged from 1 to 5. This pattern also reflects mortality of entire litters, mostly in cub or yearling age classes.

Recruitment:

Recruitment to the productive segment of the population 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 20-22 productive females in the early spring population during 1982-89, human-caused mortality of 8 adult females during 1989-91 was largely responsible for the decline to 15 by the end of 1991 (Fig. 3; Table 8). Whether this trend will continue will depend on recruitment, survival, and harvest levels. The number of female offspring available to serve as replacements has fluctuated between 2 and 12 (Table 8). The decline in the 3- to

5-year-old age classes during 1986-88 was influenced by the cub cohort failure that occurred during 1983. This will likely result in a future decline in the number of productive females unless the production or survival of young-aged females improves. The number of cubs produced that survived and remained in this area after 5 years illustrates the response of this harvested population to low survival rates: of a minimum of 56 cubs produced during 1981-86, 31 survived until weaning, but only 6 (2 males, 4 females) remained in the area as 5-year-olds (Table 7). Whether this pattern will persist is unclear; a strong cohort in 1987 produced 10 weaned offspring and the 1990 cohort may produce 14 in 1992. If hunting pressure declines or young-aged female survival increases, then recruitment may allow the adult female segment of the population to recover. I found the effect of emigration or immigration on recruitment of 2- to 5-year-old females to be negligible. Males emigrated from their maternal home ranges within 2 years of weaning, but this loss to recruitment may have been compensated for by the gain from young males immigrating to the area (Table 9). (See Movement Patterns section.)

The number of adult males in the population annually has fluctuated from 15 in 1981 to 9 in 1991, with a mean of 12 (Table 9). The number of 4- to 5-year-old males, assumed to be immigrants, has also fluctuated from a low of 2 in 1982 to a high of 8 in 1981 and 1985, with a mean of 4. The loss of the 1983 cub cohort probably affected the decline in the number of 4- and 5-year-old males during 1987-88 and adult male age classes during 1989-91 in the same manner as it did the female segment of the population.

Mortality

From 1981 through 1991 at least 128 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, 20 in 1989, 6 in 1990, and 6 in 1991. Sixty-two grizzlies were killed by hunters, 41 offspring were missing from family groups and presumed dead, 8 died as a result of capture, 5 were killed illegally, 5 were killed in defense of life or property (DLP), 4 were presumed wounding losses (by hunters or DLP), and 3 were natural mortalities for which carcasses were found (Table 10; Appendix F).

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 and has been documented in Alaska in the Brooks Range (Reynolds 1976, 1980; 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 in Canada (Mundy and Flook 1973; Pearson 1975, 1976). Natural mortality rates (i.e., excluding those caused by humans) for offspring under maternal care were 23% for cubs (n = 78), 5% for yearlings (n = 62), and 5% for 2-year-olds (n = 37).

The mortality rate for 39 radio-collared females aged 2 to 25 years, monitored for 142 bear-years, was 11.2% from human-related causes and 2.1% from natural causes. Human-caused deaths included 8 killed by sport hunters, 4 that died after probably being wounded by humans, and 2 that died from capture-related causes. Only 3 of the deaths were not human-caused: 1 female was killed and eaten by an adult male, presumably as a result of defense of her single 2-year-old, 1 had been accompanied by 3-year-old offspring and was found dead and eaten prior to the time she would have weaned her young, and the other was found dead in her collapsed den.

Harvest of grizzly bears by hunters in Game Management Subunit 20A, which includes the study area, was primarily influenced by the length of caribou and moose seasons and secondarily by the length of bear seasons and weather (Fig. 4). Bear harvests during the 1960s declined after the fall season opening changed from 1 to 15 September; it fell again following caribou and moose season reductions. Harvests climbed as moose seasons lengthened and caribou seasons re-opened. Since 1984, grizzly bear seasons have been liberal, but harvest has been influenced more by changes in caribou seasons or caribou movement patterns and rain or inclement flying weather during September. Most grizzly bears were harvested by hunters during caribou or moose hunts and with little apparent selectivity for large adult males.

Sport hunting is a major source of mortality in this population. Prior to 1981, the mean annual harvest ranged from 1 to 14 with a mean take of 5.0 (Table 11). If the population remained relatively stable during 1961-80 and the pre-1981 adjusted minimum density was stable at the 1981 estimate of 2.2 bears/100 km^2 (5.8/100 mi^2), then the average annual harvest rate was approximately 5.6% of the population, with a range of 1.1-16.5%. By comparison, during 1981-91, the mean harvest rate for the minimum population, adjusted for closure and including all human-caused mortalities, was 11% (Table 12). The same harvest rate of 11% was calculated when neither the population nor the harvest was adjusted for closure (Fig. 5). Alternately, if harvest rates are calculated for only those bears $\geq$2 years of age, and adjusted to account for lack of population closure, then the mean mortality rate for the years 1981 through 1991 was 16% (Fig. 6).

During 1981-91, hunter harvest, including those bears killed in defense of life or property, accounted for the deaths of 27 males and 14 females 2 to 5 years of age and 15 males and 11 females $\geq$6 years of age. Adult male and young-aged female grizzly bears were present in the harvest at about the same proportions in which they were present in the population. Young-aged males were twice as likely to be harvested than their presence in the population would suggest and adult females half as likely (Table 13). This pattern indicates little selectivity for large bears by hunters in the area or, if there is selectivity, that it is equally countered by hiding behavior of bears or some other factor. This relationship might not hold for other areas with a smaller rate of harvest or for areas where hunter selectivity is different. Harvest data were pooled over an 11-year period; data for individual years was more variable.

Young males are the most vulnerable segment of the population because of movement and behavioral characteristics (Bunnell and Tait 1980). Adult females are the least vulnerable segment of the population, primarily because hunting regulations prohibit killing females accompanied by cubs (defined as offspring in the first or second year of life; many hunters are hesitant to kill females accompanied by 2-year-olds because they are uncertain of the age of the offspring).

More than a simple calculation of harvest rate is necessary to evaluate the effect of harvest or to correlate harvest rates with population trend. Both Craighead et al. (1976) and Knight and Eberhardt (1984) emphasize 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. Between 1981 and 1988, observed harvest did not result in a decline in the number of adult females. The harvest rate of 6.5%, including all documented human-caused mortality but not natural mortality, apparently led to only minor fluctuations in the 20 to 22 females present in spring populations from 1981 to 1989 (Tables 8, 10, 12). During 1989-91, harvest rates of 14.3%, including unreported wounding loss, will result in a spring 1992 projected adult female population of only 15. Unless the adult female population recovers, it is probable that with this loss of productive capacity the population will decline further. The estimated population within the study area has already declined from an adjusted minimum of 71 in 1981 to 52 in 1991. Based on only those bears $\geq$2 years of age, the trend is similar, but apparently more severe; minimum adjusted estimates were 54 bears in 1981 and 33 bears in 1989 (Table 3).

The recovery of the population will be dependent upon lower rates of mortality of female adults and the young age classes that act as replacements for those adults that die. During the same 1981-91 period, the number of females in the 3- to 5-year-old age class fluctuated from 12 in 1982 to 4 in 1989, and then recovered to 8 by 1991. If survival in this age class is high, the number of adult females could recover to its previous level by 1994 or 1996.

Compensatory Production or Survival in Response to Harvest

Although compensatory changes in production or survival rates may occur in reduced populations, as hypothesized by Stringham (1983) and McCullough (1981), such responses to harvest have yet to be documented for grizzly bears. On the south side of the Alaska Range in Game Management Unit 13, no compensatory responses were identified in a heavily harvested and declining grizzly bear population (Miller 1990b).

While compensatory response to reduced populations could take the form of increased production and survival of any sex and age class in the population, recovery of the adult female segment is probably most important (Knight and Eberhardt 1984; McLellan 1989b,c; Miller 1990c).

Recovery of the productive female segment of the population in the study area would depend on either a reduction in the human-caused mortality rate (harvest, defense of life or property kills, and wounding loss) of adult females and/or 3- to 5-year-old females, or on compensatory changes in population production and/or survival of females. The most likely mechanisms of compensatory changes are (1) increased litter size production, (2) increased survival to weaning, (3) decreased reproductive interval, or (4) decreased age at first production of young.

Evidence for compensatory mechanisms were equivocal at the present level of exploitation in this study area. Mean litter size was 2.06 (n = 18) during 1982-86 compared with 2.21 (n = 24) during 1987-91. This difference is the result of a higher proportion of 1-cub litters produced in the earlier period; however, factors responsible for the failure of cub production during 1983 may also have affected litter sizes. It was not appropriate to compare total production of cubs between the 2 periods because more females were under observation during the latter period. Survival rate of cubs during their first year of life was 0.69 (n = 35) in the 1982-86 period compared with 0.80 (n = 22) in the 1987-91 period. Again, factors that affected loss of the 1983 cohort may also have affected cub survival in the earlier period, especially since survival rates of yearlings were 0.85 during both periods (n = 33, 1982-86; n = 41, 1987-91). Difference in reproductive interval length between the 2 periods is not a meaningful measure because interval lengths span from 3 to 10 years and overlap both time spans. However, both mean age of offspring at weaning and a comparison of the number of litters weaned as 2- and 3-year-olds may also serve as meaningful indicators of differences in reproductive intervals. The mean age at weaning was 2.45 years (n = 24) during 1982-86 and 2.25 years (n = 16) during 1987-91. Similarly, 55% of litters (n = 11) were weaned as 2-year-olds during 1982-86 compared with 75% (n = 16) during 1987-91. However, both of these measures could have been affected by factors responsible for the failure of the 1983 cub cohort as well; only 17% (n = 6) of females accompanied by yearlings or 2-year-olds during 1983 weaned their young as 2-year-olds. Age of reproductive maturity did not change between the 2 periods. Females produced their first litters, regardless of cub survival, at a mean age of 6.4 years (n = 5) during 1982-86 and 6.5 years (n = 4) during 1987-91. Similarly, they produced their first surviving litters at a mean age of 7.0 years (n = 4) during 1982-86 and 7.4 years (n = 5) during 1987-91. None of these measures can be used convincingly as evidence for compensatory response to the reduced population, but neither can they be used to refute it.

CONCLUSIONS AND RECOMMENDATIONS

Major findings for the 1981-91 period included the following:

1. Minimum estimated population size, adjusted for closure, was 71 in 1981 but declined to 52 by 1991. The estimated minimum population size $\geq$2 years of age, adjusted for closure, was 54 in 1981 and 33 in 1991. Densities resulting from these estimates for the 1991 population were 1.65 bears/100 km^2 and 1.04 bears $\geq$2 years of age/100 km^2. These estimates were based on numbers of marked bears, unmarked offspring of marked females, and hunter-killed bears in the population, with estimates of the proportions of each bear's home range lying outside the study area subtracted from the total to account for closure. During 1986, a capture-recapture density estimate resulted in a density of 1.12 bears $\geq$2 years of age/100 km^2 (95% CI = 1.25-3.35/100 km^2).

2. Human-caused mortality (including hunting, defense of life or property, illegal, wounding, and capture-related deaths) was 11% of both the minimum estimated population and the minimum estimated population adjusted for closure. Mean harvest rate was 16% of the estimated population $\geq$2 years of age and adjusted for closure. Harvest rates of 8% were observed for adult radio-collared females.

3. In this study area, regulation of ungulate seasons affected grizzly bear harvest by hunters more than regulation of bear seasons. Little selectivity by hunters was apparent in the sex or age of bears killed; most were taken as they were observed during caribou or moose hunts.

