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

Harry V Reynolds, III

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Grants W-24-5 and W-27-1
Study 4.28
June 1999

STATE OF ALASKA
Tony Knowles, Governor

DEPARTMENT OF FISH AND GAME
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DIVISION OF WILDLIFE CONSERVATION
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RESEARCH PROGRESS REPORT

STATE: Alaska **STUDY:** 4.28

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AUTHOR: Harry V Reynolds, III

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SUMMARY

Following the third phase 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, data were collated and analyzed for preparation of manuscripts to be submitted to scientific journals. During the third phase (1992–1998), designed to assess population recovery rates, female mortality continued to occur due to hunters, defense of life or property kills, illegal kills, and natural causes. However, by 2000–2001, the adult female segment of the population will probably recover to the mean level of 22 observed during 1981–1988, due to exceptionally good production and survival of the 1994 and 1995 cohorts. Mean litter size has shown little variation from 2.06 cubs (n = 84 litters) observed during the entire study and minimum reproductive interval remained at 4.0 years (n = 85). A paper entitled "Assessing unreported mortality and wounding loss in grizzly bears" was submitted to *Ursus*, a new journal published by the International Association for Bear Research and Management. Another manuscript entitled "Pharmacokenetics of tiletamine HCL/zolazepam HCL (Telazol®) in grizzly bears" is in preparation for the *Journal of Wildlife Disease*, with a tentative submission date of September 1998. Further genetic analysis of this population is in the final stages and a manuscript will be ready for submission to a journal by December 1998. Input data necessary for population modeling of the population are being analyzed; these data will be used to compare predictive models with actual grizzly bear population decline and recovery observed in the Alaska Range during 1981–1997. Following further consultation with a biometrician, a model to calculate sustainable mortality rates in an Interior grizzly bear population will be completed.

Key words: genetics, grizzly bear, harvest rates, Interior Alaska, population dynamics model, sustained yield, tiletamine HCL, *Ursus arctos*.

CONTENTS

BACKGROUND

An understanding of the effects of different levels of hunter harvest on grizzly bear 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 our 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 require 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*,*b*,*c*, 1993; Miller et al. 1997). 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. Measures of population production, survival, compensatory behavior, and emigration rates are essential to effectively assess this response. Because of characteristics of production and survival, grizzly bear populations respond very slowly to forces that may change population status. For instance, Alaska Range grizzly bears do not usually produce surviving young until they reach 7 years of age and the mean interval between litters can be as long as 4.1 years (Reynolds 1990; Reynolds and Boudreau 1990), so effects of compensatory production or survival are difficult to document. In addition, stochastic factors such as annual variation in weather or food resources can complicate interpretation of responses to reduction in mortality influences from sport hunting. Measurement of these variables over periods long enough so that changes in trend can be separated from annual variation is crucial to effective management.

This study was initiated in 1981 as a 3-phase study. The first phase was designed to determine baseline population numbers, production, survival and harvest levels; the second, manipulation of the population by allowing high levels of harvest; and the third, to assess population recovery. It has been conducted in a 3160-km^2 study area of representative northern Alaska Range habitat in Unit 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 (Reynolds 1993*a*).

Phase I was completed in 1985; it emphasized gathering of baseline information on 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). 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 12% harvest level during Phase I. Even though this harvest was higher than indicated in the study design, this circumstance strengthened rather than detracted from the investigation. By 1985, at the end of Phase I, the population had already begun to decline. The early high harvest level allowed monitoring of reproductive responses over a longer period.

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. In 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 inconclusive evidence for compensatory production and survival.

Following completion of Phase II, a second mark–recapture density estimate was conducted in 1992 (Reynolds 1993*a*; Miller et al. 1997) for comparison with the 1986 estimate (Reynolds et al. 1987). No changes in density were detected between the 2 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 declined by 36% since 1981 and adult females declined by 32%.

Patterns of movement or fidelity to maternal or established home ranges indicated that all females remained near 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 (Reynolds 1992).

Several other intensive studies have documented declining populations (Craighead et al. 1974; Knight and Eberhardt 1984, 1985; McLellan 1989*a*,*b*,*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 in Alaska but concluded 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 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, 1995; Reynolds 1974, 1976, 1978, 1980, 1993*a*; 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 that declined 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 Unit 20A. Study area boundaries did not include mountainous areas above 1800 m (6000 ft), glaciers, or heavily forested portions of the Tanana Flats where we made few observations and did not attempt searches. 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. The study area includes portions of 2 U.S. Army reservations: Fort Wainwright and Fort Greely.

Elevation in the study 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

Methods used to capture bears, monitor individual presence in the study area, and measure population variables have been described in previous reports and papers (Reynolds 1982, 1993*b*, 1994, 1995, 1996, 1997; Reynolds and Hechtel 1983, 1984, 1985, 1986, 1988; Reynolds et al. 1987; Taylor et al. 1989; Reynolds and Boudreau 1992; Miller et al. 1997). Standardized weight and measurement data were collected (Kingsley et al. 1988).

RESULTS AND DISCUSSION

The primary emphasis of work accomplished during 1997 was to assess population recovery in the area, to analyze population dynamics using the complete data set collected during all 3 phases, to compare observed population behavior with predictive models, and to publish results in scientific publications. As funding allowed, I also replaced radio collars on adult females and those 2- to 5-year-old females that would enter adult cohorts if they survived. In addition, I monitored reproductive status, reproductive performance, and possible compensatory changes in population dynamics. I also submitted a scientific manuscript with coauthor John Blake, DVM, University Alaska Fairbanks, entitled "A method for assessing wounding loss and unreported kills of grizzly bears" to the journal *Ursus* (Appendix A). A second paper, reporting rates at which grizzly bears cycle the immobilization drug Telazol® (tiletamine HCL and zolazepam HCL, Fort Dodge Lab, Fort Dodge, Iowa, USA) through their bodies following capture, is in preparation. This paper will be coauthored by John Blake and Dr Hugh Semple, head of the Department of Pharmacology at University of Saskatchewan, and should be submitted to the *Journal of Wildlife Disease* during Sep–Oct 1998. Sample analysis is complete and data analysis should be finalized enough to allow completion of the manuscript by the end of September 1998.

During 1997–1998, of the 26 bears captured, 15 had been recaptured previously (Table 1). Of the 11 not previously captured, 7 were offspring of radiocollared females, 2 adult females and 1 4-year-old male were captured near the study area boundaries and may have home ranges primarily outside it, and 1 was an adult male breeding with a female 22 km inside the study area.

From spring 1996 until summer 1998, we recorded 6 adult female mortalities. Bears 1398 and 1646 were killed by hunters, 1308 and 1324 were killed in defense of life or property, 1394 was killed illegally, and 1348 was killed by another bear. During this same period, females 1628, 1629, and 1658 reached 6 years of age and entered the adult cohort, for a net loss to the population of 3 adult females. This means the adult female segment of the population is presently composed of 16 bears, compared to the mean of 22 observed during 1981–1988 (range 21–23; Reynolds 1997). However, survival of the exceptionally strong cohorts of 1994 and 1995 is still high enough so that when they reach adult age in 2000 and 2001 (Reynolds 1997), recovery to the levels observed during 1981–1988 should be achieved.

During 1997, 1311, a 28-year-old female, produced her seventh litter since she was captured as a 12-year-old in 1982. Of 9 females observed that were over the age of 20, 8 produced at least one litter of cubs; the other was captured while breeding at age 23 and showed evidence of previous production (Table 2). Bear 1311 has whelped at least 3 litters since age 20 and probably produced an additional litter that did not survive.

Litter size continues to be stable. Mean litter size during 1981–1996 was 2.06 for 84 litters of cubs, 1.92 for 72 litters of yearlings, 1.98 for 46 litters of 2-year-olds, and 1.80 for 10 litters of 3-year-olds (Table 3). For comparison, Miller (1987, 1990*a*, 1997) found the same mean cub litter size (2.1) in the Nelchina Basin on the south side of the Alaska Range, but a mean yearling litter size of only 1.8.

