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

DEMOGRAPHY OF NOATAK GRIZZLY BEARS IN RELATION TO HUMAN EXPLOITATION AND MINING DEVELOPMENT

by
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Project W-23-2, Study 4.20
June 1990

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SUMMARY

During 1989, 39 grizzly bears (Ursus arctos) were immobilized with a mixture of tiletamine hydrochloride and zolazepam hydrochloride. A total of 122 bears have been marked since inception of the study (1986); their most recent status has been described. Sex and age composition, baseline blood values, and body measurements collected during immobilizations were presented. Of 24 adult males marked during 1986 through 1989, 29% (7 bears) have been harvested by hunters. Of 39 marked adult females, 10.3% (4 bears) were shot, including three in 1989. During 1989, 34 adult females were were relocated on 242 occasions. Since 1986, 62 radio-collared bears have been relocated on 1,544 occasions. Average litter size at den emergence during 1986 through 1988 was 2.22 (n = 27). By den entrance size of yearling litters averaged 1.76 (n = 21). A total of 1,121 relatively accurate relocations were obtained from 6 adult females instrumented with satellite radio collars in 1988. Satellite collars were programmed to transmit throughout the summer for 6 hours/day from 25 May through 10 October, shutoff during denning, and then repeat the first cycle at den emmergence. Only one of 6 collars provided useful data during 1989. Costs per bear relocation obtained from satellite collars averaged $27, while those obtained from conventional methods using fixed-wing aircraft averaged $68 per relocation.

Key Words: grizzly bear, Ursus arctos, harvest rates, density, population, estimates, mining development, Noatak, productivity, mortality, satellite telemetry.

CONTENTS

BACKGROUND

Background and earlier findings for this study were provided by Ballard (1987) and Ballard et al. (1988, 1989a, 1989b). Briefly, this study was designed to (1) evaluate effects of human harvests on the grizzly bear population by comparing bear density with known reported harvests and (2) provide baseline data on bear density, population structure, movements, and reproductive parameters prior to large-scale development of the Red Dog Mine. Changes in population size and composition as a result of impacts from the mine and other associated developments will be assessed at a later date by repeating the study using identical study methods. Obtaining an accurate and precise estimate of bear density in the potential impact area was a high priority and key objective of this research effort. An earlier progress report (Ballard et al. 1988) and a technical publication (Ballard et al. 1989b) focused on that objective. The study is now focused on gathering baseline data on reproductive and mortality factors affecting this population so that we can ultimately model population performance and estimate allowable harvests. We also have initiated a long-term monitoring program, using radio-collared bears to gather the types of data mentioned above and monitor and assess impacts of the Red Dog Mine on the bear population. This report focuses on estimation of several bear reproductive parameters and evaluation of satellite telemetry for monitoring changes in bear behavior resulting from mine development.

OBJECTIVES

To estimate reproductive and mortality rates of grizzly bears within a selected study area in and adjacent to the Noatak National Preserve.

To determine daily and seasonal-use patterns of adult grizzly bears in relation to development of the Red Dog Mine.

To determine short-term changes in behavior and habitat use of bears as a result of development and operation of the Red Dog Mine and associated roads.

To compare the utility of conventional telemetry with satellite telemetry for determining seasonal habitat use and home range sizes.

STUDY AREA

From 1986 through 1988, we studied bears within a 2,600-mi^2 (6,700 km^2) area that encompassed the Red Dog mine (see Ballard et al. 1989a, Appendix, Fig. 1). This large area is herein referred to as the Noatak River Study Area (NRSA). A brief description of the proposed mine development, study area, and the study design was provided by Ballard (1987). A thorough description of the proposed mine was provided in an Environmental Impact Statement (EPA and USDI 1984). The NRSA boundaries were also selected to encompass an area receiving a moderate amount of harvest pressure. Because the NRSA was too large for conducting an intensive census, a smaller area was selected based upon movements of radio-collared bears in 1986 and location of the mine and associated roads (see Ballard et al. 1989a, Appendix, Fig. 2). This smaller area is referred to as the Red Dog Mine Census Area or just census area. For this report, we refer to the bear density estimation procedure described by Miller et al. (1987) as a census.

