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

by
Harry V. Reynolds, III

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DIVISION OF WILDLIFE CONSERVATION
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SUMMARY

During 1994 the third phase continued in a long-term investigation of the effects of harvest on grizzly bear (*Ursus arctos horribilis*) population dynamics in a 3160 km^2 area of the northcentral Alaska Range. During the first 2 phases, as the total population size declined, the adult female segment of the population was stable at 21-23 from 1981 to 1989, but declined to 14 by 1993. During the third phase, the recovery rate will be determined for both the total population and the productive female segment of the population. During 1994, 20 bears were captured and 18 were radiocollared, primarily to maintain the sample of radiocollared adult females. Only 15 adult females were present in the area, compared with 21-23 from 1981 through spring 1989. However, during 1994, there were 10 young-age females (2-5 years of age) that are potential recruits to the adult female cohort.

Key words: grizzly bear, harvest rates, Interior Alaska, mortality, population dynamics, recovery rates, reproductive biology, *Ursus arctos*

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BACKGROUND

An understanding of the impacts of different levels of hunter harvest on grizzly bear (*Ursus arctos horribilis*) population density, structure, and dynamics is necessary for effective management. In addition, rates of recovery and mechanisms of response to high levels of harvest must be included in analyses for management models to reflect real-life situations. Although recent studies have increased the knowledge on some of these aspects of population dynamics, additional information is necessary to clarify the extent and direction of population response to, and recovery from, high harvest levels. Further, as demands on grizzly bear habitat and populations increase, more intensive management will be required using models based on observed harvest and recovery rates of specific segments of the population.

To determine sustainable harvest levels for grizzly bears, it is crucial to be able to document responses in population numbers or density to various harvest rates (Miller et al. 1987, Reynolds et al. 1987, Miller 1990*a*, 1990*b*, 1990*c*, 1993). It is equally important to understand the mechanisms of population responses to harvest (such as compensatory production or survival) through long-term observation of individuals (Reynolds et al. 1987, Schwartz and Franzmann 1991, Reynolds and Boudreau 1992). Use of harvest data alone is inadequate for timely determination of population trend or calculation of sustainable harvest rates (Harris and Metzgar 1987).

Documentation of population response to exploitation is necessary to fully realize the benefits from this long-term study. Additional data on population production, survival, compensatory behavior, and emigration rates will make assessment of future direction of these investigations more effective. Because of characteristics of production and survival, grizzly bear populations respond very slowly to forces that may change population status. For instance, because Alaska Range grizzly bears do not usually produce surviving young until they reach 7 years of age, and the mean interval between litters is 4.1 years (Reynolds 1990, Reynolds and Boudreau 1990), the effects of compensatory production or survival cannot be documented until additional litters are weaned and provide potential recruitment to the population, approximately 7 years.

This study was initiated in 1981 as a 2-phase study. It has been conducted in a 3160-km^2 study area of representative northern Alaska Range habitat in Subunit 20A. The study area is large enough to include the entire home ranges of 66% of females under observation for at least 5 years, and 17% of males.

Phase I was completed in 1985; it emphasized the gathering of baseline information on the population biology (Reynolds 1982; Reynolds and Hechtel 1983, 1984, 1985, 1986, 1988; Reynolds et al. 1987). Harvest level during the years 1965 through 1980 was generally moderate (i.e., 5.6% of the estimated population); however, from 1981 to 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 the 12% harvest level during Phase I. Even though this harvest was higher than study design anticipated, this circumstance strengthened rather than detracted from the investigation. The early high harvest level allowed monitoring of reproductive responses over a longer period of time.

Phase II, which continued from 1986 through 1991, was designed to measure grizzly bear population response to human-caused mortality. Throughout this period, mean annual harvest rates continued at 11% (Reynolds 1989, 1990; Reynolds and Boudreau 1992). Alaska Department of Fish and Game (ADF&G) staff monitored changes in estimated population size and productivity. During 1986 a mark-recapture density estimate was conducted (Reynolds et al. 1987). Changes in reproductive performance of adult females and survival rates of young bears showed nonconclusive evidence for compensatory production and survival; additional data from subsequent years will be necessary to substantiate any trends.

Following the completion of Phase II, a second mark-recapture density estimate was conducted in 1992 (Reynolds 1993*a*) for comparison with the 1986 estimate (Reynolds et al. 1987). No changes in density could be detected between the 2 time periods because the estimates displayed wide confidence intervals, primarily because of low density within the search areas. However, annual direct count estimates, based on intensive capture and presence of individual bears within home ranges in the area, indicated that by 1992 the population of bears > 2 years of age had declined by 20% since 1981.

Patterns of movement or fidelity to maternal or established home ranges indicated that all females remained in the vicinity of their maternal home ranges and none emigrated from the study area. All males weaned or captured as 2- or 3-year-olds emigrated from their maternal or established home ranges within 2 years. Males ≥ 4 years of age apparently left their maternal home ranges to immigrate to the study area; none of these later emigrated from the study area although some had home ranges that extended beyond the study area boundaries.

Several other intensive studies have documented declining populations (Craighead et al. 1974; Knight and Eberhardt 1984, 1985; McLellan 1989*a*, 1989*b*, 1989*c*). Harvest models that have been developed are complex and illustrate the difficulty of using harvest data to predict population changes (Tait 1983, Harris and Metzgar 1987, Miller and Miller 1990, Miller 1993). Miller (1990*a*) estimated a sustainable harvest rate of 8% in Unit 13, but concluded that a number of potential biases remained to be investigated. Other studies have addressed aspects of population biology or density of grizzly bears in Interior Alaska (Dean 1976; Murie 1981; Ballard et al. 1982; Miller and Ballard 1982; Miller 1984, 1987, 1990*a,b*, 1993).

Before the effects of various harvest rates can be assessed, the following information should be available: 1) population density or size, 2) population structure, 3) movement patterns, 4) home range size, 5) mortality and survival rates, and 6) reproductive potential including age at first breeding, litter size, and interval between litters (Craighead et al. 1974; Reynolds 1974, 1976, 1978, 1980; Bunnell and Tait 1980, 1981; McLellan 1989*a*; Miller 1990*c*; Miller and Miller 1990). The approach taken in this study is to monitor these characteristics annually so that harvest can be related to potential population responses.

OBJECTIVE

Following reductions in human-caused mortality rates, determine the rate and length of time necessary for recovery of the female segment of a grizzly bear population reduced by 32% from 1981-1988 levels; specifically, determine the recovery responses in the dynamics of the population, including female population size, total population size, and production and survival of offspring.

STUDY AREA

The 3160-km^2 (1220-mi^2) study area is located in the mountains and foothills of the northcentral Alaska Range within Subunit 20A. The study area boundaries did not include mountainous areas above 1800 m (6000 ft), glaciers, or heavily forested portions of the Tanana Flats where searches were not attempted and few observations were made. The boundaries are the Gold King Creek and Wood River drainages downstream from Virginia Creek to the west, the crest of the Alaska Range to the south, the Delta Creek drainage to the east, and the southern edge of the Tanana Flats (approx. 64°07'N) to the north. It includes portions of 2 US Army reservations, Fort Wainwright and Fort Greely.

Elevation in the area ranges from 500 to 3700 m (1500-12,000 ft). Most rivers flow northerly through U-shaped, glacially formed valleys and are fed by active glaciers. Tree line is at approximately 900 m (3000 ft). Dense patches of willow (*Salix* spp.) or alder (*Alnus crispa*), which bears use for cover, may be present up to an elevation of approximately 1200 m (4000 ft).

METHODS

The methods used to capture bears and measure population variables have been described in previous reports (Reynolds 1982, 1993*a*; Reynolds and Hechtel 1983, 1984, 1985, 1986, 1988; Reynolds et al. 1987, Taylor et al. 1989, Reynolds and Boudreau 1992). Standardized weight and measurement data were collected (Kingsley et al. 1988).

In determining the size, density, and sex and age structure of the grizzly bear population, emphasis will be placed on assessing the recovery rate of adult females to their 1981-1989 level within the population. Changes in numbers and density of females will be detected through annual monitoring of radiocollared adults. Most, if not all, of adult females in the study area have been captured and radiocollared. Maintaining contact with a high proportion of adult females in the population is possible for the following reasons: 1) intensive aerial searches are made throughout the study area annually when visibility is high, before leaves emerge; because of the long-term nature of the study, the likelihood of individual females escaping detection for more than 3 years is low; 2) no emigration of adult females or their offspring has been observed and their home ranges seem to be very stable (Reynolds 1993*a*) so that once they have been radiocollared, they can be relocated in a specific area, even when their radiocollars fail; 3) because offspring are usually radiocollared before they are weaned and female offspring do not emigrate from the vicinity of their maternal home range, all these potential recruits to the adult female segment of the population female can be monitored; and, 4) because capturing grizzly bears for this study occurs during the breeding season and both radiocollared adult males and females are monitored, any uncollared breeding bear that consorts with a radiocollared bear during the May-June capture period can also be radiocollared. Because bears are polygamous, the most effective time for increase of sample size for radiocollared adults occurs during this period and only nonbreeding bears are likely to avoid capture.