Intervals between litters did not change during 1997–1998. Offspring were observed weaned as yearlings (n = 3 litters), 2-year-olds (n = 32 litters), or 3-year-olds (n = 13 litters). Mean minimum reproductive interval, however, was 4.0 years (n = 85), based on those cycles that were observed and those projected by assuming weaning of offspring as 2-year-olds (Table 4). All 23 intervals ≥5 years resulted from interruption of the breeding cycle due to mortality of litters or to breeding that did not produce cubs the following year.

Data for use in a model to assess sustained yield of females have been collected in the area since 1982. Parameters including population size, female numbers by age class, age at first production of young, interbirth intervals, intervals between successful production of litters, and annual litter sizes that are necessary for such models have been calculated (Reynolds 1997). Age-specific survival patterns using a staggered entry design (Pollock et al. 1989) are presently being analyzed. Using these measures, I will compare models with actual grizzly bear population decline and recovery observed in the Alaska Range during 1981–1997. The first model compared observed behavior and will be one based on Eberhardt's formulations (Eberhardt and Siniff 1977; Eberhardt 1985) of the Euler–Lotka equation relating population growth rates to age-specific birth and mortality rates and adapted by W Testa (pers commun, Alaska Department of Fish and Game, Anchorage) for calculation of sustained yield of adult females. Model outputs will be compared to observed population behavior during baseline, decline, and recovery phases that have been observed in the population (Reynolds 1997).

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Table 1 Capture and marking characteristics of 182 bears captured in the northcentral Alaska Range, 1981–1998

Bear/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
	19	6/6/95	129 (285)	Dry Creek	7.2 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

Table 1 Continued

Bear/sex	Cem. age (yr)	Date of capture	Weight kg (lb)	Location	Drug dosage[a]	Ear tags[b]	Markers[c]
	22	5/10/92	121 (267)	Molybdenum Ridge	5.0 TEL M	249/250	W/W
	25	6/11/95	118 (260)	Molybdenum Ridge	7.0 TEL M	--	--
	28	8/22/98	131 (290)	Molybdenum Ridge	7.2 TEL M	None	None
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
	12	5/27/94	125 (275)	Mystic Mountain	6.0 TEL M	121/122	Bk/W
	13	6/6/95	--	Wood River Bluffs	7.2 TEL M	121/122	Bk/W

Table 1 Continued

Bear/sex	Cem. age (yr)	Date of capture	Weight kg (lb)	Location	Drug dosage[a]	Ear tags[b]	Markers[c]
1325 M	Cub	6/10/82	12 (27)	Mystic Mountain	0.10/0 M	3161/3031	W/R[f]
	2	5/15/84	67 (148)	Mystic Creek	1.0 M99 M	3233/3394	R/W
1326 F	4	6/18/82	93 (205)	Buchanan Creek	2.2/1.8 M	3008/3163	W/R
	6	6/21/84	109 (240)	Buchanan Creek	1.8/2.2 M	468/462	W/R
	7	6/27/85	111 (245)	Slate Creek	2.4/1.6 L	426/427	W/W
1327 F	16	7/8/82	127 (280)	Whistler Creek	2.2/1.8 M	3134/3192	G/R
	18	6/23/84	125 (275)	Whistler Creek	A H	458/192	G/R
1328 F	1	7/8/82	43 (95)	Whistler Creek	0.9/1.1 M	3115/3014	dB/G
1329 F	13	7/9/82	120 (265)	Buchanan Creek	2.4/1.6 M	3026/3111	W/R
1330 M	1	7/9/82	48 (106)	Buchanan Creek	-- M	--/--	R/W
	3	6/28/84	102 (225)	East Fork Delta	2.6/3.0 M	597/598	R/W
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)	Gillam 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/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
1353 M	1	6/27/83	27 (60)	West Fork Delta	--	3310/none	O/-

Table 1 Continued

Bear/sex	Cem. age (yr)	Date of capture	Weight kg (lb)	Location	Drug dosage[a]	Ear tags[b]	Markers[c]
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
		6/20/98	268 (590)	Trident Glacier	10.0 TEL M	261/262	W/W
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
	16	9/28/95	173 (380)	Threemile Creek	7.5 TEL L	834/833	lB/lB
	19	6/21/98	145(320)	Sheep Creek	7.0 TEL M	834/-3-	--/--
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/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
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
	9	6/9/95	125 (275)	Upper Wood River	4.0 TEL M	258/259	lB/Y
	10	6/3/96	111 (245)	Big Grizzly Creek	7.0 TEL M	258/259	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	--

Table 1 Continued

Bear/sex	Cem. age (yr)	Date of capture	Weight kg (lb)	Location	Drug dosage[a]	Ear tags[b]	Markers[c]
1388 M	2	5/25/88	68 (150)	Dry Creek	2.5 TEL M	153/154	Y/lB
1389 M	3	5/13/89	84 (185)	Mystic Creek	4.5 TEL H	343/344	W/dB
1390 F	3	5/13/89	77 (170)	Mystic Creek	3.4 TEL H	345/346	Y/Y
1391 F	2	5/13/89	68 (150)	Dry Creek	2.8 TEL L	333/334	O/mG
	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
	8	6/7/95	123 (270)	Slate Creek	7.0 TEL M	336/337	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
	10	6/3/97	308(680)	Sheep Creek	7.5 TEL/6 MD M	281/282	W/W
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
	7	5/28/94	125 (275)	Molybdenum Ridge	6.0 TEL M	165/166	lB/Bk
	9	6/2/96	142 (313)	Delta Creek	7.0 TEL M	126/166	lB/none
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
	15	6/2/96	127 (280)	Trident Glacier	6.4 TEL M	271/272	-/-
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

Table 1 Continued

Bear/sex	Cem. age (yr)	Date of capture	Weight kg (lb)	Location	Drug dosage[a]	Ear tags[b]	Markers[c]
	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
	8	6/4/96	111 (244)	East Hayes Glacier	7.0 TEL M	237/238	lB/dB
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
	7	5/3/95	98 (215)?	Gillam Glacier	6.0 TEL H	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)	Gillam 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
	13	6/7/95	143 (315)	Glacier Creek	7.2 TEL M	330/331	lG/W
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/-
	21	6/1/96	120 (265)	Trident Glacier	7.0 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
	9	6/2/97	86 (190)	Trident Glacier	3.0 TEL/3 MD 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

Table 1 Continued

Bear/sex	Cem. age (yr)	Date of capture	Weight kg (lb)	Location	Drug dosage[a]	Ear tags[b]	Markers[c]
1612 F	2	5/6/91	73 (160)	Threemile Creek	3.4 TEL M	131/132	Y/mG
	6	5/3/95	125 (275)	Lower Sheep Creek	6.0 TEL M	16/22	R/lG
	6	6/8/95	127 (280)	Snow Mountain Gulch	7.2 TEL M	16/22	R/lG
	7	6/3/96	109 (240)	Threemile Creek	7.0 TEL M	16/22	R/lG
	8	5/1/97	107 (235)	Sheep Creek			
1613 M	7	6/2/91	177 (390)	Wood River	12.0 TEL M	131/130	R/O
	11	5/29/95	211 (465)	West Fork Delta	12.9 TEL H	10/9	W/dB
	11	6/7/95	--	West Fork Delta	14.0 TEL M	10/9	W/dB
	13	6/4/97	247 (545)	West Fork Delta	6.3 TEL/5 MD M	235/236	lB/W
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
	5	6/9/95	105 (230)	Kansas Creek	7.0 TEL M	374/118	lG/R
	6	5/4/96	120 (265)	Kansas Creek	4.2 TEL M	374/118	lG/R
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)	Bonnifield Creek	3.6 TEL L	201/202	R/R
1620 M	2	5/7/92	75 (165)	Bonnifield Creek	3.6 TEL M	229/230	lB/lB
1621 M	2	5/7/92	82 (180)	Bonnifield 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
	5	6/6/95	107 (235)	VAMB Mystic	7.2 TEL M	191/192	O/dB
	6	6/3/96	111 (245)	Mystic Creek	7.0 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
	6	6/2/96	110 (243)	S. Molybdenum Ridge	6.5 TEL M	123/217	-/-

