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POPULATION DYNAMICS OF A HUNTED GRIZZLY BEAR POPULATION IN THE NORTHCENTRAL ALASKA RANGE

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SUMMARY

Population density and harvest rates for a grizzly bear (Ursus arctos) population in the northcentral Alaska Range were estimated during the years 1981 through 1986. Baseline population status and reproductive biology were determined during the years 1981 through 1985; the effects of increased harvest on this population will be the focus of investigations from 1986 through 1991. A population density estimation method was tested in a 950-km² (367 mi²) portion of the study area in 1986, resulting in a point estimate of 10.67 bears ≥2 years of age (95% CI = 7.59-25.44 bears) and a density of 1.12 bears ≥2 years of age/100 km² (95% CI = 0.80-2.68 bears/100 km²). The point estimate provided a close approximation to the density which we calculated and adjusted for population closure for our study area (1.04 bears ≥2 years of age/100 km²), but the wide confidence intervals indicate the estimate's usefulness is limited. However, these confidence limits would have been improved if we had searched quadrats for more than 3 days. Based on problems with violation of mark-recapture method assumptions, as well as sightability biases, we recommend estimating population densities for bears ≥2 years of age only.

Only minor changes from past patterns of harvest rates, population production, or survival rates were observed in 1986. All population estimates calculated during 1986 were

adjusted for population closure. The estimate of harvest rate for the minimum study area population was 11.5% in 1986 compared with the 1981-86 mean rate of 11.8%. Minimum population size of grizzlies ≥2 years of age increased from an estimated 34.4 in 1985 to 40.5 in 1986; however, a decline is still evident from the 1981 estimate of 53.0 bears ≥2 years of age. The difference between 1985 and 1986 population estimates of bears ≥2 years of age can be largely accounted for by the complete loss of the 1983 cub cohort.

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

CONTENTS

BACKGROUND

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

Currently, management decisions are based on the sex and age of bears killed by hunters. These parameters may provide a general estimation of the status of grizzly populations under certain conditions, but no data are available to use as a basis for establishing rates of harvest. Harvest data were adequate for making management decisions in the past, but 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. The emphasis of Phase I was to gather baseline information on the population biology of northcentral Alaska Range grizzly bears, and we have collected most data necessary for an accurate baseline description and population model (Reynolds 1982; Reynolds and Hechtel 1983, 1984, 1985, 1986). Harvest level during the years 1965 through 1980 was generally low, about 3-5% of the estimated population, and during the years 1981 through 1985 it increased to about 12%. By 1985, at the end of Phase I, the population had already begun to decline.

Initially, study design called for low to moderate levels of harvest to occur during Phase I, while baseline data were collected. This was to be followed by higher harvest levels during Phase II, while data were collected on individuals and on population response to increased harvest. However, grizzly bear harvest by hunters, supplemented in part by capture mortality, resulted in a relatively high mean harvest level of 12% during Phase I. Even though this harvest was higher than study design anticipated, this circumstance will strengthen rather than detract from the investigation. Most importantly, the early high harvest level will allow monitoring of the reproductive response over a longer period of time. This should be helpful because of the low productive rates of grizzly bears and the extended period required before females become reproductively mature.

Phase II, which will continue during the years 1986 through 1991, is designed to measure grizzly bear population response to human-caused mortality. During this period, harvest rates will continue at about 10-15% through manipulation of hunting regulations and by 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 parameters analyzed. Changes in reproductive performance of adult females and survival rates of young bears will largely determine if population compensatory mechanisms operate as harvest level is increased.

Natural history studies of grizzly bears in interior and northern Alaska have provided an adequate data base on some aspects of reproductive biology, food habits, habitat use, and home range size (Dean 1976; Reynolds 1976, 1980, 1981, in press; Murie 1981; Ballard et al. 1982; Miller and Ballard 1982; Miller and McAllister 1982; Reynolds and Hechtel 1982, 1983, 1984, 1985; Miller 1983, 1984). These studies, however, were largely descriptive or were of short duration (2-4 years). Because grizzlies 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 4- to 10-year period for adequate accuracy and utility (Craighead et al. 1974, 1976; Reynolds 1976, in press; Bunnell and Tait 1980, 1981; Knight and Eberhardt 1985). Though long-term studies are necessary for understanding and accurately predicting grizzly bear population dynamics and responses to changing patterns of human use, none have been completed and few are presently ongoing in Alaska.

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

OBJECTIVE

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

STUDY AREA

The 3,900-km² (1,500-mi²) study area is located in the mountains and foothills of the northcentral Alaska Range (Fig. 1) and is included within Game Management Subunit 20A. The boundaries are Gold King Creek drainage and Wood River drainage downstream from Virginia Creek to the west, the crest of the Alaska Range to the south, the Delta Creek drainage to the east, and the southern edge of the Tanana Flats (approx. 64° north latitude) to the north. It includes portions of 2 U.S. Army reservations, Ft. Wainwright and Ft. Greely.

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

METHODS

We continued to use the same methods to capture bears and measure population parameters (Reynolds 1982; Reynolds and Hechtel 1983, 1984, 1985, 1986). All measurements, weights, and other routine data collections which were made during Phase I will be continued during Phase II (Appendix A). During 1986, however, we modified the way in which we estimated minimum population size, and we conducted a census estimate based on marked-unmarked grizzly bear sightings as described by Miller et al. (in press).

We emphasize that the method used to estimate population size during the years 1981 through 1985 (Reynolds and Hechtel 1983, 1984, 1985, 1986) was modified during 1986 to account for lack of population closure. This modification resulted in lower estimated population sizes and, consequently, higher calculated harvest rates.

Our past estimates of minimum population size during the years 1981 through 1985 have included the sum of: (1) those bears, captured within the boundaries of the study area, that would have been alive in past years (for instance, a 14-year-old female captured in 1986 was assumed to be a resident of the study area during the years 1981 through 1985, but a 2-year-old male was only counted as a member of the population in 1986, 1985, and 1984; those known to have emigrated were not included); (2) bears that were killed within the study area, but which would have been alive in past years; and (3) bears that were observed in the area but could not be accounted for as captured or killed. In using this method, we assumed that the rates of unobserved emigration by young-aged bears equaled the rates of immigration; an assessment of this assumption was discussed in a previous report (Reynolds and Hechtel 1986). Based on the observed fidelity of adult bears to their home ranges in this study, we assumed that no adults emigrated or abandoned their established home ranges. Finally, we assumed that when we lost contact with bears, through bears shedding their radio collars or through radio-collar malfunction, those bears remained in the study area.

The degree to which this assumption is valid will become more evident as capture effort continues.

In addition to this method of calculating minimum population size, we derived "probable" population sizes by estimating that the 3,900-km² area included an additional 15-25 bears which were not 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, we had enough baseline data on home range size and movement of Alaska Range grizzlies to "adjust" our estimates to more accurately account for lack of population closure. Using this method, we have recalculated population estimates for past years. All estimates in this report were calculated using this adjustment for population size. Any differences between estimated population size or density reported here and those presented in past reports (Reynolds and Hechtel 1982, 1983, 1984, 1985, 1986) are solely due to differences in the methods used.

The fact that not all bears captured, killed, or observed within the boundaries of the study area maintain home ranges entirely within the study area results in an overestimate of population size. Bears living near the center of the study area are far more likely to remain entirely within the area than those living near the boundaries. To account for this bias, the approximate proportion of each home range lying outside the study area was estimated. These individual fractional home ranges were subtracted from total population estimates to more accurately reflect numbers of bears in the study area and resulted in "adjusted" population estimates (Reynolds 1980). For bears killed by hunters, home range size and locations were assumed to be similar to those of radio-collared grizzlies of similar sex and age living in the same area. For example, if an unmarked 5-year-old female was killed on the Wood River at Mystic Creek, we would assume that 20% of her home range would lie outside the study area, since 20% of the home range of bear No. 1336, another 5-year-old female living along the Wood River, also lies outside the study area.

We feel that we can account for most of the bears which use our study area. During 1985 and 1986, only 6 of 34 bears captured in the study area were previously unmarked bears that were not offspring of marked bears; 5 of 6 were captured near the edges of the study area. Similarly, of 12 bears killed by hunters or in defense of life or property in 1985 and 1986,

only 2 were marked; 1 was very likely the 2-year-old offspring of bear No. 1308 and the other was taken at the edge of the study area. For these reasons, we estimate that only 10-15 additional unmarked bears instead of the previously estimated (Reynolds and Hechtel 1983, 1984, 1985) 15-25 bears remain in the study area. This proportion will decline as the capture program and hunting continue in the area.