The primary means of determining size and density of the population in the study area will be from annual direct counts (Reynolds et al. 1987, Reynolds 1993*b*). Direct count estimates of annual minimum population size will include the sum of: 1) marked or radiocollared bears known or assumed to be alive and present in the area, 2) unmarked offspring of radiocollared females, 3) bears captured in the study area that would have been resident in past years (e.g., a 14-year-old female captured in 1986 was assumed to be a resident of the study area from 1981 to 1985, but a 2-year-old male captured in 1986 was only counted as a member of the population from 1984 to 1986; those known to have emigrated will not be included); and 4) unmarked bears killed within the study area, but which would have been resident in past years.

Based on observed patterns of immigration and fidelity to maternal and established home ranges, all captured females will be assumed present in the study area from the time of their birth and none will be assumed to emigrate from the area nor immigrate to it (Reynolds and Boudreau 1992, Reynolds 1993*a*). Similarly, using observed patterns, all males captured at $\geq$ 4 years of age will be assumed to have immigrated to their established home range (of which at least a portion was included in the study area) as 4-year-olds. And, all 2- or 3-year-old males captured in the area during May and June were assumed born in the area but will emigrate within 2 years after capture, regardless of whether their maternal lineage and home range are known.

When radiocollared bears are not located during a season of aerial telemetry flights, it will be assumed that either they were present in the population, but with a shed or failed collar, or they were no longer a part of the population due to emigration or death. Based on patterns of radiocollar loss and subsequent recapture or known death of specific bears, it will be assumed that females remain present in the population for 6 years after they are last observed, males ≥ 4 years of age for 4 years, and 2- or 3-year-old males for 2 years.

By 1986 enough baseline data on home range size and movement of Alaska Range grizzly bears was available to adjust estimates to more accurately account for lack of population closure (Reynolds et al. 1987). Not all bears captured, killed, or observed within the boundaries of the study area maintain home ranges entirely within the study area; this results in an overestimation of population size. Bears living near the center of the study area are far more likely to remain entirely within the area than those living near the boundaries. To account for this bias, the approximate proportion of each home range lying outside the study area will be estimated. The fractional home ranges will be subtracted from total population estimates to more accurately reflect numbers of bears in the study area and result in "adjusted" population estimates (Reynolds 1980). For bears killed by hunters, home range size and proportional inclusion in the study area will be assumed to be similar to those of radiocollared grizzly bears of similar sex and age living in the same area. For example, if an unmarked 5-year-old female is killed near the Wood River at Mystic Creek, it will be assumed that 20% of her home range would lie outside the study area, since 20% of the home range of bear no. 1336, another young adult female living along the Wood River, also lies outside the study area.

By 1992 almost all of the bears present in the area were captured and most of the bears using the study area can be accounted for. This assumption is justified because capture takes place during the breeding season when any unmarked bear consorting with a radiocollared bear can be captured. Over time, as adult females wean their offspring and breed, they can be captured so that all or almost all of the adult females present in the study area can be radiocollared. The same pattern is true of adult males, although they may have home ranges that extend beyond the study area. In the unlikely event that some adults do not breed, there is an increased likelihood they could avoid capture; however, if present, they could still be captured because most of the study area is systematically and intensively searched annually. Most 2- to 3-year-old offspring of radiocollared females are also captured before they are weaned so they can be accounted for as well. The sex and age class most likely to be underrepresented in the captured sample is that of 2- to 4-year-old immigrant, nonbreeding males. However, if the number of these young males moving into the study area approximately equals the number moving out, this effect would be minimized and further mitigated by capture of such bears during routine searches. Also likely to be underrepresented in the sample are those bears living at the edges of the study area whose home ranges only include a small portion within the study area. By adjusting population estimates to account for closure, the bias resulting from such edge effect is minimized.

One measure of the validity of using the direct count method to estimate population size is the presence of unmarked bears in the study area. This is indicated by the proportion of unmarked bears that are captured or killed by hunters. From 1986 through 1992, only 16 of 70 bears captured in the study area were previously unmarked bears that were not offspring of marked bears. The 16 included: 7 adult males captured on the edge of the study area, 1 young adult male captured in the core of the area, three 2- or 3-year-old males prone to emigrate, 3 adult females living on the edge of the study area, and 2 adult females living in the core of the study area. Similarly, of 50 bears killed in the study area by humans from 1986 to 1992 (not including 1 capture mortality), only 20 were not previously marked; 2 offspring of marked females, 3 were likely the 2- or 3-year-old offspring of marked bears, twelve 2- or 3-year-old males that were probably fall immigrants, and 3 taken at the edges of the study area. It must be emphasized that the completeness of the sample improved as the study progressed. By 1991 and 1992, of 46 grizzly bears captured, only 5 were not previously marked or offspring of previously marked females. Four of these were young males living on the edge of the study area, and only 1 was an adult female living in the core of the study area. Similarly, of the 16 bears killed by hunters or in defense of life or property from 1991 to 1992, only three 2- or 3-year-old males taken on the edge of the study area were not marked or with a marked female.

Sex and age structure will be determined through direct observation of captured bears, supplemented by sex and age of bears killed by hunters and presented at ADF&G offices for mandatory sealing. Measures of reproductive biology, including the age at first production of young, reproductive interval, and mean litter size will be calculated from direct observation of radiocollared females. Using the survival analysis techniques of Pollock et al. (1989), natural mortality rates for sex and age classes within the population will be based on monthly/yearly mortality of radiocollared bears. Annual harvest rates for sex and age classes within the population will be described both for radiocollared bears of various sex and age classes and for all bears, regardless of radiocollar status, in the estimated study area population. Movement patterns for grizzly bears of various sex and age classes within the population will be calculated from observations of radiocollared bears and reports of captured and tattooed bears without radiocollars that are killed by humans and sealed by ADF&G.

RESULTS AND DISCUSSION

The primary emphasis of the work accomplished during 1993 and 1994 was to monitor the presence of all adult females living within the study area. As funding allowed, I also replaced radiocollars on adult females and those 2- to 5-year old females that will enter the adult cohorts if they survive. In addition, I monitored measures of reproductive status, reproductive performance, and possible compensatory changes in population dynamics.

Bears Captured and Radiocollared

During 1994, 20 bears were captured; 18 of these were radiocollared (Table 1). Captures included 13 females and 7 males: 13 (10 females, 3 male) were recaptured to replace radiocollars and 7 had not been captured previously. Of those not previously captured, 2 were female cubs of radiocollared female no. 1324, 1 was presumably one of two 3-year-old weaned offspring of radiocollared female no. 1608, 1 was presumably the single weaned yearling male offspring of radiocollared female no. 1394, 2 were 4- or 5-year-old males and 1 a 4- or 5-year-old female. Two of the latter 3 grizzlies (nos. 1636 and 1637) were a breeding pair captured on the extreme northwestern boundary of the study area. The third (male no. 1639) was observed breeding with a marked female 10 km inside the eastern boundary of the study area. Because of limited funding during 1994, ADF&G did not capture 5 other offspring of radiocollared females, including two 3-year-olds of female no. 1398, one 3-year-old of female no. 1608, one 3-year-old of female no. 1303, and one 2-year-old of female no. 1391.

No capture mortalities occurred for the seventh consecutive year with 143 captures; this is in part due to the use of Telazol (Tiletamine HCL and Zolazepam HCL, Aveco Co., Ft. Dodge, IA) as an immobilizing drug (Taylor et al. 1989) and to experience gained in avoiding other hazards related to immobilization (Reynolds 1992). During 1994 the manufacturer of Telazol reportedly changed the inert ingredients that serve as a carrier for the drug. This resulted in an inability to maintain the drug in solution beyond concentrations of 250 mg/ml. In the past, concentrations of 400 mg/ml were used to reduce the volume of drug used so that only one 7- or 10-cc dart was necessary to immobilize adult males larger than 220 kg (489 lb). Unfortunately, this manufacturer change will adversely affect the utility of this drug for large carnivores.

One hundred and thirty-nine individual bears were captured in the study area from 1981 through 1993 (Table 1). In addition, 125 bears were recaptured to replace radiocollars. From 1981 to 1983, initial captures were made of bears of all sex and age classes. Since 1983, most initial captures were of offspring of previously captured bears. Radiocollars have been placed on 125 bears; 45 on young-age males ($\leq$ 5 years), 20 on adult males ($\geq$ 6 years), 36 on young-age females, and 24 on adult females. Radiocollars were not placed on 12 bears, because they were cubs or yearlings (7), capture-related mortalities (4), or captured outside the boundaries of the study area (1).

Status of Individual Bears

During December 1993 female no. 1310 was found dead 20 m east of a hunter's cabin on Three-mile Creek in the Wood River drainage. The condition of the skeletal remains indicated that she had been dead for at least 4 months, or more likely, 15 months to 17 months. Although the cause of death could not be determined, the near distance to the cabin provides some circumstantial evidence the death was human-caused. The most likely explanations for the death are wounding loss or illegal kill.