4. In the productive core of the population, only minor fluctuation from 20 to 22 adult females occurred with human-caused mortality of 6.5% during 1981-88. Following increased harvest of 14.3% during 1989-91, including wounding mortality, the estimated adult female population will decline to 15 by 1992.

5. Mean natural mortality rates observed during 1982-91 were 23% for cubs-of-the-year, 5% for yearlings, 5% for 2-year-olds, and 2% for adult females.

6. Regaining former population size will require recovery of the adult female segment of the population. This will depend on either a reduction in the human-caused mortality rate (harvest, defense of life or property kills, illegal take, and wounding loss) of adult females and/or 3- to 5-year-old females, or on compensatory changes in population production and/or survival of females.

7. Evidence for compensatory mechanisms at the present level of exploitation in this study area were equivocal. The differences in reproductive performance that were observed may have been in part related to conditions in 1982-83 that resulted in the failure of cub production in 1983.

8. In this heavily harvested population, no young females emigrated from the vicinity of their maternal home range and all adult females remained faithful to their established home ranges. All males captured as 2- or 3-year-olds emigrated from their maternal home range or area of capture within 2 years. No adult male emigration from established home ranges was documented; 2 were killed outside the study area in areas that included their home range.

9. If these patterns hold true for other populations, sustained yield management of grizzly bear populations near areas closed to hunting (often viewed as population reservoirs) should not allow higher rates of female harvest on the perimeter of the closed areas.

10. The grizzly bear population in this area was a productive one: mean age at first production of young was 6.3 years, breeding or production success was 86%, initial litter size was 2.14 cubs, litter size at weaning was 2.0 2- or 3-year-olds, and reproductive interval was 4.1 years.

Continuation of this study should enable us to answer the following questions.

1. Will the mark-recapture density estimate to be conducted in 1992 confirm the population reduction estimated by currently used methodology?

2. Will continued harvest at current or reduced levels result in a further decline in population size?

3. Can presently available population models be used to confirm observed patterns of population change that occurred in this study? If not, can they be modified or a better model be developed to more accurately predict the changes that occur in populations harvested at various rates?

4. If population recovery begins to occur in this study area, what mechanisms or changes in reproduction, survival, and harvest will be most responsible?

5. For grizzly bear populations a harvest rate of 4-6% is generally accepted as allowing maximum sustained yield. Using population modeling based on data gathered from this study, can higher rates be safely harvested if managed to minimize female mortality?

The answers to these questions should allow managers to better predict the effects of high levels of bear harvest, to better predict the length of time necessary for population recovery, and to assess the impacts of various levels of harvest on grizzly populations.

Therefore, I recommend that the mean harvest rates that began during the early 1980s be reduced to 3% of adult females and no more than 6-8% of bears $\geq$2 years of age until at least 1995. Concurrently, research effort should continue to monitor the dynamics of this population to document any recovery of numbers of adult females or 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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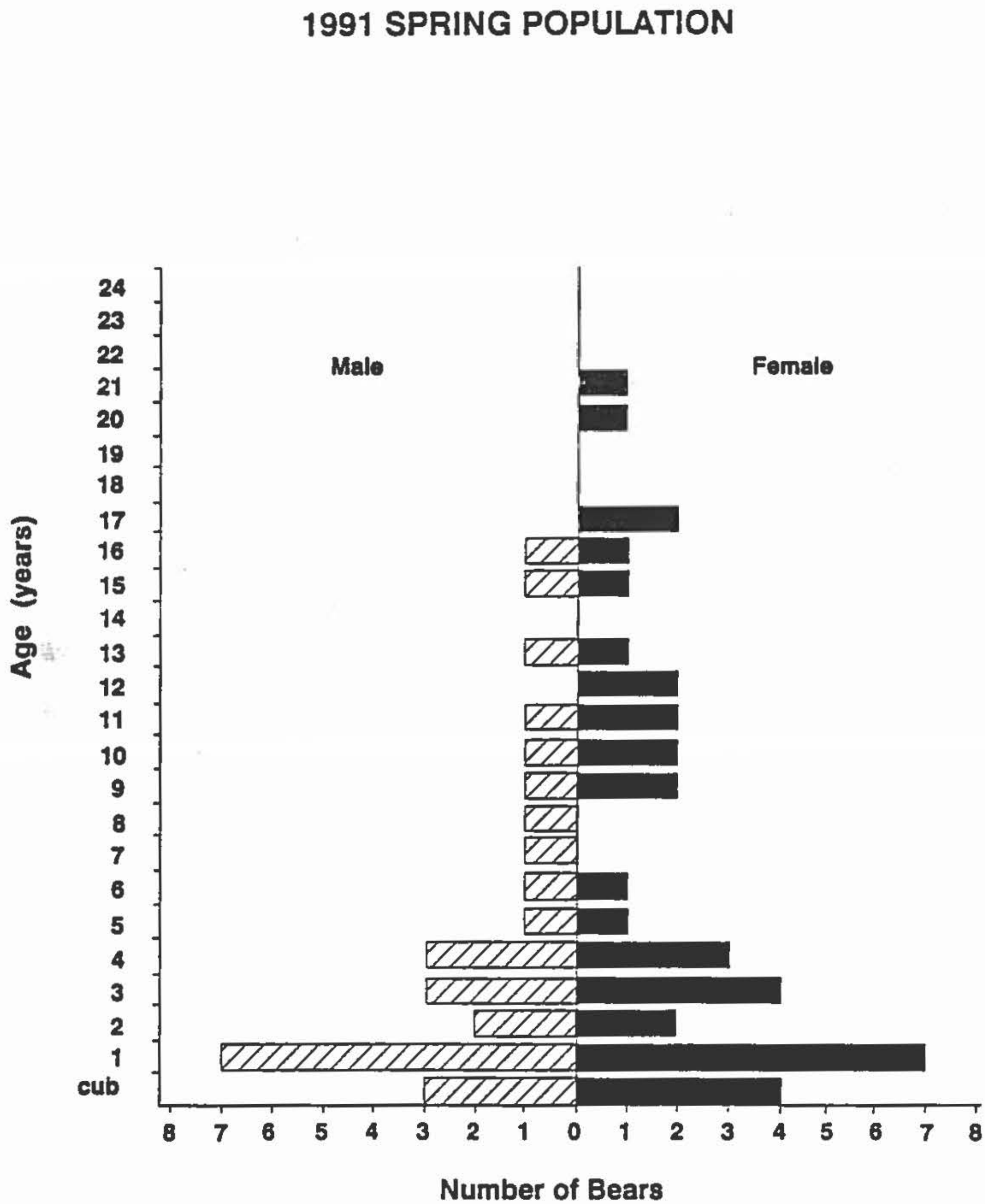

Figure 1. Sex and age structure of grizzly bears known or assumed present on the northcentral Alaska Range, spring 1991.

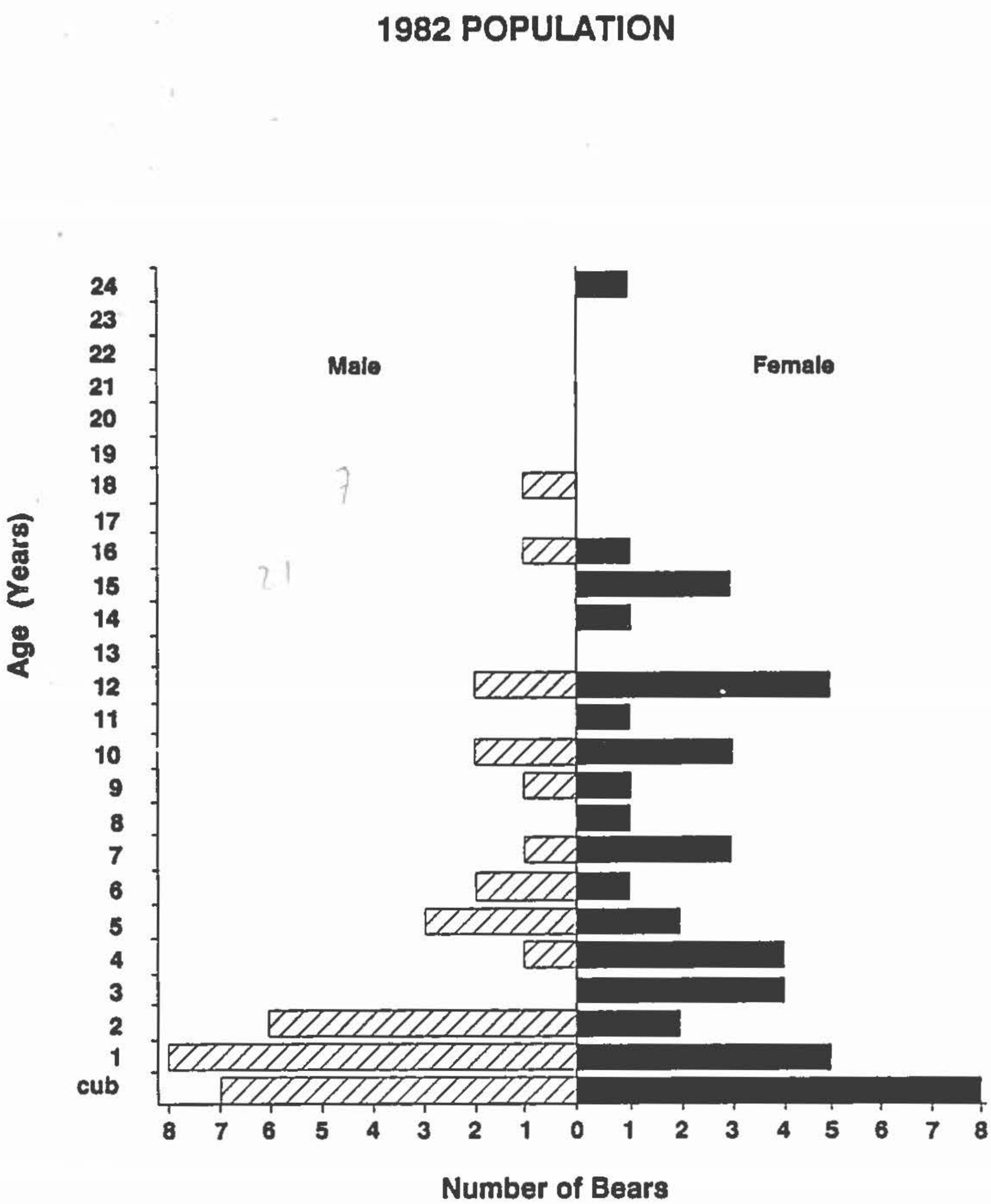

Figure 2. Sex and age structure of grizzly bears known or assumed present in the northcentral Alaska Range, spring 1982.

