Alaska Department of Fish and Game
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Federal Aid in Wildlife Restoration
Research Progress Report

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by
Harry V. Reynolds
Project W-23-1
Study 4.19
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SUMMARY

From 1981 to 1988 the population densities and harvest rates for a grizzly bear (Ursus arctos) population in the northcentral Alaska Range were estimated. The baseline population status and reproductive biology were also determined for the years 1981 through 1985. The effects of increased harvest on this population, which has been the focus of these investigations since 1986, will continue through 1991.

In 1988 I observed only minor changes from past harvest rate, production, or survival rate patterns. All population estimates calculated during 1988 were adjusted for population closure. The estimated harvest rate for the minimum study area population was 10.2% in 1988, compared with the mean rate of 11.8% for 1981 to 1987. Estimates of the minimum population size of grizzlies $\geq$2 years of age declined from 53 in 1981 to 37 in 1988. Analysis of reproductive biology indicates apparent stablility; the age at 1st production of young was 5-7 years, the observed reproductive interval was 4.1 years, and the mean litter size was 2.1.

Beginning in 1986 a mixture of tiletamine hydrochloride and zolazepam hydrochloride (Telazol R, A. H. Robins, Richmond, Virginia) was used to immobilize bears in this study area. Data from these captures were included in a paper that has

been accepted for publication in the Journal of Wildlife Management.

Key Words: density estimates, grizzly bear, harvest rates, Interior Alaska, 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 deter-

mine (1) the effects of differing levels of harvest on population status, (2) how populations respond to hunter-caused mortality, and (3) whether hunting harvest constitutes additive or compensatory mortality in grizzly bear populations.

Currently, most management decisions are based on the number, sex, and age of grizzly bears killed by hunters in a given area. Though these variables may provide a general estimate of the status of grizzly bear populations under certain conditions, a recent simulation analysis indicated this approach was inadequate for assessing the direction or rate of population trends in a timely manner (Harris and Metzgar 1987, Miller and Miller 1988). More precise information is needed to make sound management responses to increased hunting demand on grizzly bear populations.

To address these problems, a 2-phase study was begun in the northcentral Alaska Range in 1981. Phase I was completed in 1985; it emphasized the gathering of baseline information on the population biology of northcentral Alaska Range grizzly bears (Reynolds 1982; Reynolds and Hechtel 1983, 1984a, 1984b, 1985, 1986; Reynolds et al. 1987). The harvest levels during the years 1965 through 1980 were generally low (i.e., about 3-5% of the estimated population); however, during the years 1981 through 1985, the annual harvest increased to about 12%. By 1985, at the end of Phase I, the population had already begun to decline.

Initially, the study was designed to monitor the effects of low-to-moderate (Phase I) and higher (Phase II) levels of the harvest on individual grizzly bears and the population as a whole. The hunter- and capture-related mortalities, however, resulted in a relatively high mean harvest level of 12% during Phase I. Although this level was higher than anticipated, it should strengthen the investigation by allowing the monitoring of the reproductive response over a longer period of time, thus compensating for low productivity and the extended time before female grizzly bears become reproductively mature.

Phase II, which started in 1986 and will continue through 1991, is designed to measure the grizzly bear population's response to human-caused mortality. During this period, we need to maintain harvest rates at about 10-15% by manipulating hunting regulations and directing public hunting effort to the area. Changes in population size and productivity will be monitored, and the effects of increased harvest on population size and reproductive variables will be analyzed. Changes in reproductive performance of adult females and survival rates of young bears will largely determine if population compensatory mechanisms operate as harvest levels increase.

Studies of grizzly bears in Interior and northern Alaska have provided a data base on some aspects of reproductive biology, food habits, habitat use, and home range size (Dean 1976; Reynolds 1976, 1978, 1980, 1981; Murie 1981; Ballard et al. 1982; Miller and Ballard 1982; Miller and McAllister 1982; Reynolds and Hechtel 1982, 1983, 1984a, 1984b, 1985; Miller 1983, 1984, 1987). These studies, however, were largely descriptive or of short duration (2-4 yrs). Because grizzly bears do not mature until 4-10 years of age, observed (as opposed to extrapolated) measures of productivity, survival, and movement patterns must be obtained over a 10-year period to be representative of a population (Craighead et al. 1974, 1976; Reynolds 1976; Bunnell and Tait 1980, 1981; Knight and Eberhardt 1984, 1985). Although long-term studies are necessary for understanding and accurately predicting grizzly bear population dynamics and responses to changing patterns of human use in Alaska, only a few are being conducted, none of which have been completed.

Conservative harvest rates of 2-4% of the grizzly bear population have been proposed for areas in northwest Canada (Lortie, unpubl. data), and rates of 2-3% have been used as a basis for harvests in the Brooks Range (Reynolds 1976). Additional information is necessary before the effects of harvests in the Alaska Range can be understood. Before establishing safe haravest rates; the following baseline information must be established: (1) population density, (2) population structure, (3) movement patterns, (4) home range size, (5) mortality and survival rates, and (6) reproductive potential, including age at 1st breeding, litter size, and interval between litters (Craighead et al. 1974, Reynolds 1976, Bunnell and Tait 1980).

OBJECTIVES

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

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

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

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

STUDY AREA

The 3,900-km^2 (1,500 mi^2) study area is located in the mountains and foothills of the northcentral Alaska Range within Subunit 20A. The boundaries are the Gold King Creek and Wood River drainages downstream from Virginia Creek to the west, the crest of the Alaska Range to the south, the Delta Creek drainage to the east, and the southern edge of the Tanana Flats (approx. 64°N) to the north. It includes portions of 2 U.S. Army reservations: Fort Wainwright and Fort Greely.

Elevation in the area ranges from 500 to 3,700 meters (1,500 to 12,000 ft). Most rivers flow through U-shaped, glacially formed valleys and are fed by active glaciers. Treeline occurs at an elevation of approximately 900 meters (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 meters (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). All measurements, weights, and other routine data collections that were made during Phase I will be continued during Phase II; however, beginning in 1986 I modified my methodology for estimating minimum population size (Reynolds et al. 1987, Reynolds and Hechtel 1988) and conducted a census estimate based on marked-unmarked grizzly bear sightings (Miller et al. 1987, Reynolds et al. 1987). This modification resulted in lower estimated population sizes and, consequently, higher calculated harvest rates for all years (Reynolds et al. 1987, Reynolds and Hechtel 1988).

The methodology for past estimates of minimum population sizes from 1981 through 1985 included the sum of (1) those bears captured within the boundaries of the study area that would have been alive in past years (e.g., a 14-year-old female captured in 1986 was assumed to have been a resident of the study area during the years 1981 through 1985, while a 2-year-old male captured in 1986 was only counted as having been a member of the population from 1984 to 1986), excluding those bears known to have emigrated; (2) bears killed within the study area that would have been alive in past years; and (3) bears that had been observed in the area but could not be accounted for as captured or killed. In using this method, I assumed that the rates of unobserved emigration by young-aged bears equaled the rates of immigration (Reynolds and Hechtel 1986). Based on the observed fidelity of adult bears to their home ranges, I also assumed that no adults emigrated or

abandoned their established home ranges. Finally, I assumed that the bears with which we had lost contact (i.e., through loss or malfunction of radio collars) remained in the study area; however the degree to which this assumption is valid will become more evident as capture effort continues.

In addition to the above method of calculating the minimum population size, I derived "probable" population sizes by estimating that the 3,900-km^2 area included an additional 15-25 bears that had not been captured, killed, or observed. This estimate was based on the availability of habitat in the area, given the known home range sizes and distribution of marked bears living in major drainages and the fact that vegetative cover and rugged terrain can allow resident bears to escape detection for several years.

By 1986 I had enough baseline data on the 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). All estimates in this report were calculated using this method; I also have used it to recalculate population estimates for past years. Any differences between estimated population size or density reported here and those presented in past reports (Reynolds and Hechtel 1982, 1983, 1984a, 1985, 1986) are solely due to differences in the methods used.

Because not all grizzly bears captured, killed, or observed within the boundaries of the study area maintained home ranges entirely within that area (i.e., 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), an overestimation of the poplation size may occur. To account for this bias, the approximate proportion of each home range lying outside the study area was estimated and the fractional home ranges subtracted from total population estimates to more accurately reflect numbers of bears in the study area, resulting in "adjusted" population estimates (Reynolds 1980). For bears killed by hunters, home range size and locations were assumed to be similar to those of radio-collared grizzly bears of similar sex and age living in the same area. For example, if an unmarked 5-year-old female were 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 another 5-year-old female (No. 1336) living along the Wood River also lies outside the study area.

I believe I can account for most of the bears using the study area. From 1985 to 1988, only 8 of 41 grizzly bears captured in the study area were unmarked and not the offspring of marked bears; seven of the eight were captured near the edges of the study area. Similarly, of 21 bears killed in the study

area (i.e., hunting or in defense of life or property) during that time, only eight had never been previously captured, two were the 2-year-old offspring of marked bears, and the other six were killed at the edges of the study area. For these reasons, I estimate that only 10-15 additional unmarked bears, instead of the previously estimated 15-25, remain in the study area (Reynolds and Hechtel 1983, 1984a, 1985). This proportion will decline as the capture program and hunting continue in the area.

During early June 1986 I used a modified capture-recapture method for estimating the density of bears in a portion of the northcentral Alaska Range study area (Reynolds et al. 1987). Miller et al. (1987) developed this modification in South-central Alaska in 1985, where it appeared to be a promising method for addressing geographic closure and providing a statistical variance for a grizzly bear population estimate. I tested this technique in our area under different conditions than those occurring in Southcentral Alaska and was successful in comparing density-estimated recapture techniques with those based on direct counts.

RESULTS AND DISCUSSION

Immobilization and Drug Use

During the years 1986 and 1987, we began immobilizing grizzly bears with a 50:50 mixture of tiletamine hydrochloride and zolazepam hydrochloride (Telazol R, A. H. Robins, Richmond, VA) (Taylor et al., in press; Appendix A). It is an excellent drug for immobilizing grizzly bears, having important advantages over the use of previously used drugs (i.e., etorphine or phencyclidine hydrochloride). Unlike etorphine hydrochloride (M99, Lemmon Co., Sellersville, PA), it has a wide margin of safe use, a mortality rate of <0.5%, and an induction time of approximately 4-5 minutes; recovery from moderate doses begins at about 50-70 minutes. By comparison, similar dosages of phencyclidine hydrochloride (Sernylan, Bio-Ceutic Laboratories, St. Joseph, MO) have an induction time of 10-15 minutes and a recovery that begins at about 90-120 minutes.

Morphometric Data

Some morphometric data from this study were included in an analysis of sexual differences in growth and weight of northern grizzly bears (Kingsley et al. 1988) (Appendix B). All measurements recorded during this study are included in Appendix C.

Bears Captured and Radio-collared

From 1981 to 1988, 88 individual grizzly bears were captured in the study area (Table 1). In addition, 52 bears were recaptured for replacement of radio collars. From 1981 to 1983, initial captures of grizzly bears were made from all sex and age classes. Since then, most initial captures have been the offspring of previously captured bears (Appendix D). Radio collars have been placed on 76 bears: 26 on young-age males (≤5 years), 14 on adult males (≥6 years), 16 on young-age females, and 20 on adult females. By the fall of 1988, 22 bears carried functioning radio collars; 17 bears had shed collars; 41 bears were dead; 1 was presumed dead; and 7 bears could not be located, presumably because of long-range movements or collar failure (Appendices E and F). From May until June 1988, 11 bears were captured: 1 previously unmarked 6-year-old male, five 2-year-old offsprings of marked females, and five that had been previously marked.

Population Size and Density

Estimates Based on Population Closure:

Population density was calculated as a minimum value and adjusted for population closure during the years 1981 through 1988 (Table 2). "Probable adjusted" population size (57) includes an estimate of those bears presumably residing in the area that had not been killed by hunters or captured during the study. Based on the home range size of marked bears and available habitat, the study area supports an additional 10-15 bears. Therefore, the 1988 "probable adjusted" population size of bears in the area is 67-72, a decline from that for 1982 (i.e., 78-83). Based on the mean proportions of cubs and yearlings in the 1988 population, approximately 9 to 11 of these undetected bears are ≥2 years of age.

With additional years of monitoring, the remaining unmarked bears should eventually associate with the radio-collared bears and be captured. As we continue to monitor bears born and weaned in the study area, we will improve our understanding of dispersal and mortality rates in the population. The minimum adjusted 1988 spring population was 57 grizzly bears; the density was 1.45 bears/100 km^2 (3.78 bears/100 mi^2). This population estimate included 35 marked bears adjusted from a total marked population of 40 bears whose home ranges included the study area, 20 unmarked offspring of marked females adjusted from a total of 21 bears, and 1.5 unmarked bears adjusted from a total of 2 bears killed by hunters.

The measurement of population size or density should 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; i.e., a mean of 28% in the 1981-87 (Reynolds and Hechtel 1986). 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 population estimate of grizzly bears ≥2 years of age in the study area in 1988 was 37 bears, or 0.95 bears/100 km^2 (2.47 bears/100 mi^2). This represents a decline from the adjusted 1981 population estimate of 51, or 1.30 bears/100 km^2 (3.39 bears/100 mi^2) for bears ≥2 years old.