Females Present in the Population

By June 1994 no more than 15 adult females ($\geq$ 6 years of age) were assumed present in the population, compared with 21-23 present from 1982 through spring 1989 (Reynolds 1993*a,b*). This includes nos. 1603, 1605, 1609, and 1631, 6-year-olds from the 1988 cohort that were counted as adults for the first time during 1994. Another member of this cohort, no. 1604, was killed by a sport hunter during 1993. It also includes 2 adult females, nos. 1397 and 1608, that had not been observed for 1 year after radiocollar failures and were recaptured during 1994, following searches of their home ranges. However, this figure does not include female nos. 1345, 1362, or 1607, that have not been observed for 3-5 years despite searches within their well-defined home ranges. One of these, no. 1607, was probably the radiocollared female reportedly killed during October 1992, but not legally presented for sealing as required by law. Available funding did not allow intensive aerial searches for the other 2, nos. 1345 and 1362.

The apparent presence of only 1 or 2 females in the 1989 cohort means that recruitment during 1995 will be negligible, but the 1990 cohort is presently strong and may contribute 5 females during 1996 if it does not experience further mortality. At the other end of the age spectrum are 3 females, nos. 1311, 1348, and 1608, which produced cubs during 1994, but at the respective ages of 24, 23, and 20 years, are nearing the end of their life span.

For comparison, during October 1992, only 11 adult females were assumed present in the population. By May 1993, three 5-year-old females had reached adult age, bringing the adult female segment of the population up to 14. These figures included the mortalities of adult female nos. 1302, 1336, 1379, and 1626 during 1992 and the gain of female nos. 1391, 1394, and 1397 during 1993. No additional adult females were captured during 1993. The 14 adult females assumed to be alive in the population in May 1993, was a maximum figure because it included nos. 1345, 1362, and 1607, the same 3 females whose presence was not included in the 1994 estimate of adult females present in the study area, following an additional year of absence of observation. Searches for these females will continue within their established home ranges. Other similar searches have been successful in the past. Of 15 females not located for at least a year, 5 were recaptured after 1 year, 3 after 2 years, 2 after 3 years, 3 after 4 years, and 1 each after 5 and 6 years. Only 1 female, no. 1340, was not found after 6 years.

Two females of unknown family lineage, nos. 1630 and 1631, were captured in the southern Wood River drainage during May 1993. No. 1631, a 5-year-old female, was initially captured near Virginia Creek; from July through September 1993 and during 1994 she was observed only within a relatively restricted home range in the Kansas and Virginia Creek drainages. This is the same pattern observed from female no. 1322 when she was living, and strengthens the probability that no. 1631 is the offspring of no. 1322. Confirmation of such a familial relationship will require genetic testing of tissue samples that have been collected.

During 1994 no observations were made of female no. 1630, captured as a 3-year-old in 1993. The signal from her radiocollar was located outside the study area near Dean Creek in the Yanert River drainage. The slow signal pulse rate of the collar indicated either she had died or shed her collar. Funding available to check the fate of bears with collars on slow pulse rate will not be available until the 1994-1995 fiscal year.

Recovery of the adult female segment of the population depends upon the number of female offspring produced and their survival. The number of young-age (2- to 5-year-old) bears in the population that were females was 10 during 1994, 15 during 1993, and 16 during 1992; also, there were probably additional females among bears of unknown sex in the one 2-year-old and four 3-year-olds that were not captured during 1994. If it can be assumed that half of the 2- or 3-year-olds of unknown sex were females, these cohorts would have included 13 potential recruits to the adult female segment in 1994, 19 in 1993, and 18 in 1992. This compares with an annual mean of 10.3 potential 2- to 5-year-old female recruits from 1982 through 1991 (range = 6-15).

These annual differences are primarily due to the presence or absence of strong cohorts within the 2- to 5-year-old age classes in any specific year. For instance, during 1993 potential female recruits included strong cohorts from 1988, 1990, and 1991, and the weak cohort of 1989. Similarly, potential 2- to 5-year-old female recruits during 1992 included the strong cohorts of 1988 and 1990, the moderate cohort of 1987, and the weak cohort of 1989. The moderate number of recruits available in 1994 was due to inclusion of the strong cohorts of 1990 and 1991 with the weak cohorts of 1989 and 1992. If no more than 2 adult and 1 young-age female die annually from all causes, and no other adult females are living in the area, then the female segment of the population would reach 17 by spring 1998. If only 1 adult and 1 young-age female die annually from any cause in the study area, then the female segment of the population would reach 21 by spring 1998. This would constitute recovery to 1981-1989 population of adult females in the study area. Faster or slower recovery would depend on hunter kill and natural mortality.

Status of Productive Females

During 1994, 7 females produced a total of at least 15 cubs. Female no. 1311 produced 3 cubs, female nos. 1324, 1397, 1398, 1605, and 1608 each were observed with 2 cubs, and although female no. 1385 was not observed with cubs, tracks observed in the snow outside her occupied den indicated that she had at least 2. Of the five 5-year-old females (nos. 1603, 1604, 1605, 1609, and 1631) that bred during 1993, only no. 1605 produced cubs as a 6-year-old; however, no. 1604 was killed by a hunter during fall 1993 and could have also been pregnant. No. 1397 produced her first litter as a 7-year-old. Of three 4-year-old females observed during the 1994 breeding season, at least 2 consorted with males (nos. 1623 and 1624), but for the other (no. 1617) no breeding behavior was observed. Two of the breeding pairs observed during 1994 included males whose estimated age was only 4 years (no. 1637, consort of female no. 1636, and no. 1639, consort of female no. 1624).

Of 4 adult females that bred during 1992, 3 were each observed with 3 cubs during 1993 (nos. 1308, 1324, and 1374). Although no. 1311 was not observed with cubs, it is probable she produced cubs and then lost them. She remained in her den until after most other females with and without cubs had left den sites, which is usually a good indicator of cub production. Nos. 1394 and 1397, both 5-year-olds, bred but only no. 1394 produced a single cub. Four-year-old no. 1609 bred but apparently did not produce cubs.

Since 1983, six 5-year-olds and four 4-year-olds have successfully bred and produced cubs the following year. Six of those successfully reared the offspring until weaning, the offspring of 3 died before weaning, and the success of rearing of 1 set of offspring until weaning was unknown. The mean age at which 18 females first successfully produced a litter that survived until weaning was 7.3 years, with a range from 5 to 10 years of age.

I observed 7 females consorting with males during the 1994 breeding season. Three others were aged 4, 6, and 6 years, respectively, and may have bred unobserved. For comparison, during the previous 5 years, the mean annual number of females breeding was 7.8 (range = 4-11). Similarly, during 1990 through 1994, a minimum of 56 cubs were produced and 29 offspring were weaned; the annual mean was 11.2 cubs (range = 2-17) and 5.8 offspring, respectively (Table 2). From 1990 through 1994, of the 38 cubs that were observed for at least a year, 30 survived (79%).

There may have been 2 instances of weaning of yearling offspring by females during 1994. While 3 occurrences of yearling weaning were observed from 1977 through 1992 in the western Brooks Range (Reynolds 1992), none had been observed in the

Alaska Range from 1981 through 1993. No. 1394, a 7-year-old female observed with her yearling 2 weeks previously, was captured on 28 May 1994, breeding with a marked male. A male yearling caught at the 1993 capture site of no. 1394 presumably was her offspring; this can be confirmed genetically in the future. No. 1374, a radiocollared female with a home range north and east of the study area, was observed during 1993 with 3 cubs before radio contact was lost with her. Three yearlings were killed in defense of life or property at a cooperative farming community at the mouth of Delta Creek on 19 June 1994. No. 1374 and an accompanying adult male were also killed at the same site the following day, ostensibly under defense of life and property conditions. Apparently, an adult female and 3 yearling grizzlies had been seen in the area during the previous 3 weeks. Genetic tests will be needed to confirm any family relationships, but there is no doubt the 3 young were yearlings.

From 1992 through 1994, with the possible exception of the 2 litters described above that were weaned as yearlings, only no. 1348 did not wean her offspring as 2-year-olds; however, examination at her capture during 1992 indicated that she may have been wounded by a hunter and this could have influenced weaning. Two of her three 2-year-old offspring were killed by hunters during the 1992 fall season. Eight females (nos. 1303, 1308, 1311, 1324, 1336, 1391, 1398, and 1608) weaned their offspring as 2-year-olds during this period.

Mortality

Between June 1993 and July 1994 hunter kills accounted for the deaths of 6 bears within the study area and 1 marked bear outside the study area. Five other bears were killed during 1994 in 2 separate instances of alleged defense of life or property at the same site. Disappearance and presumed deaths of 3 cubs of female no. 1324, 1 of 3 cubs of female no. 1308, and the single yearling of female no. 1385 were also documented during 1993. In addition, during spring 1994, 3 to 6 other cubs probably also died, including 2 or more cubs of no. 1385 and 1 or more cubs of no. 1348. Radio signals indicated these 2 females were within their dens when other nonproductive females had left theirs. Tracks of at least 2 cubs were observed in the snow near no. 1385's den site; no tracks were observed at no. 1348's den site because no snow was present in the vicinity. During subsequent observations, neither female was accompanied by offspring and any cubs they produced were assumed dead.

Grizzly bears killed by hunters within the study area during this period included 3 males and 3 females. Two were marked residents of the study area (nos. 1604 and 1615). The 4 unmarked bears (3 males, 1 female) were all 3-year-olds and may also have been study area residents. They could have been among the 7 offspring of marked females that were weaned before they could be marked during 1992 and 1993.