During early June 1986, we also used a modified capture-recapture method to estimate the density of bears in a portion of the northcentral Alaska Range study area. Miller et al. (in press) developed this modification in southcentral Alaska in 1985 and it appeared to be a promising method of addressing geographic closure and of providing a statistical variance for a bear population estimate. By using the technique in our study area, the method allowed us the opportunity to test the technique under different conditions than those occurring in southcentral Alaska, and also provided a comparison with the density we had calculated based on direct counts.

We selected a 950-km² (367 mi²) area in the central portion of our 3,900-km² study area. We divided the area into 13 quadrats with clear topographic boundaries for purposes of consistency of search effort. Quadrats were searched on 9, 11, and 12 June. We searched 11 of 13 quadrats on 9 June, and all 13 quadrats on 11 and 12 June. Like Miller et al. (in press), we terminated search efforts on 12 June, in part because emerging leaves made search efforts more difficult and in part to conserve funds, since aircraft charter costs were approximately $3,000/day.

Searches were conducted with 3 PA-18-150 Super Cub aircraft, using experienced survey pilots and observers. One pilot had participated in the density estimate conducted by Miller et al. (in press). Two pilot-biologist teams searched quadrats during the entire day, while the 3rd crew searched quadrats in the morning and determined the presence of radio-collared bears in the area during the afternoon.

We had planned to begin search efforts with a concurrent capture program using helicopters on 2 June. However, lack of helicopter availability first delayed and then canceled the capture portion of the density estimate program. Due to logistical problems related to loss of helicopter support, we were unable to begin search efforts until 9 June.

RESULTS AND DISCUSSION

The majority of the research effort during 1986 was directed toward completing a density estimate using the mark-recapture

technique described by Miller et al. (in press). In addition, data necessary for description of population dynamics and harvest rates were collected.

Bears Captured and Radio-collared

In the study area, 78 individual bears were captured: 5 in 1981, 30 in 1982, 21 in 1983, 2 in 1984, 8 in 1985, and 18 in 1986 (Table 1). In addition, 37 bears were recaptured to replace radio collars: 2 in 1983, 18 in 1984, 12 in 1985, and 5 in 1986 (Appendix B). Radio collars were placed on 65 bears; 21 on young-age males ($\leq$5.5 years), 13 on adult males ($\geq$6.5 years), 12 on young-age females, and 19 on adult females. By fall 1986, 23 bears still carried functioning radio collars; 13 bears had shed collars; 24 bears were dead; and 5 bears could not be located, presumably because of long-range movements or collar failure (Appendix C, D).

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 1986 (Table 2). Because some bears had home ranges which extended beyond the study area, including these bears as members of the study population resulted in an overestimation bias. Adjusted values included those individuals as fractional bears, based upon the proportion of their home range which lay within the area boundaries.

Probable adjusted population size includes an estimate of those bears which we think reside in the area, but which were not killed by hunters or captured during the study. Based on the home range size and distribution of marked bears living in the area and the fact that vegetative cover and rugged terrain can allow resident bears to escape capture for several years, we feel the available habitat likely supports an additional 10-15 bears. Based on the mean proportions of cubs and yearlings in the 1986 population, we estimate that 7 to 11 of these undetected bears are $\geq$2 years of age. Therefore, the 1986 "probable adjusted" population size of bears in the area is approximately 60-65, a decline from the 1982 probable adjusted population estimate of 78-83.

As the study continues, these estimated values will converge as unmarked, resident, breeding adults associating with radio-collared bears are captured, and as monitoring of young-age bears born and weaned in the study area improves our understanding of dispersal and mortality rates.

The minimum adjusted 1986 spring population was 49.5 grizzly bears, a density of 1.27 bears/100 km² (3.30 bears/100 mi²). This included 39.3 marked bears, adjusted from a total marked population of 45 bears whose home ranges included the study area; 9 unmarked offspring of marked females, which lived entirely in the study area; and 1.2 unmarked bears killed by hunters, adjusted from a total of 2 bears using the study area as a portion of their home ranges.

A more useful measure of population size or density would include those members of the population ≥2 years of age, for 2 reasons. First, cub and yearling cohorts constitute a relatively high percentage of the population--a mean of 25% in the 1981-86 adjusted population estimates (Reynolds and Hechtel 1986) (Fig. 1, Table 2). These proportions can fluctuate widely and point estimates may not be representative of the population trend or productive capacity. 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 1986 was 40.5 bears, or 1.04 bears/100 km² (2.70 bears/100 mi²). This represents a decline from the adjusted 1981 population estimate, for bears ≥2 years old, of 50.8 or 1.30 bears/100 km² (3.39 bears/100 mi²).

Estimates Using Modified Capture-Recapture Technique:

Our use of a modified capture-recapture technique developed by Miller et al. (in press) took place on a 950-km² (367 mi²) portion of the study area from 9 through 12 June 1986. The home ranges of 14 radio-collared grizzly bears ≥2 years old included the search area; 12 of these were in the area at least once during the search period but no more than 8 were present in any 1 day (Table 3). These constituted the n_1 or "marked" portion of the study population; all other uncollared grizzly bears in the area were counted as unmarked, regardless of whether or not they had been previously captured. Unlike Miller et al. (in press), we chose not to include unmarked cub or yearling offspring which accompanied their mothers in the same status, marked or unmarked, as their mothers. When we pool these data for the search period and use the totals as advised by Miller et al. (in press), we can calculate an estimated total of 32 bear-days (var. = 33). Further, to estimate the average number of bears ≥2 years old using the area, we divide by the number of days for an estimate of 10.67 bears (var. = 33/32 = 3.67).

Based on our sample size and the proportion of marked bears in our sample, we used the binomial approach to calculate confidence intervals (Seber 1973:64). Statistical tables (Rohlf and Sokal 1969:208) show that our 95% confidence interval for

total bear-days was 22.78-76.34, and therefore 7.59-25.44 for our point estimate of 10.67 bears.

This estimate of 10.67 bears $\geq$2 years of age is a reasonable approximation of our estimate of 11.3-12.3 bears within the area using our adjusted probable population estimate methodology. Similarly, an estimate of 10.67 bears $\geq$2 years of age in the 950-km^2 search area results in a density of 1.12 bears/100 km^2 (2.91 bears/100 mi^2), which is close to the 1.22-1.32 bears/100 km^2 (3.13-3.39 bears/100 mi^2) density calculated for the probable adjusted bear population ($\geq$2 years of age) of our entire study area.

However, even though the estimate is a reasonable approximation of the number of bears known to be present in the area, confidence intervals are so wide that the utility of the estimate is poor. There are 3 major reasons for this wide confidence interval: (1) the estimate was based on a 3-day search period rather than one at least 6 days long, as Miller et al. (in press) used; (2) density of bears in the area was low, so chances of encountering bears were diminished; and (3) we chose to limit our sample to bears $\geq$2 years of age.

While Miller et al. (in press) searched quadrats for 6 days in their area, we only searched for 3 days. In their area, most of the decline in confidence interval occurred during the 1st 3 days of the search; however, with the low densities encountered in our search area, such a decrease may have required additional days of search effort. We halted our search efforts after 3 days, when emerging leaves on willows decreased visibility of bears.

Low density of bears $\geq$2 years of age in the search area was also responsible for the spread in our confidence interval even though our sampling of the search effort was consistent and thorough. Sightability of marked bears in our study (26% of marked bears $\geq$2 years) was comparable to the 28% sightability reported by Miller et al. (in press); our sightability index may actually have been higher relative to theirs because we did not include unmarked offspring of marked bears in our marked sample. In addition, search effort was similar in the 2 areas: we searched at a mean intensity of 1.13 min/km^2 (Appendix E) compared with 0.98 min/km^2 for their area (including both those quadrats which were completely and incompletely searched) (Miller et al., in press).