Population Structure

The sex and age structure of the population for 1988 indicates approximately equal proportions of females and males (Fig. 1); however, this may be biased, because six of the 20 males ≥3 years of age had not been observed prior to 1986. Four other males in the 2- to 4-year-old age class (i.e., most likely to emigrate) have not been observed since 1986. In contrast, only three of 21 females ≥3 years of age included in this structure had not been observed prior to 1986. A more intensive search and capture effort will be necessary to determine whether these bears are still present in the population.

By comparison, in 1982 the structure was more heavily weighted toward female grizzly bears ≥3 years of age (Fig. 2). Such a population structure should be expected, because males are more heavily harvested in the study area than females. The sex ratio of the harvest since 1979 has been 70 males:30 females. During this period, the harvest included 32 males and 13 females in the 1- to 5-year-old age class and 22 males and 10 females in the ≥6-year-old age classes. Because males have larger home ranges and travel more widely than females (see Movement section, p. 13), they are more likely to encounter hunters (Bunnell and Tait 1980). In addition, because regulations prohibit the taking of cubs (including yearlings) or females accompanied by cubs, productive females are less vulnerable to hunters. During the years 1981 through 1986, only 22% and 51% of those adult females whose reproductive status was known were vulnerable to hunters during spring and fall hunting seasons, respectively; all adult males were vulnerable during both seasons.

Although offspring observed as cubs had an even sex ratio (i.e., 11 males:11 females [2 unknowns]), I am hesitant to conclude that the sex ratio at birth was even because of a low

sample size. Although the sex ratios observed in older juvenile age classes tended toward male dominance, they were not significantly different from the male:female ratio for cubs. Yearlings had a sex ratio of 16 males:12 females (2 unknowns); 2-year-olds, 15 males:10 females (1 unknown); and 3-year-olds, 7 males:4 females. Of those 2- and 3-year-olds that were observed at weaning, 18 were males and 11 were females.

If there was a tendency toward greater male recruitment in the population, I believe it resulted from initial production, rather than a lower survival rate for females in litters. Of 18 litters, five, two, 11, and one each were composed of all males, all females, mixed-sex, and a male and a female with an unknown-sex litter mate, respectively. Similar sex ratios have been recorded in Yellowstone National Park. Craighead et al. (1974) reported that 57% of 74 cubs captured during the years 1959 through 1970 were males, and Knight and Eberhardt (1985) reported that 67% of 24 cubs captured during the years 1974 through 1982 were males.

Reproductive Biology

Age at 1st Production of Young:

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

Reproductive Interval:

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

tion differs from that used by others; e.g., Craighead et al. (1976) define a cycle as simply the interval from pregnancy to pregnancy.

Offspring were weaned as 2-year-olds (n = 9 litters) or 3-year-olds (n = 7 litters); however, based on those cycles we observed plus those projected by assuming weaning of offspring as 2-year-olds (Table 4), the mean minimum reproductive interval was 4.1 years (n = 30). Alternately, if we project minimum cycle length based upon observed proportions of those litters weaned as 2- and 3-year-olds, the mean reproductive interval would be 4.3 years. All 9 intervals greater than 4 years resulted from interruption of the breeding cycle because of mortality of litters or to breeding that did not produce cubs the following year.

Factors resulting in females weaning their young as 2-year-olds or keeping them another year to wean as 3-year-olds have not been identified. Weight or nutritional status in mid- to late May at the time when offspring are usually weaned and the estrus cycle begins may be important, but with our small sample sizes we were unable to detect any patterns. Nevertheless, conditions present in the summer of 1982 or winter of 1982-83 appeared to have prolonged reproductive intervals. Not only were no surviving cubs produced during 1983, but females accompanied by 2-year-olds during 1983 tended not to wean those offspring until they were 3 years old. 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, one weaned her litter as 2-year-olds but the other two weaned their litters as 3-year-olds. In contrast, of 6 litters produced in 1984 or 1985, five were weaned as 2-year-olds, and only one litter of 3-year-olds was weaned. Models of the effects of harvest on population dynamics should take these events into account.

Production Success:

Reproductive success, or the proportion of breeding activity by adult females resulting in the production of cubs, was 78%. This rate was based on the outcome of 27 observations of breeding activity by 13 individual females $\geq$6 years of age during the years 1982 through 1988. In addition, 2 females bred at ages 4 and 5 years before producing young as 6-year-olds. Successful reproduction is probably dependent upon an individual female reaching a critical weight, rather than a critical age, prior to ovulation or implantation. 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. 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. By comparison, 86% of the females that bred from 1983 to 1987 produced cubs the following year (n = 28) (Table 3).

Litter Size:

Mean litter size was 2.1 for 26 litters first observed as cubs, 1.9 for 13 litters first observed as yearlings, and 2.0 for 23 litters observed as yearlings, regardless of when they were first observed. By comparison, in the Nelchina Basin on the south side of the Alaska Range, Miller (1987) reported the same mean cub litter size (2.1) but a mean yearling litter size of only 1.7. In this study the number of females producing cubs varied from year to year, ranging from 1 female producing 1 cub in 1983 to 7 females producing 14 cubs in 1982 (Table 5). In 1987, 6 females produced 12 cubs; 3 females produced 8 cubs in 1988. Poor cub production in 1983 may have been due to failure of berry crops in 1982 (Miller 1984) or to weather patterns during the winter of 1982-83, in which little snow fell and temperatures fluctuated widely.

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

The mean size of 13 litters weaned as 2- or 3-year-olds was 2.0. The annual number of adult females in the population since 1982 has ranged from 18 to 21 (Tables 3 and 6), and the observed annual numbers of litters were 7, 1, 6, 5, 2, and 6 during the years 1982 through 1987, respectively. From 1982 to 1988, the observed annual numbers of weaned litters, however, were only 1-2, 0-1, 4, 2, 4, 1, and 2, respectively; this pattern also reflects mortality of entire litters, mostly in cub or yearling age classes.

Mortality

From 1981 through 1988 at least 90 grizzly bears died in the study area: 14 in 1981, 11 in 1982, 11 in 1983, 18 in 1984, 11 in 1985, nine in 1986, 10 in 1987, and six in 1988, including 49 hunter-related, 2 illegal, 3 defense-of-life-or-property, 8 capture-related, 2 natural mortalities for which carcasses were found, and 26 offspring that were missing from family groups and presumed dead (Table 7, Appendix G). During 1988 mortalities included 2 hunter-related harvests, and 4 missing offspring that were presumed dead.

The causes of mortality for cubs, yearlings, and 2-year-olds that disappeared while accompanying their mothers could not be determined; however, cannibalism by adult males, which has been documented in Alaska, has been suspected as the major cause in the Brooks Range (Reynolds 1976, 1980, 1984b; Reynolds and Hechtel 1982), 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 29% for cubs (n = 52), 7% for yearlings (n = 45), and 7% for 2-year-olds (n = 29).

The mortality rates for 30 radio-collared females aged 2 to 25 years that had been monitored for 88 bear-years were 8%, 2%, and 3% because of sport hunting, causes other than human, and capture-related incidents, respectively. Only two 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, and the other was found dead in her den.

Sport hunting is a major source of mortality in this population. Prior to 1981 the mean annual harvest ranged from 1 to 14; the mean harvest was 5.0 (Table 8). If the population remained relatively stable during the period 1961 to 1980 and future research confirms a pre-1981 adjusted density estimate of 2.2 bears/100 km^2 (5.7/100 mi^2), the average annual harvest rate was approximately 5.6-5.8% of the population, ranging from 1.1% to 16.5%. By comparison, during the years 1981 through 1988, the mean harvest rate for the minimum population, including all human-caused mortalities, was 11% (Table 9). If these rates were based on adjusted population size to account for those bears residing but never captured in the study, the mean mortality rate for the years 1981 through 1988 would be 8-9%. Alternately, if harvest rates were calculated for only those bears $\geq$2 years of age and based on probable population size (i.e., adjusted to account for lack of population closure and those bears living in the area that have not been detected), then the mean mortality rate for the years 1981 through 1987 would be 11-12%.

More than a simple calculation of harvest rate is necessary to evaluate population trend. Both Craighead et al. (1974) and Knight and Eberhardt (1984) emphasized that the number of productive females within a population is the most important factor in the rate of growth or decline in grizzly bear populations. These data also indicate the importance of adult females to population dynamics. Since 1982 the harvest has not resulted in a decline in the number of adult females, and there have been only minor fluctuations; i.e., from 21 females in 1982 to a projected total of 19 in 1989 (Table 6). However, the number of females in the 3- to 5-year-old age

class, which acts as replacements when adults die, has declined from 10 in 1982 to two in 1988. At the same time, the population within the study area has declined from an adjusted minimum of 66 in 1981 to 57 in 1987, and this trend is expected to continue. Based on only those bears ≥2 years of age, the trend is similar but apparently more severe; the minimum adjusted estimates were 51 bears in 1981 and 37 bears in 1988 (Table 9). Although compensatory changes in production or survival rates may occur in reduced populations, as suggested by Stringham (1983) and McCullough (1981), such mechanisms have yet to be documented. Evidence for compensatory mechanisms at the present level of exploitation in the study area will not be analyzed until more data are collected.

Movement

Some adult male bears moved outside the study area and returned after traveling as far as 40 kilometers (25 mi) north of the study area. Female bears generally stayed within the drainage where they had been captured (Reynolds and Hechtel 1986).

The fidelity of young-age bears to their maternal home ranges varied (Table 10). Based on limited observations, most females remain close to their maternal home ranges following weaning, but less than half of the males remain. Of 19 males followed during the 1st year after weaning, three moved from 44 to 74 kilometers (27 to 46 mi) outside their maternal home ranges. Of those followed during the 2nd year after weaning, four more moved from their maternal home ranges while four others remained. Of those that stayed within their maternal home range for 1 or 2 years after weaning, one was only observed the year following weaning, six were killed during the year of weaning, one stayed for 2 years following weaning, and three stayed for 3 years. All 13 females monitored stayed within their maternal home ranges; four remained for 1 year, one for 2 years, and four for ≥4 years.

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

CONCLUSIONS AND RECOMMENDATIONS

Probable adjusted population size was 78-83 in 1982, but it declined to 62-67 by 1987 and 1988. These estimates were based on the minimum numbers observed as well as on the probable number that had been present but not observed. The overall estimate was adjusted to account for lack of a closed

population. The reduction in numbers resulted in fewer females in the 3- to 5-year-old age class.

Mean natural mortality rates observed during the years 1982 through 1988 were 29% for cubs-of-the-year, 7% for yearlings, 7% for 2-year-olds, and 2% for adult females. Based on probable adjusted population estimates, human-caused mortality (including hunting, defense of life or property, illegal, and capture-related) was 11-12% during the period, ranging from 4% to 17%. Harvest rates of 8% were observed for adult radio-collared females.

Based on a limited number of observations, most young, recently weaned females remained within their maternal home ranges, in contrast to less than a third of the young males. No change in trends of reproductive capacity, cub survival, or movement patterns were detected from 1982 through 1986.

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

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

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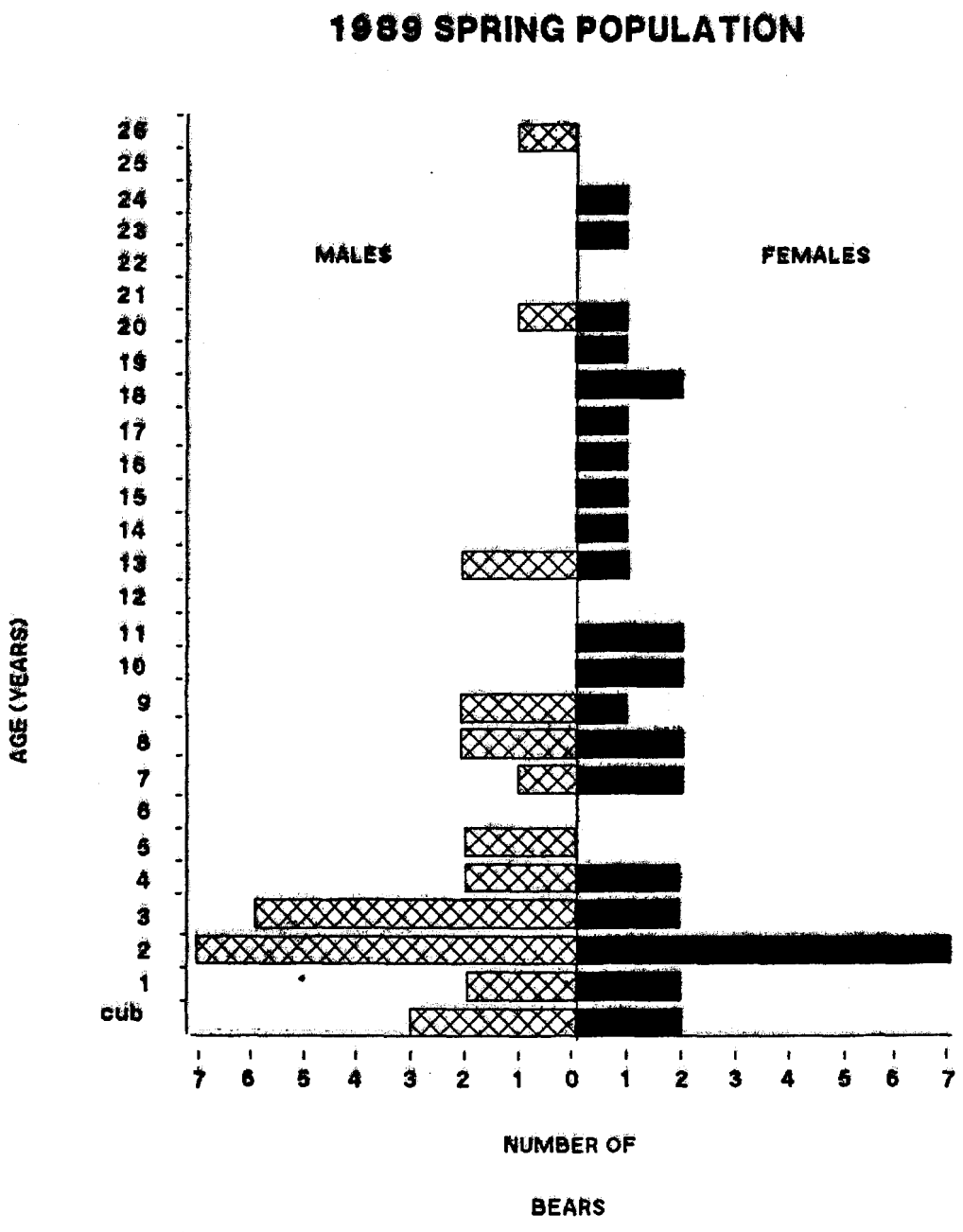

Fig. 1. Population sex and age structure of grizzly bears known alive and assumed present in the northcentral Alaska Range study area, spring 1989.