During October 1993 a guide reported his client had killed a marked female grizzly bear near Dean Creek, 12 km west of the southwestern corner of the study area. According to the guide, the bear was a young female, had apparently been wounded recently, and was in poor physical condition. Due to logistical problems, the guide was unable to retrieve much of his camping gear which included the ear tags of the bear. When the bear was sealed by ADF&G biologists, they did not check for evidence of marking or tattoos, so the identity of the bear is uncertain. The most likely possibilities are nos. 1618 or 1630, both captured within 13 km of the apparent kill site. Neither bear has been observed during 1994, although the transmitter of no. 1630 was located in the Dean Creek drainage on mortality mode.

Other human-caused kills documented outside the study area included 5 bears allegedly taken under defense of life or property conditions. The 5 bears included female no. 1374, an adult male consort, and 3 recently weaned yearlings. The home range of no. 1374 was adjacent to but outside the study area. The kills of no. 1374 and her consort occurred the day after that of the 3 yearlings at the same site; all 5 kills are currently under investigation by the Department of Public Safety for possible criminal prosecution.

Outside the study area, an adult male was killed 48 km west of the area boundary in the town of Healy shortly after the local dump was closed. A dead adult female and a live yearling were observed on the Alaska Pipeline right-of-way at about Mile 205 of the Richardson Highway. Another bear, described as a 2-year-old with a limp, was attracted to a construction camp at Mile 1389 of the Alaska Highway, but reportedly ceased its visits before it had to be shot.

Changes in Harvest Patterns

The population within the study area, adjusted for closure, declined from 72 bears during 1981 to 53 during 1992 (Reynolds 1993*a*). The time necessary for the population to recover or stabilize will depend upon the levels of both recruitment and mortality. Compensatory recruitment by heavily-harvested grizzly bear populations has not been documented (Reynolds and Boudreau 1992, Miller 1993) so mortality will have to be reduced, especially of females, for population stability or recovery. Hunter kills of no more than 3% of adult females, and 6%-8% of bears $\geq$ 2 years of age were recommended to allow recovery of this population (Reynolds 1993*a*). Because most grizzlies in this area are killed incidentally to moose or caribou hunts, and because the caribou hunting season in the area is closed, no further reduction in grizzly bear hunting seasons may be necessary. In addition, public education of the need to, and methods of, harvesting males rather than females has begun and may reduce the need for further restrictive management to accomplish these goals.

CONCLUSIONS AND RECOMMENDATIONS

This is the second year of the third phase in a study to evaluate the effects of harvest on grizzly bear population dynamics. The primary objective during this phase will be to monitor the recovery or stabilization of the population and to document the accompanying changes in productive capacity.

It will be especially important to monitor the number and status of all adult females in the study area using radiotelemetry. Besides maintaining transmitters on females presently carrying collars, it will be essential to recollar those females whose collars have failed or been shed. Intensive aerial searches of their established home ranges, coupled with radiocollaring and monitoring adult males to locate breeding females, will be necessary. Female offspring of marked females should also be radiocollared to monitor their presence in the population and the rate at which they serve as recruits to the adult female cohort.

The pattern of hunter harvest should continue to be closely monitored and the take of females discouraged. ADF&G staff should explore the effectiveness of other methods besides season and bag limit management in reducing harvest of females.

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Prepared by:

Harry V. Reynolds, III
Wildlife Biologist III

Submitted by:

Daniel J. Reed
Regional Research Coordinator

Approved by:

Wayne L. Regelin, Acting Director
Division of Wildlife Conservation

Steven R. Peterson, Senior Staff Biologist
Division of Wildlife Conservation

Table 1. Capture and marking characteristics of 139 bears captured in the northcentral Alaska Range, 1981-1994.

Bear no./ sex	Cem. age (yr)	Date of capture	Weight kg (lb)	Location	Drug dosage[a]	Ear tags[b]	Markers[c]
1301 M	6	5/18/81	120(265)	Buchanan Creek	1.8/1.2 H	373/374	G/G
1302 F	3	5/19/81	75(165)	East Fork Delta	1.0/1.0 M	368/367	R/G
	8	6/12/86	114(250)	East Fork Delta	2.2 TEL M	280/281	O/lB
	11	5/12/89	109(241)	Buchanan Creek	4.5 TEL M	339/340	O/lB
1303 F	2	6/17/81	57(125)	Mystic Mountain	1.4/1.4 M	524/523	R/R
	4	6/27/83	82(180)	Hearst Creek	5.0 M99 M	3227/3214	R/R
	6	6/14/85	73(160)	Upper Gold King	2.0/2.0 M	486/487	R/R
	12	5/31/91	95(210)	Upper Moose Creek	1.0 TEL L	104/104	Y/W
1304 M	5	6/19/81	136(300)	West Fork Delta	2.4/2.0 M	451/452	lB/R
	11	5/21/87	255(560)	Threemile Creek	8.1 TEL M	430/431	W/mG
	13	6/7/89	245(540)	Slate Creek	7.0 TEL M	778/--	W/--
	15	6/1/91	272(600)	West Fork Delta	9.6 TEL M	136/137	W/mG
1305 F	24	6/19/81	114(250)	Slate Creek	A M	453/454	O/R
1306 M	2	5/24/82	44(97)	West Fork Delta	1.0/1.0 L	3151/3086	G/lB
1307 M	2	5/24/82	44(98)	West Fork Delta	1.0/1.0 H	3087/3152	lB/G
	5	6/17/85	114(250)[d]	Sheep Creek	2.4/2.6 L	3087/3152	lB/G
1308 F	6	5/25/82	111(245)	Dry Creek	-[e]	3001/3154	O/Pp
	8	6/20/84	120(265)	Dry Creek	5.0 M99 M	3001/471	O/Pp
	11	6/8/87	123(270)	Dry Creek	3.3 TEL M	528/529	O/Pp
	15	5/6/91	125(275)	Dry Creek	6.0 TEL M	150/149	W/R
	18	5/30/94	129(285)	Dry Creek	6.0 TEL M	332/333	W/R
1309 M	8	5/25/82	318(700)[d]	Dry Creek	A L	3153/3101	dB/Bk
1310 M	13	5/25/82	250(550)[d]	Buchanan Creek	2.0/2.0 M	No tags	
	15	6/20/84	241(530)	Molybdenum Ridge	4.0/2.0 M	467/473	O/W
	18	5/21/87	264(580)	Buchanan Creek	9.0 TEL M	414/413	Y/W
1311 F	12	5/26/82	120(265)	Molybdenum Ridge	1.9/2.1 M	3106/3107	W/W
	14	6/21/84	116(255)	Molybdenum Ridge	2.0/2.2 M	466/455	W/W
	17	6/8/87	123(270)[d]	Molybdenum Ridge	3.4 TEL M	571/570	W/W
	21	6/3/91	125(275)	Molybdenum Ridge	5.5 TEL M	139/140	W/W
	22	5/10/92	121(267)	Molybdenum Ridge	5.0 TEL M	249/250	W/W

Table 1. Continued.

Bear no./ sex	Cem. age (yr)	Date of capture	Weight kg (lb)	Location	Drug dosage[a]	Ear tags[b]	Markers[c]
1312 F	Cub	5/26/82	12(26)	Molybdenum Ridge	0.1/0.1 M	3104/3155	O/W[f]
1313 F	Cub	5/26/82	12(27)	Molybdenum Ridge	0.08/0.13 M	3156/3105	W/O[f]
1314 M	6	5/27/82	116(255)	Iowa Ridge	2.1/1.9 H	3088/3002	dB/lB
1315 M	13	6/4/82	272(600)	Buchanan Creek	1.9/2.1 L	3102/3157	Bk/O
	15	5/17/84	295(650)	Hayes Creek	A H	3322/none	Bk/-
1316 M	11	6/7/82	236(520)	West Fork Delta	3.8/0.0 H	3089/3090	O/lB
1317 F	3	6/8/82	36(80)	Forgotten Creek	1.2/1.8 L	3091/3003	lB/O
	5	5/16/84	55(122)	Upper West Fork	A L	3486/3239	lB/O
	6	5/23/85	59(130)	Upper Wood River	7.0 M99 M	497/498	lB/O
1318 F	13	6/8/82	104(230)	Buchanan Creek	A L	3004/3103	W/G
	15	6/22/84	118(260)[d]	Slate Creek	A M	458/472	W/G
	18	6/2/87	105(230)[d]	Slate Creek	3.3 TEL M	--	--
1319 M	Cub	6/8/82	12(26)	Buchanan Creek	0.15/0 L	3005/3092	R/Y[f]
1320 F	17	6/8/82	102(225)	Trident Glacier	A M	3158/3093	G/B
	19	6/25/84	139(305)	East Hayes Creek	5.0 M99 M	463/461	G/B
	22	6/12/87	114(250)	Hayes Glacier	4.0 TEL M	517/518	mG/dB
1321 F	16	6/9/82	141(310)	Snow Mountain Gulch	2.1/1.9 M	3028/3108	G/W
	17	5/17/83	127(280)	Dry Creek	1.8/2.2 M	3028/3427	G/W
	19	7/22/85	218(480)	North VABM Wood	2.6/1.0 L	399/398	G/W
	23	6/6/89	170(375)	Dry Creek	-- TEL M	788/789	lG/W
1322 F	8	6/9/82	91(200)	Sheep Creek	1.9/2.1 M	3051/3159	W/lB
1323 F	11	6/10/82	95(210)	Mystic Mountain	1.9/2.1 M	3160/3030	G/G
	13	6/29/84	132(290)	VABM Wood	A M	579/582	G/G
1324 F	Cub	6/10/82	12(26)	Mystic Mountain	0.12/0 M	3027/3162	R/W[f]
	6	5/26/88	111(245)	Coal Creek	3.6 TEL L	159/160	Bk/W
	10	5/26/92	129(285)	Dry Creek	5.5 TEL L	121/122	Bk/W
	14	5/27/94	125(275)	Mystic Mountain	6.0 TEL M	121/122	Bk/W
1325 M	Cub	6/10/82	12(27)	Mystic Mountain	0.10/0 M	3161/3031	W/R[f]
	2	5/15/84	67(148)	Mystic Creek	1.0 M99 M	3233/3394	R/W

Table 1. Continued.