Table 1 Continued

Bear/sex	Cem. age (yr)	Date of capture	Weight kg (lb)	Location	Drug dosage[a]	Ear tags[b]	Markers[c]
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
	5	5/29/95	109 (240)	Slide Creek	6.0 TEL H	378/379	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
	4	5/3/95	84 (185)	Buchanan Creek	4.5 TEL L	173/174	lG/R
	5	5/6/96	112 (247)	Forgotten Creek	5.8 TEL L	173/174	-/R
	6	6/4/97	88 (195)	W. Hayes Creek	2.5 TEL/		
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
	6	6/3/97	84 (185)	Forgotten Creek	3.8 TEL/3 MD M	231/230	-/-
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
	7[d]	6/10/95	127 (280)	Upper Wood River	7.2 TEL M	169/375	mG/O
	10	6/21/98	125(275)	Upper Wood River	7.0 TEL M	265/266	DG/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	-/-
	1	6/6/95	52 (115)	Wood River Bluffs	4.7 TEL M	7/8	Bk/lB
	2	5/4/96	86 (190)	Mystic Mountain	3.8 TEL M	7/8	-/-
	3	5/2/97	100 (220)	St. George Creek	2.5 TEL/2 MD M	7/8	-/-
1635 F	Cub	5/27/94	6 (14)	Mystic Mountain	0.25 TEL L	157/-	-/-
	1	6/6/95	52 (115)	Wood River Bluffs	4.7 TEL M	19/20	W/Y
1636 F	4[d]	5/27/94	129 (285)	Mystic Mountain	6.0 TEL M	382/383	dB/Y
	5[d]	6/5/95	111 (245)	Coal Creek	7.2 TEL M	383/382	Y/dB
1637 M	4[d]	5/27/94	188 (415)	Mystic Mountain	7.0 TEL M	992/993	mG/W
1638 M	1	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
	6	6/1/96	262 (578)	Trident Glacier	13.0 TEL M	354/-	-/-

Table 1 Continued

Bear/sex	Cem. age (yr)	Date of capture	Weight kg (lb)	Location	Drug dosage[a]	Ear tags[b]	Markers[c]
1640 M	2	5/2/95	80 (175)	Dry Creek	4.5 TEL M	13/14	W/mG
	2	6/8/95	64 (140)	Dry Creek	6.0 TEL M	13/14	W/mG
1641 F	2	5/2/95	57 (125)	Dry Creek	4.5 TEL M	23/24	R/W
	2	6/7/95	61 (135)	Dry Creek	5.5 TEL M	23/24	R/W
	4	5/1/97	91 (200)	Forgotten Creek	2.5 TEL/2 MD M	23/24	R/W
	5	6/21/98	109 (240)	Dry Creek	7.0 TEL M	23/24	R/W
1642 F	6[d]	5/2/95	125 (275)	Healy Creek	6.0 TEL M	4/3	lB/R
1643 M	Cub	6/6/95	13 (29)	VAMB Mystic	0.5 TEL H	17/-	-/-
1644 M	Cub	6/6/95	11 (24)	VAMB Mystic	0.5 TEL ?	-/18	-/-
1645 M	4[d]	6/7/95	120 (265)	Forgotten Creek	7.2 TEL ?	5/6	lB/W
	6	6/3/97	134 (295)	O'Brien Creek	6.3 TEL/5 MD M	257/257	lG/lG
1646 F	3	6/7/95	61 (135)	Upper West Fork	7.2 TEL M	328/329	O/R
	4	6/4/96	83 (185)	West Fork Little Delta	5.0 TEL M	328/329	O/R
1647 M	5[d]	6/9/95	270 (595)	Virginia Creek	13.2 TEL L	11/12	lB/W
1648 M	2	5/4/96	96 (212)	Chute Creek	A TEL M	113/114	mG/mG
1649 F	2	5/4/96	86 (190)	Chute Creek	3.8 TEL	171/172	W/lG
1650 M	5[d]	5/5/96	163 (359)	Trident Glacier	7.4 TEL M	293/294	lB/W
1651 F	7[d]	5/5/96	85 (187)	Trident Glacier	5.6 TEL M	267/268	lB/Y
1652 F	1	5/5/96	28 (62)	Trident Glacier	2.4 TEL M	119/120	lB/Gy
1653 M	1	5/5/96	28 (62)	Trident Glacier	2.4 TEL M	135/136	0/Y
1654 F	17[d]	5/5/96	128 (283)	Trident Glacier	5.8 TEL M	141/142	W\Bk
1655 M	1	5/5/96	57 (126)	Trident Glacier	4.0 TEL M	104/110	Gy/Y
1656 M	2	5/6/96	--	Molybdenum Ridge	4.2 TEL M	259/260	R/G
1657 F	2	5/6/96	--	Molybdenum Ridge	4.0 TEL M	253/254	Y/W
	4	6/20/98	102 (225)	Molybdenum Ridge	7.0 TEL M	281/254	Y/W
1658 F	4[d]	5/6/96	89 (196)	O'Brien Creek	4.2 TEL M	149/150	dB/G
1659 M	4[d]	6/1/96	156 (345)	West Fork Little Delta River	9.0 TEL M	273/274	mG/lG
1660 M	2	6/1/96	88 (195)	Trident Glacier	4.6 TEL M	247/248	O/lG
1661 M	1	6/2/96	45 (100)	Molybdenum Ridge	3.0 TEL M	228/229	-/-
1662 F	1	6/2/96	23 (50)	Molybdenum Ridge	3.0 TEL M	192/191	-/-
1663 M	1	6/2/96	45 (100)	Molybdenum Ridge	3.0 TEL M	231/232	Y/R

Table 1 Continued

Bear/sex	Cem. age (yr)	Date of capture	Weight kg (lb)	Location	Drug dosage[a]	Ear tags[b]	Markers[c]
1664 F	1	6/2/96	29 (65)	Molybdenum Ridge	3.0 TEL M	297/298	-/-
1665 F	1	6/3/96	48 (105)	Glacier Creek	3.0 TEL M	289/290	lB/O
1666 M	1	6/3/96	50 (110)	Glacier Creek	3.0 TEL M	287/288	O/W
1667 F	1	6/3/96	45 (100)	Glacier Creek	3.0 TEL M	279/280	lG/lG
1668 M	1	6/3/96	29 (63)	Big Grizzly Creek	2.5 TEL M	277/278	lG/lB
1669 F	1	6/3/96	32 (70)	Big Grizzly Creek	2.0 TEL M	286/285	W/O
16770 F	1	6/4/96	44 (96)	East Hayes Creek	3.5 TEL M	296/295	R/dB
1671 M	1	6/4/96	43 (95)	East Hayes Creek	3.5 TEL M	102/101	lB/O
1672 F	2	5/1/97	58 (125)	Chute Creek	2.0 Tel/1.6 Md M	103/104	Y/Bk
1673 F	2	5/1/97	58 (125)	Chute Creek	2.0TEL/1.6MD M	275/276	Gy/W
1674 F	2	5/1/97	62 (135)	Dry Creek	2.0TEL/1.6MD M	133?/134?	Bk/Y
1675 M	2	5/1/97	62 (135)	Dry Creek	2.0TEL/1.6MD M	133/134	lG/dB
1676 M	7	6/2/97	304 (670)	Whistler Creek	A TEL/MD M	251/252	R/R
1677 M	1	6/2/97	25 (55)	Trident Glacier	3.0 TEL M	251/252	dB/dB
1678 M	3	6/3/97	77 (170)	Buchanan Creek	5.0 TEL M	283/284	lB/lB
1679 F	23[d]	6/20/98	113 (248)	Trident Glacier	7.0 TEL M	269/270	lB/Y
1680 M	4[d]	6/20/98	160 (352)	Trident Glacier	7.0 TEL M	243/244	dB/dB
1681 M	1	6/21/98	84 (185)	Upper Wood River	3.6 TEL M	123/124	R/O
1682 F	7[d]	8/22/98	145 (320)	Upper Moose Creek	7.2 TEL M	132/133	lB/dB