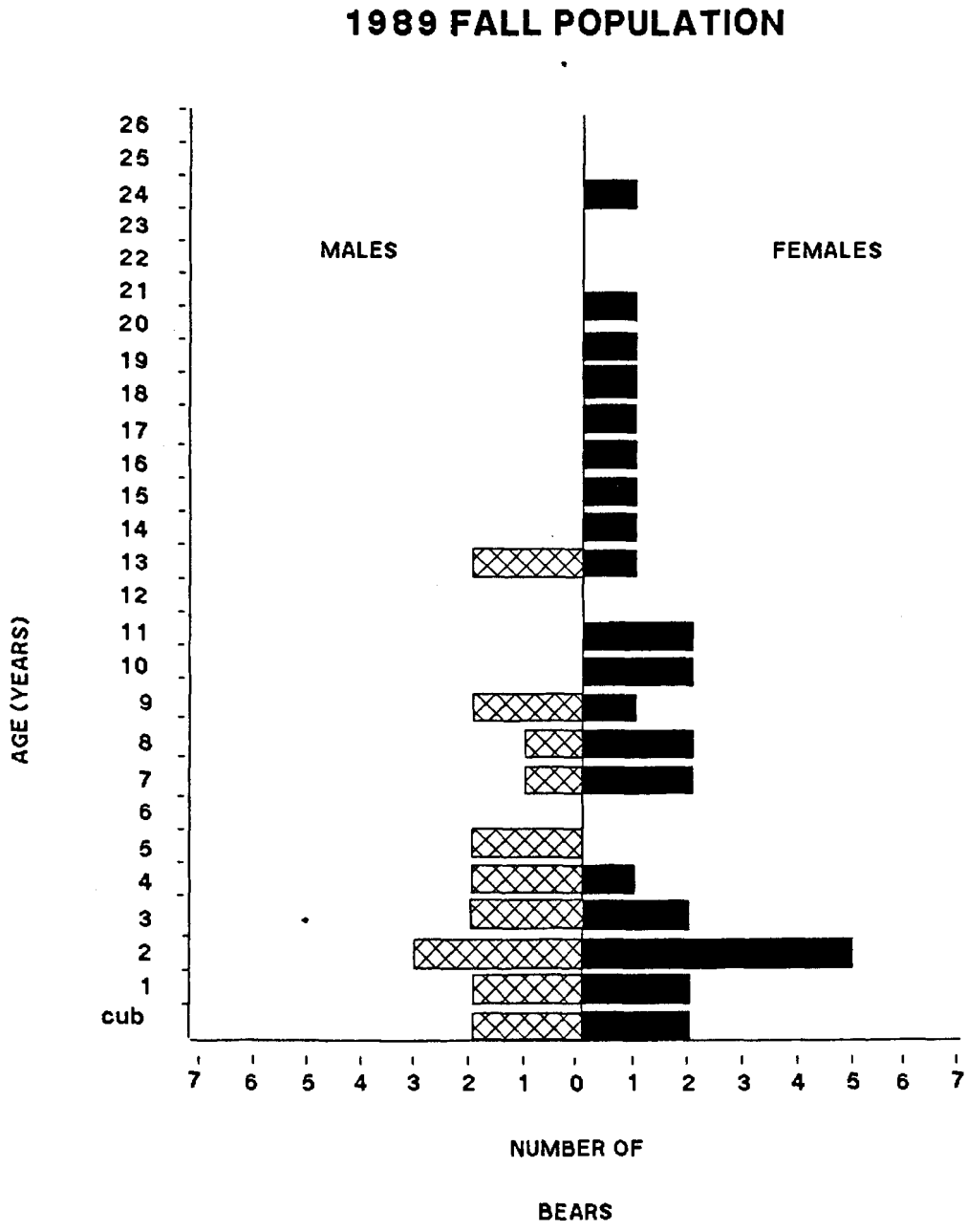

Fig. 2. Population sex and age structure of grizzly bears known alive and assumed present in the northcentral Alaska Range study area after the hunting season, fall 1989.

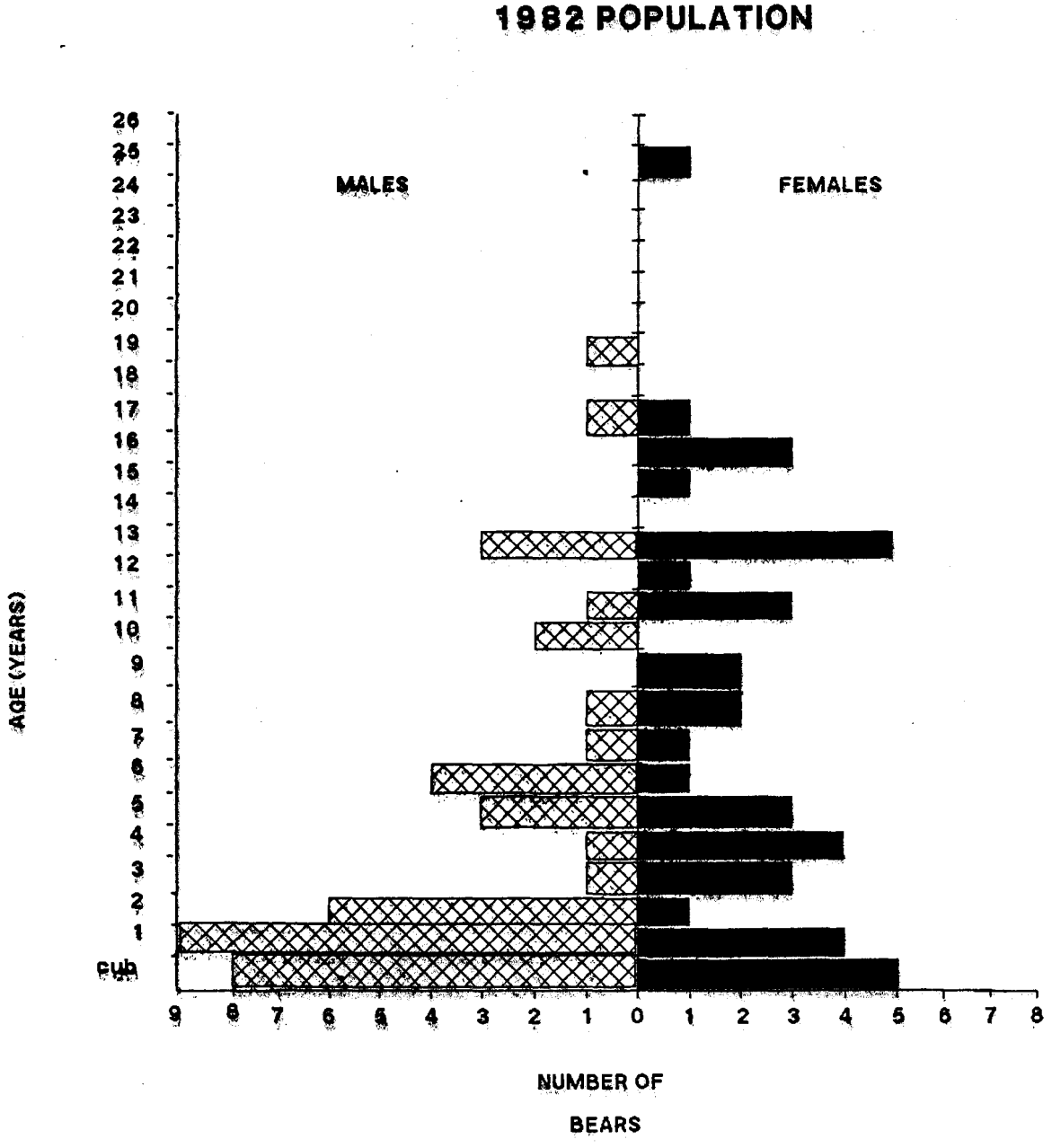

Fig. 3. Population sex and age structure of grizzly bears known alive and assumed present in the northcentral Alaska Range study area, spring 1982.

Table 1. Status and summary of 88 bears captured in the northcentral Alaska Range, 1981-88.

Bear No. and sex	Cem. age (yr)	Date of capture	Weight kg (lb)	Location	Drug dosage[a]	Ear tags[b]	Markers[c]
1301 M	6.5	5/18/81	120(265)	Buchanan Cr.	1.8/1.2 H	373/374	G/G
1302 F	3.5	5/19/81	75(165)	E. Fork Delta	1.0/1.0 M	368/367	R/G
	8.5	6/12/86	114(250)	E. Fork Delta	2.2 TEL M	280/281	O/1B
1303 F	2.5	6/17/81	57(125)	Mystic Mtn.	1.4/1.4 M	524/523	R/R
	4.5	6/27/83	82(180)	Hearst Cr.	5.0 M99 M	3227/3214	R/R
	6.5	6/14/85	73(160)	Upper Gold King	2.0/2.0 M	486/487	R/R
1304 M	5.5	6/19/81	136(300)	W. Fork Delta	2.4/2.0 M	451/452	1B/R
	11.5	5/21/87	255(560)	Threemile Cr.	8.1 TEL M	430/431	W/mG
1305 F	24.5	6/19/81	114(250)	Slate Cr.	A M	453/454	O/R
1306 M	2.5	5/24/82	44(97)	W. Fork Delta	1.0/1.0 L	3151/3086	G/1B
1307 M	2.5	5/24/82	44(98)	W. Fork Delta	1.0/1.0 H	3087/3152	1B/G
	5.5	6/17/85	114(250)[d]	Sheep Cr.	2.4/2.6 L	3087/3152	1B/G
1308 F	6.5	5/25/82	111(245)	Dry Cr.	-[e]	3001/3154	O/Pp
	8.5	6/20/84	120(265)	Dry Cr.	5.0 M99 M	3001/471	O/Pp
	11.5	6/8/87	123(270)[d]	Dry Cr.	3.3 TEL M	528/529	O/Pp
1309 M	8.5	5/25/82	318(700)[d]	Dry Cr.	A L	3153/3101	dB/Bk
1310 M	13.5	5/25/82	250(550)	Buchanan Cr.	2.0/2.0 M	No tags	
	15.5	6/20/84	241(530)	Molybdenum Rg.	4.0/2.0 M	467/473	O/W
	18.5	5/21/87	264(580)	Buchanan Cr.	9.0 TEL M	414/413	Y/W
1311 F	12.5	5/26/82	120(265)	Molybdenum Rg.	1.9/2.1 M	3106/3107	W/W
	14.5	6/21/84	116(255)	Molybdenum Rg.	2.0/2.2 M	466/455	W/W
	17.5	6/8/87	123(270)[d]	Molybdenum Rg.	3.4 TEL M	571/570	W/W[f]
1312 F	0.5	5/26/82	12(26)	Molybdenum Rg.	0.1/0.1	3104/3155	O/W[f]
1313 F	0.5	5/26/82	12(27)	Molybdenum Rg.	0.08/0.13	3156/3105	W/O[f]
1314 M	6.5	5/27/82	116(255)	Iowa Rg.	2.1/1.9 H	3088/3002	dB/1B
1315 M	13.5	6/4/82	272(600)	Buchanan Cr.	1.9/2.1 L	3102/3157	Bk/O
	15.5	5/17/84	295(650)	Hayes Cr.	A H	3322/none	Bk/-

Table 1. Continued.