METHODS

Bears were captured for radio-collaring and/or marking using standard helicopter immobilization procedures that have become widely used in Alaska (Spraker et al. 1981, Ballard et al. 1982, Reynolds and Hechtel 1985, Miller et al. 1987). Bears were immobilized with either a mixture of tiletamine hydrochloride and zolazepam hydrochloride (Telazol, A. H. Robins, Richmond, VA) or etorphine hydrochloride (M99, Lemmon Co., Sellersville, PA) used alone. Each drug was delivered by a dart projectile fired from a Cap-Chur gun (Palmer Chemical Equipment Co., Douglasville, Georgia 30134) or hand injection. The effective dosages as well as advantages of using Telazol were reported by Taylor et al. (1989). Bears were permanently marked with 3 lip tattoos and ear-tagged with rototags.

All bears except cubs-of-the-year (COY) have had one or more premolars extracted for age determination. Teeth obtained from 1986 to 1988 were cut, stained, and read by the Division's laboratory staff using methods described by Goodwin and Ballard (1985). Beginning in 1989 all teeth were cut, stained, and aged commercially with a Giemsa stain by Matson's Laboratory (Milltown, Montana).

RESULTS AND DISCUSSION

During late May and early June 1989, 39 grizzly bears were immobilized and either radio-collared and permanently marked or just marked. Of the 39 bears immobilized in 1989, 10 adult females were recaptures that required new radio collars so that radio contact could be continued. Four new adult females were captured and radio-collared. We also captured and marked all young that had been with immobilized adults. The latter were composed of 10 male COY and 6 yearlings (3 males and 3 females). Because this study is now focusing on long-term reproductive success, radio-collared males are no longer needed for telemetry studies. Also, because many of the males captured earlier were relatively young and still growing, we chose to remove the collars to reduce the potential of rub marks or lacerations caused by the collars. All 6 adult males had their radio collars removed in 1989, and 3 new adults were marked but not radio-collared.

Since the inception of this study in 1986, 122 bears have been immobilized and permanently marked. It has been our intent to mark and radio-collar all adult females encountered within the study area. We have also marked males and younger age classes of females so that the occurrence of marked bears within the harvest can be monitored. Ages, weights, eartag numbers, morphometrics, blood values, and other statistics associated with capture of grizzly bears within the study area from 1986 through 1989 are summarized in Tables 1-4. These data will be used to estimate baseline blood values, rates of growth and size differences among sex and age classes, and relationships among several body measurements. These data will be analyzed for the final report.

During 1989, 34 radiocollared adult females were relocated on 242 occasions (Table 5). From 1986 through 1989, 39 radio-collared female grizzly bears were relocated on 1,074 occasions. During 1986 through 1988, 23 males were relocated on 388 occasions (Table 6). Radio collars on adult males were removed during 1989. Twenty-nine females had functioning radio collars when last relocated in November 1989. All bear radio relocations have been digitized and, along with associated descriptive data, entered into DBASE computer files to facilitate future analyses. There are currently 1,544 records of grizzly bear relocations.

Known reproductive histories of adult female grizzly bears are presented in Table 7. Average litter size at den emergence during 1986 through 1989 was 2.22 ($\underline{N}$ = 27, SD = 0.70). By den entrance the subsequent autumn, average litter size had declined to 1.96 ($\underline{N}$ = 24, SD = 0.75). This decline in litter size was due to mortality from unknown causes. Ten litters were produced by radio-collared females in 1989.

Known status of the 122 grizzly bears marked since inception of this study are summarized in Table 8. Of 122 immobilized bears, only three (2.5%) died as a result of capture activities. Two of

the 3 known mortalities were immobilized with etorphine hydrochloride, which we stopped using after 1987. The other mortality occurred after a bear had been immobilized with Telazol, and it may have been unavoidable because of the animals relatively poor physical condition (Ballard et al. 1988, Taylor et al. 1989).

Of 24 adult males originally marked and radiocollared as part of this study, at least seven (29.2%) were harvested by hunters between spring 1986 and late autumn 1989. Four (10.3%) of 39 adult females were killed during the same period. Of the 4 adult female hunting mortalities, three occurred during 1989 and all had young when killed (two with COY and one with yearlings). Fates of the young accompanying these adults are unknown. At the beginning of 1989, 30 adult females wore radio collars. Radio contact with 2 females was lost during the hunting season, and these may have been unreported hunting mortalities. Of 28 adult radio-collared females whose fates were known in 1989, 10.7% were killed by hunters. Ballard et al. (1989b) estimated that from 1983 through 1987, 8% to 16% of the study area's grizzly bear population were being harvested annually. Comparison of estimated harvest rates with those ((2-4%) reported for bear populations in northern latitudes (Reynolds 1976, Sidororowicz and Gilbert 1981) suggests that the bear population within the study area is being overharvested; the relatively high proportion of radio-collared females killed during 1989 supports this hypothesis. Following this year's field season in preparation for the final report, we intend to estimate annual survival rates and model the existing bear population to estimate sustainable harvests. Until these analyses are completed, grizzly bear hunting regulations within the study area and probably within all of Unit 23 should not be liberalized.