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 1378, an offspring of 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 (≥5 years of age) in the northcentral Alaska Range, 1981–1998

Bear/Age[a] (Offspring)	Reproductive status[b]																		Reproductive history[b]
	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	
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
1303/19 (1364, 1UM, 2UM)	NB	NB	B?	B	2c/B	UN	UN	UN	UN	UN/B	2c	1yl	1 2yr/B	UN	UN	UN	UN	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
1308/21 (2UM, 1391, 1392, 1UM, 1640, 1641)	UN	?/B	B	2c	2yl	1 2y/B	2c	2yl	2 2y/B	3c	2yl	2 2y/B	3c	2yl	2 2y/B	2c	2yl/D		Offsp 1982 or before; lost 1 yl 1985; lost 1 c 1990; lost 1 c 1993
1311/28 (1312, 1313, 1372, 1378, 1UM, 1395, 1624, 1625, 1656, 1657)	UN/B	2c	B	2c	2yl	2 2y/B	2c	2yl	2 2y/B	2c	2yl	2 2y/B	?c/B	3c	2yl	2 2yr/B	B	2c	Lost 2 c Aug 1982; lost UM 2yr? spring 1989; lost 1 c 1994
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)	UN	?/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, 1379c, 1381c, 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	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

Table 2 Continued

Bear/Age[a] (Offspring)	Reproductive status[b]																		Reproductive history[b]
	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	
1324/14 (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	2yl	2 2yr /B/D			Lost 3 c 1993; DLP 1996
1326/8 (1UM)		NB	B	B	1c	B/D													No offsp prior 1982; lost 1 c 1985; hunter kill 1986
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/D							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	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
1345/19 (2UM, 1385, 1386, 3UM)	UN	UN	B	2c	1yl/B	2c	2yl	2 2y	2 3y/B	3c	3yl	UN	UN	UN/D?					Lost 1 c 1984; lost 1yl 1985; probable hunter kill, 1994
1348/26 (1367, 1368, 1369, 2UM, 1UM, 1619, 1620, 1621)	UN	UN	?/B	3c	3yl	3 2y/B	2c	2yl/B	1 c/B	3c	3yl	3 2y	1 3yr/B	?c/B	2c	UN	UN/D		Probably weaned or lost offsp 1983; lost 2 yl 1988; lost 1 c 1989; killed by other bear, 1997

Table 2 Continued

Bear/Age[a] (Offspring)	Reproductive status[b]																		Reproductive history[b]
	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	
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 (1UM)				NB	NB	NB	UN	UN/B	1+c	1+yl	1 2y/D								No offsp prior 1985; both 1361 and 2 yr hunter kills 1991
1362/19 (1387, 1388, 1648, 1649)				UN	B	2c	2yl	2 2y/B	B	UN	UN	UN	UN/B	2+c	2+yl	2 2yr	2 3yr/B	B	No offsp prior 1985
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 illegally killed (claimed defense of life) 1994
1376/18 (1393, 1394)	UN	UN	UN	UN	UN	?/B	2c	2yl	2 2y	2 3y/D									Offsp prior 1986; dead spring 1990
1379/7								NB	B	UN	UN	D							Dropped collar spring 1990; hunter kill 1992
1385/12 (1 UM, 1668, 1669)										NB	B	1c	1yl/B	c?/B	2c	2yl	2 2yr/B	2c	Lost 1 yl 1993?; probable cub loss in 1994
1391/8 (1 UM, 2UM)										NB	B	1c	1yl	1 2y/B	2c/D				Lost 2c, 1995; hunter kill 1995
1394/9 (1638, 1661, 1662)												B	1+c	1yl/B	2c	2yl/D			Weaned 1 yl and bred 1994; illegal kill, 1996
1397/10											UN	B	B	UN	UN	UN	UN	UN	
1398/15 (1397, 1399, 2UM, 3UM)						?/B	2+c	2+yl	2 2y/B	UN/B	2c	2yl	UN?/B	2c	1yl/B	3c/D			Lost 1 c 1994; weaned 1yl 1995; lost 3c, hunter kill 1996

Table 2 Continued

Bear/Age[a] (Offspring)	Reproductive status[b]																		Reproductive history[b]
	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	
1603/10 (1670, 1671)										NB	B	B	B	B	2c	2yl	B	2c	
1605/7 (2UM)													B	2c	2yl/D				Killed by other bear 5/22/95
1607/16 (1610, 1611, 1612, 1665, 1666, 1667)								?/B	3+c	3yl	3 2y/B	UN	UN	B	3c	3yl	2 2yr	B	Lost 1 yl, 1996
1608/23 (1609?, 1UM, 1633?, 1UM, 1660?)	UN	UN	UN	UN	UN	UN	UN/B?	1+c?	1+yl?	1+ 2y?/B	2c	2yl	2 2yr/B	2c	2yl	2 2y/B	B	2c	Assumed 1609 was offsp from strong circumstantial evidence
1609/10 (1677)															B	1c	1yl	1 2y/B	
1612/9 (1UM, 2UM)													B	1+c	1yl/B	2c	2yl	UN	Lost 1 yl and bred 1995
1617/8 (2UM)														NB	B	c?/B	2c	2yl	
1623/8 (1643, 1644)													NB	B	2c	2yl	2 2yr	UN	
1624/7 (1663, 1664)													NB	B	2c	2yl	2 2yr/B	1c	
1626/16 (1628, 1629)	UN	UN	UN	UN	UN	UN	UN	UN	UN	UN/B	2+c	2yl/D							Killed by hunter in defense of life
1627/8 (1674, 1675)														B	2c	2yl	2 2yr/B	2c	
1628/7 (2UM)															NB	B	2c	2yl	No offspring prior 1995
1629/7 (2UM)															NB	B	2c	2yl	No offspring prior 1995
1631/10 (1UM, 2UM, 1681)													B	B	1c/B	2c/B	1c	1yl	Lost 1 c 1995 (capture ?); lost 2c 1996
1636/8 (1672, 1673, 1UM)														B	3c	3yl	2 2yr/B	3c	Lost 1 yl, 1996

Table 2 Continued

Bear/Age[a] (Offspring)	Reproductive status[b]																		Reproductive history[b]
	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	
1642/8? (2UM)													B	2+c	2yl	2 2y/B	1+c/D		Hunter kill, 1997
1646/5																B/D			Hunter kill, 1996
1651/9 (1652, 1653)														B	2+c	2yl	2 2yr/B	1c	
1654/19 (1655)				UN	UN	UN	UN	UN	UN	UN	UN	UN	UN	B	1+c	1yl	B	UN	Weaned or lost 1 yl, 1996
1658/6																B	B	1c	No prior offsp; 1996
1679/23																	B	B	
1682/7 (3UM)																	B	3c	

[a] Age in 1998 or last year in which bear was alive.

[b] Designations: B, in breeding condition; NB, observed in nonbreeding 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 ; 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.