Bear No. and sex	Cem. age (yr)	Date of capture	Weight kg (lb)	Location	Drug dosage[a]	Ear tags[b]	Markers[c]
1316 M	11.5	6/7/82	236(520)	W. Fork Delta	3.8/0.0 H	3089/3090	O/1B
1317 F	3.5	6/8/82	36(80)	Forgotten Cr.	1.2/1.8 L	3091/3003	1B/0
	5.5	5/16/84	55(122)	Upper West Fk.	A L	3486/3239	1B/O
	6.5	5/23/85	59(130)	Upper Wood R.	7.0 M99	497/498	1B/O
1318 F	13.5	6/8/82	104(230)	Buchanan Cr.	A L	3004/3103	W/G
	15.5	6/22/84	118(260)[d]	Slate Cr.	A M	458/472	W/G
	18.5	6/2/87	105(230)[d]	Slate Cr.	3.3 TEL M	--	--
1319 M	0.5	6/8/82	12(26)	Buchanan Cr.	0.15/0 L	3005/3092	R/Y[f]
1320 F	17.5	6/8/82	102(225)	Trident Gl.	A M	3158/3093	G/B
	19.5	6/25/84	139(305)	E. Hayes Cr.	5.0 M99 M	463/461	G/B
	22.5	6/12/87	114(250)	Hayes Gl.	4.0 TEL M	517/518	mG/dB
1321 F	16.5	6/9/82	141(310)	Snow Mt. Glch.	2.1/1.9 M	3028/3108	G/W
	17.5	5/17/83	127(280)	Dry Cr.	1.8/2.2 M	3028/3427	G/W
	19.5	7/22/85	218(480)	N. VABM Wood	2.6/1.0 L	399/398	G/W
1322 F	8.5	6/9/82	91(200)	Sheep Cr.	1.9/2.1 M	3051/3159	W/1B
1323 F	11.5	6/10/82	95(210)	Mystic Mt.	1.9/2.1 M	3160/3030	G/G
	13.5	6/29/84	132(290)	VABM Wood	A M	579/582	G/G[f]
1324 F	0.5	6/10/82	12(26)	Mystic Mt.	0.12/0 M	3027/3162	R/W[f]
	6.5	5/26/88	111(245)	Coal Cr.	3.6 TEL L	159/160	Bk/W[f]
1325 M	0.5	6/10/82	12(27)	Mystic Mt.	0.10/0 M	3161/3031	W/R[f]
	2.5	5/15/84	67(148)	Mystic Cr.	1.0 M99 M	3233/3394	R/W
1326 F	4.5	6/18/82	93(205)	Buchanan Cr.	2.2/1.8 M	3008/3163	W/R
	6.5	6/21/84	109(240)	Buchanan Cr.	1.8/2.2 M	468/462	W/R
	7.5	6/27/85	111(245)	Slate Cr.	2.4/1.6 L	426/427	W/W
1327 F	16.5	7/8/82	127(280)	Whistler Cr.	2.2/1.8 M	3134/3192	G/R
	18.5	6/23/84	125(275)	Whistler Cr.	A H	458/192	G/R
1328 F	1.5	7/8/82	43(95)	Whistler Cr.	0.9/1.1 M	3115/3014	dB/G
1329 F	13.5	7/9/82	120(265)	Buchanan Cr.	2.4/1.6 M	3026/3111	W/R
1330 M	1.5	7/9/82	48(106)	Buchanan Cr.	-- M	--/--	R/W
	3.5	6/28/84	102(225)	E. Fk. Delta	2.6/3.0 M	597/598	R/W

Table 1. Continued.

Bear No. and sex	Cem. age (yr)	Date of capture	Weight kg (lb)	Location	Drug dosage[a]	Ear tags[b]	Markers[c]
1331 F	4.5	7/10/82	77(170)[d]	Trident Gl.	2.4/1.6 M	3120/3194	Bk/O
	9.5	5/20/87	114(250)[d]	E. Hayes Cr.	3.0 TEL M	519/520	Bk/Y
1332 F	5.5	7/12/82	104(230)	Gillam Gl.	2.4/1.6 M	394/190	R/dB
1333 F	16.5	7/13/82	141(310)	Buchanan Cr.	A M	474/469	G/R
1334 M	1.5	7/13/82	49(108)	Buchanan Cr.	1.0/1.0 M	395/392	Y/G
	3.5	6/27/84	107(235)	McGinnis Cr.	A M	585/583	O/G
1335 F	1.5	7/13/82	38(84)	Buchanan Cr.	1.0/1.0 M	32/456	G/Y
	3.5	6/25/84	80(175)	Gilliam Gl.	1.5/3.0 M	465/464	dB/G
1336 F	2.5	5/16/83	48(105)	Kansas Cr.	1.0/1.0 M	3201/3204	Bk/mG
	3.5	6/26/84	89(195)	Copper Cr.	2.0/3.0 M	470/595	Bk/mG
	4.5	6/17/85	102(224)	Wood R.	A L	470/595	Bk/mG
	6.5	5/15/87	109(240)	Rogers Cr.	2.2/2.0 M	521/522	Bk/mG
1337 M	20.5	5/18/83	293(645)	Sheep Cr.	3.5/3.5	3209/3205	R/O
	25.5	6/15/88	277(610)	Sheep Cr.	A TEL H	364/363	O/R
1338 M	6.5	5/20/83	111(245)	Molybdenum Rg.	A M	3203/3202	O/Bk
1339 M	6.5	5/23/83	120(265)	Trident Gl.	-- M	3286/3351	1B/W
	7.5	5/17/84	168(370)	E. Fk. Delta	6.0 M99 H	3254/3398	1B/W
1340 F	3.5	5/23/83	71(157)[d]	Hayes Cr.	1.2/0.8 H	3277/3208	G/O
	4.5	5/19/84	91(200)[d]	Molybdenum Rg.	4.0 M99 M	3277/3208	mG/O
	5.5	6/27/85	100(220)	W. Hayes Cr.	2.4/1.6 L	590/596	mG/mG
1341 F	10.5	5/23/83	107(235)[d]	NE Portage	1.5/1.5 H	3210/3428	R/dB
	12.5	6/13/85	107(235)[d]	E. Fk. Delta	2.0/2.0 M	442/none	O/-
	15.5	6/14/88	164(360)	E. Fk. Delta	7.0 TEL M	356/355	dkB/Y
1342 M	2.5	5/24/83	49(108)	Threemile Cr.	0.6/1.2 M	3354/3207	W/dB
1343 M	2.5	5/24/83	43(95)	Threemile Cr.	0.6/1.2 M	3426/3285	R/Bk
1344 M	2.5	5/24/83	56(123)	Threemile Cr.	0.6/1.2M	3361/3433	1B/Bk
	3.5	6/23/84	123(270)	Hayes Cr.	2.2/3.2 M	475/460	1B/Bk
1345 F	8.5	5/24/83	--	Upper W. Fork	1.2/1.8 L	3206/3352	O/O
	10.5	5/23/85	105(230)[d]	Upper W. Fork	7.0 M99	499/500	O/O
1346 M	5.5	5/25/83	114(250)	Hayes Gl.	A M	3359/3356	1B/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]
1347 M	6.5	5/31/83	189(415)[d]	Coal Cr.	3.5 M99	None	Dead
1348 F	12.5	5/31/83	123(270)[d]	Mystic Mtn.	A M	3363/3372	W/O
	15.5	5/16/86	116(255)	Wood R.	2.4/1.6 M	235/236	W/O
1349 M	18.5	6/2/83	264(580)	O'Brien Cr.	3.8/1.2L	3364/3292	R/1B
1350 M	8.5	6/2/83	202(445)[d]	Ptarmigan Cr.	3.0/2.0L	3432/3430	dB/R
	11.5	6/12/86	205(450)[d]	E. Fork Delta	3.5 TEL L	273/272	dB/R
1351 F	14.5	6/23/83	114(250)[d]	Dry Cr.	4.0 M99 M	3217/3390	dB/W
	16.5	6/10/85	111(245)	Little Delta R.	2.0/2.0 M	477/436	dB/W
	18.5	5/19/87	130(285)	Dry Cr.	AM	503/504	dB/W
1352 F	14.5	6/27/83	111(245)	W. Fork Delta	--	3215/3316	O/W
1353 M	1.5	6/27/83	27(60)	W. Fork Delta	--	3310/none	O/-
1354 F	1.5	6/27/83	12(27)	W. Fork Delta	--	None/3314	-/O
1355 M	3.5	6/30/83	60(133)	E. Fork Delta	4.0 M99 H	3232/3473	O/Bk
	5.5	6/3/85	70(155)	Whistler Cr.	2.2/1.8 H	586/587	O/Bk
1356 M	2.5	6/30/83	50(110)	Little Delta R.	2.0 M99 H	3234/3392	Bk/O
1357 M	2.5	5/15/84	63(138)	Dry Cr.	1.1 M99 M	3323/3235	W/Bk
	3.5	6/24/85	93(205)	Dry Cr.	1.5/1.5 M	447/448	W/Bk
1358 M	13.5	5/18/84	205(450)	Hayes Cr.	A L	3318/3447	1B/dB
	15.5	5/20/86	236(520)	Trident Gl.	3.4/2.0 L	297/296	1B/dB
1359 M	3.5	5/28/85	61(134)	Snow Mt. Glch.	4.0 M99 M	489/488	dB/O
1360 F	10.5	5/28/85	95(210)	Snow Mt. Glch.	7.0 M99 H	None	None
1361 F	3.5	5/28/85	63(138)	Dry Cr.	4.0 M99 M	482/483	mG/R
	4.5	5/19/86	100(220)	Rogers Cr.	1.7/2.0 L	274/275	G/Bk
1362 F	6.5	6/5/85	--	Glacier Cr.	2.0/2.0 L	None	None
	6.5	6/24/85	114(250)	Threemile Cr.	2.2/1.8 L	443/490	dB/dB
	9.5	5/15/88	--	Sheep Cr.	5.0 TEL H	197/198	O/Y
1363 M	3.5	6/5/85	55(120)	Slide Cr.	1.0/2.0 M	592/593	dB/1B
1364 M	0.5	6/14/85	7(15)	Gold King Cr.	0.7/- M	None	None
1365 M	5.5	6/19/85	118(260)	Wood R.	A M	476/441	1B/G
1366 M	8.5	7/22/85	234(515)	Tatlanika R.	3.2/1.0 M	390/391	mG/R

Table 1. Continued.

Bear No. and sex	Cem. age (yr)	Date of capture	Weight kg (lb)	Location	Drug dosage[a]	Ear tags[b]	Markers[c]
1367 M	2.5	5/19/86	61(134)	Threemile Cr.	1.4/2.0 M	400/241	1B/W
1368 F	2.5	5/19/86	48(106)	Threemile Cr.	1.4/2.0 M	257/256	1B/lB
1369 M	2.5	5/19/86	68(150)	Threemile Cr.	1.4/2.0 L	247/246	W/dB
1370 F	2.5	5/20/86	47(103)	Buchanan Cr.	1.4/2.0 H	253/252	dB/Bk
	3.5	5/20/87	69(151)	Buchanan Cr.	1.5/1.5	--	--
1371 M	2.5	5/20/86	57(126)	Buchanan Cr.	1.4/2.0 M	269/268	Bk/dB
1372 M	2.5	5/20/86	72(158)	Ptarmigan Cr.	1.4/2.0 M	387/386	1B/O
1373 M	7.5	5/21/86	193(425)	Delta Cr.	4.0/2.0 M	295/294	1B/R
1374 F	6.5	5/21/86	106(233)	Delta Cr.	2.0/2.0 M	249/248	R/G
1375 M	6.5	6/13/86	186(410)	Sheep Cr.	4.5 TEL L	276/277	Y/W
1376 F	14.5	6/13/86	130(285)	Hayes Cr.	3.0 TEL M	279/278	G/O
1377 M	2.5	8/28/86	132(290)[d]	Iowa Rg.	4.0 TEL L	505/507	Bk/R
1378 F[g]	2.5	5/20/86	59(130)	Ptarmigan Cr.	--	None	None
1379 F	2.5	5/15/87	67(148)	Sheep Cr.	2.2/2.0 L	334/335	W/W
1380 M	2.5	5/18/87	65(142)	W. Fork Delta	2.2 TEL H	513/514	W/R
	3.5	5/17/88	109(240)	Buchanan Cr.	3.2 TEL	175/174	W/R
1381 M	2.5	5/21/87	73(160)	Dry Cr.	3.0 TEL M	481/480	1B/Bk
1382 F	3.5[d]	5/15/88	68(150)	W. Fk. Delta	3.2 TEL M	169/170	R/Y
1383 M	2.5[d]	6/12/87	77(170)	Coal Cr.	AM	389/390	mG/dB
1384 M	7.5[d]	5/15/88	191(420)	Chute Cr.	7.0 TEL M	960/959	W/Y
1385 F	2.5	5/15/88	68(150)	Upper Wood R.	2.2 TEL H	168/167	1B/Y
1386 M	2.5	5/15/88	73(160)	Upper Wood R.	2.2 TEL M	181/180	Bk/Y
1387 F	2.5	5/23/88	55(120)	Dry Cr.	A TEL M	179/178	Y/R
1388 M	2.5	5/25/88	68(150)	Dry Cr.	2.5 TEL M	153/154	Y/lB

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

Table 1. Continued.

[b] Ear tag numbers, left/right.

[c] Marking designations:
Colors: R, red; G, light green; mG, medium green; 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.