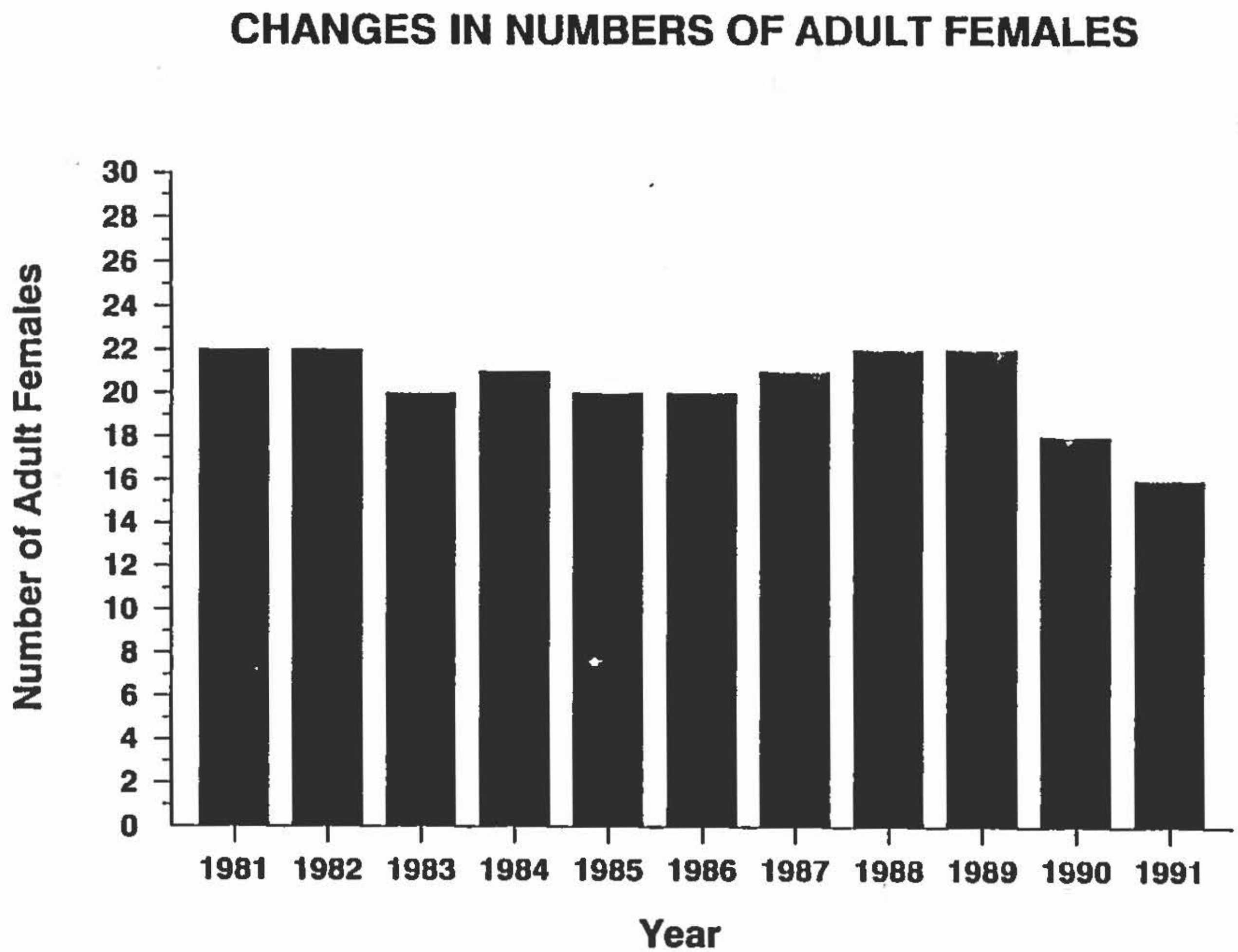

Figure 3. Numbers of adult female grizzly bears present in the northcentral Alaska Range, 1981-91.

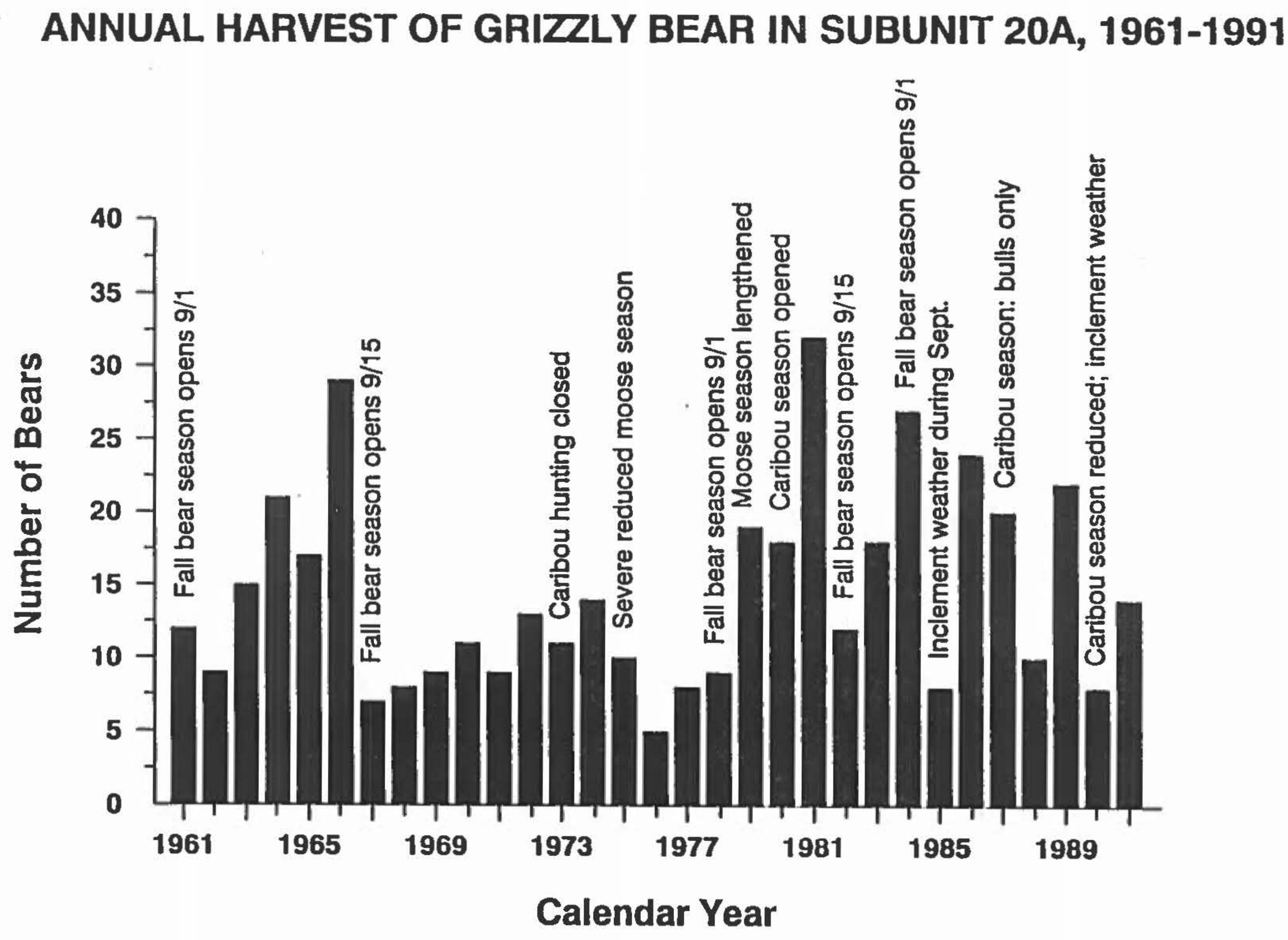

Figure 4. Annual harvest of grizzly bears in Game Management Subunit 20A, 1961-91.

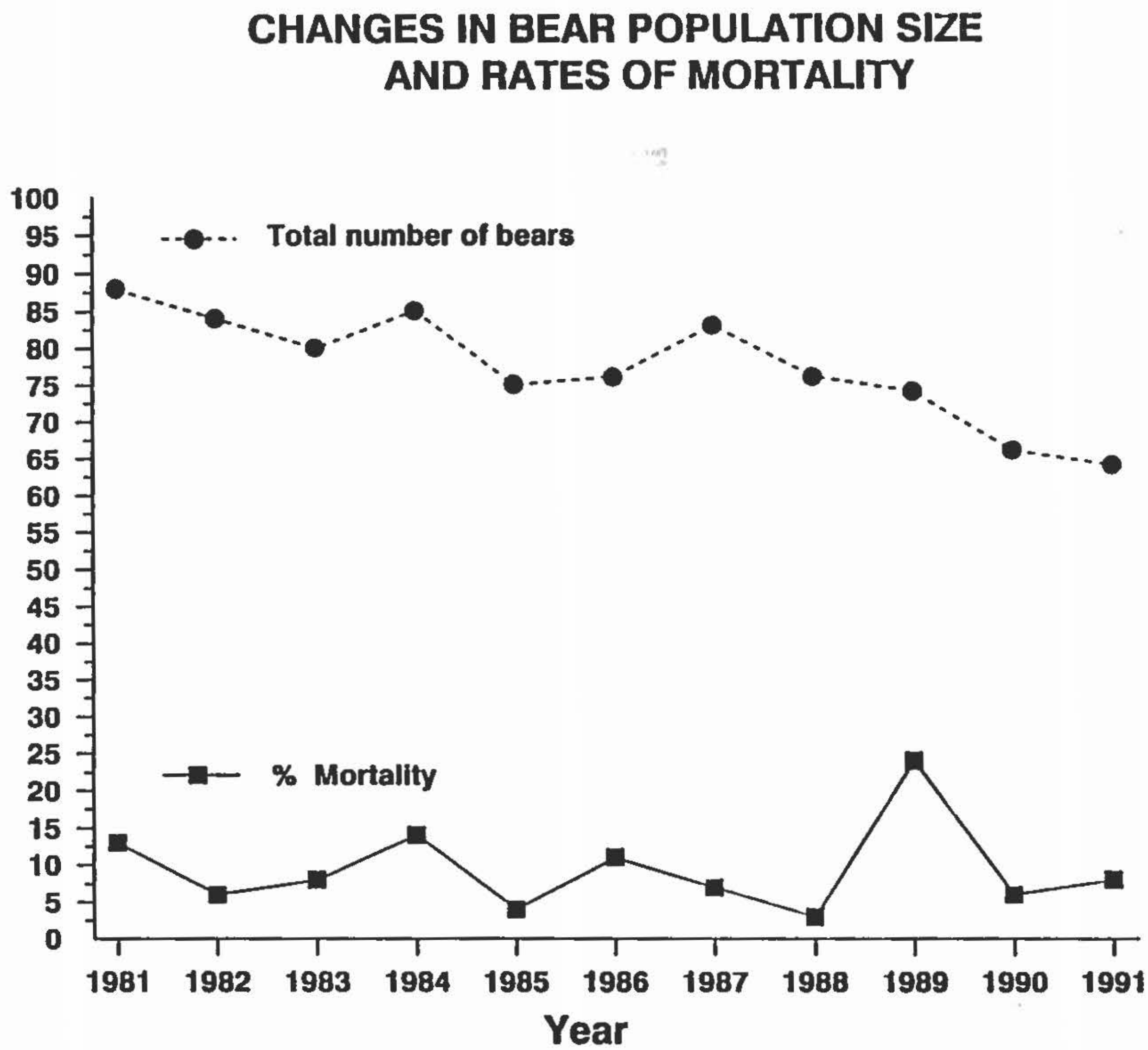

Figure 5. Estimated population size and mortality rates in the northcentral Alaska Range, 1981-91.