Bear no./ sex	Cem. age (yr)	Date of capture	Weight kg (lb)	Location	Drug dosage[a]	Ear tags[b]	Markers[c]
1326 F	4	6/18/82	93(205)	Buchanan Creek	2.2/1.8 M	3008/3163	W/R
	6	6/21/84	109(240)	Buchanan Creek	1.8/2.2 M	468/462	W/R
	7	6/27/85	111(245)	Slate Creek	2.4/1.6 L	426/427	W/W
1327 F	16	7/8/82	127(280)	Whistler Creek	2.2/1.8 M	3134/3192	G/R
	18	6/23/84	125(275)	Whistler Creek	A H	458/192	G/R
1328 F	1	7/8/82	43(95)	Whistler Creek	0.9/1.1 M	3115/3014	dB/G
1329 F	13	7/9/82	120(265)	Buchanan Creek	2.4/1.6 M	3026/3111	W/R
1330 M	1	7/9/82	48(106)	Buchanan Creek	-- M	--/--	R/W
	3	6/28/84	102(225)	East Fork Delta	2.6/3.0 M	597/598	R/W
1331 F	4	7/10/82	77(170)	Trident Glacier	2.4/1.6 M	3120/3194	Bk/O
	9	5/20/87	114(250)[d]	East Hayes Creek	3.0 TEL M	519/520	Bk/Y
	12	5/15/90	111(245)	Trident Glacier	6.0 TEL H	196/197	Bk/Y
1332 F	5	7/12/82	104(230)	Gillam Glacier	2.4/1.6 M	394/190	R/dB
1333 F	16	7/13/82	141(310)	Buchanan Creek	A M	474/469	G/R
1334 M	1	7/13/82	49(108)	Buchanan Creek	1.0/1.0 M	395/392	Y/G
	3	6/27/84	107(235)	McGinnis Creek	A M	585/583	O/G
1335 F	1	7/13/82	38(84)	Buchanan Creek	1.0/1.0 M	32/456	G/Y
	3	6/25/84	80(175)	Gilliam Glacier	1.5/3.0 M	465/464	dB/G
1336 F	2	5/16/83	48(105)	Kansas Creek	1.0/1.0 M	3201/3204	Bk/mG
	3	6/26/84	89(195)	Copper Creek	2.0/3.0 M	470/595	Bk/mG
	4	6/17/85	102(224)	Wood River	A L	470/595	Bk/mG
	6	5/15/87	109(240)	Rogers Creek	2.2/2.0 M	521/522	Bk/mG
	8	5/17/89	145(320)	Upper Wood River	4.5 TEL M	330/329	Bk/mG
	11	5/7/92	116(255)	Wood River	6.0 TEL M	330/329	Bk/mG
1337 M	20	5/18/83	293(645)	Sheep Creek	3.5/3.5 L	3209/3205	R/O
	25	6/15/88	277(610)	Sheep Creek	A TEL H	364/363	O/R
1338 M	6	5/20/83	111(245)	Molybdenum Ridge	A M	3203/3202	O/Bk
1339 M	6	5/23/83	120(265)	Trident Glacier	-- M	3286/3351	lB/W
	7	5/17/84	168(370)	East Fork Delta	6.0 M99 H	3254/3398	lB/W

Table 1. Continued.

Bear no./ sex	Cem. age (yr)	Date of capture	Weight kg (lb)	Location	Drug dosage[a]	Ear tags[b]	Markers[c]
1340 F	3	5/23/83	71(157)	Hayes Creek	1.2/0.8 H	3277/3208	G/O
	4	5/19/84	91(200)[d]	Molybdenum Ridge	4.0 M99 M	3277/3208	mG/O
	5	6/27/85	100(220)	West Hayes Creek	2.4/1.6 L	590/596	mG/mG
1341 F	10	5/23/83	107(235)	NE Portage	1.5/1.5 H	3210/3428	R/dB
	12	6/13/85	107(235)[d]	East Fork Delta	2.0/2.0 M	442/none	O/-
	15	6/14/88	164(360)	East Fork Delta	7.0 TEL M	356/355	dkB/
1342 M	2	5/24/83	49(108)	Threemile Creek	0.6/1.2 M	3354/3207	W/dB
1343 M	2	5/24/83	43(95)	Threemile Creek	0.6/1.2 M	3426/3285	R/B
1344 M	2	5/24/83	56(123)	Threemile Creek	0.6/1.2 M	3361/3433	lB/Bk
	3	6/23/84	123(270)	Hayes Creek	2.2/3.2 M	475/460	lB/Bk
1345 F	8	5/24/83	--	Upper West Fork	1.2/1.8 L	3206/3352	O/O
	10	5/23/85	105(230)[d]	Upper West Fork	7.0 M99 M	499/500	O/O
	14	5/13/89	118(260)	Upper Wood River	4.5 TEL M	445/446	O/O
1346 M	5	5/25/83	114(250)	Hayes Glacier	A M	3359/3356	lB/lB
	12	5/14/90	--	Trident Glacier	10.5 TEL M	192/193	mG/mG
	13	6/1/91	249(550)	Buchanan Creek	11.0 TEL M	192/193	mG/mG
	16	5/28/94	254(560)	Delta Creek	7.6 TEL M	192/193	None
1347 M	6	5/31/83	189(415)	Coal Creek	3.5 M99	None	Dead
1348 F	12	5/31/83	123(270)[d]	Mystic Mountain	A M	3363/3372	W/O
	15	5/16/86	116(255)	Wood River	2.4/1.6 M	235/236	W/O
	19	5/12/90	141(310)	Gold King	6.0 TEL M	117/118	W/O
	20	5/9/91	120(265)	SW Gold King	11.0 TEL H	117/118	W/O
	21	5/9/92	107(235)	Wood River	5.5 TEL M	117/118	W/O
1349 M	18	6/2/83	264(580)	O'Brien Creek	3.8/1.2 L	3364/3292	R/lB
1350 M	8	6/2/83	202(445)	Ptarmigan Creek	3.0/2.0 L	3432/3430	dB/R
	11	6/12/86	205(450)[d]	East Fork Delta	3.5 TEL L	273/272	dB/R
1351 F	14	6/23/83	114(250)[d]	Dry Creek	4.0 M99 M	3217/3390	dB/W
	16	6/10/85	111(245)	Little Delta River	2.0/2.0 M	477/436	dB/W
	18	5/19/87	130(285)	Dry Creek	A M	503/504	dB/W
1352 F	14	6/27/83	111(245)	West Fork Delta	--	3215/3316	O/W

Table 1. Continued.

Bear no./ sex	Cem. age (yr)	Date of capture	Weight kg (lb)	Location	Drug dosage[a]	Ear tags[b]	Markers[c]
1353 M	1	6/27/83	27(60)	West Fork Delta	--	3310/none	O/-
1354 F	1	6/27/83	12(27)	West Fork Delta	--	None/3314	-/O
1355 M	3	6/30/83	60(133)	East Fork Delta	4.0 M99 H	3232/3473	O/Bk
	5	6/3/85	70(155)	Whistler Creek	2.2/1.8 H	586/587	O/Bk
1356 M	2	6/30/83	50(110)	Little Delta River	2.0 M99 H	3234/3392	Bk/O
1357 M	2	5/15/84	63(138)	Dry Creek	1.1 M99 M	3323/3235	W/Bk
	3	6/24/85	93(205)	Dry Creek	1.5/1.5 M	447/448	W/Bk
1358 M	13	5/18/84	205(450)	Hayes Creek	A L	3318/3447	lB/dB
	15	5/20/86	236(520)	Trident Glacier	3.4/2.0 L	297/296	lB/dB
1359 M	3	5/28/85	61(134)	Snow Mountain Gulch	4.0 M99 M	489/488	dB/O
1360 F	10	5/28/85	95(210)	Snow Mountain Gulch	7.0 M99 H	None	None
1361 F	3	5/28/85	63(138)	Dry Creek	4.0 M99 M	482/483	mG/R
	4	5/19/86	100(220)	Rogers Creek	1.7/2.0 L	274/275	G/Bk
1362 F	6	6/5/85	--	Glacier Creek	2.0/2.0 L	None	None
	6	6/24/85	114(250)	Threemile Creek	2.2/1.8 L	443/490	dB/dB
	9	5/15/88	--	Sheep Creek	5.0 TEL H	197/198	O/Y
1363 M	3	6/5/85	55(120)	Slide Creek	1.0/2.0 M	592/593	dB/lB
1364 M	Cub	6/14/85	7(15)	Gold King Creek	0.7/- M	None	None
1365 M	5	6/19/85	118(260)	Wood River	A M	476/441	lB/G
1366 M	8	7/22/85	234(515)	Tatlanika River	3.2/1.0 M	390/391	mG/R
1367 M	2	5/19/86	61(134)	Threemile Creek	1.4/2.0 M	400/241	lB/W
1368 F	2	5/19/86	48(106)	Threemile Creek	1.4/2.0 M	257/256	lB/lB
1369 M	2	5/19/86	68(150)	Threemile Creek	1.4/2.0 L	247/246	W/dB
1370 F	2	5/20/86	47(103)	Buchanan Creek	1.4/2.0 H	253/252	dB/Bk
	3	5/20/87	69(151)	Buchanan Creek	1.5/1.5	--	--
1371 M	2	5/20/86	57(126)	Buchanan Creek	1.4/2.0 M	269/268	Bk/dB
1372 M	2	5/20/86	72(158)	Ptarmigan Creek	1.4/2.0 M	387/386	lB/O
	5	5/17/89	186(410)	Chute Creek	7.0 TEL M	310/309	lB/O
1373 M	7	5/21/86	193(425)	Delta Creek	4.0/2.0 M	295/294	lB/R