We did not follow the suggestion by Miller et al. (in press) to include the unmarked offspring accompanied by their mothers in the same status (marked or unmarked) as their mothers. We did not use this approach for 2 reasons. First, this violates the critical assumption for mark-recapture studies that the 2nd sample (n_2 or recapture) is a simple random sample in which each possible sample has an equal chance of being chosen

(Seber 1973:59). A family group is not sampled as a number of independent individuals, but as a group. There is no way that a yearling can be included as part of n_2, or the recapture sample, without the entire 2- to 4-member family group being included. Therefore, such use results in a lack of independence between observations, which artificially reduces the confidence interval. The 2nd reason we did not include offspring in the same status as their mothers was that the young would tend to compound the problems resulting from differential sightabilities between family groups and other members of the population. Miller et al. (in press) noted that females with yearlings have significantly higher sightability than females with cubs and suggested that confidence intervals be viewed skeptically when the assumption of equal sightability is not satisfied.

By using only the adult females but not their offspring in our analysis, we reduced these biases but did not eliminate them, since the adult females retain the sightability characteristics of the family group. When Miller et al. (in press) calculated an estimate for the number of bears $\geq$2 years of age in their area, the result was 25.1 bears, with a 95% confidence interval of 20.9-34.0 bears. While this confidence interval is wider than that which they calculated for total bears in their area, it has fewer biases and provides a more usable figure for management purposes.

Another problem which we did not attempt to treat was presented by observations of breeding pairs. Since breeding pairs may remain together for 1 to 7 days, and estrous periods may last more than 14 days (Reynolds and Hechtel, unpubl. data), the observation of breeding pairs also violates the assumption of independence between observations; in addition, sightability of breeding pairs is probably higher than that of lone bears. The major problem with this approach to census estimation may be that populations were treated as if they were made up of a series of single individuals instead of as if they were made up of clusters with group sizes of 1 to 4. Computer simulation of an approach which estimates numbers of groups and mean group size using the data of Miller et al. (in press) would be instructive and may help to improve this technique.

An additional suggestion for improving the technique includes separating the period of capture from the period of recapture or resighting by at least 2 days. Experience with immobilization in our studies (Reynolds 1980, in press; Gebhard 1982) and others (Boertje and Gasaway, pers. commun.) has been that

bears may not resume normal movement patterns and behavior for 1 or 2 days following capture. Such behavioral changes may affect sightability and could have been responsible for the low sightability index of lone adult females which Miller et al. (in press) reported.

We do not imply that this method is seriously flawed. To the contrary, this effort by Miller et al. (in press) toward correcting for closure is an important step in developing a workable technique for estimating bear densities. As with any promising approach, it needs to be tested and modified as problems with its use become apparent. Indeed, Miller et al. (in press) characterized problems which arose, and suggested further testing be done to improve the utility of the method.

Population Structure

Sex and age structure of the population was determined from grizzly bears captured during the study or killed by hunters. Once a bear was captured or killed, its presence in the study area during previous years was extrapolated, based on our knowledge of emigration, immigration, and fidelity to established home range. Use of this method results in a more complete representation of structure in past years due to increased sample sizes. The most likely bias to occur with this approach would be the underrepresentation of those younger age classes which are subjected to high mortality rates. However, as the study continues, more offspring of radio-collared females are observed, so the effect of such biases declines. By 1986, due to continuing capture effort, most of the bears in the study area were either marked or were unmarked offspring accompanied by marked mothers.

The sex and age structure of bears in the population during 1986 (Fig. 1) illustrates that there are more live females than males which were older than 3 years of age. Males are more heavily harvested in the study area than females. The sex ratio of bears killed there by hunters since 1979 is 66 males:34 females. During this period, hunter harvest accounted for 28 males and 12 females in the 1- to 5-year-old class and 19 males and 9 females for bears $\geq$6 years old. This difference is expected because males have larger home ranges and travel more widely than females (see Movement section) and thus are more likely to encounter hunters (Bunnell and Tait 1980). In addition, because regulations prohibit the take of cubs (including yearlings) or females accompanied by cubs, productive females are less vulnerable to hunters. During the years 1981 through 1986, for those adult females whose reproductive status was known, only 22% were vulnerable to hunters during spring hunting seasons and 51% were vulnerable during fall; all adult males were vulnerable during both seasons.

Although offspring observed as cubs had an even sex ratio, 7 males:6 females:1 unknown sex, we are hesitant to conclude that the sex ratio at birth is even. We rarely attempted to capture cubs and, as a result, our sample size was low and our estimate is not very precise. The sex ratios we observed in older juvenile age classes tend to be male dominant but none are significantly different from the male:female ratio we observed for cubs. Yearlings had a sex ratio of 14 males:9 females:2 unknown sex; 2-year-olds, 13 males:7 females:1 unknown sex; and 3-year-olds, 6 males:3 females. Of those 2- and 3-year-olds that were observed at weaning, 15 were males and 8 were females. If there is a real tendency toward greater male recruitment in the population, we believe it is more likely the result of initial production rather than a lower survival rate for females in litters. Of 16 litters, 5 were composed of all males, 2 were composed of all females, 7 were composed of mixed-sex litters, and 1 each was composed of a male and a female with an unknown-sex litter mate. Similar patterns favoring males have been recorded in Yellowstone National Park; Craighead et al. (1974) found 57% of 74 cubs captured during the years 1959 through 1970 were males, and Knight and Eberhardt (1985) reported that 67% of 24 cubs captured during the years 1974 through 1982 were males.

By 1986, population size had declined; age structure (Fig. 1) showed the same basic patterns as in 1982. However, there were fewer total females present, primarily because of hunting mortality in the population, and there were more males than females present in the 3- to 5-year-old age class. A major change from the 1982 structure is that the 3-year-old cohort is missing, a result of the cub cohort failure in 1983.

Reproductive Biology

Age at 1st Production of Young:

The age at which females first produce cubs in this area ranged from 5.5 to 7.5 years, but the age at which females produce cubs which are successfully reared may be 5.5-9.5 years (Table 4). None of 8 females aged 4.5-5.5 years were observed with cubs or showed evidence of suckling, although 7 had been observed consorting with males. Of 6 females 6.5 years old, 2 had cubs which did not survive, 3 bred and produced cubs as 7.5-year-olds, and 1 did not breed.

Reproductive Interval:

Reproductive interval, or reproductive cycle, is the period between weaning of 1 litter by an adult female and the successful rearing and weaning of her subsequent litter. For females producing cubs for the 1st time, intervals begin at the 1st breeding which 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 since females may not always produce young subsequent to breeding efforts following weaning (Craighead et al. 1969, 1976; Reynolds 1974, 1976, 1980, in press; Glenn et al. 1976; Reynolds and Hechtel 1982). This definition differs from that used by others. Craighead et al. (1976) define a cycle as the interval from pregnancy to pregnancy.

In the study area, offspring were weaned as 2-year-olds (n = 6 litters) or 3-year-olds (n = 5 litters). Mean minimum reproductive interval, however, was 4.0 years (n = 21), based on those cycles which were observed plus those which were projected by assuming weaning of offspring as 2-year-olds (Table 5). Alternately, if we project minimum cycle length based upon observed proportions of those litters weaned as 2- and 3-year-olds, then a mean reproductive interval of 4.2 years results. All 5 intervals greater than 4 years resulted from interruption of the breeding cycle due to mortality of litters or to breeding which did not produce cubs the following year.

Factors which result in females weaning their young as 2-year-olds or keeping them another year to wean as 3-year-olds have not been identified. Weight or nutritional status in mid- to late May at the time when offspring are usually weaned and the estrus cycle begins may be important, but with our small sample sizes we were unable to detect any patterns. Nevertheless, conditions present in 1983 appear to have prolonged reproductive intervals. Not only were no surviving cubs produced during that year, but females with yearlings or 2-year-olds tended not to wean those offspring until they were 3 years of age. Of 3 females accompanied by 2-year-olds in 1983, all weaned their litters as 3-year-olds. Similarly, of 3 females with yearlings in 1983, 1 weaned her litter as 2-year-olds but the other 2 weaned their litters as 3-year-olds. Because of the likelihood that such events periodically occur, models of the effects of harvest on population dynamics should take these events into account.