CHANGES IN BEAR POPULATION SIZE FOR ≥ 2 YEAR OLDS AND RATES OF MORTALITY

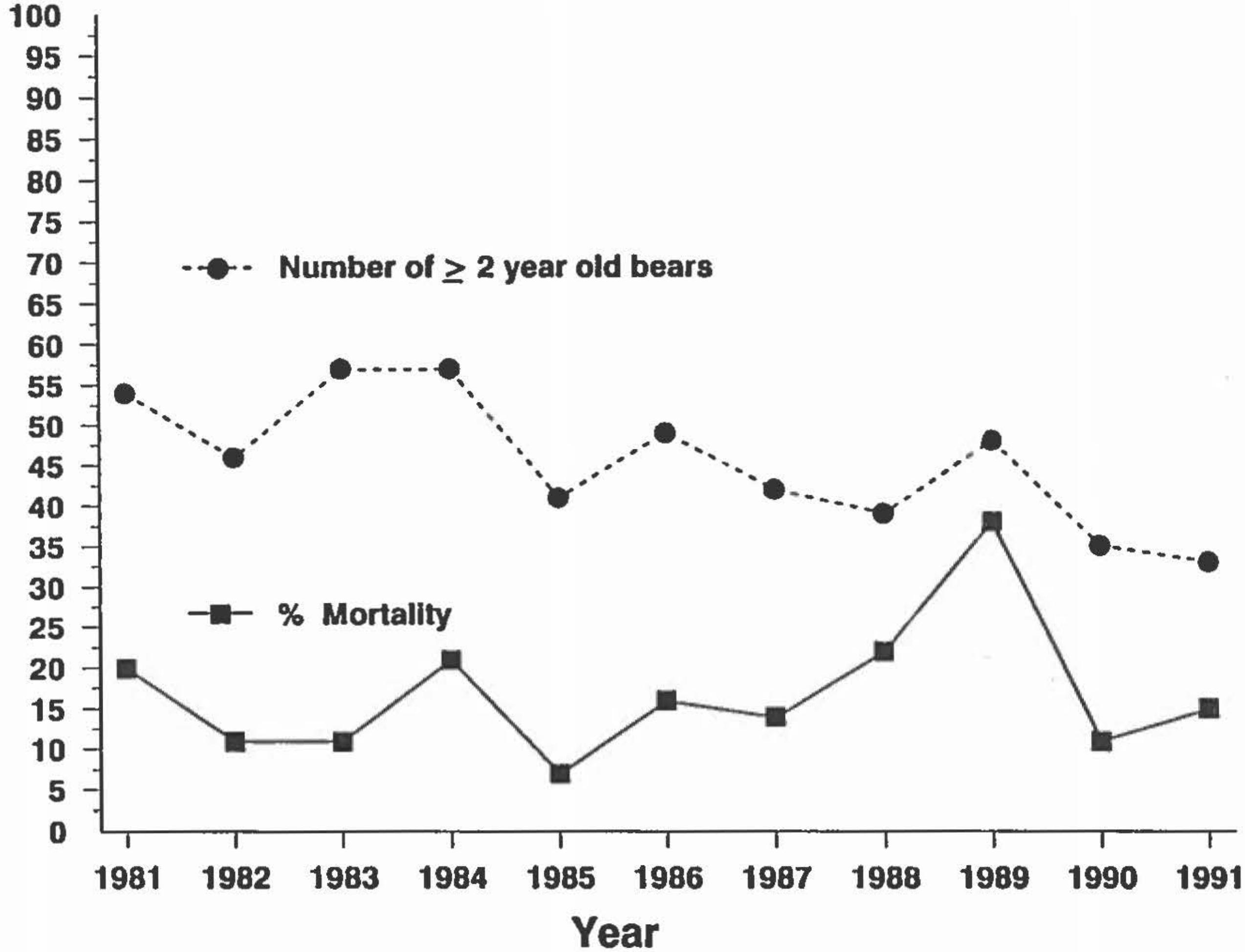

Figure 6. Population size and mortality rate of grizzly bears ≥2 years of age in the northcentral Alaska Range, 1981-91.

Table 1. Capture and marking characteristics of 115 bears captured in the northcentral Alaska Range, 1981-91.

Bear no. and sex	Cem. age (yr)	Date of capture	Weight kg (lb)	Location	Drug dosage[a]	Ear tags[b]	Marks[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/lB
	11	5/12/89	109(241)	Buchanan Creek	4.5 TEL M	339/340	O/lB
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
	12	5/31/91	95(210)	Upper Moose Creek	1.0 TEL L	104/104	Y/W
1304 M	5	6/19/81	136(300)	West Fork Delta	2.4/2.0 M	451/452	lB/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/--
	15	6/1/91	272(600)	West Fork Delta	9.6 TEL M	136/137	W/mG
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/lB
1307 M	2	5/24/82	44(98)	West Fork Delta	1.0/1.0 H	3087/3152	lB/G
	5	6/17/85	114(250)[d]	Sheep Creek	2.4/2.6 L	3087/3152	lB/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
	15	5/6/91	125(275)	Dry Creek	6.0 TEL M	150/149	W/R
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
	21	6/3/91	125(275)	Molybdenum Ridge	5.5 TEL M	139/140	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/lB

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]
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/-
1316 M	11	6/7/82	236(520)	West Fork Delta	3.8/0.0 H	3089/3090	O/lB
1317 F	3	6/8/82	36(80)	Forgotten Creek	1.2/1.8 L	3091/3003	lB/O
	5	5/16/84	55(122)	Upper West Fork	A L	3486/3239	lB/O
	6	5/23/85	59(130)	Upper Wood River	7.0 M99	497/498	lB/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 Mountain 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	lG/W
1322 F	8	6/9/82	91(200)	Sheep Creek	1.9/2.1 M	3051/3159	W/lB
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

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]
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
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
	12	5/15/90	111(245)	Trident Glacier	6.0 TEL H	196/197	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	lB/W
	7	5/17/84	168(370)	East Fork Delta	6.0 M99 H	3254/3398	lB/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/
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/B
1344 M	2	5/24/83	56(123)	Threemile Creek	0.6/1.2 M	3361/3433	lB/Bk
	3	6/23/84	123(270)	Hayes Creek	2.2/3.2 M	475/460	lB/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]
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
1346 M	5	5/25/83	114(250)	Hayes Glacier	A M	3359/3356	lB/lB
	12	5/14/90	--	Trident Glacier	10.5 TEL M	192/193	mG/mG
	13	6/1/91	249(550)	Upper Buchanan Creek	11.0 TEL M	192/193	mG/mG
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
	19	5/12/90	141(310)	Gold King	6.0 TEL M	117/118	W/O
	20	5/9/91	120(265)	SW Gold King	11.0 TEL H	117/118	W/O
1349 M	18	6/2/83	264(580)	O'Brien Creek	3.8/1.2L	3364/3292	R/lB
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	lB/dB
	15	5/20/86	236(520)	Trident Glacier	3.4/2.0 L	297/296	lB/dB
1359 M	3	5/28/85	61(134)	Snow Mountain Gulch	4.0 M99 M	489/488	dB/O
1360 F	10	5/28/85	95(210)	Snow Mountain Gulch	7.0 M99 H	None	None

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]
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/lB
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	lB/G
1366 M	8	7/22/85	234(515)	Tatlanika River	3.2/1.0 M	390/391	mG/R
1367 M	2	5/19/86	61(134)	Threemile Creek	1.4/2.0 M	400/241	lB/W
1368 F	2	5/19/86	48(106)	Threemile Creek	1.4/2.0 M	257/256	lB/lB
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	lB/O
	5	5/17/89	186(410)	Chute Creek	7.0 TEL M	310/309	lB/O
1373 M	7	5/21/86	193(425)	Delta Creek	4.0/2.0 M	295/294	lB/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	lG/lB
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	9.0 TEL L	439/440	O/W
	11	5/31/91	295(650)	Threemile Creek	14.0 TEL H	146/440	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	lB/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]
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
	4	5/11/90	95(210)	Upper Wood River	A TEL H	--	--
	5	6/2/91	118(260)	West Fork Delta	5.5 TEL M	108/107	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
	4	6/7/90	120(265)	Upper Wood River	7.0 TEL H[h]	790/791	Bk/Y
	5	5/31/91	156(345)	West Fork Delta	6.0 TEL H[h]	790/791	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)	Rogers Creek	3.4 TEL M	337/338	Y/R
	4	5/15/90	84(185)	Sheep Creek	A TEL M	190/191	--
1388 M	2	5/25/88	68(150)	Dry Creek	2.5 TEL M	153/154	Y/1B
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
	3	5/12/90	95(210)	Dry Creek	3.8 TEL M	333/334	O/mG
	4	5/7/91	109(240)	Forgotten Creek	5.5 TEL H	109/110	O/mG
1392 M	2	5/13/89	89(195)	Dry Creek	2.8 TEL M	341/342	1G/O
1393 M	2	5/17/89	66(145)	Molybdenum Ridge	3.5 TEL H	326/325	Bk/1B
	3	5/14/90	100(220)	Trident Glacier	4.4 TEL M	326/325	Bk/1B
1394 F	2	5/17/89	59(130)	Molybdenum Ridge	3.5 TEL -	331/332	1B/Bk
1395 M	2	5/17/89	86(190)	Molybdenum Ridge	3.1 TEL M	302/301	dkB/W
1396 M	13[d]	5/18/89	295(650)	Molybdenum 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/1B

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]
1601 M	7[d]	6/9/89	193(425)	Whistler Creek	6.5 TEL M[h]	782/785	Gr/Y
	9[d]	5/7/91	245(540)	Slate Creek	13.0 TEL L	125/126	Gr/Y
1602 M	7[d]	5/13/90	166(365)	Molybdenum Ridge	A TEL M	122/121	1B/Gr
1603 F	2[d]	5/13/90	55(120)	Hayes Creek	3.6 TEL H	141/142	1B/dB
	3[d]	5/8/91	70(155)	Whistler Creek	3.6 TEL M	128/127	
1604 F	2	5/13/90	48(105)	Buchanan Creek	3.4 TEL M	119/120	1B/R
	3	5/7/91	59(130)	Buchanan Creek	4.0 TEL H	101/120	1B/R
1605 F	2	5/13/90	59(130)	Buchanan Creek	3.6 TEL M	213/150	mG/1B
	3	5/8/91	68(150)	East Fork Delta	3.6 TEL M	213/293	mG/1B
1606 M	2	5/13/90	50(110)	Buchanan Creek	A TEL M	143/144	R/dB
	3	5/8/91	70(155)	Gilliam Glacier	3.6 TEL M	143/144	R/dB
1607 F	10[d]	5/14/90	141(310)	Glacier Creek	5.5 TEL M	188/189	W/1B
1608 F	16[d]	5/14/90	136(300)	Trident Glacier	5.5 TEL M	184/-	1G/-
1609 F	2[d]	5/14/90	61(135)	Trident Glacier	3.2 TEL M	103/104	dB/mG
	3[d]	5/7/91	77(170)	Trident Glacier	4.0 TEL M	103/102	dB/mG
1610 F	2	5/6/91	70(155)	Threemile Creek	3.4 TEL M	116/115	O/R
1611 M	2	5/6/91	91(200)	Threemile Creek	3.4 TEL M	106/105	Gr/O
1612 F	2	5/6/91	73(160)	Threemile Creek	3.4 TEL M	131/132	Y/mG
1613 M	6	6/2/91	177(390)	Wood River	12.0 TEL M	131/130	R/O
1614 M	3[d]	6/1/91	109(240)	Hayes Creek	12.0 TEL H	144/145	1G/1G
1615 M	4[d]	6/3/91	125(275)	Hayes Creek	5.5 TEL H	112/111	R/W

[a] Dosage in ml. No designation indicates use of phencyclidine hydrochloride/acepromazine maleate at 100 mg/ml concentration; use of M-99 is designated M99 at 1 mg/ml concentration; use of Telazol at 200 mg/ml concentrations 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.

Table 1. Continued.

[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.