Satellite Telemetry

During early June 1988, 6 adult females that had been previously radio-collared and monitored for 1-2 years were recaptured and fitted with satellite collars manufactured by Telonics (Mesa, Arizona). Each satellite collar also contained a separately packaged conventional VHF transmitter that allowed each animal to be located by conventional tracking methods. The Argos Data Collection and Location System (DCLS) has been used for receiving signals and processing of data. The Argos system is a cooperative effort among the French Centre National d'Etudes Spatiales (CNES), the National Oceanic and Atmospheric Administration (NOAA), and the National Aeronautics and Space Administration (NASA). History and current use of satellite transmitters on wildlife in Alaska has been described by Fancy et al. (1988).

Satellite transmitters used in this study, herein referred to as platform transmitter terminals (PTT), were programmed to transmit for 6 hours per day from 25 May through 10 October and then cease transmission during the denning period; at den emergence the

subsequent year, they were to repeat the above cycle. These PTT's were expected to operate through 2 field seasons. Each PTT can be programmed to transmit at varying intervals for up to 4 different transmission schedules. A 6-hour transmission period is an optimal length for allowing the satellite sufficient opportunity for fixing 1 accurate relocation while maximizing battery life (B. Berger, Telonics, Inc., pers. commun.). On a monthly basis, users are provided diskettes that contain all of the relocations, including several types of sensory data. Users can usually obtain relocations by telephone modem within 6 hours following a satellite overpass.

Argos provides several types of data processing, including accurate, standard, nonguaranteed, and special processing (Table 9). Argos routinely provides users with accurate and standard processing, but nonguaranteed processing must be requested even though there is no additional cost. The latter type of processing is essential for PTT's that are to be used on animals, because significantly fewer relocations are obtained without it. The accurate (N1 or LQ = 3 or QQ = 9) processing reportedly has 68% of its relocations within 150 m of the true value, while standard processing has 68% within 350 m (Harris et al. 1990). Nonguaranteed relocations reportedly have 68% of their relocations within 1 km of the true value. Argos also provides a special category of data processing that costs $1.25 per day per PTT for data received. Although this latter category provides the greatest number of relocations, the accuracy of most relocations may be poor. Although we used this service in 1988, we chose not to use any of the relocations in this report, because data have not yet analyzed for accuracy. Data collected using special processing on several PTT's deployed on wolves in northwest Alaska contained many inaccurate relocations, and we suspect the same may be true for the bear PTT's (ADF&G files).

Aside from relocations, PTT's also provide other types of data, depending on the user's needs (Fancy et al. 1988); PTT's used in this study provided canister temperature, which is correlated with ambient air temperature, and short and long-term activity patterns, as reflected by activation of mercury tip switches. However, Fancy et al. (1988) pointed out the orientation of the switches and the counting interval have a large bearing on the usefulness of these data and that it probably varies by species. To date there have been no attempts to correlate any of the above parameters with grizzly bear behavior.

Each PTT cost approximately $3,500. Data received from each PTT is processed by Service Argos and distributed to users on microcomputer diskettes. Data processing in 1990 cost $4,000 per PTT-year (equivalent to 365 days of transmission by 1 PTT). Assuming that each bear PTT functioned as expected, we required 2.27 PTT-years of data processing annually at a cost of $9,074. Each PTT was expected to transmit 138 days per season. Special data processing costs $1.25 per day per PTT, or for this study

$1,035 per year. Total projected costs, including the cost of 6 PTT's over 2 summer seasons, were $41,218.