Production Success:

Production success rate, or the proportion of breeding activity by adult females which results in the production of cubs, was 76%. This rate was based on the outcome of 17 observations of breeding activity by 11 individual females $\geq$6 years of age during the years 1982 through 1986. In addition, 1 female bred as both a 4- and 5-year-old, producing young as a 6-year-old; 2 others, a 4-year-old and a 5-year-old, bred without producing cubs. Production success is probably dependent upon an individual female's 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 females observed breeding in 1982 produced cubs in 1983. In addition, at least 3 other females that were later either captured or killed in the study area may have bred in 1982 but were not accompanied by surviving offspring in spring 1983. In comparison, 6 of 8 females that bred in 1983 were observed with cubs in 1984, and all 5 that bred in 1984 produced cubs in 1985.

Litter Size:

Mean litter size was 2.06 for 17 litters first observed as cubs, 1.90 for 10 litters first observed as yearlings, and 2.00 for 18 litters observed as yearlings regardless of when they were first observed. Mean cub litter size was small, especially compared with 2.3 found in the Nelchina Basin (Miller and McAllister 1982); however, mean yearling litter size was only 1.6 for the Nelchina Basin. The number of females producing cubs varied from year to year: during 1981, 5 females produced a minimum of 9 cubs; in 1982, 7 females produced 14 cubs; in 1983, 1 female produced 1 cub; in 1984, 6 females produced 14 cubs; in 1985, 6 females produced 13 cubs; and in 1986, 2 females produced 4 cubs (Table 6). Two adult females whose radio collars failed or were shed before they were observed in 1985 may have produced cubs in 1985 or 1986; similarly, 3 other adult females which were not observed in 1986 also may have had cubs. Poor cub production in 1983 may have been due to failure of berry crops in 1982 (Miller 1984) or to the weather patterns of winter 1982-83, in which little snow fell and temperatures fluctuated widely.

Although the difference in mean litter size between cubs and yearlings is small, this is the result of mortality of entire litters rather than an indication of high survival rates. Similar patterns of loss of cub litters have been recorded in northwestern Alaska (Reynolds, in press).

The mean size of 10 litters weaned as 2- or 3-year-olds was 2.00. The annual number of adult females in the population since 1982 has ranged from 18 to 21 (Tables 4, 7), and the observed annual numbers of cub litters were 7, 1, 6, 5, and 2 during the years 1982 through 1986, respectively. The observed annual numbers of weaned litters, however, were only 1-2, 0-1, 4, 2, and 4. This pattern also reflects mortality of entire litters, mostly in cub or yearling age classes.

Mortality

During the years 1981 through 1986, at least 74 bears died in the study area: 14 in 1981, 11 in 1982, 11 in 1983, 18 in 1984, 11 in 1985, and 9 in 1986. These mortalities included 40 hunter kills, 2 illegal kills, 3 defense of life or property kills, 7 capture-related mortalities, 2 natural mortalities for which carcasses were found, and 20 offspring which were missing from family groups and presumed dead (Table 8, Appendix F). During 1986, mortality included 6 hunter kills, 2 killed in defense of life or property, and 1 missing offspring which was presumed dead.

The causes of mortality for cubs, yearlings, and 2-year-olds that disappeared while accompanying their mothers could not be determined. Cannibalism by adult males was suspected as the major cause and has been documented in Alaska in the Brooks Range (Reynolds 1976, 1980, in press; 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 36% for cubs (n = 28), 12% for yearlings (n = 32), and 7% for 2-year-olds (n =15).

Mortality rates for 28 radio-collared females aged 2 to 25 years, monitored for 49 bear-years, were 9% due to sport hunting, 3% from causes other than man, and 3% due to capture-related mortalities. Only 2 of the deaths were not man-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. Annual harvest has ranged from 1 to 14 during the years 1961 through 1980 (Table 9). Prior to 1981 the mean annual take was 5.0. If the population remained relatively stable during the 1961-80 period 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, with a range of 1.1-16.5%. Mean harvest rate for the minimum population, including all human-caused mortalities during the years 1981 through 1986, was 11.8% (Table 10). If these rates are based on adjusted population size, to account for lack of population closure, mean mortality rate for the years 1981 through 1986 was 9.4-10.1%. Alternately, if harvest rates are calculated for only those bears $\geq$2 years of age, and based on probable population size (adjusted to account for lack of population closure), then the mean mortality rate for the years 1981 through 1986 was 12.5-13.4%.

More than a simple calculation of harvest rate is necessary to evaluate the effect of harvest or to correlate harvest rates with population trend. Both Craighead et al. (1974) and Knight and Eberhardt (1984) emphasize that the number of productive females within a population is the most important factor in the rate of growth or decline in grizzly bear populations. Our data also indicate the importance of adult females to population dynamics. Since 1982, the harvest has resulted in annual declines in the numbers of adult females during 3 of 4 years and a net change from 21 females in 1982 to a projected total of 18 in 1987 (Table 7). Similarly, the number of females in the 3- to 5-year-old age class, which act as replacements when adults die, has declined from 10 in 1982 to 4 in 1986. At the same time, the population within the study area has declined from an adjusted minimum of 65.6 in 1981 to 49.5 in 1986, and this trend is expected to continue. Based on only those bears $\geq$2 years of age, the trend is similar, but not as severe; minimum adjusted estimates were 50.8 bears in 1981 and 40.5 bears in 1986 (Table 10). 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. No compensatory mechanisms have been evident at the present level of exploitation in the study area.

Movement

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

The fidelity of young-age bears to their maternal home ranges varied (Table 11). Of 16 males followed during the 1st year after they had been weaned, 3 moved from 44 to 74 km (27 to 46 mi) outside their maternal home ranges. During the 2nd year after weaning, 2 more moved from their maternal home ranges but 4 others remained. Of those that stayed within their maternal home range, 2 were only observed the year following weaning, 5 were killed during the year of weaning, 1 stayed for 2 years following weaning, and 3 stayed for 3 years. Of 5 females that were monitored and stayed within their maternal home ranges, 3 remained for 1 year, 1 for 2 years, and 1 for 3 years. Siblings do not necessarily display similar patterns of movement. Of 6 sets of weaned offspring, 4 sets remained within their maternal home ranges; in 2 sets, 1 sibling emigrated while the other did not. Based on these limited observations, we speculate that females will tend to remain close to their maternal home ranges following weaning, but that less than half of the males will remain.

CONCLUSIONS AND RECOMMENDATIONS

Major findings of importance in the determination of the effects of harvest on the population for the 1981-86 period included:

1. Probable adjusted population size was 78-83 in 1982 but declined to 60-65 by 1986. These estimates were based on the minimum numbers observed plus the probable number which were present but not observed, and this overall estimate was adjusted to account for lack of a closed population. The reduction in numbers resulted in fewer productive females and fewer females in the 3- to 5-year-old age class being available for recruitment.

2. A modified capture-recapture method developed by Miller et al. (in press) to estimate bear density was tested in a portion of the area. The method provided a point estimate which was a close approximation to the number of bears which we calculated to be in the area, but the confidence interval associated with the capture-recapture method was too wide to be useful. Additional search days would have resulted in a reduced confidence interval but several other problems remain to be addressed to make the method useful. Based on our experiences, we recommend that quadrats be searched for at least 6 days (especially in low-density populations). In addition, using present methodology, density should represent only animals $\geq$2 years of age to avoid violation of independent sample assumptions for family groups. In addition, new approaches are needed to address similar problems with lack of independence for breeding pairs; sightability biases are probably present for breeding pairs as well.

3. Mean natural mortality rates observed during the years 1982 through 1986 were 36% for cubs-of-the-year, 12% for yearlings, 7% for 2-year-olds, and 3% for adult females.

4. Human-caused mortality (including hunting, defense of life or property, illegal, and capture-related deaths) was 9.4-10.1% during the period, with a range of 3.9-17.2% based on probable adjusted population estimates. Harvest rates of 10% were observed for adult radio-collared females.

5. Based on a limited number of observations, young, recently weaned females tend to remain within their maternal home range; in contrast, less than a third of the males observed stayed in their maternal home ranges.

6. No changes in trends of productive capacity, cub survival, or movement patterns were detected during the years 1982 through 1986.

Continuation of this study should place us in a position to learn what responses occur in the population as a result of high harvest levels, including:

1. If continued harvest at current levels will result in further decline of population size;

2. Whether changes in litter size, reproductive interval, or the age at which females first successfully produce cubs will follow population reduction, and if changes do occur, how they affect population productivity;

3. Whether declines in the population size will reduce natural mortality rates of adult females or their offspring; and

4. Whether patterns of immigration and emigration of young-age bears will 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.