[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 Telazol administered at a concentration of 300 mg/ml, instead of the usual 200 mg/ml.

Table 2. Movement of young-age bears from their maternal home ranges (MHR) subsequent to weaning or from their established home range (EHR) at capture as a 2- or 3-year-old, northcentral Alaska Range, 1981-91.

Maternal female No.	Offspring No. and sex	Age when weaned	Age/year during movement	Movement pattern
1302	1604 F	2	2/1990	Within MHR
			3/1991	Moved 34 km E of MHR, returned
	1605 F	2	2/1990	Moved 15 km SW of MHR, returned
			3/1991	Within MHR
	1606 M	2	2/1990	Within MHR
			3/1991	Within MHR
1305	1306 M	2	2/1982	Within MHR
			3/1983	Within MHR
			4/1984	Killed by hunter 5/20/84 in MHR
	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
			10/1990	Status unknown
			11/1991	Status unknown
1308	1391 F	2	2/1989	Within MHR
			3/1990	Within MHR
			4/1991	Within MHR
	1392 M	2	2/1989	Within MHR
			3/1990	Status unknown
			4/1991	Status unknown
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
			6/1990	Status unknown
			7/1991	Status unknown
	1378 F	2	2/1986	Killed by hunter 5/25/86 prior to weaning

Table 2. Continued.

Maternal female No.	Offspring No. and sex	Age when weaned	Age/year during movement	Movement pattern
	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
			5/1990	Killed by hunter 4/22/90 46 km SE of MHR
	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
	1379 F	2	2/1987	Within MHR
			3/1988	Within MHR
			4/1989	Within MHR
			5/1990	Status unknown, shed collar
			6/1991	Status unknown
	1381 M	2	2/1987	Killed by hunter 9/8/87 in MHR
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
			9/1990	Adjacent to MHR; with 2 cubs
			10/1991	Adjacent to JHR; with 2 yearlings
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
			8/1990	Within MHR; with 2 cubs
			9/1991	Within MHR; with 2 yearlings
	1325 M	2	2/1984	Within MHR; killed in defense of life or property 9/9/84

Table 2. Continued.

Maternal female No.	Offspring No. and sex	Age when weaned	Age/year during movement	Movement pattern
1324	1389 M	2	2/1989	Status unknown, shed collar 38 km S of MHR
			3/1990	Assumed emigrated
	1390 F	2	2/1989	Within MHR
			3/1990	Killed by hunter 5/18/90 in MHR
1329	1330 M	2[a]	2/1983	Within MHR
			3/1984	Moved outside MHR?; no radio contact
			4/1985	Status unknown, assumed emigrated
			5/1986	Status unknown, assumed emigrated
1331	1603 F	2	2/1990	Within MHR
			3/1991	Within MHR
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
	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
	1371 M	2	2/1986	Killed by hunter 9/7/86 in MHR
1345	1385 F	3	3/1989	Within MHR
			4/1990	Within MHR
			5/1991	Within MHR
	1386 M	3	3/1989	Within MHR
			4/1990	Within MHR
			5/1991	Stayed in MHR in June, moved 38 km SE by 10/12/91
1348	1367 M	2	2/1986	Killed in defense of life or property 6/28/86 in MHR
	1368 F	2	2/1986	Killed in defense of life or property 5/31/86 in MHR

Table 2. Continued.

Maternal female No.	Offspring No. and sex	Age when weaned	Age/year during movement	Movement pattern
	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
	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
			8/1990	Status unknown
			9/1991	Killed by hunter; with 2-yr-old offspring in MHR
1352	1353 M	2[b]	2/1984	Killed by hunter 9/4/84 in MHR
	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, assumed emigrated
			5/1987	Status unknown, assumed emigrated
	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, assumed emigrated
			6/1987	Status unknown, assumed emigrated
			7/1988	Status unknown
1362	1387 F	2	2/1988	Within MHR
			3/1989	Within MHR
			4/1990	Killed illegally? in MHR
	1388 M	2	2/1988	Within MHR
			3/1989	Status unknown, shed collar
			4/1990	Status unknown, assumed emigrated
			5/1991	Status unknown, assumed emigrated
1376	1393 M	3	3/1990	Within MHR
			4/1991	Status unknown

Table 2. Continued.

Maternal female No.	Offspring No. and sex	Age when weaned	Age/year during movement	Movement pattern
	1394 F	3	3/1990	Status unknown, collar failed
			4/1991	Status unknown
1398	1397 F	2	2/1989	Within MHR
			3/1990	Status unknown
			4/1991	Status unknown
	1399 M	2	2/1989	Killed by hunter 16 km W of MHR
1607	1610 F	2	2/1991	Within MHR
	1611 M	2	2/1991	Killed by hunter 19 km W of MHR
	1612 F	2	2/1991	Within MHR
1608	1609 F	2	2/1990	Within MHR
			3/1991	Within MHR
Unk	1302 F	2-3[d]	3/1981	Within EHR
			4-7	Shed collar 8/81, no contact until 1986 recapture
			8/1986	Within EHR
			9/1987	Within EHR
			10/1988	Within EHR; with 3 cubs
			11/1989	Within EHR; with yearlings
			12/1990	Within EHR; weaned 3 2-yr-olds
			13/1991	Within EHR; with 1 cub
Unk	1303 F	2	2/1981	Within EHR
			3/1982	Within EHR
			4/1983	Within EHR
			5/1984	Within EHR
			6/1985	Within EHR
			7-11	Status unknown
			12/1991	Adjacent to EHR, with cubs
Unk	1340 F	2-3[d]	3/1983	Within EHR
			4/1984	Within EHR
			5/1985	Within EHR, shed collar
			6-11	Status unknown
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

Table 2. Continued.

Maternal female No.	Offspring No. and sex	Age when weaned	Age/year during movement	Movement pattern
Unk	1356 M	Unk	3/1984	Moved 74 km ESE of den area between 4/27 and 5/20/84 when killed by hunter
Unk	1377	2	2/1986	Within EHR
			3/1987	Shed collar 83 km W of EHR by 5/18/87
			4/1988	Status unknown, assumed emigrated
			5-6	Status unknown
			7/1991	Killed by hunter 103 km W of EHR
Unk	1383	2	2/1987	Within EHR
			3/1988	Shed collar, status unknown
			4/1989	Status unknown, assumed emigrated
Unk	1614	2-3[d]	3/1991	Within EHR

[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, weaned as 2- or 3-year-old.

Table 3. Estimate of the minimum spring grizzly bear population size in the northcentral Alaska Range, 1981-91.[a]

Bears alive during spring of year[b]	1981			1982			1983			1984			1985			1986			1987			1988			1989			1990			1991		
	N	Adj	≥2	N	Adj	≥2	N	Adj	≥2	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	45	40	38	57	49	38	63	53	51	62	54	53	49	40	40	54	45	45	49	39	39	45	37	37	53	43	43	44	35	35	42	34	31
Unmarked young with marked mothers	12	12	0	13	13	0	7	7	0	15	15	1	20	20	0	13	13	0	26	24	0	25	23	0	14	14	0	20	19	0	17	21	0
Unmarked bears killed by hunters	26	19	16	14	9	8	10	7	6	7	4	3	6	3	1	9	5	4	8	5	3	7	5	2	7	5	5	2	2	0	2	2	2
Minimum observed population	83	71	54	84	70	46	80	67	57	85	73	57	75	63	41	76	63	49	83	68	42	76	65	39	74	62	48	66	56	35	65	53	33

[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 to age 4 years for adult males and to birth for bears captured at age 2 or 3 years.

Table 4. Reproductive status and litter sizes of potentially mature females in the northcentral Alaska Range, 1981-91.

Bear No.	Age in 1991[a] (yr)	Offspring No.	Reproductive status[b] 1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	Reproductive history
1302	13	1604, 1605, 1606, 1UM	NB	UN	UN	UN	UN	B	B	3cb	3ylg	3 2yr/B	1cb	No offspring prior 1986
1303	12	1364, 1UM 2UM	NB	NB	B?	B	2cb/B	UN	UN	UN	UN	UN/B	2cb	No offspring prior 1981; lost 2 cubs 1985, lost 1 cub 1991
1305	25	1306, 1307	2ylg	2 2yr/B D										Hunter kill fall 1982
1308	15	2UM, 1391, 1392, 3UM		?/B	B	2cb	2ylg	1 2yr/B	2cb	2ylg	2 2yr/B	3cb	2ylg	Offspring 1982 or before; lost 1 ylg 1985; 1 cub 1990
1311	21	1312, 1313, 1372, 1378, 1UM, 1395, 2UM	UN/B	2cb	B	2cb	2ylg	2 2yr/B	2cb	2ylg	2 2yr/B	2cb	2ylg	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/D			Lost cub 1982; dead August 1990
1320	24	1UM, 3UM, 2UM		?/B	1cb/B?	B	3cb	B	2cb	1ylg	B/D			Weaned or lost offspring 1982; lost cub 1983; lost 3 cubs 19851; lost 1 cub 1987; lost 1 ylg 1988; dead fall 1989
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/D			1342 killed illegally fall 1983; lost 1 ylg 1983; lost 3 cubs 1988
1322	17	1336	UN/1+cb	1ylg	1 2yr	1 3yr/B	UN	UN	UN	UN	UN	UN	B?/D	Hunter kill fall 1991
1323	18	1324, 1325 2UM	UN/B	2cb	2ylg	2 2yr/B	UN	UN/B	2+cb	2+ylg	2 2yr/D			DLP kill[b] fall 1989
1324	9	1389, 1390, 2UM		NB	NB	NB	UN/NB?	UN/B	2+cb	2ylg	2 2yr/B	2cb	2ylg	

Table 4. Continued.

Bear No.	Age in 1991[a] (yr)	Offspring No.	Reproductive status[b] 1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	Reproductive history
1326	8	1UM		NB	B	B	1cb	B/D						No offspring prior 1982; lost cub 1985; hunter kill 1986
1327	18	1328, 1UM, 3UM	UN/2+cb	2ylg	B	3cb/D								1UM ylg capture mortality; lost 1328 in 1982; 1327 capture mortality? 1984
1329	14	1330	UN/1+cb	1ylg	1 2yr/D									Killed by male May 1983
1331	12	1UM, (1603)?		NB	B	UN	UN/B	UN/1+cb	1ylg/B	1+cb	1ylg	1 2yr/B/D		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	10	2UM, 3UM			NB	NB	B	B	2cb	2ylg	B	3cb	2ylg	No offspring prior 1983; lost 2 ylg 1988; 1 cub 1990
1340	11				NB	NB	B	UN	UN	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/D			Lost ylg 1983; lost 2 cubs 1988; dead fall 1989
1345	16	2UM, 1385, 1386, 3UM			B	2cb	1ylg/B	2cb	2ylg	2 2yr	2 3yr/B	3cb	3ylg	Lost 1 cub 1984; lost 1 ylg 1985
1348	20	1367, 1368, 1369, 2UM, 1UM, 3UM			?/B	3cb	3ylg	3 2yr/B	2cb	2ylg/B	1 cb/B	3cb	3ylg	Probably weaned or lost offspring 1983; lost 2 ylg 1988; lost 1 cub 1989
1351	18	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	15	1353, 1354	UN/B	UN/2+cb	2ylg	2 2yr/D								Hunter kill 1984; 1353 hunter kill 1984

Table 4. Continued.