Table 3 Observed litter size and number of offspring in cub, yearling, 2-year-old, and 3-year-old age classes, northcentral Alaska Range, 1982–1998

Age class	Observed litters 1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	Total Litters	Total Offspring	$\bar{x}$ litter size
Cub																				
litter size 1	1	1	0	1	0	0	0	1	0	1	2	1	0	2	1	1	3	15	15	
litter size 2	2	0	4	2	2	7	1	2	2	3	0	0	5	9	3	3	4	49	98	
litter size 3	0	0	2	2	0	0	2	0	4	1	0	3	1	2	1	0	2	20	60	
Total	3	1	6	5	2	7	3	3	6	5	2	4	6	13	5	4	9	84	173	2.06
Yearling																				
litter size 1	2	1	0	1	0	1	1	1	0	0	2	2	1	2	1	1	1	17	17	
litter size 2	2	2	0	3	2	2	5	1	0	4	3	0	1	6	7	2	3	44[a]	88[a]	
litter size 3	1	1	0	1	1	1	0	1	1	2	0	0	0	0	2	0	0	11	33	
Total	5	4	0	5	3	4	6	3	1	6	5	2	2	8	10	3	4	72[a]	138[a]	1.92[a]
2-year-old																				
litter size 1	0	2	0	0	1	0	0	0	1	0	0	1	1	0	0	0	1	7	7	
litter size 2	1	1	2	0	2	2	2	5	1	0	4	0	0	1	5	7	0	33	66	
litter size 3	0	1	1	0	1	0	0	0	1	1	1[b]	0	0	0	0	0	0	6	18	
Total	1	4	3	0	4	2	2	5	3	1	5	1	1	1	5	7	1	46	91	1.98
3-year-old																				
litter size 1	0	0	1	0	0	0	0	0	0	0	0	1[b]	0	0	0	0	0	2	2	
litter size 2	0	0	2	1	0	0	1	1	1	0	0	0	0	0	0	1	1	8	16	
litter size 3	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Total	0	0	3	2	0	0	1	1	1	0	0	1	0	0	0	1	1	10	18	1.80

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

[b] Two 2-year-old offspring of bear 1348 were legally killed by hunters while they still accompanied their mother in fall 1992.

Table 4 Observed and projected minimum reproductive intervals for adult female grizzly bears in the northcentral Alaska Range, 1981–1998 (projected status underlined)

Bear/ Age[b]	Annual reproductive status by year of interval observation[a] 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	Minimum interval length
1302/7	B?	B	B	C	Y	2B	C	YD	2B										5,3
1303/5	B	CB	B	C	Y	2B	?	?	C	Y	2B								5,5
1305/22	WB	C	Y	2BD															3
1308/6	C?B	B	C	Y	2B	C	Y	2B	C	Y	2B	C	Y	2B	C	Y	2B		5,3,3,3,3
1311/10	WB	C	B	C	Y	2B	C	Y	2B	C	Y	2B	CB	C	Y	2B	B	C	5,3,3,4,4
1318/12	WB	CB	B	B	C	Y	2	3B	CD	Y	2B								7,3
1320/17	WB	CB?	B	C	B	C	YB?	BD	C	Y	2B								10
1321/14	WB	C	Y	2	3B	C	Y	2B	C	BD	C	Y	2B						4,3,5
1322/6	B	C	Y	3B															4
1323/11	WB	C	Y	2B	?	?B	C	Y	2D	3B									3,6
1324/5	B	C	Y	2B	C	Y	2B	CB	C	Y	2BD								3,3,4
1326/6	B	CB?	BD	C	Y	2B													5
1329/11	WB	C	Y	2D															3
1331/7	B	C	YB	C.	Y	2BD													5
1333/14	WB	C	Y	2	3BD														4
1336/5	B	C	Y	B	C	Y	2B												7
1341/10	WB	C	YB	C	Y	2B	B	CB	CD	Y	2B								5,5
1345/8	B	C	YB	C	Y	2	3B	C	Y	2B									6,3
1348/12	WB	C	Y	2B	C	YB	CB	C	Y	2	3B	C?B	CD	Y	2B				3,7,4
1351/12	WB	C	Y	2	3B	C	YD	2B											4,3
1352/13	WB	C	Y	2D															3
1360/6	WB	C	Y	2	3D														4
1361/6	B	C	Y	2D	3B														4
1362/6	B	C	Y	2B	B	C	Y	2B	B	C	Y	2/B	?B	C	Y	2	3B	B	3,4,4,5,4
1374/4	B	C	Y	2B	C	Y	2B	C	Y	2B	C	B	C	YBD					3,3,3,4
1376/14	WB	C	Y	2	3?D														4
1385/5	B	C	YB	C?B	C	Y	2B	C	Y	B									6,3
1391/4	B	C	Y	2B	CBD	C	Y	2B											3,4
1394/5	B	C	YB	C	YD	2B													2,3
1398/5	B	C	Y	2B	?/B	C	Y	2B	C	YB	C	Y	2B						3,4,5
1603/6	B	C	Y	2B	C	Y	2B												3,3
1605/5	B	C	YD	2B															3
1607/6	B	C	Y	2B	?	?	?B	C	Y	2B	B	C							3,-c,5
1608/?	2?B	C	Y	2B	C	Y	2B	C	Y	2B	B	C							3,3,5
1609/7	B	C	Y	2B															3
1612/4	B	C	YB	C	Y	2B													5
1617/5	B	C?/B	C	Y	2B														4

Table 4 Continued

Bear/ Age[b]	Annual reproductive status by year of interval observation[a]																		Minimum interval length
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
1623/4	B	C	Y	2B															3
1624/4	B	C	Y	2B	C														3
1626/17	?B	C	YD	2B															3
1627/4	B	C	Y	2B															3
1631/6	B	CB	CB	C	Y	2B													5
1636/4	B	C	Y	2B															3
1642/4	B	C	Y	2B															3
1651/5	B	C	Y	2B															3
1654/15	?B	C	YB	B	C	Y	2B												2,4

[a] Age when interval began.

[b] Reproductive intervals are defined as the periods between the weaning (raising surviving offspring to the age that maternal bonds were severed) of 1 litter and the weaning of the next. For females in their first productive cycle, intervals were defined as beginning at the first breeding that resulted in observed cub production the following year. Many reproductive intervals were minimum values because they were partially based on projections prior to or after years when direct observations were made. In addition all projected calculations assume weaning of young as 2-year-olds; however, in weanings that were observed, 10 of 42 weaned litters of offspring were composed of 3-year-olds.

Underlining indicated reproductive status that was projected to allow minimum cycle length calculation; status that was observed is not underlined. Designations are: B, bred; WB, weaned offspring, then bred; CB, lost cubs, then bred; YB, lost yearling, then bred; C, with cubs; C?, evidence that female had cubs was not confirmed; Y, with yearlings; 2, with 2-year-olds; 3, with 3-year-olds; D, died or was killed. Thus CBD indicates a year in which a female had cubs, lost them, bred, and then died.

[c] Female 1607 was not observed for 2 years following breeding and was not observed in the third year until after she could have weaned offspring; because of this uncertainty this period of unknown status was not included in calculations.

APPENDIX A Manuscript submitted to *Ursus* 11:000–000, entitled, "Assessing unreported kills and wounding loss of grizzly bears"

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RH: UNREPORTED KILLS • *Reynolds and Blake*

ASSESSING UNREPORTED KILLS AND WOUNDING LOSS OF GRIZZLY BEARS

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Abstract: It is difficult to account for unreported kills or wounding loss in demographic studies of grizzly bear (*Ursus arctos horribilis*) populations that are hunted or otherwise subject to human exploitation. Use of implantable transmitters can provide an objective means of estimating the cause or extent of such deaths. Mortality rates are usually assessed by using radiocollars to estimate the proportions of bears that die from human-related causes. Such measures are subject to bias related to the necessity for censoring collars that cease functioning. The likely causes for inability to locate radiocollared animals include transmitter damage or malfunction, undetected emigration or long-range movements, collars that are shed and then damaged by the bear, and collars that are purposely destroyed by humans who illegally kill bears. As more humans become aware that radiocollars can lead biologists to bears that are killed illegally, the uncertainty of the extent of human-related mortalities increases. In Interior Alaska, some illegal kills have been documented in a population under study since 1981; others were suspected but unconfirmed. During 1995, we implanted transmitters with mortality sensors in 14 grizzly bears in an area of the northcentral Alaska Range that has been subject to unreported illegal kills. We describe incidence of illegal kills, the characteristics of the transmitters used, the procedure used to implant transmitters, and compare the mortality rates calculated using this method with those calculated using standard radiocollars.

Key words: Alaska, grizzly bear, illegal kills, telemetry implants, unreported kills, *Ursus arctos*, wounding losses.