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

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Locating and capturing bears in this area was a particularly arduous task due to dense vegetative cover and precipitous terrain. The success we experienced was due in large part to the skill and abilities of the UH-1 helicopter pilots-in-command, especially Col. Christopher Calhoun, Warrant Officers James Watson and James Kennedy, and the crews of the 6th Combat Aviation Brigade. Every individual from this unit performed in a competent and professional manner. Super Cub pilot Bill Lentsch again demonstrated his unequaled capability for spotting bears in alder patches, glacial moraines, and fog banks. During our census estimate, Mark McNay, Kem Sibetts, and Arnold Dresselhaus piloted search aircraft, and biologist Stephen DuBois lent his expertise as an observer.

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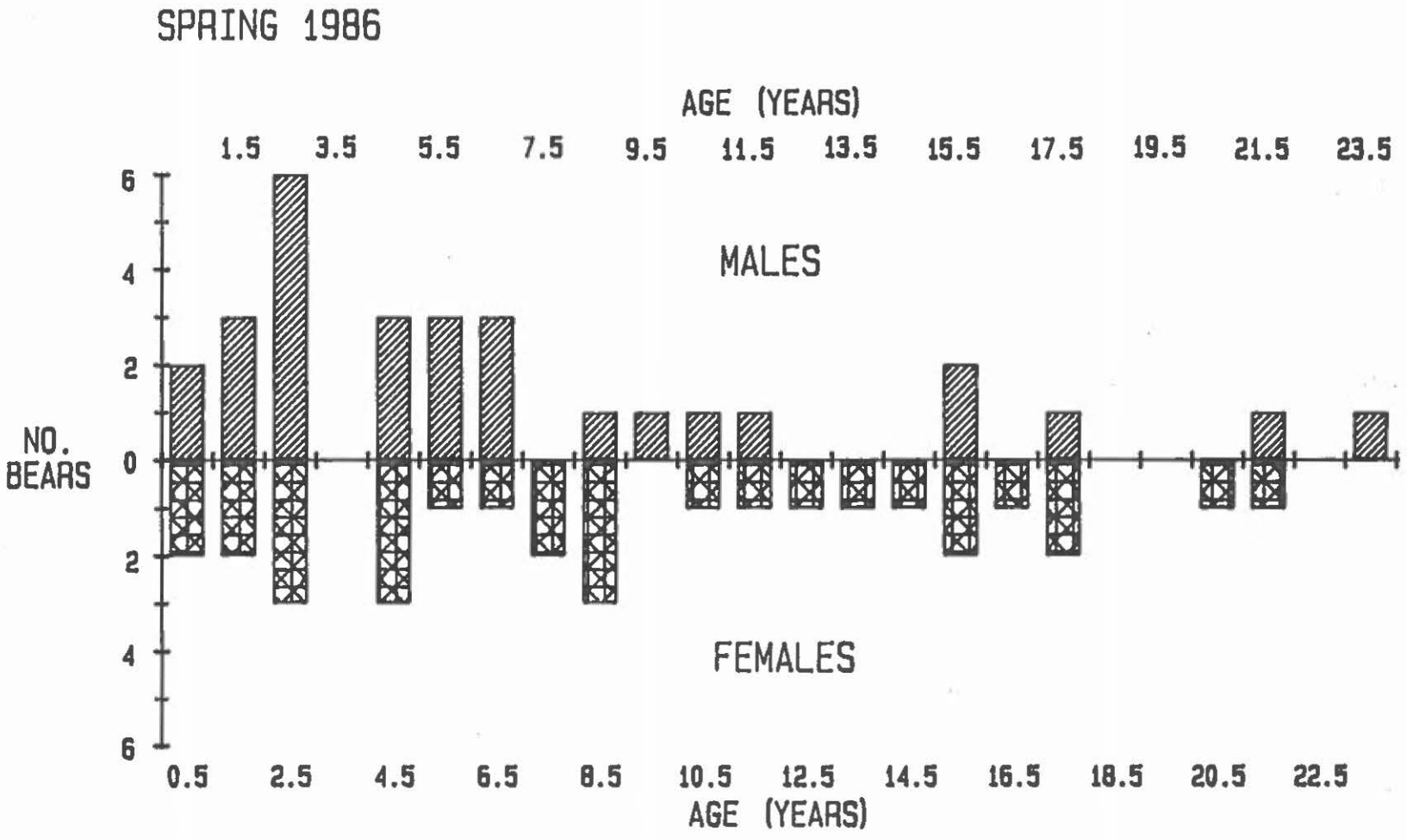

Fig. 1. Population sex and age structure for grizzly bears present in the northcentral Alaska Range study area, 1986.

Table 1. Capture and marking characteristics of 78 bears captured in the northcentral Alaska Range, 1981-86.

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
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
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)[d]	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
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[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/-
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/O
	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

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]
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
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/lB
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]
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
1331 F	4.5	7/10/82	77(170)	Trident Gl.	2.4/1.6 M	3120/3194	Bk/O
1332 F	5.5	7/12/82	104(230)	Gillam Gl.	2.4/1.6 M	394/190	R/dB
1333 F	16.5	7/13/82	141(310)	Buchanan Cr.	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

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]
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
1337 M	20.5	5/18/83	293(645)	Sheep Cr.	3.5/3.5	3209/3205	R/O
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	lB/W
	7.5	5/17/84	168(370)	E. Fk. Delta	6.0 M99 H	3254/3398	lB/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/-
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	lB/Bk
	3.5	6/23/84	123(270)	Hayes Cr.	2.2/3.2 M	475/460	lB/Bk
1345 F	8.5	5/24/83	--[d]	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	lB/lB
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/lB
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
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

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]
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	lB/dB
	15.5	5/20/86	236(520)	Trident Gl.	3.4/2.0 L	297/296	lB/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
1363 M	3.5	6/5/85	55(120)	Slide Cr.	1.0/2.0 M	592/593	dB/lB
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	lB/G
1366 M	8.5	7/22/85	234(515)	Tatlanika R.	3.2/1.0 M	390/391	mG/R
1367 M	2.5	5/19/86	61(134)	Threemile Cr.	1.4/2.0 M	400/241	lB/W
1368 F	2.5	5/19/86	48(106)	Threemile Cr.	1.4/2.0 M	257/256	lB/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
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	lB/O
1373 M	7.5	5/21/86	193(425)	Delta Cr.	4.0/2.0 M	295/294	lB/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)[d]	Ptarmigan Cr.	--	None	None

Table 1. Continued.

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

[b] Ear tag numbers, left/right.

[c] Marking designations:
Colors: R, red; G, light green; mG, medium green; 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 grizzly bear population present in northcentral Alaska Range study area, 1981-86.[a]

Bears alive during spring of year[b]	1981			1982			1983			1984			1985			1986		
	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	55	47.3	35.7	65	56.8	39.1	59	50.2	43.1	62	53.3	35.4	50	42.8	34.4	45	39.3	39.3
Unmarked young with marked mothers	1	1	0	2	2	0	3	3	0	6	6	0	13	12.5	0	9	9	0
Unmarked bears killed by hunters	25	17.3	15.1	11	8.9	7.2	8	6.2	6.0	4	2.9	2.7	1	0.2	0.2	2	1.2	1.2
Minimum observed population	81	65.6	50.8	78	67.7	46.3	69	59.4	49.1	72	62.2	48.1	64	55.5	34.6	56	49.5	40.5

[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.

[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. Daily availability of marked bears and observations of marked and unmarked bears in a search area of the northcentral Alaska Range, 1986.[a]

Date	No. of marked bears present (n_1)	No. of marked bears observed (m_2)	No. of bears observed (n_2)
9 Jun	8	3	6
11 Jun	8	2	2
12 Jun	4	1	2
Total	20	6	10

[a] Only those bears ≥2 years of age are included in these data.

Table 4. Reproductive status and litter sizes of potentially mature females in the northcentral Alaska Range, 1981-86.