Bear No.	Age in 1991[a] (yr)	Offspring No.	Reproductive status[b] 1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	Reproductive history
1360	10	1359, 1363	UN/B	UN/2+cb	UN/2+ ylg	UN/2+ 2yr	2 3yr/D							Capture mortality 1985
1361	9	1+UM				NB	NB	NB	UN	UN/B	1+cb	1+ylg	1 2yr/D	No offspring prior 1985; both 1361 and 2yr hunter kills 1991
1362	12	1387, 1388				UN	B	2cb	2ylg	2 2yr/B	B	UN	UN	No offspring prior 1985
1374	11	2UM, 2UM, 3UM				UN/B	UN/2+cb	2ylg	?/B	2+cb	2ylg	2 2yr/B	3cb	
1376	18	1393, 1394					UN	?/B	2cb	2ylg	2 2yr	2 3yr/D		Offspring prior 1986; dead spring 1990
1379	6									NB	B	UN	UN	Dropped collar spring 1990
1385	5											NB	NB	
1391	4											NB	B	
1398	10	1397, 1399, 2UM						?/B	2+cb	2+ylg	2 2yr/B	UN/B	2cb	
1603	3											NB	B	
1607	10	1610, 1611, 1612								?/B	3+cb	3ylg	3 2yr/B	
1608	16	1609?, 2UM							UN/B?	1+cb?	1+ylg?	1+ 2yr?/B	2cb	Assumed 1609 was offspring from strong circumstantial evidence

[a] Age in 1991 <u>or</u> last year in which bear was alive.

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

[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 5. Observed and projected minimum reproductive intervals for adult female grizzly bears in the northcentral Alaska Range, 1981-91.

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	Year 12	Year 13
1302	7	5	B?	B	B	C	Y	2/B	C	Y	2/B				
1303	5	5,5	B	C/B	B	C	Y	2/B	?	?	C	Y	2/B		
1305	22	3	W/B	C	Y	2/B/D									
1308	6	4,3,3	C?/B	B	C	Y	2/B	C	Y	2/B	C	Y	2/B		
1311	10	5,3,3	W/B	C	B	C	Y	2/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/D	Y	2/B		
1320	17	10	W/B	C/B?	B	C	B	C	Y/B?	B/D	C	Y	2/B		
1321	14	4,3,5	W/B	C	Y	2	3/B	C	Y	2/B	C	B/D	C	Y	B
1322	6	4	B	C	Y	2	3/B								
1323	11	3,6	W/B	C	Y	2/B	?	?/B	C	Y	2/D	3/B			
1324	5	3,3	B	C	Y	2/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/D							
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/D	Y	2/B		
1345	8	6,3	B	C	Y/B	C	Y	2	3/B	C	Y	2/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								
1361	6	4	B	C	Y	2/D	3/B								
1362	6	3,4	B	C	Y	2/B	B	C	Y	2/B	C				
1374	4	3,3,3	B	C	Y	2/B	C	Y	2/B	C	Y	2/B			
1376	14	4	W/B	C	Y	2	3?/D								

Table 5. Continued.

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	Year 12	Year 13
1398	5	3,4	B	C	Y	2/B	?/B	C	Y	2/B					
1607	6[c]	3	B	C	Y	2/B									
1608	?	3	2?/B	C	Y	2/B									

[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, 9 of 26 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.

[c] Based on estimated age.

Table 6. Observed litter size and number of offspring in cub, yearling, 2-year-old, and 3-year-old age classes, northcentral Alaska Range, 1982-91.

Age class	Observed no. of litters										Total		Mean litter size
	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	No. of litters	No. of offspring	
Cub													
litter size 1	1	1	0	1	0	0	0	1	0	1	5	5	
litter size 2	2	0	4	2	2	7	1	2	2	3	25	50	
litter size 3	0	0	2	2	0	0	2	0	4	1	11	33	
total	3	1	6	5	2	7	3	3	6	5	41	88	2.14
Yearling													
litter size 1	2	1	0	1	0	1	1	1	0	0	7	7	
litter size 2	2	2	0	3	2	2	5	1	0	4	22[a]	44[a]	
litter size 3	1	1	0	1	1	1	0	1	1	2	9	27	
total	5	4	0	5	3	4	6	3	1	6	38[a]	78[a]	2.05[a]
2-year-old													
litter size 1	0	2	0	0	1	0	0	0	1	0	4	4	
litter size 2	1	1	2	0	2	2	2	5	1	0	16	32	
litter size 3	0	1	1	0	1	0	0	0	1	1	5	15	
total	1	4	3	0	4	2	2	5	3	1	25	21	2.04
3-year-old													
litter size 1	0	0	1	0	0	0	0	0	0	0	1	1	
litter size 2	0	0	2	1	0	0	1	1	1	0	6	12	
litter size 3	0	0	0	1	0	0	0	0	0	0	1	3	
total	0	0	3	2	0	0	1	0	1	0	8	16	2.00

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

Table 7. Annual number of breeding females, cubs produced, cub survival to weaning, and subsequent presence of offspring in the northcentral Alaska Range, 1981-91 (+ indicates minimum figures).

	Number during given year										
	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Females bred during the previous year[a]	5+	7+	3+	9+	5+	5+	11+	5+	6+	7+	4+
Minimum litters produced	5	7	1	6	5	4	9	5	5	6	4
Cubs produced	9+	13+	1	14+	11	8+	18+	10+	9+	16	7
Cubs survived to weaning	7[b,c]	8[c]	0	8[b]	4	4[b]	10[c]	7	3	--	--
Still in area as 3-year-olds	6	5	0	3	3	3	4-10	5	--	--	--
Still in area as 5-year-olds	1	1	0	2	0-1	2-4	--	--	--	--	--
Offspring weaned during year	--	2+	1[c]	9[c]	4	9	2	4	12[c]	7	3+

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

Table 7. Continued.

[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. In addition, female no. 1352 was killed by a hunter during May 1984 before it was determined whether she had weaned her offspring. One was killed during September while it still traveled with its sibling. The remaining 2-year-old was a runt, weighing only 12 kg the previous year, and presumably died during fall-winter 1984.

[c] The survival of 2 litters of 2-year-olds to weaning age was assumed, because 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. In addition, female no. 1352 was killed by a hunter during May 1984 before it was determined whether she had weaned her offspring. One was killed during September while it still traveled with its sibling. The remaining 2-year-old was a runt, weighing only 12 kg the previous year, and presumably died during fall-winter 1984. Bear no. 1323 was shot in self-defense by a hunter in August 1989; her 2 accompanying offspring would have been weaned as 3-year-olds.

Table 8. Minimum number of female grizzly bears present in the study population in the northcentral Alaska Range, 1981-91.

	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]	22[d]	-[c]	-[c]	-[c]
1982	9-12	12	4	3	-[c]	22	1	1	0
1983	6-8	10	1	3	-2	20	0	2	-2
1984	9-12	8	3	5	-2	21	3	2	+1
1985	8-11[e]	7	3	4	-1	20	3	4	-1
1986	7-8[e]	5	0	2	-2	20	2	2	0
1987	12-14[e]	4	1	2	-1	21	2	1	+1
1988	13-15[e]	2	2	4	-2	22	2	1	-1
1989	10-12[e]	4	2	0	+2	22	0	0	0
1990	12-14	7	4	1	+3	17	0	5	-5
1991	10-12[e]	8	4	3	+1	16	1	3	-2
1992		9	2	1	+1	15	1	2	-1

[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] Calculation 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.

Table 8. Continued.

[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 9. Number of male grizzly bears which have been present in the study population in the northcentral Alaska Range, 1981-91.

	Number of males in population								
		4-5 yrs old				≥6 yrs old			
			Change from previous year				Change from previous year		
Year	No. ≤3 yrs old	No.	+	-	Net	No.	+	-	Net
1981	17	8	-[a]	-[a]	-[a]	15	-[a]	-[a]	-[a]
1982	19	4	1	5	-4	13	3	5	-2
1983	17	2	1	3	-2	14	3	2	+1
1984	19	6	5	1	+4	12	1	3	-2
1985	15	8	4	2	-2	11	1	2	-1
1986	13	7	3	4	-1	14	3	0	-3
1987	16	3	1	5	-4	14	2	2	0
1988	15	3	2	2	0	15	2	1	+1
1989	19	4	3	2	+1	12	1	4	-3
1990	16	3	2	3	-1	10	1	3	-2
1991	15	4	3	2	+1	9	1	2	-1
1992	-[b]	4	2	2	0	10	1	0	+1

[a] Because no observations were made prior to 1981, calculations of changes in the numbers within age classes were not made.

[b] Numbers in this age class include cubs that cannot be counted until after their emergence from dens during spring 1992. Other figures for 1992 can be reliably estimated from fall 1991 data.

Table 10. Mortality of grizzly bears in the northcentral Alaska Range, 1981-91.

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 10. 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 or 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
1354	F	2	6/27/83	Fall 1984	West Fork Little Delta	Assumed dead, offspring of 1352
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

Table 10. Continued.

Bear No.[a]	Sex[b]	Age[c]	Date of initial capture	Date of death	Location	Cause of death
1360	F	10	5/28/85	5/28/85	Snow Mountain Gulch	Capture mortality
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 10. 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
M	Unk	Unk	--	7/89	St. George Creek	Illegal kill
UM	Unk	2[f]	--	7/89	St. George Creek	Illegal kill

Table 10. Continued.

Bear No.[a]	Sex[b]	Age[c]	Date of initial capture	Date of death	Location	Cause of death
UM	M	3[f]	--	8/16/89	Gillam Glacier	Defense of life or property kill
1318	F	20	6/18/82	5/13-8/10/89	West Fork Little Delta	Unk, wounding loss?
UM	Unk	Cub	--	5/13-8/10/89	West Fork Little Delta	Unk, offspring of 1318
UM	Unk	Cub	--	5/13-8/10/89	West Fork Little Delta	Unk, offspring of 1318
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
1320	F	24	6/8/82	8/10-30/89	Hayes Creek	Unk, wounding loss?
1341	F	16	5/23/83	6/9-8/30/89	Little Delta River	Unk, wounding loss?
UM	Unk	Cub	--	6/9-8/30/89	Little Delta River	Unk, offspring of 1341
UM	Unk	Cub	--	6/9-8/30/89	Little Delta River	Unk, offspring of 1341
1380[e]	M	5	5/18/87	4/22/90	Nenana Glacier	Hunter kill
1376	F	18	6/13/86	5/5-15/90	Moly Ridge	Unk, scavenged by bear
1390	F	4	5/13/89	5/18/90	Kansas Creek	Hunter kill
UM	Unk	Cub	--	6/6-8/30/90	Wood River	Unk, offspring of 1336
1331	F	13	7/10/82	Fall 1990	West Hayes Glacier	Unk, wounding loss
1387	F	4	5/23/88	Sep 1990	Rogers Creek	Assumed illegal kill
UM	Unk	Cub/ylg	--	6/6/90-5/6/91	Dry Creek	Unk, offspring of 1308
1611	M	2	5/6/91	5/27/91	Gold King Airstrip	Hunter kill at residence
UM	Unk	Cub	--	6/19-8/29/91	Moose Creek	Unk, offspring of 1303
UM	M	3	--	9/3/91	East Hayes Glacier	Hunter kill

Table 10. Continued.

Bear No.[a]	Sex[b]	Age[c]	Date of initial capture	Date of death	Location	Cause of death
1322	F	17	6/9/82	9/4/91	West Fork Little Delta	Hunter kill
1377[e]	M	7	8/28/86	9/6/91	June Creek, Nenana River	Hunter kill at residence
1361	F	9	5/28/85	9/7/91	East Fork Little Delta	Hunter kill
UM	M	2	--	9/7/91	East Fork Little Delta	Hunter kill; offspring of 1361

[a] UM designates an unmarked bear; M, marked bear whose number was unknown.