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A knowledge of grizzly bear population ecology and response to human activities is crucial to developing management strategies that ensure coexistence of bears and humans. Grizzly bear populations are vulnerable to hunting and other human activities because of their wide-ranging movements, sparse distribution, and low productive capacity (Miller and Ballard 1982; Reynolds 1982, 1997; Reynolds et al. 1987; Miller 1990*a*; Miller 1997). Decline or recovery of populations depend on rates of mortality, production, and emigration/immigration (Craighead et al. 1974, 1995; McLellan 1989*a,b,c*). For management programs to be effective in providing for population recovery, accurate measures of each characteristic must be available.

In 2 areas of Interior Alaska, long-term investigations of the effects of harvest on grizzly bears are presently being conducted. Miller (1990*b*, 1997) has addressed impacts of heavy hunting pressure south of the Alaska Range in the Susitna River basin. A 3-phase study of the effects of harvest on grizzly bear population dynamics has been conducted in the northcentral Alaska Range since 1981 (Reynolds 1982, 1997; Reynolds et al. 1987). During phases 1 and 2, baseline population characteristics were determined and subsequently monitored for response as hunter harvest was purposely allowed an annual mean take of 11% of the population. Subsequently, during phase 3, population recovery was assessed as hunting seasons were reduced and hunters were encouraged to avoid killing females (Reynolds 1997).

Relevant findings from this study include: (1) documenting baseline population biology, including a 1996 density estimate of 12 bears ≥2 years of age/1000 km^2,(2) confirming a 44% decline in the portion of population ≥2 years of age between 1981 and 1988, but a recovery to 69% of the 1981 population ≥2 years of age by 1996, (3) determining that the population is not likely to compensate for harvest by increased production or survival of cubs, and (4) demonstrating that movement by females into an overharvested area from adjacent less intensively harvested areas to improve recovery rates is unlikely to occur (Reynolds 1997).

Monitoring all mortality due to human influences is crucial to accurate assessment of human-caused deaths of bears and is necessary for effective management. Where bears are present, most wildlife management agencies have regulations that require reporting of all bears killed by humans (Miller 1990*a*). However, illegal take and wounding loss by humans is usually only roughly estimated.

Because of the illegal nature of such kills, radiocollars on marked bears are usually destroyed so kill documentation is difficult. Further, without a knowledge of the circumstances of the kills and confirmation of whether illegal acts have occurred (1) the validity of mortality data used to determine population dynamics is compromised, (2) it is more difficult to determine whether a bear has emigrated or been illegally killed when contact with radiocollars is lost, (3) there is no basis for enforcement officers to use for apprehending violators and reducing illegal take, and (4) the sources of unreported mortality cannot be mitigated. To address these problems, we tested the practicality of using implantable transmitters to overcome some of the drawbacks associated with the illegal take of bears wearing easily recognizable radiocollars.

This project was funded by Federal Aid in Wildlife Restoration Grants W-24-3 and W-24-4, the US Army Natural Resource Offices of Fort Wainwright and Fort Richardson, and the Veterinary Services, the Institute of Arctic Biology and Large Animal Research Facility at the University of Alaska Fairbanks. We thank Dr. K. Beckman, J. Selinger, T. Boudreau, P. Bruce, and numerous Alaska Department of Fish and Game biologists for assistance in the field. Supercub pilots W. Lentsch and M. Webb and helicopter pilots P. Walters and F. Friederichs were largely responsible for our success and safety in capturing and monitoring bears.

STUDY AREA

The 3160-km^2 study area is located in the mountains and foothills of the northcentral Alaska Range within Unit 20A. Study area boundaries did not include mountainous areas above 1800 m, glaciers, or heavily forested portions of the Tanana Flats where searches were not attempted and few observations were made. 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. The study area includes portions of 2 U.S. Army reservations, Fort Wainwright and Fort Greely. 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 (Reynolds 1993). The area is remote and is readily accessible only by aircraft during May–October. The northwestern boundary is 48 km south of Fairbanks, the eastern boundary edge is on the far side of a large river that is not crossed by any bridge and 22 km from the nearest road, the western boundary is 43 km from the nearest maintained road, and the mountains of the Alaska Range form the southern boundary.

Elevation in the study area ranges from 500 to 3700 m. Most rivers flow northerly through U-shaped, glacially formed valleys and are fed by active glaciers. Tree line is at approximately 900 m. Stunted black spruce (*Picea mariana*) and balsam poplar (*Populus balsamiferi*) stands are present along creeks and in riparian habitats. 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.

METHODS

Bears were captured using standard helicopter darting techniques (Reynolds 1974, 1992; Ballard et al. 1982). Tiletamine HCL/zolazepam HCL (Telazol®, Fort Dodge Laboratory, Fort Dodge, Iowa, USA) at doses of approximately 11mg/kg was used as the immobilizing agent (Taylor et al. 1989). Standard large mammal radiocollars (Model 505, with inverse mortality option, Telonics Inc., Mesa, Arizona, USA) were fitted to all bears used in this study. Collar connections designed to deteriorate and fall off after 2 years (Telonics, Inc.) were used on bears that had not reached maximum size. Locations of radiocollared grizzly bears and their implant mortality transmitters were monitored from light 2- or 4-person capacity aircraft.

Implant transmitters (model Imp/400, Telonics, Inc.) were encased in a lexan tube that was covered in standard physiological wax that was minimally reactive to body tissues.

Implants were 154 mm in length, cylindrical with a 35 mm diameter and weighed 573 g. To maximize reliability and longevity, these transmitters were designed to emit a pulse rate of 5.4 pulses/min when body temperature was >29.4°C (S. Tomkiewicz, Telonics, Inc., pers. commun.). When body temperature fell to <29.4°C, pulse rate switched to 54/min. Body core temperature in winter dens does not fall below 35.3°C (Follmann et al. 1978), so the higher pulse rate did not switch on unless the bear was dead. The implant transmitter was designed to transmit at the low pulse rate to "exercise" the battery and enable functionality to be easily assessed. Estimated transmitter life at initial activation was 36–60 months at 5.4 pulses/min and 6 months at 54 pulses/min.

Incidence of Unreported Mortality

Of the 191 grizzly bears that were known to have died in the study area during 1981–97, 84 were killed by hunters, 63 were offspring that were lost from their mothers and assumed dead, 14 were known taken illegally, 9 were killed in defense of life or property, 9 were capture-related mortalities, 8 were natural mortalities, and on circumstantial evidence, 4 were assumed killed by humans but not recovered. Additional incidences of illegal kill may have occurred, for which there was no circumstantial evidence or reports. Without confirmation of death, these may have mistakenly been attributed to emigration or natural mortality.

At least 9 illegal kills or suspected illegal kills have occurred in the western-most portion of the study area drained by the Wood River and Dry Creek (Table 1), and until 1996 no illegal kills were documented in other portions of the area. In these drainages, a total of 14 bears have been killed that were taken illegally, suspected taken illegally, taken in defense of life or property, or taken at cabins or residences but legally reported as hunter-killed animals. In comparison, in other portions of the study area, 3 were killed in defense of life or property, 2 were recorded as hunter kills at cabins or residences, and 4 were suspected wounding losses or unrecovered defense of life or property kills.

All 5 illegal kills and 3 suspected illegal kills that occurred in the study area took place in the Wood River drainage. No illegal kills were confirmed or suspected in other portions of the study area. Of the illegal kills, no. 1342, a 2-year-old accompanied by her mother, no. 1321, was killed during 1983 with a snare placed at a cabin which had been previously damaged by bears. Bear no. 1317 was killed by hunters or big game guides in the Yanert or upper Wood River drainage during autumn 1985, but was never presented to ADF&G as required by regulation. Two bears, 1 radiocollared and 1 unmarked were killed near a mining camp on St. George Creek near the Wood River during 1989. According to a witness, the bears were about 1/2 mile from the camp when they were stalked and killed. The radiocollar was destroyed and both bears buried with the use of heavy equipment. Female no. 1336 was illegally killed during 1992 in the upper Wood River drainage.