Table 1. Continued.

Bear no./ sex	Cem. age (yr)	Date of capture	Weight kg (lb)	Location	Drug dosage[a]	Ear tags[b]	Markers[c]
1374 F	6	5/21/86	106(233)	Delta Creek	2.0/2.0 M	249/248	R/G
	9	6/9/89	147(325)	Delta River	6.0 TEL M	320/319	lG/lB
1375 M	6	6/13/86	186(410)	Sheep Creek	4.5 TEL L	276/277	Y/W
	9	5/13/89	281(620)	Mystic Creek	9.0 TEL L	439/440	O/W
	11	5/31/91	295(650)	Threemile Creek	14.0 TEL H	146/440	O/W
1376 F	14	6/13/86	130(285)	Hayes Creek	3.0 TEL M	279/278	G/O
1377 M	2	8/28/86	132(290)	Iowa Ridge	4.0 TEL L	505/507	Bk/R
1378 F[g]	2	5/20/86	59(130)[d]	Ptarmigan Creek	--	None	None[i]
1379 F	2	5/15/87	67(148)	Sheep Creek	2.2/2.0 L	334/335	W/W
	4	6/6/89	102(225)	Dry Creek	3.5 TEL L	777/776	W/W
1380 M	2	5/18/87	65(142)	West Fork Delta	2.2 TEL H	513/514	W/R
	3	5/17/88	109(240)	Buchanan Creek	3.2 TEL	175/174	W/R
1381 M	2	5/21/87	73(160)	Dry Creek	3.0 TEL M	481/480	lB/Bk
1382 F	3	5/15/88	68(150)	West Fork Delta	3.2 TEL M	169/170	R/Y
	4	6/7/89	84(185)	Buchanan Creek	4.0 TEL M	169/170	R/Y
1383 M	2[d]	6/12/87	77(170)	Coal Creek	A M	389/390	mG/dB
1384 M	7[d]	5/15/88	191(420)	Chute Creek	7.0 TEL M	960/959	W/Y
1385 F	2	5/15/88	68(150)	Upper Wood River	2.2 TEL H	168/167	lB/Y
	3	5/13/89	82(180)	Wood River	3.4 TEL M	--	lB/Y
	4	5/11/90	95(210)	Upper Wood River	A TEL H	--	--
	5	6/2/91	118(260)	West Fork Delta	5.5 TEL M	108/107	lB/Y
	7	5/9/93	86(190)	West Fork Delta	4.0 TEL M	108/107	lB/Y
1386 M	2	5/15/88	73(160)	Upper Wood River	2.2 TEL M	181/180	Bk/Y
	3	5/13/89	91(200)	Upper Wood River	3.4 TEL M	181/180	Bk/Y
	4	6/7/90	120(265)	Upper Wood River	7.0 TEL H[h]	790/791	Bk/Y
	5	5/31/91	156(345)	West Fork Delta	6.0 TEL H[h]	790/791	Bk/Y
1387 F	2	5/23/88	55(120)	Dry Creek	A TEL M	179/178	Y/R
	3	5/12/89	77(170)	Rogers Creek	3.4 TEL M	337/338	Y/R
	4	5/15/90	84(185)	Sheep Creek	A TEL M	190/191	--
1388 M	2	5/25/88	68(150)	Dry Creek	2.5 TEL M	153/154	Y/lB

Table 1. Continued.

Bear no./ sex	Cem. age (yr)	Date of capture	Weight kg (lb)	Location	Drug dosage[a]	Ear tags[b]	Markers[c]
1389 M	3	5/13/89	84(185)	Mystic Creek	4.5 TEL H	343/344	W/dB
1390 F	3	5/13/89	77(170)	Mystic Creek	3.4 TEL H	345/346	Y/Y
1391 F	2	5/13/89	68(150)	Dry Creek	2.8 TEL L	333/334	O/mG
	3	5/12/90	95(210)	Dry Creek	3.8 TEL M	333/334	O/mG
	4	5/7/91	109(240)	Forgotten Creek	5.5 TEL H	109/110	O/mG
	5	5/23/92	111(245)	Dry Creek	5.0 TEL L	109/898	O/mG
1392 M	2	5/13/89	89(195)	Dry Creek	2.8 TEL M	341/342	lG/O
	5	5/26/92	229(505)	Dry Creek	13.0 TEL L	881/882	mG/R
1393 M	2	5/17/89	66(145)	Molybdenum Ridge	3.5 TEL H	326/325	Bk/lB
	3	5/14/90	100(220)	Trident Glacier	4.4 TEL M	326/325	Bk/lB
1394 F	2	5/17/89	59(130)	Molybdenum Ridge	3.5 TEL -	331/332	lB/Bk
	6	5/10/93	94(207)	Molybdenum Ridge	3.4 TEL M	165/166	lB/Bk
1395 M	2	5/17/89	86(190)	Molybdenum Ridge	3.1 TEL M	302/301	dkB/W
1396 M	13[d]	5/18/89	295(650)	Molybdenum Ridge	7.0 TEL M[h]	327/328	Y/O
1397 F	2	5/18/89	61(135)	Delta Creek	3.2 TEL M	314/313	O/O
	5	5/25/92	116(255)	East Fork Delta	5.5 TEL M	793/792	O/O
1398 F	8[d]	5/18/89	127(280)	Delta Creek	4.5 TEL M	315/316	W/Y
	13	5/8/94	147(325)	Trident Glacier	5.6 TEL L	-/316	-/Y
1399 M	2	5/18/89	66(145)	Delta Creek	3.2 TEL M	303/304	R/R
1400 M	8[d]	6/8/89	239(525)	Trident Glacier	7.0 TEL M[h]	425/426	R/lB
1601 M	9	6/9/89	193(425)	Whistler Creek	6.5 TEL M[h]	782/785	Gr/Y
	11	5/7/91	245(540)	Slate Creek	13.0 TEL L	125/126	Gr/Y
	12	10/4/92	340(750)[d]	Buchanan Creek	A TEL M	179/180	dB/W
1602 M	7	5/13/90	166(365)	Molybdenum Ridge	A TEL M	122/121	lB/Gr
	9	5/25/92	200(440)	East Fork Delta	7.0 TEL M	980/981	lB/Gr
	11	5/28/94	238(525)	East Fork Delta	10.5 TEL L	338/339	lB/mG
1603 F	2	5/13/90	55(120)	Hayes Creek	3.6 TEL H	141/142	lB/dB
	3	5/8/91	70(155)	Whistler Creek	3.6 TEL M	128/127	lB/dB
	4	5/24/92	102(225)	West Hayes Creek	6.0 TEL M	214/213	lB/dB
	6	5/30/94	113(250)	West Hayes Creek	5.6 TEL M	348/349	lB/dB

Table 1. Continued.