Bear No.	Age in 1986[a] (yr)	Offspring No.	Reproductive status[b] 1981	1982	1983	1984	1985	1986	Reproductive history
1302	8		NB	UN	UN	UN	UN	B	No offspring prior 1986
1303	7	1364, 1UM	NB	NB	B?	B	2cubs/B	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	10	2UM		?/B	B	2cubs	2yrlg	1 2-yr/B	Offspring 1982 or before; lost 1 yrlg 1985
1311	16	1312, 1313, 1372, 1378	UN/B	2cubs	B	2cubs	2yrlg	2 2-yr/B	Lost cubs August 1982;
1317	6			NB	NB?	NB	NB/Dead		Illegal kill fall 1985
1318	17	1319, 2UM	UN/B	1cub/B	B	B	2cubs	2yrlg	Lost cub 1982
1320	21	1UM, 3UM		?/B	1cub/B?	B	3cubs	B	Weaned or lost offspring 1982; lost cub 1983; lost 3 cubs 1985
1321	20	1342, 1343, 1344, 3UM	UN/3+cubs	3yrlg	3 2-yr	2 3-yr/B	3cubs	3yrlg	1342 killed illegally fall 1983; lost 1 yrlg 1986
1322	12	1336	UN/1+cubs	1yrlg	1 2-yr	1 3-yr/B	UN	UN	
1323	15	1324, 1325	UN/B	2 cubs	2yrlg	2 2-yr/B	UN	UN	
1326	8	UM		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	8			NB	B	UN	UN	UN	No offspring prior 1982
1332	6			NB?	Dead				No offspring prior 1982; died in den 1983

Table 4. Continued.

Bear No.	Age in 1986[a] (yr)	Offspring No.	Reproductive status[b] 1981	1982	1983	1984	1985	1986	Reproductive history
1336	5				NB	NB	B	B	No offspring prior 1983
1340	6				NB	NB	B	UN	No offspring prior 1983
1341	13	1UM, 1370, 1371		UN/1+cubs	1yrlg/B	2cubs	2yrlg	2 2-yr/B	Lost yrlg 1983
1345	11	2UM, 2UM			B	2cubs	1yrlg/B	2cubs	Lost 1 cub 1984; lost 1 yrlg 1985
1348	15	1367, 1368, 1369			?/B	3cubs	3yrlg	3 2-yr/B	Probably weaned or lost offspring 1983
1351	17	1357, 1361, 1UM	UN/B	UN/3+cubs	3yrlg	3 2-yr	2 3-yr/B	UN	Lost 1UM offspring 1984
1352	16	1353, 1354	UN/B	UN/2+cubs	2yrlg	2 2-yr/Dead			Hunter kill 1984; 1353, hunter kill 1984
1360	11	1359, 1363	UN/B	UN/2+cubs	UN/2+yrlg	UN/2+2-yr	2 3-yr/ Dead		Capture mortality 1985
1361	4					NB	NB	NB	No offspring prior 1985
1362	7	2UM				UN	B	2cubs	No offspring prior 1985
1374	6	UM				UN/B	UN/2+cubs	2yrlg	
1376	14						UN	?/B	Offspring prior 1986

[a] Age in 1986 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.

Table 5. Observed and projected minimum reproductive intervals for adult female grizzly bears in the northern Alaska Range, 1981-86.

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
1303	5	5	B	C/B	B	C	Y	2/B	
1305	22	3	W/B	C	Y	2/B			
1308	6	4	C?/B	B	C	Y	2/B		
1311	10	5	W/B	C	B	C	Y	2/B	
1318	12	6	W/B	C/B	B	B	C	Y	2/B
1320	17	6	W/B	C/B?	B	C	B	C	Y
1321	14	4	W/B	C	Y	2	3/B	C	Y
1322	6	4	B	C	Y	2	3/B		
1323	11	3	W/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			
1333	14	4	W/B	C	Y	2	3/B		
1341	10	5	W/B	C	Y/B	C	Y	2/B	
1345	8	5	B	C	Y/B	C	Y	2/B	
1348	12	3	W/B	C	Y 2/B				
1351	12	4	W/B	C	Y	2	3/B		
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	2B			
1376	14	3	W/B	C	Y	2/B			

[a] All reproductive cycles or intervals were minimum values because they were partially based on projections prior to or after years when actual observations were made. In addition, all projected calculations assume weaning of young as 2-year-olds; however, in weanings which were observed, 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 6. Observed litter size and number of offspring in cub, yearling, 2-year-old, and 3-year-old age classes, 1982-86.

Age class	Observed no. of litters					Total		Mean litter size
	1982	1983	1984	1985	1986	No. of litters	No. of offspring	
Cub								
litter size 1	1	1	0	1	0	3	3	
litter size 2	2	0	4	2	2	10	20	
litter size 3	0	0	2	2	0	4	12	
total	3	1	6	5	2	17	35	2.06
Yearling								
litter size 1	2	1	0	1	0	4	4	
litter size 2	2	2	0	3	2	10[a]	20[a]	
litter size 3	1	1	0	1	1	4	12	
total	5	4	0	5	3	18[a]	36[a]	2.00[a]
2-year-old								
litter size 1	0	2	0	0	1	3	3	
litter size 2	1	1	2	0	2	6	12	
litter size 3	0	1	1	0	1	3	9	
total	1	4	3	0	4	12	24	2.00
3-year-old								
litter size 1	0	0	1	0	0	1	1	
litter size 2	0	0	2	1	0	3	6	
litter size 3	0	0	0	1	0	1	3	
total	0	0	3	2	0	5	10	2.00

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

Table 7. Minimum number of female grizzly bears present in the study population in northcentral Alaska, 1981-87.

	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
1980	-[b]	-[c]				18[d]			
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	-[b]	4	1	1	0	18	1	1	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] Six adult females were not observed in 1985 (3) or 1986 (3 additional) but bred during the last year in which they were observed. It is very likely that these females produced offspring which these figures do not include.

Table 8. Mortality of grizzly bears in Alaska Range study area, 1981-86.

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[d]	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 8. 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 8. 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	Unk	--	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 8. Continued.

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[a] UM designates an unmarked bear.

[b] M, male; F, female; Unk, unknown sex.

[c] Age at death; Unk denotes unknown age.

[d] Hunter kills with location only listed as Wood River were counted in the study area.

[e] Killed outside study area.

[f] Estimate.

[g] Bear killed in September 1985, but not reported or sealed.

Table 9. Grizzly bear harvest[a] within the study area, 1961-86.

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	3[g]	0[g]	3[g]	8
Totals	19	47	21	58	145

[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.

[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.

Table 10. Human-caused mortality and mortality rates for a grizzly bear population in the northcentral Alaska Range, 1981-86.[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	10.9	65.6	16.6	50.8	21.5	19.2	0	0
1982	5.2	67.7	7.2	46.3	11.2	20.2	2.0	9.9
1983	5.5	59.4	9.3	49.3	11.2	19.2	1.8	14.6
1984	12.4	62.2	19.9	48.3	25.7	18.9	4.0	21.2
1985	2.8	55.5	5.0	34.6	8.1	17.1	1.8	10.5
1986	5.7	49.5	11.5	40.5	14.1	16.3	1.0	6.1
$\bar{x}$	7.1	60.0	11.8	45.0	15.8	18.4	1.9	10.5

[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. 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 11. Movement of young-age bears subsequent to weaning, Alaska Range, 1983-86.

Bear No. and sex	Maternal female No.	Age when weaned	Age during movement	Movement pattern
1306 M	1305	2.5	2.5	Within maternal home range (MHR)
			3.5	Within MHR
			4.5	Killed by hunter 5/20/84 in MHR
1307 M	1305	2.5	2.5	Within MHR
			3.5	Within MHR
			4.5	Sighted once within 15 km of MHR
			5.5	Moved 12 km NW of MHR
			6.5	Home range includes MHR
1372 M	1311	2.5	2.5	Within MHR
1378 F	1311	2.5	2.5	Killed by hunter 5/25/86 prior to weaning
1344 M	1321	3.5	3.5	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
1336 F	1322	3.5	3.5	Within MHR
			4.5	Within MHR, bred
			5.5	Within MHR, collar nonfunctional
1324	1323	2.5	--	Not radio-collared, status unknown
1325 M	1323	2.5	2.5	Within MHR; killed in defense of life or property 9/9/84
1330 M	1329	2.5[a]	2.5	Within MHR
			3.5	Moved outside MHR?; no radio contact
			4.5	No radio contact 1986
1334 M	1333	3.5	3.5	Moved 48 km to SE between 6/4 and 6/25/84
			4.5	No radio contact 1985
			5.5	No radio contact 1986
1335 F	1333	3.5	3.5	Killed by hunter 9/14/84 in MHR
1370 F	1341	2.5	2.5	Within MHR

Table 11. Continued.