[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 11. Grizzly bear harvest[a] within the northcentral Alaska Range, 1961-91.

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	7[j]	2[j]	5[j]	15
1990	1[k]	0	0	2[k]	3
1991	1	3[l]	0	1[l]	5
Totals	23	58	26	69	177

[a] Includes hunter harvest, bears killed in defense of life or property, assumed wounding deaths, 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 11. 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. Strong circumstantial evidence suggested 3 marked bears died after being wounded and are included here.

[k] Two marked bears were killed in the Wood River drainage of the study area during 1990: 1 was killed by a hunter and 1 was very probably killed illegally. Another marked bear probably died after being wounded.

[l] Three marked bears were killed in the study area during 1991: 2 were killed in the Little Delta River and 1 at Gold King airstrip. In addition, 1 of the unmarked bears killed was probably the 2-year-old offspring of no. 1361, one of the marked bears killed.

Table 12. Human-caused mortality[a] and mortality rates for a grizzly bear population[b] in the northcentral Alaska Range, 1981-91.

Year	Human-caused mortalities	Minimum population of all age classes: n	Minimum population of all age classes: Mortality rate (%)	Minimum population ≥2 yrs of age: n	Minimum population ≥2 yrs of age: Mortality rate (%)	Adult females ≥6 yrs of age: n	Adult females ≥6 yrs of age: All deaths[c]	Adult females ≥6 yrs of age: Mortality rate (%)
1981	11	75	15	54	20	22	0	0
1982	5	70	9	46	11	22	2	9
1983	6	67	9	57	11	20	3	15
1984	12[d]	73	19	57	21	21	4	19
1985	3	63	5	41	7	20	2	10
1986	8	63	13	49	16	20	1	5
1987	7	68	9	42	14	21	1	5
1988	2	65	3	39	22	22	0	0
1989	15[d]	62	29	48	38	22	5	22
1990	4	56	7	35	11	18	2	11
1991	5	52	10	33	15	16	2	13
$\bar{x}$	7	65	11	46	16	20	2	10

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

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

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.

Table 12. Continued.

[c] Mortality of adult females from all causes, due to both human and natural causes, 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.

[d] Did not count 4 cubs with mothers.

Table 13. Comparison of grizzly bear harvest[a] within sex and age classes with percentage occurrence in the minimum population of bears ≥ 2 years of age, northcentral Alaska Range, 1981-91.

	Age of males		Age of females	
	2-5 years	≥ 6 years	2-5 years	≥ 6 years
$\bar{x}$ annual percentage in minimum population ≥ 2 years of age	22	22	17	39
$\bar{x}$ annual percentage in harvest	40	22	21	16

[a] Harvest included hunter-killed bears and those taken in defense of life or property, but not those that died as a result of capture, from illegal causes, or from probable wounding loss.

APPENDIX A. Abstract of manuscript published in the Journal of Wildlife Management, 1989.

IMMOBILIZATION OF GRIZZLY BEARS WITH TILETAMINE HYDROCHLORIDE AND ZOLAZEPAM HYDROCHLORIDE

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Abstract: We successfully immobilized 185 grizzly bears (Ursus arctos horribilis) with tiletamine hydrochloride (HCL) and zolazepam HCL during May-June 1986-87. One hundred eighty bears were captured in several areas in Alaska by darting from a helicopter; 5 were immobilized from traps or snares in Banff National Park in Alberta, Canada. Use of the recommended dose for immobilizing grizzly bears (7-9 mg/kg) resulted in a mean induction time of 4.1 ± 1.8 (SD) minutes and a safe handling period of 45-75 minutes. Tiletamine HCL/zolazepam HCL was an excellent drug for immobilizing grizzly bears because of rapid induction, timely and predictable recovery, wide safety margin, and few adverse side effects.

J. WILDL. MANAGE. 53:978-981

APPENDIX B. Abstract of manuscript submitted for publication in the Proceedings of the Ninth International Conference on Bear Research and Management.

CHARACTERISTICS OF AN EXPLOITED GRIZZLY BEAR POPULATION IN THE NORTHCENTRAL ALASKA RANGE

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Abstract: Population size, structure, production, and survival of an interior Alaska grizzly bear population were documented during 1981-91. During this period, mean harvest rate was 11% and the population ≥ 2 years of age declined by 24% from approximately 53 in 1982 to 40 in 1991. Mean litter size was 2.15 (n = 41) for cubs, and for both yearlings and 2-year-olds it was 2.0. The age at first production of surviving young was 5-7 years and the reproductive interval was 4.1 years. Response of different sex and age classes of bears to harvest indicates that in this area, the number of producing females remained relatively stable while the population as a whole declined. Factors influencing production and survival were examined and the potential for compensatory production or survival responses were evaluated. Patterns of hunter harvest and implications of harvest levels were discussed.

INT. CONF. BEAR RES. AND MANAGE. 9:000-000

APPENDIX C. Abstract of manuscript submitted for publication in the Proceedings of the Ninth International Conference on Bear Ressearch and Management.

PATTERNS OF LONG-TERM HOME RANGE USE AND EMIGRATION OF GRIZZLY BEARS IN THE NORTHCENTRAL ALASKA RANGE

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Abstract: Home range fidelity, emigration from maternal home range, and immigration patterns of grizzly bears (*Ursus arctos*) were examined in the northcentral Alaska Range during 1981-91. No emigration or abandonment of home ranges occupied by adult females were documented. Some adult males moved outside the study area and returned, remaining within their apparent home ranges. Fidelity of young-aged grizzlies to their maternal home ranges appeared to be related to the sex of the bear; females were less likely than males to immigrate. Implications of movement patterns to population management were discussed.

INT. CONF. BEAR RES. AND MANAGE. 9:000-000

Appendix D. Physical attributes[a] of grizzly bears captured in the northcentral Alaska Range, 1981-91.

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	--	--
	5/31/91	F	12	210	173	--	--	57	104	--	20.0	32.1	--	--
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	--	--
	6/1/91	M	15	600	236	--	--	94	151	--	26.2	40.2	--	--
1305	6/19/81	F	24	114	174	103	28	60	100	96	20.1	32.6	3.0	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	--	--
	5/6/91	F	15	275	182	--	--	62	107	--	21.8	33.9	--	--
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	--	--
	6/3/91	F	21	275	177	--	--	62	108	--	21.2	34.1	--	--

Appendix D. 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]
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	--	--
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	--	--

Appendix D. 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]
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
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	--	--
	5/15/90	F	12	111	189	--	--	54	90	--	20.5	34.0	--	--
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	--	--

Appendix D. 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]
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
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
	5/14/90	M	12	--	213	--	--	88	141	--	26.0	39.1	--	--
	6/1/91	M	13	550	213	--	--	87	143	--	25.4	39.1	--	--
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	--	--
	5/12/90	F	19	141	191	--	--	57	112	--	21.0	33.3	--	--
	5/9/91	F	20	265	180	--	--	60	109	--	20.0	34.5	--	--
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

Appendix D. 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]
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	--	--
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	--	--

Appendix D. 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]
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	--	--
	5/31/91	M	11	650	224	--	--	92	152	--	26.0	39.3	--	--
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	--	--
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	--	--
	5/11/90	F	4	95	178	--	--	50	85	--	18.3	32.1	--	--
	6/2/91	F	5	260	189	--	--	57	103	--	19.5	32.0	--	--
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	--	--
	6/7/90	M	4	120	183	--	--	61	99	--	19.0	35.2	--	--
	5/31/91	M	5	345	178	--	--	68	115	--	20.6	36.4	--	--

Appendix D. 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]
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	--	--
	5/15/90	F	4	84	166	--	--	49	87	--	17.3	31.7	--	--
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	--	--
	5/12/90	F	3	95	171	--	--	52	97	--	18.5	31.5	--	--
	5/7/91	F	4	240	176	--	--	59	112	--	18.7	33.1	--	--
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	--	--
	5/24/90	M	3	100	169	--	--	52	92	--	18.3	31.5	--	--
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	--	--
	5/7/91	M	9[d]	540	199	--	--	84	135	--	24.5	39.0	--	--
1602	5/13/90	M	7[d]	166	198	--	--	69	110	--	21.3	35.8	--	--
1603	5/13/90	F	2[d]	55	150	--	--	42	73	--	16.3	28.1	--	--
	5/8/91	F	3	155	162	--	--	53	94	--	18.8	30.3	--	--
1604	5/13/90	F	2	48	141	--	--	42	69	--	14.5	26.6	--	--
	5/7/91	F	3	130	157	--	--	47	77	--	15.4	29.6	--	--
1605	5/13/90	F	2	59	140	--	--	43	76	--	15.3	26.7	--	--
	5/8/91	F	3	150	168	--	--	46	88	--	16.8	30.3	--	--

Appendix D. 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]
1606	5/13/90	M	2	50	135	--	--	43	68	--	14.7	27.4	--	--
	5/8/91	M	3	155	162	--	--	48	85	--	16.7	28.5	--	--
1607	5/14/90	F	10[d]	141	198	--	--	--	107	--	21.6	36.8	--	--
1608	5/14/90	F	16[d]	136	189	--	--	68	111	--	22.5	35.3	--	--
1609	5/14/90	F	2[d]	61	145	--	--	56	84	--	15.7	27.5	--	--
	5/7/91	F	3	170	162	--	--	59	85	--	17.6	30.6	--	--
1610	5/6/91	F	2	155	152	--	--	46	80	--	16.8	31.3	--	--
1611	5/6/91	M	2	200	157	--	--	58	102	--	17.3	30.6	--	--
1612	5/6/91	F	2	160	155	--	--	53	86	--	16.5	28.6	--	--
1613	6/2/91	M	6[d]	390	190	--	--	71	113	--	22.0	37.5	--	--
1614	6/2/91	M	3[d]	240[d]	78	--	--	65	98	--	--	--	--	--
1615	6/3/91	M	4[d]	275	191	--	--	60	97	--	20.1	33.4	--	--

[a] Weights in kg and measurements in cm; head measurements made using calipers, all others were with a steel tape and were judged less accurate.

[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 E. Grizzly bear captures, recaptures, and capture-related mortalities, northcentral Alaska Range, 1981-91.

	Bear No.				Capture mortalities			
			Total no.	Cumulative	Yearly		Percentage	
Year	New captures	Recaptures	captured during year	no. total captures	total	Bear No.	Year	Cumulative
1981	1301-1305		5	5	1	1301	20	20
1982	1306-1335		31[a]	36[a]	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 E. Continued.

Year	Bear No.		Total no. captured during year	Cumulative no. total captures	Capture mortalities			
	New captures	Recaptures			Yearly total	Bear No.	Percentage	
							Year	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
1990	1602-1609	1331, 1346, 1348, 1385, 1386, 1387, 1391, 1393	16	181	0	--	0	4
1991	1610-1615	1303, 1304, 1308, 1311, 1346, 1348, 1375, 1385, 1386, 1391, 1601, 1603, 1604, 1605, 1606, 1609	22	203	0	--	0	4

Appendix E. Continued.

[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. Her 3 cubs probably died without her care.

Appendix F. Status of marked bears in the northcentral Alaska Range, 1991.