Table 2. Minimum spring grizzly bear population present in northcentral Alaska Range study area, 1981-88.[a]

Bears alive during spring of year[b]	1982			1983			1984			1985			1986			1987			1988		
	N	Adj. N	Adj. N ≥ 2yrs	N	Adj. N	Adj. N ≥ 2yrs	N	Adj. N	Adj. N ≥ 2yrs	N	Adj. N	Adj. N ≥ 2yrs	N	Adj. N	Adj. N ≥ 2yrs	N	Adj. N	Adj. N ≥ 2yrs	N	Adj. N	Adj. N ≥ 2yrs
Marked bears	65	57	39	59	50	43	62	53	35	50	43	34	45	39	39	38	33	33	40	35	35
Unmarked young with marked mothers	2	2	0	3	3	0	6	6	0	13	13	0	9	9	0	21	20	0	21	20	0
Unmarked bears killed by hunters	12	9	7	9	6	6	5	3	3	3	1	1	3	1	1	7	2	1	2	1	1
Minimum observed population	78	68	46	69	59	49	72	62	48	64	56	35	56	50	41	66	57	31	64	57	37

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

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

Table 3. Reproductive status and litter sizes of potentially mature females in the northcentral Alaska Range, 1981-88.

Bear No.	Age in 1988[a] (yr)	Offspring No.	Reproductive status[b] 1981	1982	1983	1984	1985	1986	1987	1988	Reproductive history
1302	10		NB	UN	UN	UN	UN	B	B	3cubs	No offspring prior 1986
1303	9	1364, 1UM	NB	NB	B?	B	2cubs/B	UN	UN	UN	No offspring prior 1981; lost cubs in 2 separate incidents 1985
1305	25	1306, 1307	2yrlg	2 2 yr/B/Dead							Hunter kill fall 1982
1308	12	2UM, 2UM		?/B	B	2cubs	2yrlg	1 2-yr/B	2cubs	2yrlg	Offspring 1982 or before; lost 1 yrlg 1985
1311	18	1312, 1313, 1372, 1378, 2UM	UN/B	2cubs	B	2cubs	2yrlg	2 2-yr/B	2cubs	2yrlg?	Lost cubs August 1982
1317	6			NB	NB?	NB	NB/Dead				Hunter kill fall 1985
1318	19	1319, 1380, 1382	UN/B	1cub/B	B	B	2cubs	2yrlg	2 2-yr	2 3-yr/B	Lost cub 1982
1320	23	1UM, 3UM, 2UM		?/B	1cub/B?	B	3cubs	B	2cubs	1yrlg	Weaned or lost offspring 1982; lost cub 1983; lost 3 cubs 1985, lost 1 cub 1987; lost 1 yrlg 1988
1321	22	1342, 1343, 1344, 1UM,[c] 1379,[c] 1381[c]	UN/3+cubs	3yrlg	3 2-yr	2 3-yr/B	3cubs	3yrlg	2 2-yr/B	3 cubs	1342 killed illegally fall 1983; lost 1 yrlg 1986; lost 1 cub 1988
1322	14	1336	UN/1+cubs	1yrlg	1 2-yr	1 3-yr/B	UN	UN	UN	UN	
1323	17	1324, 1325	UN/B	2 cubs	2yrlg	2 2-yr/B	UN	UN	UN	UN	
1324	6	2UM		NB	NB	NB	NB?	B	2+ cubs	2yrlg	
1326	8	1UM		NB	B	B	1cub	B/Dead			No offspring prior 1982; lost cub 1985; hunter kill 1986
1327	18	1328, 1UM, 3UM	UN/2+cubs	2yrlg	B	3cubs/ Dead					1UM yrlg capture mortality; lost 1328 in 1982; 1327 capture mortality? 1984
1329	14	1330	UN/1+cubs	1yrlg	1 2-yr/Dead						Killed by male May 1983
1331	10	1UM		NB	B	UN/B	UN	1+cubs	1yrlg	UN	No offspring prior 1982; lost yrlg 1987

Table 3. Continued.

Bear No.	Age in 1988[a] (yr)	Offspring No.	Reproductive status[b] 1981	1982	1983	1984	1985	1986	1987	1988	Reproductive history
1332	6			NB?	Dead						No offspring prior 1982; died in den 1983
1333	18	1334, 1335	UN/2+cubs	2yr1g	2 2-yr	2 3-yr/ B/Dead					Hunter kill 1984
1336	7	2UM			NB	NB	B	B	2cubs	2yr1g	No offspring prior 1983
1340	8				NB	NB	B	UN	UN	UN	No offspring prior 1983
1341	15	1UM, 1370, 1371		UN/1+cubs	1yr1g/B	2cubs	2yr1g	2 2-yr/B	B	2cubs	Lost yr1g 1983; lost 2 cubs 1988
1345	13	2UM, 1385, 1386			B	2cubs	1yr1g/B	2cubs	2yr1g	2 2-yr/B	Lost 1 cub 1984; lost 1 yr1g 1985
1348	17	1367, 1368, 1369, 2UM			?/B	3cubs	3yr1g	3 2-yr/B	2cubs	2yr1g	Probably weaned or lost offspring 1983
1351	18	1357, 1361, 1UM, 3UM	UN/B	UN/3+cubs	3yr1g	3 2-yr	2 3-yr/B	UN/3+cubs	3yr1g/Dead		Lost 1UM offspring 1984 Hunter kill 1987, 3UM yr1g orphaned?
1352	16	1353, 1354	UN/B	UN/2+cubs	2yr1g	2 2-yr/Dead					Hunter kill 1984; 1353, hunter kill 1984
1360	11	1359, 1363	UN/B	UN/2+cubs	UN/2+yr1g	UN/2+2-yr	2 3-yr/ Dead				Capture mortality 1985
1361	6					NB	NB	NB	UN	UN	No offspring prior 1985
1362	9	1387, 1388				UN	B	2cubs	2yr1g	2 2yr/B	No offspring prior 1985
1374	8	UM				UN/B	UN/2+cubs	2yr1g	?/B?	UN	
1376	16	2UM					UN	?/B	2cubs	2yr1g	Offspring prior 1986

[a] Age in 1988 or last year in which bear was alive.

[b] Designations: NB, not observed in breeding condition; UN, not observed in that year; B, observed in breeding condition; ?, status unknown; UM, unmarked; cub, cub of year; ylg, yearling; 2-yr, 2-year-old; +, 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 4. Observed and projected minimum reproductive intervals for adult female grizzly bears in the northern Alaska Range, 1981-88.

Bear No.	Maximum age at beginning of interval	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
1302	7	5	B?	B	B	C	Y	2/B			
1303	5	5	B	C/B	B	C	Y	2/B			
1305	22	3	W/B	C	Y	2/B					
1308	6	4,3	C?/B	B	C	Y	2/B	C	Y	2/B	
1311	10	5,3	W/B	C	B	C	Y	2/B	C	Y	2/B
1318	12	7	W/B	C/B	B	B	C	Y	2	3/B	
1320	17	9	W/B	C/B?	B	C	B	C	Y/B?	C	Y
1321	14	4,3	W/B	C	Y	2	3/B	C	Y	2/B	C
1322	6	4	B	C	Y	2	3/B				
1323	11	3	W/B	C	Y	2/B					
1324	5	3	B	C	Y	2/B					
1326	6	5	B	C/B?	B/D	C	Y	2/B			
1329	11	3	W/B	C	Y	2/D					
1331	7	5	B	C	Y/B	C	Y	2/B			
1333	14	4	W/B	C	Y	2	3/B/D				
1336	5	3	B	C	Y	2/B					
1341	10	5,5	W/B	C	Y/B	C	Y	2/B	B	C/B	C
1345	8	5	B	C	Y/B	C	Y	2	3/B		
1348	12	3,3	W/B	C	Y	2/B	C	Y	2/B		
1351	12	4	W/B	C	Y	2	3/B	C	Y/D		
1352	13	3	W/B	C	Y	2/D					
1360	6	4	W/B	C	Y	2	3/D				
1362	6	3	B	C	Y	2/B					
1374	4	3	B	C	Y	2/B					
1376	14	3	W/B	C	Y	2/B					

Table 4. Continued.

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

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

Table 5. Observed litter size and number of offspring in cub, yearling, 2-year-old, and 3-year-old age classes, Alaska Range, 1982-88.

Age class	Observed no. of litters							Total		Mean litter size
	1982	1983	1984	1985	1986	1987	1988	No. of litters	No. of offspring	
Cub										
litter size 1	1	1	0	1	0	0	0	3	3	
litter size 2	2	0	4	2	2	7	1	18	36	
litter size 3	0	0	2	2	0	0	2	6	18	
total	3	1	6	5	2	6	3	26	57	2.19
Yearling										
litter size 1	2	1	0	1	0	1	1	6	6	
litter size 2	2	2	0	3	2	2	5	17[a]	34[a]	
litter size 3	1	1	0	1	1	1	0	5	15	
total	5	4	0	5	3	4	6	28[a]	55[a]	1.96[a]
2-year-old										
litter size 1	0	2	0	0	1	0	0	3	3	
litter size 2	1	1	2	0	2	2	2	10	20	
litter size 3	0	1	1	0	1	0	0	3	9	
total	1	4	3	0	4	2	2	16	32	2.00
3-year-old										
litter size 1	0	0	1	0	0	0	0	1	1	
litter size 2	0	0	2	1	0	0	1	4	8	
litter size 3	0	0	0	1	0	0	0	1	3	
total	0	0	3	2	0	0	1	6	12	2.00

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

Table 6. Minimum number of female grizzly bears present in the study population in northcentral Alaska, 1981-88.

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

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

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

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

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

[e] These are minimum figures because not all marked and reproductively active females were observed every year due to radio collar loss or failure. We assumed that these females remained in the study area and continued to produce offspring. There were 2 reproductively mature females which were not observed in 1985, 4 in 1986, 4 in 1987, and 7 in 1988. But since the number and age of offspring was not known, their estimated numbers were not included here.

Table 7. Mortality of grizzly bears in Alaska Range study area, 1981-88.

Bear No.[a]	Sex[b]	Age[c]	Date of initial capture	Date of death	Location	Cause of death
UM	F	3.5	--	5/16/81	Dry Creek	Hunter kill
UM	M	6.5	--	5/18/81	Buchanan Creek	Hunter kill
1301	M	6.5	5/18/81	5/18/81	Buchanan Creek	Capture mortality
UM	M	2.5	--	5/23/81	Wood River	Hunter kill
UM	M	3.5	--	5/25/81	W. Fk. Little Delta	Hunter kill
UM	M	2.5	--	9/4/81	Wood River	Hunter kill
UM	F	2.5	--	9/6/81	Iowa Ridge[d]	Hunter kill
UM	M	12.5	--	9/7/81	Wood River[d]	Hunter kill
UM	M	2.5	--	9/12/81	W. Fk. Little Delta	Hunter kill
UM	F	3.5	--	9/28/81	Wood River[d]	Hunter kill
UM	M	7.5	--	10/2/81	E. Fk. Little Delta	Hunter kill
UM	M	Unk	--	10/8/81	Wood River[d]	Hunter kill
UM	F	5.5	--	10/9/81	Wood River[d]	Hunter kill
UM	M	8.5	--	10/17/81	Gold King	Hunter kill
UM	M	10.5	--	5/22/82	Gold King	Hunter kill
1319	M	Cub	6/8/82	6/18-7/2/82	W. Fk. Little Delta	Unk, offspring of 1318
UM	Unk	1.5	7/8/82	7/8/82	E. Fk. 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	1.5	7/8/82	8/27-9/23/82	E. Fk. Little Delta	Unk, offspring of 1327
UM	F	5.5	--	9/15/82	W. Fk. Little Delta	Hunter kill
UM	M	2.5	--	9/15/82	Dry Creek	Hunter kill
1305	F	25.5	6/19/81	9/15/82	Dry Creek	Hunter kill
1314	M	6.5	5/27/82	9/15/82	Little Delta River	Hunter kill
UM	F	11.5	--	9/17/82	E. Fk. Little Delta	Hunter kill
1332	F	6.5	7/12/82	Winter 82/83	Buchanan Creek	Unk, den mortality
UM	F	4.5	--	5/1/83	Trident Glacier	Hunter kill

Table 7. Continued.