Bear No. and sex	Maternal female No.	Age when weaned	Age during movement	Movement pattern]\[
1371 M	1341	2.5	2.5	Killed by hunter 9/7/86 in MHR
1367 M	1348	2.5	2.5	Killed in defense of life or property 6/28/86 in MHR
1368 F	1348	2.5	2.5	Killed in defense of life or property 5/31/86 in MHR
1369 M	1348	2.5	2.5	Within MHR
1357 M	1351	3.5	3.5	Moved 44 km NNW of MHR by 12/3/85
			4.5	Killed by hunter 9/23/86 46 km WNW MHR
1361 F	1351	3.5	3.5	Within MHR
			4.5	Within MHR
1353 M	1352	2.5[b]	2.5	Killed by hunter 9/4/84 in MHR
1354 F	1352	2.5[b]	2.5	Not radio-collared, status unknown
1359 M	1360	3.5[c]	3.5	Within MHR
			4.5	Moved 62 km SE of MHR
1363 M	1360	3.5[c]	3.5	Within MHR
			4.5	Shed collar between 4/28 and 5/16/86 within MHR
1355 M	Unk	Unk	3.5	Within established home range
			4.5	Within established home range
			5.5	Killed by hunter 9/13/85 12 km N of home range
1356 M	Unk	Unk	3.5	Moved 74 km ESE of den area between 4/27 and 5/20/84 when killed by hunter
1302 F	Unk	2.5[d]	3.5	Within established home range
			4.5-7.5	Shed collar 8/81, no contact until 1986 recapture
			8.5	Within established home range

Table 11. Continued.

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[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. Physical attributes[a] of grizzly bears captured in the northcentral Alaska Range, 1981-86.

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
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[d]	--	--	--	64	116	--	20.8	34.1	--	--
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	--	--
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	--	--
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
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[d]	--	--	--	59	105	--	19.8	33.5	--	--

Appendix A. Continued.

Bear No.	Date	Sex	Age (yr)[b]	Measured weight	Total length	Shoulder height	Hind foot	Neck	Girth	Body length	Head width	Head length	Left upper canine[c]	Left lower canine[c]
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	--	--
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
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	--	--
1331	7/10/82	F	4.5	77	161	102	28	50	96	98	17.0	30.5	--	--
1332	7/12/82	F	5.5	104	173	100	32	54	92	97	18.0	33.4	3.1	2.9
1333	7/13/82	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	--	--

Appendix A. Continued.

Bear No.	Date	Sex	Age (yr)[b]	Measured weight	Total length	Shoulder height	Hind foot	Neck	Girth	Body length	Head width	Head length	Left upper canine[c]	Left lower canine[c]
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	--	--
1337	5/18/83	M	20.5	289	210	122	36	98	151	135	26.6	39.8	4.0b	b
1338	5/20/83	M	6.5	111	175	89	29	35	107	101	19.9	34.8	3.5	3.4
1339	5/20/83	M	6.5	120	174	103	29	37	109	100	19.7	34.4	3.6	3.1
	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[d]	--	--	--	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	--	--	--	--	--
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[d]	--	--	--	56	103	--	18.6	33.6	--	--
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[d]	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	--	--
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

Appendix A. Continued.

Bear No.	Date	Sex	Age (yr)[b]	Measured weight	Total length	Shoulder height	Hind foot	Neck	Girth	Body length	Head width	Head length	Left upper canine[c]	Left lower canine[c]
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	--	--
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	--	--
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	--	--
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	130	171	--	--	64	103	--	21.8	34.2	--	--

Appendix A. Continued.

Bear No.	Date	Sex	Age (yr)[b]	Measured weight	Total length	Shoulder height	Hind foot	Neck	Girth	Body length	Head width	Head length	Left upper canine[c]	Left lower canine[c]
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[d]	--	--	--	--	--	--	--	--	--	--

[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 B. Grizzly bear captures, recaptures, and capture-related mortalities, Alaska Range, 1981-86.

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 B. Continued.

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

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

Appendix C. Current status of marked bears in the northcentral Alaska Range, 1986.

Bear No.	Sex	Initial capture Age	Initial capture Date	Date last location	Status as of fall 1986
1301	M	6.5	5/18/81	5/18/81	Dead, capture mortality
1302	F	3.5	5/19/81	11/6/86	Alive, functional collar
1303	F	2.5	6/17/81	7/22/85	Unk, shed collar or dead by 12/3/85
1304	M	5.5	6/19/81	9/23/82	Unk, shed collar between 9/23 and 10/31/82
1305	F	24.5	6/19/81	9/15/82	Dead, hunter kill
1306	M	2.5	5/24/82	5/20/84	Dead, hunter kill
1307	M	2.5	5/24/82	5/20/86	Alive, 1986 den not located
1308	F	6.5	5/25/82	11/6/86	Alive, functional collar
1309	M	8.5	5/25/82	9/15/84	Dead, hunter kill
1310	M	13.5	5/25/82	7/28/86	Alive, 1986 den not located
1311	F	12.5	5/26/82	11/6/86	Alive, functional collar
1312	F	0.5	5/26/82	8/5/82	Dead, disappeared between 8/5 and 8/27/82
1313	F	0.5	5/26/82	8/5/82	Dead, disappeared between 8/5 and 8/27/82
1314	M	6.5	5/27/82	9/15/82	Dead, hunter kill
1315	M	13.5	6/4/82	5/17/84	Dead, capture mortality
1316	M	11.5	6/7/82	7/12/82	Unk, shed collar between 7/12 and 8/4/82
1317	F	3.5	6/8/82	7/22/85	Probable illegal kill
1318	F	13.5	6/8/82	11/6/86	Alive, collar functional; w/2 yrlgs
1319	M	0.5	6/8/82	6/18/82	Dead, disappeared between 6/18 and 7/2/82
1320	F	17.5	6/8/82	11/6/86	Alive, collar functional
1321	F	16.5	6/8/82	11/6/86	Alive, collar functional; 2 yrlgs
1322	F	8.5	6/9/82	4/27/84	Unk, probably alive, collar nonfunctional
1323	F	11.5	6/10/82	6/29/84	Unk, unbolted collar recovered
1324	F	0.5	6/10/82	5/16/84	Unk, never radio-collared before weaning
1325	M	0.5	6/10/82	9/9/84	Dead, killed in defense of life or property
1326	F	4.5	6/18/82	5/27/86	Dead, hunter kill
1327	F	16.5	7/8/82	6/23/84	Dead, capture-related mortality
1328	F	1.5	7/8/82	8/27/82	Dead, disappeared between 8/27 and 9/23/82
1329	F	13.5	7/9/82	5/15/83	Dead, killed and eaten by bear No. 1315M
1330	M	1.5	7/9/82	8/14/84	Unk, probably emigrated
1331	F	4.5	7/10/82	6/30/83	Unk, shed collar between 6/30 and 8/19/83
1332	F	5.5	7/12/82	10/31/82	Dead, died in den, winter 82/83
1333	F	16.5	7/12/82	5/22/84	Dead, hunter kill
1334	M	1.5	7/13/82	6/27/84	Unk, probably emigrated
1335	F	1.5	7/13/82	9/14/84	Dead, hunter kill
1336	F	2.5	5/16/83	4/28/86	Unk, collar nonfunctional
1337	M	20.5	5/18/83	5/19/84	Unk, tore collar off between 5/19 and 6/4/84, probably dead?
1338	M	6.5	5/20/83	5/20/83	Dead, capture mortality
1339	M	6.5	5/20/83	6/4/84	Unk, shed collar between 6/4 and 9/10/84
1340	F	3.5	5/23/83	6/27/85	Unk, collar shed between 6/27/85 and 4/28/86
1341	F	10.5	5/23/83	12/3/85	Alive, functional collar
1342	M	2.5	5/24/83	6/27/83	Dead, illegal kill, snared fall 1983

Appendix C. Continued.