Bear no./ sex	Cem. age (yr)	Date of capture	Weight kg (lb)	Location	Drug dosage[a]	Ear tags[b]	Markers[c]
1604 F	2	5/13/90	48(105)	Buchanan Creek	3.4 TEL M	119/120	lB/R
	3	5/7/91	59(130)	Buchanan Creek	4.0 TEL H	101/120	lB/R
	4	5/25/92	95(210)	West Fork Delta	6.0 TEL M	101/889	lB/R
	5	5/8/93	82(180)	Buchanan Creek	5.0 TEL M	889/101	R/lB
	5	5/10/93	--	East Fork Delta	5.0 TEL M	889/101	R/lB
1605 F	2	5/13/90	59(130)	Buchanan Creek	3.6 TEL M	213/150	mG/lB
	3	5/8/91	68(150)	East Fork Delta	3.6 TEL M	213/293	mG/lB
	4	5/25/92	102(225)	Buchanan Creek	4.0 TEL M	213/293	mG/lB
	5	5/10/93	102(225)	East Fork Delta	3.2 TEL M	195/196	mG/lB
1606 M	2	5/13/90	50(110)	Buchanan Creek	A TEL M	143/144	R/dB
	3	5/8/91	70(155)	Gilliam Glacier	3.6 TEL M	143/144	R/dB
	5	5/8/93	105(230)	West Hayes Creek	5.4 TEL M	396/397	R/dB
1607 F	8	5/14/90	141(310)	Glacier Creek	5.5 TEL M	188/189	W/lB
1608 F	15	5/14/90	136(300)	Trident Glacier	5.5 TEL M	184/-	lG/-
	19	5/30/94	127(280)	Trident Glacier	5.6 TEL M	172/-	lG/-
1609 F	2	5/14/90	61(135)	Trident Glacier	3.2 TEL M	103/104	dB/mG
	3	5/7/91	77(170)	Trident Glacier	4.0 TEL M	103/102	dB/mG
	4	5/25/92	93(205)	Ptarmigan Creek	A TEL M	103/102	dB/mG
	5	6/29/93	107(235)	E. Hayes Creek	6.2 TEL M	103/102	dB/mG
1610 F	2	5/6/91	70(155)	Threemile Creek	3.4 TEL M	116/115	O/R
1611 M	2	5/6/91	91(200)	Threemile Creek	3.4 TEL M	106/105	Gr/O
1612 F	2	5/6/91	73(160)	Threemile Creek	3.4 TEL M	131/132	Y/mG
1613 M	7	6/2/91	177(390)	Wood River	12.0 TEL M	131/130	R/O
1614 M	4	6/1/91	109(240)	Hayes Creek	12.0 TEL H	144/145	lG/lG
1615 M	4[d]	6/3/91	125(275)	Hayes Creek	5.5 TEL H	112/111	R/W
1616 M	5	5/7/92	169(370)	Mystic Creek	14.0 TEL H	239/240	Y/R
1617 F	2	5/7/92	54(120)	Wood River	3.6 TEL M	847/848	R/lG
	3	5/9/93	43(95)	Wood River	3.6 TEL M	848/847	lG/R
	4	5/27/94	84(185)	Wood River	3.6 TEL M	848/847	lG/R

Table 1. Continued.

Bear no./ sex	Cem. age (yr)	Date of capture	Weight kg (lb)	Location	Drug dosage[a]	Ear tags[b]	Markers[c]
1618 F	2	5/7/92	54(120)	Wood River	3.6 TEL M	209/210	lB/lG
	3	5/9/93	49(107)	Virginia Creek	3.6 TEL M	209/210	lB/lG
1619 F	2	5/7/92	68(150)	Bonnefield Creek	3.6 TEL L	201/202	R/R
1620 M	2	5/7/92	75(165)	Bonnefield Creek	3.6 TEL M	229/230	lB/lB
1621 M	2	5/7/92	82(180)	Bonnefield Creek	3.6 TEL L	147/148	mG/Y
1622 M	2[d]	5/9/92	100(220)	Wood River	3.6 TEL M	143/236	Y/Y
1623 F	2[d]	5/9/92	95(210)	Wood River	3.4 TEL M	127/126	O/dB
	3	5/9/93	93(205)	Wood River	3.6 TEL M	191/192	O/dB
1624 F	2	5/10/92	70(155)	Molybdenum Ridge	3.6 TEL M	245/246	dB/lB
	3	5/8/93	57(125)	Molybdenum Ridge	3.4 TEL M	245/246	dB/lB
	4	5/28/94	98(215)	Molybdenum Ridge	6.0 TEL M	245/217	dB/lB
1625 M	2	5/10/92	84(185)	Molybdenum Ridge	3.6 TEL M	243/244	R/Y
1626 F	16	5/23/92	109(240)	Dry Creek	6.0 TEL L	150/233	W/lB
1627 F	3	5/7/93	73(160)	Dry Creek	3.6 TEL M	997/998	Y/lB
1628 F	2	5/7/93	45(100)	Dry Creek	3.6 TEL M	173/174	lG/R
	3	5/8/94	64(140)	West Fork Delta	3.6 TEL M	173/174	lG/R
1629 F	2	5/7/93	41(90)	Dry Creek	3.6 TEL M	230/231	R/mG
	3	5/8/94	59(125)	West Fork Delta	3.6 TEL M	231/230	mG/R
1630 F	3[d]	5/7/93	59(125)	Wood River	3.6 TEL M	168/167	dB/lG
1631 F	5[d]	5/9/93	89(195)	Virginia Creek	5.6 TEL M	169/170	mG/O
1632 M	10[d]	5/10/93	277(610)	Tatlanika Creek	12.2 TEL M	161/162	lG/mG
	11	5/30/94	281(620)	Mystic Creek	13.4 TEL M	372/373	lG/mG
1633 M	3[d]	5/8/94	66(145)	Trident Glacier	6.4 TEL H	238/239	Gy/lB
1634 F	Cub	5/27/94	8(18)	Mystic Mountain	0.25 TEL L	-/988	-/-
1635 F	Cub	5/27/94	6(14)	Mystic Mountain	0.25 TEL L	157/-	-/-
1636 F	4[d]	5/27/94	129(285)	Mystic Mountain	6.0 TEL M	382/383	dB/Y

Table 1. Continued.

Bear no./ sex	Cem. age (yr)	Date of capture	Weight kg (lb)	Location	Drug dosage[a]	Ear tags[b]	Markers[c]
1637 M	4[d]	5/27/94	188(415)	Mystic Mountain	7.0 TEL M	992/993	mG/W
1638 M	1[d]	5/28/94	54(120)	Delta Creek	3.6 TEL M	358/359	Y/mG
1639 M	4[d]	5/29/94	220(485)	East Fork Delta	10.5 TEL M	354/355	Bk/R

[a] Dosage in ml. No designation indicates use of phencyclidine hydrochloride/acepromazine maleate at 100 mg/ml concentration; use of M-99 is designated M99 at 1 mg/ml concentration; use of Telazol at 200 mg/ml concentrations is designated TEL; A denotes multiple injections with unknown effective dosage. Drug effects were as follows: L = light, M = optimum, H = heavy.

[b] Ear tag numbers, left/right.

[c] Marking designations:

Colors: R, red; G, light green; mG, medium green; Gr, gray; O, orange; lB, light blue; dB, dark blue; W, white; Bk, black; Pp, purple; Y, yellow.

Marker types: One or 2 color combinations were used for ear flags, e.g., O/W is orange in left ear, white in right ear; -/G is no flag, left; green, right.

[d] Estimated.

[e] Data collected but not recorded.

[f] Ear tags only and not ear-flagging material were used to mark cubs of the year; therefore, for these bears only, marker colors indicate ear tags and not ear flags.

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

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

Table 2. Reproductive status and litter sizes of potentially mature females in the northcentral Alaska Range, 1981-1994.

Bear No./ Age[a]	Offspring No.	Reproductive status[b] 1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	Reproductive history[b]
1302/14	1604, 1605, 1606, 1UM	NB	UN	UN	UN	UN	B	B	3c	3yl	3 2y/B	1c	1yl/D			No offsp prior 1986; killed by 1601 9/30/92
1303/14	1364, 1UM 2UM	NB	NB	B?	B	2c/B	UN	UN	UN	UN	UN/B	2c	1yl	2yr/B	UN	No offsp prior 1981; lost 2 c 1985, lost 1 c 1991
1305/25	1306, 1307	2yl	2 2y/B/D													Hunter kill fall 1982
1308/17	2UM, 1391, 1392, 3UM		?/B	B	2c	2yl	1 2y/B	2c	2yl	2 2y/B	3c	2yl	2 2y/B	3c	2yl	Offsp 1982 or before; lost 1 yl 1985; lost 1 c 1990; lost 1 c 1993
1311/24	1312, 1313, 1372, 1378, 1UM, 1395, 1624, 1625 ?UM, 2UM	UN/B	2c	B	2c	2yl	2 2y/B	2c	2yl	2 2y/B	2c	2yl	2 2y/B	?c/B	3c	Lost 2 c Aug 1982; lost UM 2yr? spring 1989
1317/6			NB	NB?	NB	NB/D										Illegal kill 1985
1318/20	1319, 1380, 1382, 2UM	UN/B	1c/B	B	B	2c	2yl	2 2y	2 3y/B	2c/D						Lost 1 c 1982; dead Aug 1990
1320/24	1UM, 3UM, 2UM		?/B	1c/B?	B	3c	B	2c	1yl	B/D						Weaned or lost offsp 1982; lost 1 c 1983; lost 3 c 1985; lost 1 c 1987; lost 1 yl 1988; dead, fall 1989
1321/23	1342, 1343, 1344, 1UM, 1379[c], 1381[c] 3UM	UN/ 3+c	3yl	3 2y	2 3y/B	3c	3yl	2 2y/B	3c	B/D						1342 killed illegally fall 1983; lost 1 yl 1983; lost 3 c 1988
1322/17	1336	UN/1+c	1yl	1 2y	1 3y/B	UN	UN[d]	UN	UN	UN	UN	B?/D				Hunter kill fall 1991
1323/18	1324, 1325 2UM	UN/B	2c	2yl	2 2y/B	UN	UN/B	2+c	2+yl	2 2y/D						DLP kill[b] fall 1989
1324/12	1389, 1390, 1622, 1623, 3UM 1634, 1635		NB	NB	NB	UN/NB?	UN/B	2+c	2yl	2 2y/B	2c	2yl	2 2y/B	3c/B	2c	Lost 3 c 1993
1326/8	1UM		NB	B	B	1c	B/D									No offsp prior 1982; lost 1 c 1985; hunter kill 1986

Table 2. Continued.