Bear No.[a]	Sex[b]	Age[c]	Date of initial capture	Date of death	Location	Cause of death
1329	F	14.5	7/9/82	5/15/83	Buchanan Creek	Killed and eaten by 1315M
1338	M	6.5	5/20/83	5/20/83	Molybdenum Ridge	Capture mortality
UM	F	5.5	--	5/24/83	W. Fk. Little Delta	Hunter kill
1347	M	6.5	5/31/83	5/31/83	Wood River	Capture mortality
UM	Unk	Cub	--	6/83	Delta Creek	Unk, offspring 1320
UM	Unk	1.5	--	5/23-8/21/83	Little Delta River	Unk, offspring 1341
UM	F	14.5	--	9/16/83	Kansas Creek	Hunter kill
UM	M	7.5	--	9/19/83	Little Delta River/ Tenmile Creek	Hunter kill
1342	M	2.5	5/24/83	10/83	Wood River	Nonsport illegal kill
1315	M	15.5	6/4/82	5/17/84	Delta Creek	Capture mortality
1306	M	4.5	5/24/82	5/20/84	W. Fk. Little Delta	Hunter kill
1356	M	3.5	6/30/83	5/20/84	Gerstle River	Hunter kill
1333	F	18.5	7/12/82	5/22/84	E Fk Little Delta	Hunter kill
1352	F	15.5	6/27/83	5/30/84	W Fk Little Delta	Hunter kill
1327	F	18.5	7/8/82	6/23/84	E Fk Little Delta	Capture mortality?
3UM	Unk	Cub	--	6/23/84	E Fk Little Delta	Unk, offspring of 1327
UM	Unk	Cub	--	6/84	Wood River	Unk, offspring of 1345
UM	Unk	2.5	--	8-9/84	Dry Creek	Unk, offspring of 1351
UM	F	Unk	--	9/2/84	Delta Creek	Hunter kill
1353	M	2.5	6/27/83	9/4/84	W Fk Little Delta	Hunter kill
UM	M	3.5	--	9/6/84	Dry Creek	Hunter kill
1344	M	3.5	5/24/83	9/7/84	Dry Creek	Hunter kill
1325	M	2.5	6/10/82	9/9/84	Gold King Creek	Defense of life and property kill
1335	F	3.5	7/13/82	9/14/84	E Fk Little Delta	Hunter kill
1309	M	10.5	5/25/82	9/15/84	Gold King	Hunter kill
UM	F	17.5	--	10/7/84	W Fk Little Delta	Hunter kill

Table 7. Continued.

Bear No.[a]	Sex[b]	Age[c]	Date of initial capture	Date of death	Location	Cause of death
3UM	Unk	Cub	--	5/85	Hayes Glacier	Unk, offspring of 1320
UM	Unk	1.5	--	5/12/85-5/15/86	Dry Creek	Unk, offspring of 1308
1360	F	10.5	5/28/85	5/28/85	Snow Mtn Gulch	Capture mortality
UM	Unk	Cub	--	5/23-6/5/85	Mystic Creek	Unk, offspring of 1303
UM	Unk	1.5	--	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	6.5	6/8/82	9/85	Wood R./Yanert R.	Illegal kill?[g]
1355	M	5.5	6/30/83	9/13/85	Iowa Ridge	Hunter kill
1378	F	2.5	--	5/25/86	Delta Creek	Hunter kill, offspring of 1311
1326	F	8.5	6/18/82	5/27/86	O'Brien Creek	Hunter kill
1358	M	15.5	5/18/84	5/31/86	Delta Creek	Hunter kill
1368	F	2.5	5/19/86	5/31/86	Bonnifield Creek	Defense of life or property kill, offspring of 1348
1367	M	2.5	5/19/86	6/28/86	Bonnifield Creek	Defense of life or property kill, offspring of 1348
UM	M	3.5[f]	--	9/2/86	Wood River	Hunter kill
1373[e]	M	7.5[f]	5/20/86	9/2/86	McGinnis Creek	Hunter kill
UM	M	2.5[f]	--	9/3/86	W. Fk. Little Delta	Hunter kill, offspring of 1308?
1371	M	2.5	5/20/86	9/7/86	Little Delta River	Hunter kill, offspring of 1341
1357[e]	M	4.5	5/15/84	9/23/86	Tatlanika River	Hunter kill, offspring of 1351
UM	Unk	1.5	--	fall 1986	Dry Creek	Unk, offspring of 1321

Table 7. Continued.

Bear No.[a]	Sex[b]	Age[c]	Date of initial capture	Date of death	Location	Cause of death
UM	Unk	1.5	--	5/20/87-7/3/87	E. Hayes Creek	Unk, offspring of 1331
UM	Unk	Cub	--	7/3/87-8/30/87	Hayes Glacier	Unk, offspring of 1320
UM	M	3.5[f]	--	5/9/87	Slate Creek	Hunter kill
1370	F	3.5	5/20/86	5/20/87	Buchanan Creek	Capture mortality, offspring of 1341
1349[e]	M	22.5	6/2/83	5/22/87	Coal Creek (Healy)	Hunter kill
1369[e]	M	3.5	5/19/86	6/26/87	Lignite	Defense of life or property kill, offspring of 1348
UM	F	2.5	--	9/2/87	Delta Creek	Hunter kill, offspring of 1374?
UM	M	2.5	--	9/2/87	Wood River	Hunter kill
UM	M	8.5	--	9/2/87	Wood River	Hunter kill
UM	M	17.5	--	9/7/87	Virginia Creek	Hunter kill
1381	M	2.5	5/21/87	9/8/87	Dry Creek	Hunter kill
1351	F	18.5	6/23/83	9/11/87	Slide Creek	Hunter kill
UM	Unk	1.5	--	Spring 1988	Hayes Glacier	Unk, offspring of 1320
UM	Unk	Cub	--	Spring 1988	Sheep Creek	Unk, offspring of 1321
UM	Unk	Cub	--	Spring 1988	E. Fork Delta River	Unk, offspring of 1345
UM	Unk	Cub	--	Spring 1988	E. Fork Delta River	Unk, offspring of 1345
UM	M	3.5[f]	--	9/7/88	S. of Gold King	Hunter kill
1350	M	13.5	6/2/83	9/14/88	Dry Creek	Hunter kill

Table 7. Continued.

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

Table 8. Grizzly bear harvest[a] within the study area, 1961-88.

Year	Drainage of reported harvest				Total
	Delta Creek	Little Delta River	Dry Creek	Wood River[b]	
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	1	2
Totals	20	48	24	62	154

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

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

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

[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.

Table 8. Continued.

[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.

Table 9. Human-caused mortality and mortality rates for a grizzly bear population in the northcentral Alaska Range, 1981-88.[a]

Year	Human-caused mortalities	Minimum population of all age classes		Minimum population ≥2 yrs of age		Adult females[b] ≥6 yrs of age		
		n	Mortality rate (%)	n	Mortality rate (%)	n	Deaths	Mortality rate (%)
1981	11	66	17	51	21	19	0	0
1982	5	68	7	46	11	20	2	10
1983	6	59	9	49	11	19	2	15
1984	12	62	20	48	26	19	4	21
1985	3	56	5	35	8	17	2	11
1986	6	50	12	41	14	16	1	6
1987	6	57	10	31	18	19	1	6
1988	2	56	3	36	4	17	0	0
$\bar{x}$	6	59	11	42	15	18	1	8

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

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

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

Table 10. Movement of young-age bears from their maternal home ranges (MHR) subsequent to weaning, Alaska Range, 1983-88.

Maternal female No.	Offspring No. and sex	Age when weaned	Age/year during movement	Movement pattern
1305	1306 M	2.5	2.5/1982	Within maternal home range (MHR)
			3.5/1983	Within MHR
			4.5/1984	Killed by hunter 5/20/84 in MHR
1305	1307 M	2.5	2.5/1982	Within MHR
			3.5/1983	Within MHR
			4.5/1984	Sighted once within 15 km of MHR
			5.5/1985	Moved 12 km NW of MHR
			6.5/1986	Home range includes MHR
			7.5/1987	No radio contact
			8.5/1988	No radio contact
1311	1372 M	2.5	2.5/1986	Within MHR
			3.5/1987	Moved 40 km WNW of MHR, shed collar?
1311	1378 F	2.5	2.5/1986	Killed by hunter 5/25/86 prior to weaning
1318	1380 M	3.5	1988	Within MHR
1318	1382 F	3.5	1988	Within MHR
1321	1344 M	3.5	3.5/1984	Moved 44 km SE of MHR between 5/15 and 6/4/84, remained there through 6/23; killed in MHR by hunter 9/7/84
1321	1379 F	2.5	2.5/1987	Within MHR
			3.5/1988	Within MHR
1321	1381 M	2.5	2.5/1987	Killed by hunter 9/8/87 in MHR
1322	1336 F	3.5	3.5/1984	Within MHR
			4.5/1985	Within MHR; bred
			5.5/1986	Within MHR; collar nonfunctional
			6.5/1987	Within MHR; with 2 cubs
			7.5/1988	Within MHR; with 2 yearlings
1323	1324 F	2.5	2.5/1984	Within MHR; not radio-collared
			3.5/1985	Not sighted
			4.5/1986	Not sighted
			5.5/1987	Not sighted
			6.5/1988	Within MHR; with 2 yearlings

Table 10. Continued.

Maternal female No.	Offspring No. and sex	Age when weaned	Age/year during movement	Movement pattern
1322	1325 M	2.5	2.5/1984	Within MHR; killed in defense of life or property 9/9/84
1329	1330 M	2.5[a]	2.5/1983	Within MHR
			3.5/1984	Moved outside MHR?; no radio contact
			4.5/1985	No radio contact
			5.5/1986	No radio contact
			6.5/1987	No radio contact
			7.5/1988	No radio contact
1333	1334 M	3.5	3.5/1984	Moved 48 km to SE between 6/4 and 6/25/84
			4.5/1985	No radio contact
			5.5/1986	No radio contact
			6.5/1987	No radio contact
			7.5/1988	No radio contact
1333	1335 F	3.5	3.5/1984	Killed by hunter 9/14/84 in MHR
1341	1370 F	2.5	2.5/1986	Within MHR
			3.5/1987	Within MHR; capture mortality
1341	1371 M	2.5	2.5/1986	Killed by hunter 9/7/86 in MHR
1348	1367 M	2.5	2.5/1986	Killed in defense of life or property 6/28/86 in MHR
1348	1368 F	2.5	2.5/1986	Killed in defense of life or property 5/31/86 in MHR
1348	1369 M	2.5	2.5/1986	Within MHR
			3.5/1987	Killed in defense of life or property 6/26/87 48 km WSW of MHR
1351	1357 M	3.5	3.5/1985	Moved 44 km NNW of MHR by 12/3/85
			4.5/1986	Killed by hunter 9/23/86 46 km WNW MHR
1351	1361 F	3.5	3.5/1985	Within MHR
			4.5/1986	Within MHR
			5.5/1987	Shed collar in den
			5.6/1988	Status unknown

Table 10. Continued.

Maternal female No.	Offspring No. and sex	Age when weaned	Age/year during movement	Movement pattern
1352	1353 M	2.5[b]	2.5/1984	Killed by hunter 9/4/84 in MHR
1352	1354 F	2.5[b]	2.5/1984	Not radio-collared, status unknown, assumed dead
1360	1359 M	3.5[c]	3.5/1985 4.5/1986	Within MHR Moved 62 km SE of MHR, shed collar
1360	1363 M	3.5[c]	3.5/1985 4.5/1986	Within MHR Shed collar between 4/28 and 5/16/86 within MHR
1362	1387 F	2.5	1988	Within MHR
1362	1388 M	2.5	1988	Within MHR
Unk	1302 F	2.5-3.5[d]	3.5/1981 4.5-7.5 8.5/1986 9.5/1987 10.5/1988	Within established home range Shed collar 8/81, no contact until 1986 recapture Within established home range Within established home range Within established home range
Unk	1355 M	Unk	3.5/1983 4.5/1984 5.5/1985	Within established home range Within established home range Killed by hunter 9/13/85 12 km N of home range
Unk	1356 M	Unk	3.5/1984	Moved 74 km ESE of den area between 4/27 and 5/20/84 when killed by hunter

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

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

[c] Orphaned when 1360 died during capture.

[d] Captured as 3.5-year-old in 1981.

Appendix A. Abstract of: Taylor, W. P., Jr., H. V. Reynolds III, and W. B. Ballard. In press. Immobilization of grizzly bears with tiletamine hydrochloride and zolazepam hydrochloride.

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.

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Key words: grizzly bears, immobilization, tiletamine HCl/zolazepam HCl, Ursus arctos horribilis.

Appendix B. Abstract from: Kingsley, M. C. S., J. A. Nagy, and H. V. Reynolds. 1988. Growth in length and weight of northern brown bears: differences between sexes and populations. Can. J. Zool. 66:981-986.

Abstract: Growth curves were fitted to data on age, length, and spring weight for individuals from three populations of the brown bear, Ursus arctos, in northern Canada and northwest Alaska. Females reached 90% of asymptotic length before sexual maturity and before the age of first production. Their weight remained approximately in proportion to the cube of their length. Males reached 90% of asymptotic length 0.7 to 1.7 years later than females, and had asymptotic lengths 10-15% greater. Males continued their growth in weight even longer, and reached asymptotic weights 80-100% greater than females. Variation between these populations was small compared with the total range of variation in the species.

Appendix C. Physical attributes[a] of grizzly bears captured in the northcentral Alaska Range, 1981-88.