Bear No.	Sex	Initial capture Age	Initial capture Date	Date last location	Status 1991
1301	M	6	5/18/81	5/18/81	Dead, capture mortality
1302	F	3	5/19/81	8/29/91	Alive, functional collar; bred
1303	F	2	6/17/81	8/29/91	Alive, functional collar; with cubs
1304	M	5	6/19/81	8/29/91	Alive, functional 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	Unknown, probably alive, shed collar?
1308	F	6	5/25/82	8/29/91	Alive, functional collar; with yearlings
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	8/29/91	Alive, functional collar; with yearlings
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	Unknown, 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	5/13/89	Dead, unknown cause
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	Dead, unknown cause between 8/10 and 8/30/89
1321	F	16	6/8/82	9/1/89	Dead, hunter kill
1322	F	8	6/9/82	4/27/84	Alive spring, hunter kill 9/4/91
1323	F	11	6/10/82	8/18/89	Dead, killed in defense of life or property
1324	F	Cub	6/10/82	8/29/91	Alive, collar functional; with yearlings
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	Unknown, probably emigrated
1331	F	4	7/10/82	5/15/90	Dead, unknown cause summer-fall 1990
1332	F	5	7/12/82	10/31/82	Dead, died in den winter 1982-83
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	8/29/91	Alive, functional collar; with yearlings
1337	M	20	5/18/83	9/1/89	Dead, hunter kill
1338	M	6	5/20/83	5/20/83	Dead 5/20/83, capture mortality
1339	M	6	5/20/83	6/4/84	Unknown, shed collar between 6/4 and 9/10/84
1340	F	3	5/23/83	6/27/85	Unknown, shed collar between 6/27/85 and 4/28/86
1341	F	10	5/23/83	8/30/89	Dead, unknown cause fall 1989
1342	M	2	5/24/83	6/27/83	Dead, illegal kill, snared fall 1983
1343	M	2	5/24/83	5/15/84	Unknown, collar nonfunctional or emigrated?
1344	M	2	5/24/83	9/7/84	Dead, hunter kill
1345	F	8	5/24/83	8/29/91	Alive, functional collar; with yearlings

Appendix F. Continued.

Bear No.	Sex	Initial capture Age	Initial capture Date	Date last location	Status 1991
1346	M	5	5/25/83	6/1/91	Alive, functional collar
1347	M	6	5/31/83	5/31/83	Dead, capture mortality
1348	F	12	5/31/83	9/91	Alive, functional collar; with yearlings
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	Unknown, 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	Unknown, 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	9/7/91	Alive spring, hunter kill 9/7/91
1362	F	6	6/5/85	5/18/89	Unknown, collar nonfunctional
1363	M	3	6/5/85	4/28/86	Unknown, 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	Unknown, not located in 1988-89
1366	M	8	7/22/85	12/3/85	Unknown, 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	Unknown, shed collar 1989
1373	M	7	5/21/86	9/2/86	Dead, hunter kill
1374	F	6	5/21/86	9/18/91	Alive, functional collar; with cubs
1375	M	6	6/13/86	6/2/91	Alive, shed collar between 6/2/91 and 8/29/91
1376	F	14	6/13/86	8/10/88	Died between 5/5/90 and 5/15/90
1377	M	3[a]	8/28/86	3/25/87	Alive spring, hunter kill 9/6/91 west of study area
1378	F	2	6/20/86	6/20/86	Dead, hunter kill
1379	F	2	5/15/87	8/30/89	Unknown, shed collar
1380	M	2	5/18/87	8/30/88	Dead, hunter kill 4/22/90
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	Unknown, 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	8/29/91	Alive, functional collar

Appendix F. Continued.

Bear No.	Sex	Initial capture Age	Initial capture Date	Date last location	Status 1991
1386	M	2	5/15/88	10/12/91	Alive, functional collar
1387	F	2	5/23/88	8/30/90	Unknown, illegal kill?
1388	M	2	5/25/88	8/30/88	Unknown, shed collar
1389	M	3	5/13/89	7/89	Unknown, shed collar Yanert
1390	F	3	5/13/89	8/30/89	Dead, hunter kill 5/18/90
1391	F	2	5/13/89	6/2/91	Alive, functional collar
1392	M	2	5/13/89	8/10/89	Unknown, shed collar
1393	M	2	5/17/89	5/13/90	Unknown, heard only 6/1/91
1394	F	2	5/17/89	5/10/90	Unknown, nonfunctional collar?
1395	M	2	5/17/89	9/9/89	Dead, hunter kill
1396	M	13[a]	5/18/89	8/30/89	Unknown, shed collar
1397	F	2	5/18/89	8/30/89	Unknown
1398	F	8[a]	5/18/89	8/29/91	Alive, functional collar; with cubs
1399	M	2	5/18/89	9/9/89	Dead, hunter kill
1400	M	8[a]	6/8/89	8/30/89	Unknown
1601	M	7[a]	6/9/89	6/2/91	Alive, shed collar by 8/29/91?
1602	M	7[a]	5/13/90	5/13/90	Unknown, shed collar
1603	F	2[a]	5/13/90	6/3/91	Alive, functional collar
1604	F	2	5/13/90	8/29/91	Alive, functional collar
1605	F	2	5/13/90	8/29/91	Alive, functional collar
1606	M	2	5/13/90	8/29/91	Alive, functional collar
1607	F	10[a]	5/14/90	8/29/91	Alive, functional collar
1608	F	16[a]	5/14/90	8/29/91	Alive, functional collar; with cubs
1609	F	2[a]	5/14/90	5/7/91	Alive, functional collar
1610	F	2	5/6/91	10/12/91	Alive, functional collar
1611	M	2	5/6/91	5/27/91	Alive spring, hunter kill 5/27/91
1612	F	2	5/6/91	5/6/91	Alive, functional collar
1613	M	6[a]	6/2/91	6/19/91	Alive, functional collar
1614	M	3[a]	6/1/91	8/29/91	Alive, functional collar
1615	M	4[a]	6/3/91	6/3/91	Alive spring, shed collar by 8/31/91

[a] Estimate.

Appendix G. Status summary of marked bears in the northcentral Alaska Range, spring 1991.

			Shed or nonfunctional collar unknown status		
Dead		Alive, active collar	Alive in the area?	Dispersed? or dead?	Never collared, dead?
1301	1353	1302	1307	1316	1354
1305	1355	1303	1340	1330	
1306	1356	1304	1362	1339	
1309	1357	1308	1372	1343	
1310	1358	1311	1379	1359	
1312	1360	1322[a]	1383	1363	
1313	1364	1324	1388	1365	
1314	1367	1336	1392	1366[b]	
1315	1368	1345	1394	1377	
1317	1369	1346	1396	1387	
1318	1370	1348	1400	1389	
1319	1371	1361[a]	1602[c]	1397	
1320	1373	1374[b]			
1321	1376	1375			
1323	1378	1385			
1325	1380	1386			
1326	1381	1391			
1327	1382	1393			
1328	1384	1398			
1329	1390	1601			
1331	1395	1603			
1332	1399	1604			
1333	1611	1605			
1334		1606			
1335		1607			
1337		1608			
1338		1609			
1341		1610			
1342		1611			
1344		1612			
1347		1613			
1349		1614			
1350		1615			
1351					
1352					

[a] Alive but with nonfunctional collars.

[b] Home range is situated outside boundaries of the study area.

[c] Captured outside but adjacent to the study area.

Appendix H. Status of maternal grizzly bears and their offspring in the northcentral Alaska Range, 1981-91.

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	1604 F	1988	2	Weaned 1990
			1605 F	1988	2	Weaned 1990
			1606 M	1988	2	Weaned 1990
			UM[a]	1991	--	With mother 1991
1303	2	Alive	1364 M	1985	--	Assumed dead 1985
			UM	1985	--	Assumed dead 1985
			UM	1991	--	With mother 1991
			UM	1991	--	Assumed dead 1991
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	Last observed 1989
			UM	1990	--	With mother 1991
			UM	1990	--	With mother 1991
			UM	1990	--	Assumed dead 1990
1311	12	Alive	1312 F	1982	--	Assumed dead 1982
			1313 F	1982	--	Assumed dead 1982
			1372 M	1984	2	Last observed 1989
			1378 F	1984	2	Hunter kill 1986
			UM	1987	2	Hunter kill 1989?
			1395	1987	2	Hunter kill 1989
			UM	1990	--	With mother 1991
			UM	1990	--	With mother 1991
1318	13	Dead 1989	1319 M	1982	--	Assumed dead 1982
			1380 M	1985	--	Hunter kill 1990
			1382 F	1985	--	Hunter kill 1989
			UM	1989	--	Assumed dead 1989
			UM	1989	--	Assumed dead 1989
1320	17	Dead 1989	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	Hunter kill 1989	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	Last observed 1989
			1381 M	1985	2	Hunter kill 1987
			UM	1988	--	Assumed dead 1988

Appendix H. 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
			UM	1988	--	Assumed dead 1988-89
			UM	1988	--	Assumed dead 1988-89
1322	8	Hunter kill 1991	1336 F	1981	3	Had cubs 1987, 1990
			UM?	1989?	2?	May have had 2 yearlings 1990
1323	11	Hunter kill 1989	1324 F	1982	2	Had cubs 1987, 1990
			1325 M	1982	2	Killed DLP[b] 1984
			UM	1987	--	With mother 8/18/89
			UM	1987	--	With mother 8/18/89
1324	0	Alive	?1389 M	1987	2	Last observed 1989
			?1390 F	1987	2	Hunter kill 1990
			UM	1990	--	With mother 1991
			UM	1990	--	With mother 1991
1326	4	Hunter kill 1986	UM	1985	--	Assumed dead 1985
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	Dead 1990	UM	1986	--	Assumed dead 1987
			?1603 F	1988	2	Weaned 1990
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
			UM	1990	--	Assumed dead 1990
			UM	1990	--	With mother 1991
			UM	1990	--	With mother 1991
1341	10	Dead 1989	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	--	Assumed dead 1989
			UM	1989	--	Assumed dead 1989
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
			UM	1990	--	With mother 1991
			UM	1990	--	With mother 1991
			UM	1990	--	With mother 1991

Appendix H. 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
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
			UM	1990	--	With mother 1991
			UM	1990	--	With mother 1991
			UM	1990	--	With mother 1991
1351	14	Hunter kill 1987	UM	1982	--	Assumed dead 1984
			1357 M	1982	3	Hunter kill 1986
			1361 F	1982	3	Hunter kill 1991
			UM	1986	1	Assumed dead 1987[d]
			UM	1986	1	Assumed dead 1987[d]
			UM	1986	1	Assumed dead 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
1361	3	Hunter kill 1991	UM M	1989	--	Hunter kill 9/7/91
1362	6	Alive	1387 F	1986	2	Illegal kill? 1990
			1388 M	1986	2	Last observed 1988
1374	6	Alive	UM	1985	2?	Weaned 1987?
			UM	1985	2?	Weaned 1987?
			UM	1988	2	Weaned 1990
			UM	1988	2	Weaned 1990
			UM	1991	--	With mother 1991
			UM	1991	--	With mother 1991
			UM	1991	--	With mother 1991
1376	23[e]	Dead May 1990	1393 M	1987	3	Weaned 1990
			1394 F	1987	3	Last observed 1990
1398	8[e]	Alive	1397 F	1987	2	Last observed 1989
			1399 M	1987	2	Hunter kill 1989
			UM	1991	--	With mother 1991
			UM	1991	--	With mother 1991
1607	10[e]	Alive	1610 F	1989	2	Weaned 1991
			1611 M	1989	2	Hunter kill 1991
			1612 F	1989	2	Weaned 1991
1608	16[e]	Alive	1609?F	1988	2	Weaned 1990

[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.