Bear No./ Age[a]	Offspring No.	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	Reproductive history[b]
		Reproductive status[b]														
1327/18	1328, 1UM, 3UM	UN/2+c	2yl	B	3c/D											1UM yl capture mortality; lost 1328 in 1982; 1327 capture mortality? 1984
1329/14	1330	UN/1+c	1yl	1 2y/D												Killed by male May 1983
1331/12	1UM, (1603)?		NB	B	UN	UN/B	1+c	1yl/B	1+c	1yl	1 2y/B/D					No offsp prior 1982; lost yl 1987
1332/6			NB?	D												No offsp prior 1982; died in den 1983
1333/18	1334, 1335	UN/2+c	2yl	2 2y	2 3y/B/D											Hunter kill 1984
1336/11	2UM; 1UM, 1617, 1618			NB	NB	B	B	2c	2yl	B	3c	2yl	2 2y/ Dead			No offsp prior 1983; lost 2 yl 1988; lost 1 c 1990
1340/11				NB	NB	B	UN	UN	UN	UN	UN	UN				No offsp prior 1983
1341/16	1UM, 1370, 1371, 2UM, 2UM		UN/1+c	1yl/B	2c	2yl	2 2y/B	B	2c/B	2c/D						Lost yl 1983; lost 2 c 1988; dead fall 1989
1345/18	2UM, 1385, 1386, 3UM			B	2c	1yl/B	2c	2yl	2 2y	2 3y/B	3c	3yl	UN			Lost 1 c 1984; lost 1 yl 1985
1348/23	1367, 1368, 1369, 2UM, 1UM, 1619, 1620,1621			?/B	3c	3yl	3 2y/B	2c	2yl/B	1 c/B	3c	3yl	3 2y	1 3yr/B	?c	Probably weaned or lost offsp 1983; lost 2 yl 1988; lost 1 c 1989;
1351/18	1357, 1361, 1UM, 3UM	UN/B	3+c	3yl	3 2y	2 3yr/B	3+c	3yl/D								Lost 1UM offsp 1984; hunter kill 1987, 3UM yl orphaned?
1352/15	1353, 1354	UN/B	2+c	2yl	2 2y/D											Hunter kill 1984; 1353 hunter kill 1984
1360/10	1359, 1363	UN/B	2+c	2+yl	2+ 2y	2 3y/D										Capture mortality 1985
1361/9	1+UM				NB	NB	NB	UN	UN/B	1+c	1+yl	1 2y/D				No offsp prior 1985; both 1361 and 2yr hunter kills 1991
1362/14	1387, 1388				UN	B	2c	2yl	2 2y/B	B	UN	UN	UN	UN	UN	No offsp prior 1985

Table 2. Continued.

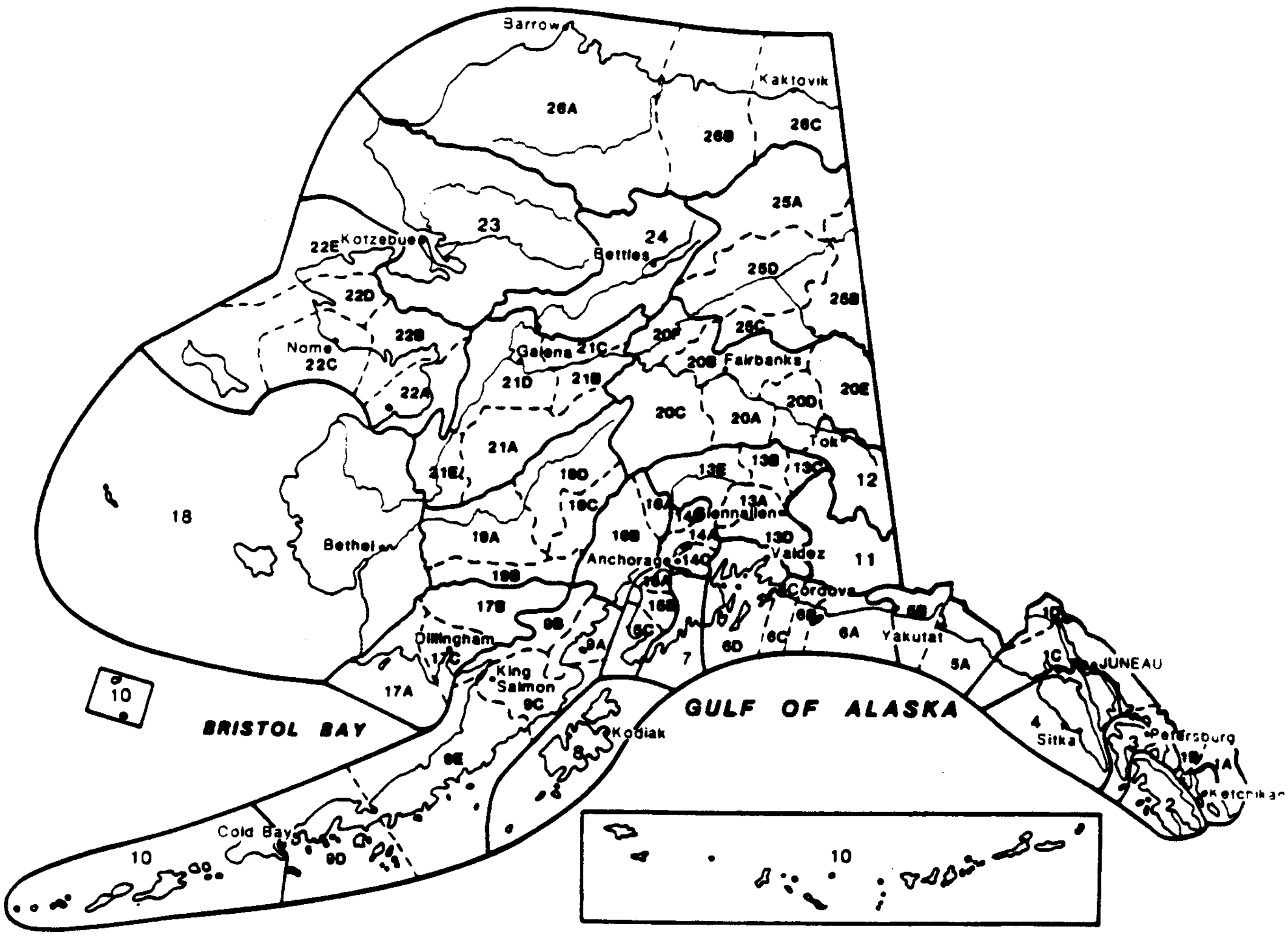
Bear No./ Age[a]	Offspring No.	Reproductive status[b] 1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	Reproductive history[b]
1374/14	2UM, 2UM, 3UM				UN/B	2+c	2yl	?/B	2+c	2yl	2 2y/B	3c	UN/B	3c	3yl/B/D	1374 and 3 yl killed defense of life 1994
1376/18	1393, 1394					UN	?/B	2c	2yl	2 2y	2 3y/D					Offsp prior 1986; dead spring 1990
1379/6									NB	B	UN	UN	D			Dropped collar spring 1990; hunter kill 1992
1385/8	1UM, 2UM?										NB	B	1c	1yl/B	2c?	Lost 1 yl 1993?
1391/7	1UM										NB	B	1c	1yl	1 2y/B	
1394/7	1633												B	1c	1yl/B	Weaned 1 yl and bred 1994
1397/7	2UM											UN	B	B	2c	
1398/13	1397, 1399, 2UM, 2UM						?/B	2+c	2+yl	2 2y/B	UN/B	2c	2yl	UN/B	2c	
1603/6											NB	B	B	B	B	
1605/6	2UM													B	2c	
1607/13	1610, 1611, 1612								?/B	3+c	3yl	3 2y/B	UN	UN	UN	
1608/19	1609?, UM, 1633?, 2UM							UN/B?	1+c?	1+yl?	1+ 2y?/B	2c	2yl	2 2yr/B	2c	Assumed 1609 was offsp from from strong circumstantial evidence
1609/6													NB	B	B	
1623/4														NB	B	
1624/4														NB	B	
1626/17	2UM										UN/B	2+c	2yl/D			Probably killed by hunter in defense of life
1631/6														B	B	
1636/4															B	

[a] Age in 1994 or last year in which bear was alive.

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

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

Alaska's Game Management Units



The Federal Aid in Wildlife Restoration Program consists of funds from a 10% to 11% manfacturer's excise tax collected from the sales of handguns, sporting rifles, shotguns, ammunition, and archery equipment. The Federal Aid program distributes funds to states using a formula based on each state's geographic area and number of paid hunting license holders. Alaska receives a maximum 5% of revenues collected each year. The Alaska Department of Fish and Game uses its funds to help restore, conserve, and manage wild birds and mammals. These funds are also used to educate hunters to develop skills and attitudes for responsible hunting. Federal Aid funds paid for 75% of this study.