Bear No.	Sex	Initial capture Age	Initial capture Date	Date last location	Status as of fall 1986
1343	M	2.5	5/24/83	5/15/84	Unk, collar nonfunctional? or emigrated?
1344	M	2.5	5/24/83	9/7/84	Dead, hunter kill
1345	F	8.5	5/24/83	6/13/86	Alive, functional collar; w/2cubs
1346	M	5.5	5/25/83	8/19/83	Unk, shed collar? between 5/25 and 8/19/83
1347	M	6.5	5/31/83	5/31/83	Dead, capture mortality
1348	F	12.5	5/31/83	11/6/86	Alive, functional collar; breeding
1349	M	18.5	6/2/83	10/15/84	Unk, shed collar between 6/2 and 10/15/84 sighting fall 1985?
1350	M	8.5	6/2/83	6/13/86	Alive, functional collar
1351	F	14.5	6/23/83	7/22/86	Unk, shed collar between 7/22 and 12/3/85
1352	F	14.5	6/27/83	5/30/84	Dead, hunter kill
1353	M	1.5	6/27/83	9/4/84	Dead, hunter kill
1354	F	1.5	6/27/83	5/18/84	Unk, never radio-collared
1355	M	3.5	6/30/83	9/13/85	Dead, hunter kill
1356	M	2.5	6/30/83	5/20/84	Dead, hunter kill
1357	M	2.5	5/15/84	9/23/86	Dead, hunter kill
1358	M	12.5	5/18/84	5/31/86	Dead, hunter kill
1359	M	3.5	5/28/85	11/6/86	Alive, functional collar
1360	F	10.5	5/28/85	5/28/85	Dead, capture mortality
1361	F	3.5	5/28/85	11/6/86	Alive, functional collar
1362	F	6.5	6/5/85	11/6/86	Alive, functional collar; w/2 cubs
1363	M	3.5	6/5/85	4/28/86	Unk, shed collar between 4/28 and 5/16/86
1364	M	0.5	6/14/85	6/14/85	Dead, disappeared between 6/14 and 6/24/85
1365	M	5.5	6/19/85	7/28/86	Alive, functional collar; 1986 den not located
1366	M	8.5	7/22/85	12/3/85	Unk, shed collar?
1367	M	2.5	5/19/86	6/28/86	Dead, killed in defense of life or property
1368	F	2.5	5/19/86	5/31/86	Dead, killed in defense of life or property
1369	M	2.5	5/19/86	5/19/86	Unk, not heard since capture
1370	F	2.5	5/20/86	11/6/86	Alive, functional collar
1371	M	2.5	5/20/86	9/7/86	Dead, hunter kill
1372	M	2.5	5/20/86	6/11/86	Alive, functional collar; 1986 den not located
1373	M	7.5	5/21/86	9/2/86	Dead, hunter kill
1374	F	6.5	5/21/86	7/28/86	Alive, functional collar; 1986 den not located
1375	M	6.5	6/13/86	11/6/86	Alive, functional collar
1376	F	14.5	6/13/86	11/6/86	Alive, functional collar
1377	M	3.5[a]	8/28/86	8/28/86	Alive, functional collar
1378	F	2.5	6/20/86	6/20/86	Dead, hunter kill

[a] Estimate.

Appendix D. Status summary of marked bears in the northcentral Alaska Range, fall 1986.

Dead	Alive, active collar	Shed collar, unknown status	Unknown, nonfunctional, dispersed?	Never collared
1301	1302	1303	1322	1324
1305	1307	1304	1330	1354
1306	1308	1316	1334	
1309	1310	1323	1336	
1312	1311	1331	1343	
1313	1318	1337		
1314	1320	1339		
1315	1321	1340		
1317	1341	1346		
1319	1345	1349		
1325	1348	1351		
1326	1350	1363		
1327	1359	1366		
1328	1361			
1329	1362			
1332	1365			
1333	1369			
1335	1370			
1338	1372			
1342	1374			
1344	1375			
1347	1376			
1352	1377			
1353				
1355				
1356				
1357				
1358				
1360				
1364				
1367				
1368				
1371				
1373				
1378				

Appendix E. Daily search effort, Alaska Range population estimate, spring 1986.

Quadrat No.	Size mi^2	Size km^2	9 June Time spent (min)	9 June Min/ mi^2	9 June Min/ km^2	11 June Time spent (min)	11 June Min/ mi^2	11 June Min/ km^2	12 June Time spent (min)	12 June Min/ mi^2	12 June Min/ km^2	$\bar{x}$ min/km^2	SD
A	20	52	70	3.5	1.3	82	4.1	1.6	96	4.8	1.8	1.57	0.25
B	24	61	85	3.5	1.4	88	3.7	1.4	89	3.7	1.5	1.43	0.06
C	29	76	102	3.5	1.3	64	2.2	0.8	86	3.0	1.1	1.07	0.25
D	25	64	80	3.2	1.3	105	4.2	1.6	89	3.6	1.4	1.43	0.15
E	27	70	--	--	--	84	3.1	1.2	45	1.7	0.6	0.90	0.42
F	20	52	64	3.2	1.2	72	3.6	1.4	84	4.2	1.6	1.40	0.20
G	27	69	81	3.0	1.2	69	2.6	1.0	56	2.1	0.8	1.00	0.20
H	32	84	--	--	--	108	3.4	1.3	43[a]	1.3	0.5	0.92	0.59
I	36	94	70	1.9	0.7	83	2.3	0.9	66	1.8	0.7	0.77	0.12
J	32	83	76	2.4	0.9	74	2.3	0.9	122	3.8	1.5	1.10	0.35
K	33	85	77	2.3	0.9	80	2.4	0.9	86	2.6	1.0	0.93	0.06
L	32	82	81	2.5	1.0	88	2.8	1.1	104	3.3	1.3	1.13	0.15
M	30	78	66	2.2	0.8	87	2.9	1.1	93	3.1	1.2	1.03	0.21
All	367[b]	950	852	2.8	1.1	1,084	3.0	1.1	1,059	2.9	1.1	1.07	

Appendix E. Continued.

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[a] Search ended to capture another bear.

[b] Area searched on 9 June was 308 mi^2 (796 km^2) (quadrats E & H [59 mi^2] not searched.

Appendix F. Status of maternal grizzly bears and their offspring in the northcentral Alaska Range, 1981-86.

Maternal female			Offspring			
Bear No.	Age at capture (yrs)	Present status	Bear No. and sex[a]	Year of birth	Age at weaning (yrs)	Present status
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
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
1318	13.5	Alive	1319 M	1982	--	Assumed dead 1982
			UM	1985	--	With mother 1986
			UM	1985	--	With mother 1986
1320	17.5	Alive	UM	1983	--	Assumed dead 1983
			UM	1985	--	Assumed dead 1985
			UM	1985	--	Assumed dead 1985
			UM	1985	--	Assumed dead 1985
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
			UM	1985	--	With mother 1986
			UM	1985	--	With mother 1986
1322	8.5	Last observed 1984	1336 F	1981	3.5	Bred 1986
1323	11.5	Last observed 1984	1324 F	1982	2.5	Last observed 1984
			1325 M	1982	2.5	Killed DLP[b] 1984
1326	4.5	Hunter kill 1986	UM	1985	--	Assumed dead 1985
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	Last observed 1984
1333	16.5	Hunter kill 1984	1334 M	1981	3.5	Last observed 1984
			1335 F	1981	3.5	Hunter kill 1984
1341	10.5	Alive	UM	1982	--	Assumed dead 1983
			1370 F	1984	2.5	Alive 1986
			1371 M	1984	2.5	Hunter kill 1986

Appendix F. Continued.

Maternal Female			Offspring			
Bear No.	Age at capture (yrs)	Present status	Bear No. and sex[a]	Year of birth	Age at weaning (yrs)	Present status
1345	8.5	Alive	UM	1984	--	Assumed dead 1984
			UM	1984	--	Assumed dead 1985
			UM	1986	--	With mother 1986
			UM	1986	--	With mother 1986
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	Alive 1986
1351	14.5	Last observed 1985	UM	1982	--	Assumed dead 1984
			1357 M	1982	3.5	Hunter kill 1986
			1361 F	1982	3.5	Alive 1986
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	--	Alive 1986
			1363 M	1982	--	Alive 1986
1362	6.5	Alive	UM	1986	--	With mother 1986
			UM	1986	--	With mother 1986
1374	6.5	Alive	UM	1985	--	With mother 1986
			UM	1985	--	With mother 1986

[a] Unmarked.

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