Bear No.	Date	Sex	Age (yr)[b]	Measured weight	Total length	Shoulder height	Hind foot	Neck	Girth	Body length	Head width	Head length	Left upper canine[c]	Left lower canine[c]
1301	5/18/81	M	6.5	120	180	119	31	61	114	101	21.0	36.8	3.4	3.0
1302	5/19/81	F	3.5	75	165	102	26	55	100	90	16.7	30.5	3.0	2.7
	6/12/86	F	8.5	114	180	--	--	61	106	--	19.2	33.1	--	--
1303	6/17/81	F	2.5	57	122	87	23	53	89	78	15.1	27.7	2.5	2.7
	6/27/83	F	4.5	82	159	97	26	55	91	79	18.4	32.3	3.0	2.9
	6/14/85	F	6.5	73	--	--	--	47	85	--	18.8	32.2	--	--
1304	6/19/81	M	5.5	136	196	121	30	63	108	109	20.0	36.0	3.9	3.5
	5/21/87	M	11.5	255	205	--	--	80	132	--	24.0	39.7	--	--
1305	6/19/81	F	24.5	114	174	103	28	60	100	96	20.1	32.6	3.0b	3.3b
1306	5/24/82	M	2.5	44	131	85	26	44	73	76	15.1	29.6	2.7	2.8
1307	5/24/82	M	2.5	44[d]	148	84	28	46	74	83	15.4	27.3	2.6	2.5
	6/17/85	M	5.5	114[d]	--	--	--	55	94	--	19.2	34.8	--	--
1308	5/25/82	F	6.5	111	186	103	32	63	100	101	20.2	33.1	3.0	2.2b
	6/20/84	F	8.5	120	--	--	--	64	116	--	20.8	34.1	--	--
	6/8/87	F	11.5	123	183	--	--	56	106	--	21.5	34.9	--	--
1309	5/25/82	M	8.5	318[d]	238	150	36	89	152	128	25.0	39.1	4.0	3.5
1310	5/25/82	M	13.5	250[d]	--	--	--	--	--	--	--	--	b	--
	6/20/84	M	15.5	255	--	--	--	74	129	--	24.6	39.3	--	--
	5/21/87	M	18.5	264	212	--	--	80	143	--	25.5	39.1	--	--
1311	5/26/82	F	12.5	120	190	107	30	63	113	105	21.8	33.8	3.0	2.6
	6/21/84	F	14.5	116	--	--	--	59	100	--	20.0	34.2	--	--
	6/8/87	F	17.5	123[e]	188	--	--	62	115	--	21.2	34.1	--	--
1312	5/26/82	F	0.5	12	81	48	15	28	43	42	10.2	16.5	m	m
1313	5/26/82	F	0.5	12	76	50	15	30	48	45	11.1	16.8	m	m
1314	5/27/82	M	6.5	116	191	114	33	61	105	99	18.5	34.8	3.6	3.3
1315	6/4/82	M	13.5	273	197	126	36	96	154	122	26.4	38.2	3.5	3.3
	5/17/84	M	15.5	295	--	--	--	97	139	--	26.8	37.5	--	--
1316	6/7/82	M	11.5	236	211	133	33	81	133	135	24.0	40.7	3.8	3.7

Appendix C. 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]
1317	6/8/82	F	3.5	36	142	91	24	38	62	72	14.2	27.9	2.9	2.9
	5/16/84	F	5.5	55	--	--	--	45	89	--	16.2	29.7	--	--
	5/23/85	F	6.5	59	--	--	--	43	77	--	16.4	30.3	--	--
1318	6/8/82	F	13.5	104[d]	188	113	31	57		113	19.5	33.5	3.1	2.8
	6/22/84	F	15.5	118[e]	--	--	--	59	105	--	19.8	33.5	--	--
	6/2/87	F	18.5	105	--	--	--	--	--	--	--	--	--	--
1319	6/8/82	M	0.5	12	85	52	14	26	34	44	10.8	17.2	d	d
1320	6/8/82	F	17.5	102	181	110	29	65	103	100	21.0	33.1	2.9w	2.7w
	6/25/84	F	19.5	139	--	--	--	62	106	--	21.0	33.0	--	--
	6/12/87	F	22.5	114	173	--	--	58	106	--	21.7	33.4	--	--
1321	6/9/82	F	16.5	141	199	107	34	69	105	115	22.1	35.8	3.5	3.1
	5/17/83	F	17.5	127	178	91	30	69	109	112	21.9	36.0	2.4b	3.2
	7/22/85	F	19.5	218	--	--	--	63	121	--	22.1	35.6	--	--
1322	6/9/82	F	8.5	91	169	100	29	62	97	97	18.9	32.8	3.2	3.0
1323	6/10/82	F	11.5	95	171	106	32	57	98	93	20.0	33.5	3.2	2.9
	6/29/84	F	13.5	132	--	--	--	61	109	--	20.9	33.6	--	--
1324	6/10/82	F	0.5	12	77	49	16	29	47	39	10.6	17.5	m	m
	5/26/88	F	6.5	111	158	--	--	63	109	--	18.8	34.0	--	--
1325	6/10/82	M	0.5	12	86	54	15	26	48	42	11.5	18.0	m	m
	5/15/84	M	2.5	67	--	--	--	46	80	--	16.5	30.1	--	--
1326	6/18/82	F	4.5	93	172	102	27	54	88	98	17.9	31.4	3.1	2.9
	6/21/84	F	6.5	109	--	--	--	58	92	--	18.9	32.8	--	--
	6/27/85	F	7.5	111	--	--	--	52	95	--	20.1	33.3	--	--
1327	7/8/82	F	16.5	127	175	106	29	62	100	117	20.9	32.9	2.3	2.8
	6/23/84	F	18.5	125	--	--	--	61	109	--	21.0	33.5	--	--
1328	7/8/82	F	1.5	43	122	83	26	41	75	68	14.5	25.7	2.0	1.7
1329	7/9/82	F	13.5	120	186	112	30	59	106	104	19.8	34.2	3.3	3.0
1330	7/9/82	M	1.5	48	130	83	27	45	75	67	14.4	26.2	1.4	1.8
	6/28/84	M	3.5	102	--	--	--	50	99	--	17.5	32.9	--	--

Appendix C. Continued.

Bear No.	Date	Sex	Age (yr)[b]	Measured weight	Total length	Shoulder height	Hind foot	Neck	Girth	Body length	Head width	Head length	Left upper canine[c]	Left lower canine[c]
1331	7/10/82	F	4.5	77[e]	161	102	28	50	96	98	17.0	30.5	--	--
	5/20/87	F	9.5	114	175	--	--	56	104	--	19.8	33.4	--	--
1332	7/12/82	F	5.5	104	173	100	32	54	92	97	18.0	33.4	3.1	2.9
1333	7/13/82	F	16.5	141	175	112	33	65	117	124	21.0	34.0	3.1	2.6
1334	7/13/82	M	1.5	49	129	86	27	42	87	72	14.4	24.9	1.3	1.6
	6/27/84	M	3.5	107	--	--	--	52	104	--	18.1	31.3	--	--
1335	7/13/82	F	1.5	38	127	77	24	40	76	73	13.5	24.0	1.6	1.8
	6/25/84	F	3.5	80	--	--	--	47	90	--	16.8	30.0	--	--
1336	5/16/83	F	2.5	47	141	86	27	56	90	86	14.9	28.2	2.6	2.4
	6/26/84	F	3.5	89	--	--	--	49	101	--	16.9	31.7	--	--
	6/17/85	F	4.5	102	--	--	--	61	102	--	18.3	33.3	--	--
	5/15/87	F	6.5	109	160	--	--	67	103	--	18.8	34.6	--	--
1337	5/18/83	M	20.5	289	210	122	36	98	151	135	26.6	39.8	4.0b	b
	6/15/88	M	25.5	277	210	--	--	84	135	--	26.6	39.4	--	--
1338	5/20/83	M	6.5	111	175	89	29	35	107	101	19.9	34.8	3.5	3.4
1339	5/20/83	M	6.5	120	174	103	29	37	109	100	19.7	34.4	3.6	3.1
	5/17/84	M	7.5	168	--	--	--	60	102	--	20.0	35.0	--	--
1340	5/23/83	F	3.5	71[d]	159	86	27	58	95	91	15.7	30.2	3.2	3.2
	5/19/84	F	4.5	91	--	--	--	51	95	--	17.3	31.8	--	--
	6/27/85	F	5.5	100	--	--	--	54	94	--	18.5	33.6	--	--
1341	5/23/83	F	10.5	107	171	110	31	63	125	110	20.7	33.2	3.2	3.1
	6/13/85	F	12.5	107	--	--	--	57	104	--	--	--	--	--
	6/14/88	F	15.5	164	185	--	--	59	114	--	21.8	34.1	--	--
1342	5/24/83	M	2.5	49	133	85	27	52	91	67	15.6	27.2	2.5	2.8
1343	5/24/83	M	2.5	43	139	85	26	48	88	69	15.5	27.1	3.0	3.0
1344	5/24/83	M	2.5	56	151	79	--	49	93	--	14.9	28.5	2.5	2.5
	6/23/84	M	3.5	123	--	--	--	55	105	--	18.5	33.2	--	--
1345	5/24/83	F	8.5	--[d]	175	99	30	65	110	98	18.3	33.0	3.1	2.8
	5/23/85	F	10.5	105	--	--	--	56	103	--	18.6	33.6	--	--

Appendix C. 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]
1346	5/25/83	M	5.5	114	145	98	30	71	110	94	19.7	25.1	3.2	3.0
1347	5/31/83	M	6.5	189	188	119	23	71	144	114	22.0	37.5	3.7	3.4
1348	5/31/83	F	12.5	--	175	107	20	72	123	110	20.0	37.6	3.2	2.9
	5/16/86	F	15.5	116	180	--	--	58	100	--	20.2	32.8	--	--
1349	6/2/83	M	18.5	264	217	124	33	93	145	125	25.6	35.5	4.0b	3.4
1350	6/2/83	M	8.5	202	201	119	30	77	118	118	22.5	--	3.7	3.1
	6/12/86	M	11.5	205[d]	207	--	--	76	--	--	23.7	38.2	--	--
1351	6/23/83	F	14.5	114	181	91	23	69	114	116	21.0	38.0	3.3	3.2
	6/10/85	F	16.5	111	--	--	--	56	98	--	21.3	35.5	--	--
	5/19/87	F	18.5	130	178	--	--	64	110	--	22.0	35.5	--	--
1352	6/27/83	F	14.5	111	175	102	29	59	103	108	19.5	34.1	3.1	2.8
1353	6/27/83	M	1.5	27	107	75	20	34	54	56	12.4	21.9	r	r
1354	6/27/83	F	1.5	12	87	60	17	24	41	43	11.0	18.4	r	r
1355	6/30/83	M	3.5	60	138	98	27	45	77	77	15.2	27.5	--	--
	6/3/85	M	5.5	70	--	--	--	49	84	--	17.4	31.6	--	--
1356	6/30/83	M	2.5	50	--	--	24	46	69	--	14.9	25.2	--	--
1357	5/15/84	M	2.5	63	--	--	--	53	90	--	14.7	27.5	--	--
	6/24/85	M	3.5	93[d]	--	--	--	50	88	--	18.5	31.1	--	--
1358	5/18/84	M	13.5	205	--	--	--	86	--	--	--	38.4	--	--
	5/20/86	M	15.5	236	216	--	--	79	143	--	24.2	38.5	--	--
1359	5/28/85	M	3.5	61	--	--	--	44	--	--	14.4	29.1	--	--
1360	5/28/85	F	10.5	95	--	--	--	--	89	--	19.5	34.4	--	--
1361	5/28/85	F	3.5	63	--	--	--	44	81	--	17.3	30.0	--	--
	5/19/86	F	4.5	100	155	--	--	51	100	--	18.6	32.1	--	--
1362	6/5/85	F	6.5	--	--	--	--	--	--	--	--	--	--	--
	6/24/85	F	6.5	114	--	--	--	55	98	--	19.2	33.1	--	--
	5/15/88	F	9.5	--	181	--	--	56	102	--	20.0	34.0	--	--
1363	6/5/85	M	3.5	55	128	--	--	50	86	--	16.0	28.3	--	--
1364	6/14/85	M	0.5	7	69	--	--	20	37	--	9.8	15.6	--	--

Appendix C. 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]
1365	6/19/85	M	5.5	118	--	--	--	57	97	--	18.9	34.9	--	--
1366	7/22/85	M	8.5	234	--	--	--	83	130	--	23.2	36.3	--	--
1367	5/19/86	M	2.5	61	138	--	--	48	91	--	15.5	28.8	--	--
1368	5/19/86	F	2.5	48	140	--	--	51	82	--	15.0	27.0	--	--
1369	5/19/86	M	2.5	68	158	--	--	56	98	--	16.4	30.2	--	--
1370	5/20/86	F	2.5	47	136	--	--	41	81	--	14.9	25.5	--	--
	5/20/87	F	3.5	69	136	--	--	46	92	--	16.3	29.0	--	--
1371	5/20/86	M	2.5	57	150	--	--	51	83	--	16.5	28.2	--	--
1372	5/20/86	M	2.5	72	--	--	--	--	--	--	--	--	--	--
1373	5/21/86	M	7.5	193	190	--	--	69	119	--	22.6	37.1	--	--
1374	5/21/86	F	6.5	106	171	--	--	64	99	--	19.8	35.2	--	--
1375	6/13/86	M	6.5	186	208	--	--	67	117	--	21.0	36.6	--	--
1376	6/13/86	F	14.5[d]	130	171	--	--	64	103	--	21.8	34.2	--	--
1377	8/28/86	M	3.5[d]	132[d]	174	--	--	58	98	--	17.3	31.6	--	--
1378	5/20/86	F	2.5	130	--	--	--	--	--	--	--	--	--	--
1379	5/15/87	F	2.5	67	--	--	--	52	96	--	15.4	17.3	--	--
1380	5/18/87	M	2.5	65	153	--	--	49	84	--	16.6	30.3	--	--
	5/17/88	M	3.5	109	178	--	--	50	92	--	17.5	33.5	--	--
1381	5/21/87	M	2.5	73	158	--	--	45	83	--	16.3	29.6	--	--
1382	5/14/88	F	3.5[d]	68	154	--	--	46	83	--	16.2	30.3	--	--
1383	6/12/87	M	2.5[d]	77	146	--	--	52	88	--	17.4	30.9	--	--
1384	5/15/88	M	7.5[d]	191	198	--	--	83	116	--	24.5	39.8	--	--
1385	5/15/88	F	2.5	68	142	--	--	50	76	--	15.5	27.4	--	--
1386	5/15/88	M	2.5	73	146	--	--	45	75	--	16.0	29.1	--	--
1387	5/23/88	F	2.5	55	129	--	--	58	79	--	15.8	27.5	--	--
1388	5/25/88	M	2.5	68	148	--	--	50	93	--	16.3	29.0	--	--

Appendix C. Continued.