The 3 suspected illegal kills that took place in the Wood River drainage included 1 2-year-old female that was collared near Glacier Creek on 6 May 1991; it was not observed subsequently but was found dead near a hunting cabin belonging to the same individual who had previously killed a bear illegally. Because no young-aged females have emigrated from the vicinity of their maternal home ranges during this study (Reynolds and Boudreau 1992), and because it is unlikely that the radiocollars carried by both of these bears failed at the same time, it is suspected that it was killed illegally. The radiocollar of 4-year-old female no. 1387 was located on mortality mode near a cabin on Rogers Creek during 1990, but a later search for the collar was unsuccessful. An adult female grizzly wearing a radiocollar was reported killed by a resident of the area during early October 1992. Because it was not presented for sealing at ADF&G, positive identification was not possible.

Of the 7 bears killed in defense of life or property, 4 were killed in the Wood River drainage. Nos. 1325, 1367, and 1368 were all 2-year-olds, killed at mining sites during the year in which they were weaned. Mining operators sought advice on aversive conditioning or other means to avoid killing nos. 1367 and 1368, but the bears continued to cause problems at the mine and they were shot. Adult female no. 1323 was accompanied by 2 yearlings or 2-year-old offspring when she charged a sheep hunter on upper Gold King Creek and was shot.

Of the 3 killed in defense of life or property in locations outside the Wood River and Dry Creek drainages, no. 1369 was killed at a cabin in Lignite during 1987; an unmarked 3-year-old was killed by a hunter near Gillam Glacier during 1989; and no. 1626, an adult female with 2 yearlings, was killed when she attacked 2 hunters near Dry Creek, as previously described.

In addition to bears killed in defense of life or property, 4 bears have been killed at cabins or residences, but were taken under hunting license regulations. These mortalities include no. 1377, a 7-year-old male killed at a residence outside the study area north of Healy in 1991; no. 1611, a recently weaned 2-year-old killed at a residence near Gold King airstrip during 1991; no. 1379, a 7-year-old female killed at a cabin near Dry Creek, September 1992; and no. 1621, a 2-year-old that still accompanied his mother, at a trapper's cabin near Gold King Creek, October 1992.

During the study, we suspected that 4 radiocollared adult females found dead were either killed in defense of life or property and not recovered or were wounded by hunters, escaped, and later died. No. 1318 was accompanied by 2 cubs in 1989 when she was killed 500 m from an airstrip used by sheep hunters near the West Fork of the Little Delta River. Similarly, no. 1341 also had 2 cubs in 1989 when she was found dead 500 m from a hunting camp and near an all-terrain vehicle trail at the junction of the East and West Forks of the Little Delta River. The remains of both nos. 1320 and 1331 were found near the western moraine of Hayes Glacier. When the mortality site of no. 1320 first located on 30 August 1989, a sheep hunter's spike camp was observed 300 m away, but the hunters were never contacted to determine if they had shot at a bear. No. 1331 died during 1990, 500 m from where no. 1320's remains were found.

Based on these patterns of illegal kills and the potential for additional unreported kills in the Wood River and Dry Creek drainages, we chose that 1440-km^2 portion of the 3160-km^2 study area in which to select grizzlies for mortality-sensing implant transmitters. This section was easier to access logistically because it is the closest portion of the study area to our base in Fairbanks. We further chose females in this area because their home ranges were known and they are much smaller than those of males (Reynolds et al. 1987). Similarly, we avoided implanting transmitters in young males because they emigrate within 2 years following breakup of maternal-offspring bonds (Reynolds 1993).

Field Surgical Procedure for Inserting Transmitters

Surgical equipment for up to 6 surgeries were transported into the field each day. To fit with other equipment in the helicopter the surgical supplies were packaged into 3 small containers: a soft walled cooler (24 cm wide x 32 cm long x 35 cm high) for autoclaved surgical packs, presterilized packs containing individual transmitters, sutures, and surgical gloves; a hard plastic, water resistant case (25 cm wide x 39 cm long x 33 cm high) for clippers, catheters and surgical prep fluids/materials; and a cylindrical, soft canvas bag (26 cm deep x 60 cm long) for intravenous fluid bags, IV tubing, syringes, medical waste and miscellaneous gear. Each day we took 6 autoclaved surgical packs containing instruments, drapes and gauze sponges needed for each surgery. Surgical blades, gloves and suture material were packaged separately. Abdominal transmitters had been previously, individually wrapped in disposable surgical drape material and gas sterilized (ethylene oxide). For preparing the surgical site, we carried into the field 2 liters of distilled water, 1 liter of 70% alcohol, 1 liter of povidone iodine surgical scrub (Vetadine Surgical Scrub, Vedco, Inc. St. Joseph, Missouri 64504, USA), and 1 liter of povidone iodine solution (Vetadine Solution, Vedco, Inc. St. Joseph, Missouri 64504, USA). In addition we took 3 1-liter bags of normal saline with intravenous administration tubing and a 1-meter aluminum pole for use as an IV stand.

Once immobilized, a 6 x 4 cm area over the right cephalic vein was shaved. The area was prepared using a single wash of povidone iodine surgical scrub followed by an alcohol rinse. We then placed an 18 gauge, 1.25 inch intravenous catheter (Angiocath, Becton Dickenson and Company, Sandy, Utah 84070, USA) into the cephalic vein. The catheter was taped in place and blood was drawn for a complete blood count, serum chemistry profile, trace mineral analysis, and for archival serum. Physiologic saline was administered through the catheter at a rate of 0.5ml/kg/hour for the duration of the procedure. This provided maintenance fluids for the bear during the procedure, maintained an intravenous line in case of emergency and allowed for continuous blood sampling for a separate pharmacokinetics study.

The bear was rolled into dorsal recumbency and a 20 cm x 5 cm area over the ventral midline was shaved using portable clippers (Oster Pro-Cord/Cordless rechargeable clippers). Although well into spring, the shaved site was kept to a minimum since these bears were to be released immediately following recovery. After an initial cleaning to remove scale and debris the surgical site was prepared using 3 separate washes with povidone iodine soap. The first 2 washes were rinsed using distilled water and the third wash was rinsed using 70% alcohol. The surgical site was then painted with full strength povidone iodine solution. The surgical site was draped using autoclaved disposable drape material. To prevent wind from disturbing the drape they were cut large enough to accommodate the girth of the bear permitting the 4 corners to be staked into the ground with tent pegs. Using a #10 scalpel blade we made an 8–10 cm ventral midline incision extending caudal from the umbilicus. The subcutaneous tissue was bluntly dissected to the body wall and the linea alba identified. The linea alba was picked up using rat tooth forceps and a stab incision made into the peritoneum. This incision was extended cranial and caudal using Mayo scissors. The transmitter was pushed into the lower left quadrant of the abdomen. The linea alba was closed using 0 catgut with a swaged-on CT-1 taper needle (Ethicon, Inc. Somerville, New Jersey 08876, USA) in a simple interrupted pattern, the subcutaneous tissue was closed using 2-0 Dexon (Davis + Geck, Inc. Manati, Puerto Rico 00701, USA) with a swaged-on T-5 taper needle in a simple continuous pattern, and the skin was closed with 2-0 Dexon with a swaged-on CE-6 cutting needle in a subcuticular pattern. This skin closure pattern was used to provide a completely buried, absorbable suture line since these animals were not going to be recaptured for suture removal. Nitrofurazone powder was applied to the surgical site at the end of the procedure. As a prophylactic antibiotic and as a marker for cementum layering we administered a single intramuscular dose of a long acting, oxytetracycline (Liquamycin LA-200, Pfizer Animal Health, New York, New York 10017, USA). The surgical procedure including the prep time ranged from 20 to 30 minutes.