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[a] Weights in kg; measurements in cm.

[b] Age determined by cementum layering.

[c] Designations of tooth characteristics: b=broken, w=heavily worn; r=erupting; m=deciduous milk teeth.

[d] Estimate after close examination.

Appendix D. Grizzly bear captures, recaptures, and capture-related mortalities, Alaska Range, 1981-88.

Year	Bear No.		Total no. captured during year	Cumulative no. total captures	Capture mortalities		Percentage capture mortality	
					Yearly mortality			
	New captures	Recaptures			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 D. Continued.

Year	Bear No.		Total no. captured during year	Cumulative no. total captures	Capture mortalities		Percentage capture mortality	
	New captures	Recaptures			Yearly mortality Total	Bear No.	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

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

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

Appendix E. Current status of marked bears in the northcentral Alaska Range, 1988.

Bear No.	Sex	Initial capture Age	Initial capture Date	Date last location	Status as of fall 1988
1301	M	6	5/18/81	5/18/81	Dead, capture mortality
1302	F	3	5/19/81	8/30/88	Alive, functional collar
1303	F	2	6/17/81	7/22/85	Unk, shed collar by 12/3/85
1304	M	5	6/19/81	5/23/88	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	Unk, probably alive, shed collar?
1308	F	6	5/25/82	8/30/88	Alive, functional collar; with 2 yearlings
1309	M	8	5/25/82	9/15/84	Dead, hunter kill
1310	M	13	5/25/82	6/9/88	Unk, shed collar 6/9-14/88
1311	F	12	5/26/82	8/30/88	Alive, functional collar
1312	F	Cub	5/26/82	8/5/82	Dead, disappeared between 8/5 and 8/27/82
1313	F	Cub	5/26/82	8/5/82	Dead, disappeared between 8/5 and 8/27/82
1314	M	6	5/27/82	9/15/82	Dead, hunter kill
1315	M	13	6/4/82	5/17/84	Dead, capture mortality
1316	M	11	6/7/82	7/12/82	Unk, shed collar between 7/12 and 8/4/82
1317	F	3	6/8/82	7/22/85	Probable illegal kill
1318	F	13	6/8/82	6/14/88	Alive, collar functional
1319	M	Cub	6/8/82	6/18/82	Dead, disappeared between 6/18 and 7/2/82
1320	F	17	6/8/82	8/30/88	Alive, collar functional
1321	F	16	6/8/82	8/30/88	Alive, collar functional
1322	F	8	6/9/82	4/27/84	Unk, probably alive, collar nonfunctional
1323	F	11	6/10/82	6/29/84	Unk, unbolted collar recovered
1324	F	Cub	6/10/82	8/30/88	Alive, collar functional; with 2 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	Unk, probably emigrated
1331	F	4	7/10/82	4/23/88	Unk, shed collar between 4/23 and 8/30/88
1332	F	5	7/12/82	10/31/82	Dead, died in den, winter 82/83
1333	F	16	7/12/82	5/22/84	Dead, hunter kill
1334	M	1	7/13/82	6/27/84	Unk, probably emigrated
1335	F	1	7/13/82	9/14/84	Dead, hunter kill
1336	F	2	5/16/83	8/30/88	Alive, functional collar; with 2 yearlings
1337	M	20	5/18/83	6/15/88	Alive, functional collar
1338	M	6	5/20/83	5/20/83	5/20/83 Dead, capture mortality
1339	M	6	5/20/83	6/4/84	Unk, shed collar between 6/4 and 9/10/84
1340	F	3	5/23/83	6/27/85	Unk, collar shed between 6/27/85 and 4/28/86
1341	F	10	5/23/83	8/30/88	Alive, functional collar
1342	M	2	5/24/83	6/27/83	Dead, illegal kill, snared fall 1983

Appendix E. Continued.

Bear No.	Sex	Initial capture Age	Initial capture Date	Date last location	Status as of fall 1988
1343	M	2	5/24/83	5/15/84	Unk, collar nonfunctional or emigrated?
1344	M	2	5/24/83	9/7/84	Dead, hunter kill
1345	F	8	5/24/83	8/30/88	Alive, functional collar
1346	M	5	5/25/83	8/19/83	Unk, shed collar? between 5/25/83 and 8/19/83
1347	M	6	5/31/83	5/31/83	Dead, capture mortality
1348	F	12	5/31/83	8/30/88	Alive, functional collar; with 2 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	Unk, never radio-collared, assumed dead
1355	M	3	6/30/83	9/13/85	Dead, hunter kill
1356	M	2	6/30/83	5/20/84	Dead, hunter kill
1357	M	2	5/15/84	9/23/86	Dead, hunter kill
1358	M	12	5/18/84	5/31/86	Dead, hunter kill
1359	M	3	5/28/85	11/6/86	Unk, shed collar between 4/28/86 and 11/6/86
1360	F	10	5/28/85	5/28/85	Dead, capture mortality
1361	F	3	5/28/85	11/6/86	Unk, shed collar in den
1362	F	6	6/5/85	8/30/88	Alive, functional collar
1363	M	3	6/5/85	4/28/86	Unk, shed collar between 4/28/86 and 5/16/86
1364	M	Cub	6/14/85	6/14/85	Dead, disappeared between 6/14/85 and 6/24/85
1365	M	5	6/19/85	7/28/86	Unk, not located in 1988
1366	M	8	7/22/85	12/3/85	Unk, shed collar
1367	M	2	5/19/86	6/28/86	Dead, killed in defense of life or property
1368	F	2	5/19/86	5/31/86	Dead, killed in defense of life or property
1369	M	2	5/19/86	6/26/87	Dead, killed in defense of life or property
1370	F	2	5/20/86	5/20/87	Dead, capture mortality
1371	M	2	5/20/86	9/7/86	Dead, hunter kill
1372	M	2	5/20/86	6/11/86	Unk, shed collar between 6/11/86 and 5/11/87
1373	M	7	5/21/86	9/2/86	Dead, hunter kill
1374	F	6	5/21/86	8/30/87	Unk, functional collar
1375	M	6	6/13/86	9/19/87	Unk, shed collar between 9/18/87-4/23/88
1376	F	14	6/13/86	8/30/88	Alive, functional collar; with 2 yearlings
1377	M	3[a]	8/28/86	3/25/87	Unk, shed collar between 3/25/87 and 8/30/87
1378	F	2	6/20/86	6/20/86	Dead, hunter kill
1379	F	2	5/15/87	8/30/88	Unk, shed collar between 9/19/87 and 4/18/88
1380	M	2	5/18/87	8/30/88	Alive, functional collar
1381	M	2	5/21/87	9/8/87	Dead, hunter kill
1382	F	3	5/15/88	8/30/88	Alive, functional collar
1383	M	2	6/12/87	9/19/87	Unk, shed collar between 9/19/87 and 4/18/88
1384	M	7[a]	5/15/88	6/14/88	Alive, functional collar
1385	F	2	5/15/88	8/30/88	Alive, functional collar

Appendix E. Continued.

Bear No.	Sex	Initial capture Age	Initial capture Date	Date last location	Status as of fall 1988
1386	M	2	5/15/88	8/30/88	Alive, functional collar
1387	F	2	5/23/88	8/30/88	Alive, functional collar
1388	M	2	5/25/88	8/30/88	Alive, functional collar

[a] Estimate.

Appendix F. Status summary of marked bears in the northcentral Alaska Range, fall 1988.

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

Appendix G. Status of maternal grizzly bears and their offspring in the northcentral Alaska Range, 1981-88.

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	3.5	Alive	UM[a]	1988	--	With mother 1988
			UM	1988	--	With mother 1988
			UM	1988	--	With mother 1988
1303	2.5	Last observed 1985	1364 M	1985	--	Assumed dead 1985
			UM	1985	--	Assumed dead 1985
1305	24.5	Hunter kill 1982	1306 M	1980	2.5	Hunter kill 1984
			1307 M	1980	2.5	Last observed 1986
1308	6.5	Alive	UM	1984	--	Assumed dead 1985
			UM	1984	2.5	Probable hunter kill 1986
			UM	1987	--	With mother 1988
			UM	1987	--	With mother 1988
1311	12.5	Alive	1312 F	1982	--	Assumed dead 1982
			1313 F	1982	--	Assumed dead 1982
			1372 M	1984	2.5	Alive 1986
			1378 F	1984	2.5	Hunter kill 1986
			UM	1987	--	Assumed dead 1988
			UM	1987	--	Assumed dead 1988
1318	13.5	Alive	1319 M	1982	--	Assumed dead 1982
			1380 M	1985	--	Weaned 1988
			1382 M	1985	--	Weaned 1988
1320	17.5	Alive	UM	1983	--	Assumed dead 1983
			UM	1985	--	Assumed dead 1985
			UM	1985	--	Assumed dead 1985
			UM	1985	--	Assumed dead 1985
			UM	1987	--	Assumed dead 1987
			UM	1987	--	Mother alone? 8/88
1321	16.5	Alive	1342 M	1981	--	Illegal kill 1983
			1343 M	1981	3.5	Last observed 1984
			1344 M	1981	3.5	Hunter kill 1984
			UM	1985	--	Assumed dead 1986
			1379 F	1985	2.5	Alive 1987, 1988?
			1381 M	1985	2.5	Hunter kill 1987
			UM	1988	--	Assumed dead 1988
			UM	1988	--	With mother 1988
			UM	1988	--	With mother 1988
1322	8.5	Last observed 1984	1336 F	1981	3.5	Had cubs 1987
1323	11.5	Last observed 1984	1324 F	1982	2.5	Had cubs 1987
			1325 M	1982	2.5	Killed DLP[b] 1984
1324	0.5	Alive	UM	1987	--	With mother 1988
			UM	1987	--	With mother 1988
1326	4.5	Hunter kill 1986	UM	1985	--	Assumed dead 1985

Appendix G. Continued.

Maternal Female			Offspring			
Bear No.	Age at capture (yrs)	Present status	Bear No. and sex	Year of birth	Age at weaning (yrs)	Present status
1327	16.5	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	13.5	Dead 1983	1330 M	1981	2.5[c]	Last observed 1984
1331	4.5	Alive	UM	1986	--	Assumed dead 1987
1333	16.5	Hunter kill 1984	1334 M	1981	3.5	Last observed 1984
			1335 F	1981	3.5	Hunter kill 1984
1336	2.5	Alive	UM	1987	--	With mother 1988
			UM	1987	--	With mother 1988
1341	10.5	Alive	UM	1982	--	Assumed dead 1983
			1370 F	1984	2.5	Capture death 1987
			1371 M	1984	2.5	Hunter kill 1986
			UM	1988	--	With mother 1988
			UM	1988	--	With mother 1988
1345	8.5	Alive	UM	1984	--	Assumed dead 1984
			UM	1984	--	Assumed dead 1985
			1385 F	1986	--	With mother 1988
			1386 M	1986	--	With mother 1988
1348	12.5	Alive	1367 M	1984	2.5	Killed DLP 1986
			1368 F	1984	2.5	Killed DLP 1986
			1369 M	1984	2.5	Killed DLP 1987
			UM	1987	--	With mother 1988
			UM	1987	--	With mother 1988
1351	14.5	Hunter kill 1987	UM	1982	--	Assumed dead 1984
			1357 M	1982	3.5	Hunter kill 1986
			1361 F	1982	3.5[d]	Last observed 1986
			UM	1986	1.5[d]	Unk, 1987[d]
			UM	1986	1.5[d]	Unk, 1987[d]
			UM	1986	1.5[d]	Unk, 1987[d]
1352	14.5	Hunter kill 1984	1353 M	1982	--	Hunter kill 1984
			1354 F	1982	--	Last observed 1984
1360	11.5	Dead 1985	1359 M	1982	--	Last observed 1986
			1363 M	1982	--	Last observed 1986
1362	6.5	Alive	1387 F	1986	2.5	Weaned 1988
			1388 M	1986	2.5	Weaned 1988
1374	6.5	Alive	UM	1985	--	Not marked; mother alone 8/87
			UM	1985	--	Not marked; mother alone 8/87
1376	23[e]	Alive	UM	1987	--	With mother 1987
			UM	1987	--	With mother 1987

Appendix G. Continued.

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[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.

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