An adequate level of surgical anesthesia was obtained in most bears receiving the full 11 mg/kg dose of Telazol®. This dose provided excellent muscle relaxation with loss of palpebral, corneal and withdrawal reflexes. In most bears this dose was sufficient to induce moderate ventro-medial rotation of the eyes. Although immobilized with the initial dart injection, a few bears had inadequate muscle relaxation with excessive head and leg movements. This was suitable for placing a radiocollar, obtaining measurements and blood samples, however these bears were administered additional Telazol® by intramuscular injection to facilitate a surgical level of anesthesia. All bears had an ophthalmic ointment (Artificial Tears Lubricant Eye Ointment, Vedco, Inc,, St. Joseph, Missouri, USA) placed into each eye for protection. Anesthetic recovery in all cases was uneventful and each bear was visually observed from a fixed wing aircraft or helicopter by the following day.

Function of Implanted Transmitters

In this area, radiocollar transmitters can commonly be received at distances of 15–70 km. We received signals from implant transmitters at ranges of 3–8 km; this reduced range is due in part to resistance related to the body mass of the bear. However, because we knew the home ranges of the bears prior to implanting transmitters, and because females are faithful to their home ranges (Reynolds 1993), if mortalities occurred, we very likely could find transmitters by flying a search grid throughout the bear's home range. During the course of the study, 2 females shed their radiocollars but were relocated using the signals from the implanted transmitters, even though the pulse rate was on slow mode at only 5.4/min instead of the 55–65 pulses/min that is standard for radiocollars.

Transmitters were implanted in 14 grizzly bears in the Wood River and Dry Creek drainages (Table 2). Of these 3 were implanted in 1- or 2-year-old females, 5 in 5- to 7-year-old females, 5 in 9- to 19-year-old females, and 1 in a yearling male. One surgical procedure took place during late September 1995, but the rest were completed during the first week of June 1995. The male emigrated from the area during autumn 1995 and was not located again. All the females except 1 were still alive on 23 August 1997.

Female no. 1324, 14 years of age, was shot in defense of life or property by a woman who was alone except for her 2 infant children at a remote cabin site near Gold King airstrip. The woman was awakened by her barking dogs at about 2330 hr, and feared that the bear would break into her house and injure her children. She shot the bear with a high caliber rifle; the wound wasn't immediately mortal and the bear ran away. The woman's husband returned from work at a nearby mine within an hour, but the lighting was poor and he couldn't follow a blood trail of the wounded bear for more than 100 m. After unsuccessfully searching for signs of the bear the next morning, no additional effort was made to find the bear, which we found dead 10 days later 400 m from the cabin.

An annual mortality rate of 3.5% can be calculated from the 14 bears by dividing the single mortality by the 337 total months, corrected to years, that the bears survived (Table 2). The survival for the male was censored after contributing 4 months to this total prior to the time contact was lost with him. This compares to a mortality rate of 6.3% due to human causes during 1981–88 calculated using radiocollar data from females (Reynolds 1997). These differences could be due to several factors. Mines in the area may not have been operating at the same scale as they were during 1981–94. In addition, caribou hunting seasons in the area have been closed for the last 5 years; since most bears are killed incidentally to other hunts, lower caribou hunting effort may also result in fewer hunters in the field and consequently lowered bear harvests (Reynolds et al. 1987).

It is not likely that hunters, miners, and residents of this remote area learned of the implanted mortality transmitters. We took steps to maintain secrecy of the purpose of the implant transmitters. Even to those few people who were aware that we were performing surgical procedures on the bears were given vague answers to inquiries and the purpose of the implanted transmitters were portrayed core temperature monitors, even to our coworkers. Even 3 years after the transmitters were implanted, no rumors of their presence have been reported to us.

MANAGEMENT IMPLICATIONS

Mortality transmitters are feasible to implant abdominally in grizzly bears under field conditions and can provide useful information for population studies. Although no unreported or illegal mortalities were documented in this study, the transmitters did function well and could fulfill their role. They have the advantage of not being readily detectable to someone who might illegally kill a bear, they serve as a backup transmitter to standard radiocollars and can even be used by experienced aerial radiotrackers to locate bears who have shed their collar. Use of these collars could reduce bias caused by poachers or others who kill bears and destroy radiocollars. Alternatively, if it were widely known bears or other mammals carried such transmitters, it could prove a deterrent to poaching in areas where such activities cause substantial management problems. Implant transmitters should be used to verify calculation of mortality rates due to illegal kills and adjust estimates of mortality used in models of population recovery and sustained yield.

Disadvantages of their use include the expense and logistical problems related to conducting field surgery to implant the transmitters. The reception range of the implant transmitters is less than standard radiocollars and they need to be used as an adjunct to rather than a substitute for radiocollars. Although their predicted life is 3–5 years, they cannot be practically retrieved and reused. Even though they can be used to locate animals, the slow pulse rate when not on mortality mode, makes this use very difficult to accomplish.

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APPENDIX A Continued

Table 1. Mortalities of grizzly bears from illegal kills, defense of life or property, wounding losses, and hunter kills taken at remote residences, northcentral Alaska Range, 1981–97

Bear no.[a]	Sex	Age	Date	Cause of mortality[a]	Site or circumstance at death
1325	M	2	9/84	DLP	Mine
1368	F	2	5/86	DLP	Mine
1367	M	2	6/86	DLP	Mine
UM	M	3	8/89	DLP	Hunting camp
1323	F	18	8/89	DLP	Sheep hunting
UM	F	2	6/95	DLP	Remote tourist lodge
1324	F	14	7/96	DLP	Remote residence
1611	M	2	5/91	DLP (hunter)	Remote residence
1626	F	17	9/92	DLP (mauling)	Sheep hunting
1379	F	7	9/92	Hunter kill	Remote residence
1619 w/adF[c]	F	2	9/92	Hunter kill	Hunting airstrip
1317	F	6	9/85	Illegal	Unreported; shot by guide/hunter
UM	Unk	Unk	7/89	Illegal	Mine
M (unk no.)	Unk	Unk	7/89	Illegal	Mine
1387	F	4	9/90	Illegal	Hunting cabin
1336	F	11	9/92	Illegal	Unreported kill; hid radiocollar
1630	F	3	10/93	Illegal	Illegal; reported by other hunter
1394 w/2ylg		9	9/96	Illegal	Unreported kill; hid radiocollar
1342	M	2	10/83	Illegal	Snared at cabin
1318 w/2c	F	20	8/89	Unk; Wounding loss?	Hunting camp 400 m
1320	F	24	8/89	Unk; Wounding loss?	Hunting camp 300 m
1341 w/2c	F	16	8/89	Unk; Wounding loss?	Hunting camp 1 km
1331	F	13	8–9/90	Unk; Wounding loss?	Same site as 1320F

[a] Designations: w/c, ylg, or ad F indicates bear was with cubs, yearlings, or adult females respectively; UM indicates unmarked bear; M (unk no.) indicates a marked bear whose number was unknown; DLP, legally killed under provisions of defense of life or property.

Table 2. Survival and status of bears with implanted mortality transmitters, northcentral Alaska Range, 1995–97

Bear no./sex	Ages at capture and survival	Months survived, 1995–97	Status, Aug 1997
1308 F	19, 20, 21	27	Alive
1324 F	13, 14	13	Unrecovered DLP[a] 15 Jul 96
1362 F	16, 17, 18	23	Alive
1385 F	9, 10, 11	27	Alive
1607 F	13, 14, 15	27	Alive
1612 F	6, 7, 8	27	Alive; Shed 10/96, Recapture 5/97
1617 F	5, 6, 7	27	Alive
1623 F	5, 6, 7	27	Alive
1631 F	7, 8, 9	27	Alive
1634 F	1, 2, 3	27	Alive; Shed 6/97, Observed 8/97
1635 F	1, 2, 3	27	Alive
1636 F	5, 6, 7	27	Alive
1641 F	2, 3, 4	27	Alive
1640 M	2	4	Emigrated? >7 Oct 96

[a] This bear was legally shot under Defense of Life or Property (DLP) regulations at a remote cabin site. The bear was wounded and was found dead 10 days later 400 m from the location where it was shot.