Five PTT's were deployed on 5 June 1988 (Julian date [JD]157) and one on 6 June. Prior to deployment we activated the units on 26 May (JD 147) and allowed them to transmit from known locations (from JD 147 through 154) so that we could later evaluate the accuracy and precision of relocations provided by each unit. During 1988 the 6 grizzly bear PTT's provided 1,865 relocations and 14,220 sets of behavioral data, with an average of 0.5 relocations and 3.8 sets of behavioral data per satellite overpass (Table 10). Approximately 40% of the relocations were classified as location class (LQ) zero, which are often highly inaccurate, and only 1.4% of the relocations were of the highest quality (LQ 3)(Table 11). Most of the relocations were of intermediate quality. Prior to deployment on bears, 18.5% of the relocations at known locations were highquality relocations. Apparently, when PTT's are placed on animals, the closeness of the antenna to the animals body affects the voltage:standing wave ratio, which results in a reduction of the effective radiated power from the antenna (Fancy et al. 1988, Harris et al. 1990), resulting in a higher proportion of lowquality relocations.

Disproportionately fewer relocations and behavioral data were obtained during August 1988 (Tables 10 and 11). A similar discrepancy was observed for several wolf PTT's in northwest Alaska (Ballard et al. 1990). Reasons for the smaller amount of data are unknown, but they may be related to errors in the raw data provided by Argos or errors made in transferring data from Argos format to DBASE files.

Movements of the 6 PTT-equipped grizzly bears during June through October 1988 are depicted in Figures 1 through 6. Although we had several reasons for using satellite telemetry during this study, one primary reason was our interest in monitoring how bears reacted to the construction and operation of the Red Dog Mine. We used the relocations to evaluate how often some bears may have frequented the garbage dump at the mine site (Appendix). Comparisons of conclusions reached from analyses of satellite relocations will be compared with those obtained from conventional telemetry in the final report.

One transmitter ceased transmission in the fall of 1988 on the exact date it had been programmed to cease (10 Oct), while 3 others ceased within 1 day of their programmed dates, one within 8 days, and one within 10 days (Table 10). The latter 2 PTT's quit transmitting earlier than expected. In late May of the following year (i.e., 1989, when the PTT's were programmed to resume transmission), 3 of 6 PTT's failed and no signals were received for the remainder of the year. PTT No. 902 resumed transmission on 27 May (JD 147) for 1 day and then quit transmitting. PTT No. 904 provided one set of activity data on 22 May 1989, and then it also failed. The only PTT that functioned more than 1 day was No. 905, which resumed

transmission on 5 June (JD 156) and apparently transmitted daily until about 30 June 1989 (JD 181) before failing. In summary, during 1989 all of the PTT's deployed on grizzly bears failed.

Unfortunately, by the time we discovered the failures, we were unable to locate a helicopter within a reasonable distance of the study area to attempt retrieval of the collars. The closest available helicopter was located in Fairbanks, Alaska. The estimated cost at that time for retreiving the 6 satellite PTT's was prohibitive (i.e., exceeding $10,000). Hopefully, the VHF units will continue to function long enough to allow us to retrieve the units in the spring of 1990 so that we can determine the reasons for the high failure rate.

High failure rates of satellite radio collars deployed on brown bears have been reported elsewhere in Alaska. Harris et al. (1990) reported that of the 11 PTT's deployed on brown bears in 1987, eight had been programmed to transmit through the denning season into May, while the remaining three had been programmed similarly to the ones in this study; i.e., to cease transmission while in the den and then resume transmission at den emergence the following spring. Of those 11 collars, 1 bear shed its collar, while 9 of 10 of the remaining collars failed. The one remaining functioning collar transmitted for 3 weeks, and then it failed as well. The 3 collars that were programmed similiarly to the ones in this study had not been programmed properly and did not resume transmission. We wondered if the same problem had occurred in this study as well, but Telonics indicated their records indicated that our PTT's had been programmed properly.

Aside from not receiving much data from the bear PTT's during the second summer, the study also lost $9,100 in data processing costs, which had been paid in advance at the beginning of the year. Telonics policy regarding satellite PTT's stipulates no liability, unless it can be shown that the failure was related to flaws in their design or workmanship. Since 1987 and 1988, several additional PTT's have been deployed on grizzly bears with transmission programming similar to that attempted in this study. Unfortunately, these units had the same failure rates as those reported here. At this point it appears that the PTT's undergo severe stresses either during denning or immediately after den emergence, resulting in complete failure of the PTT. Thus far these stresses have not yet effected the VHF units. In spite of nearly complete failure of the satellite PTT's during the 2nd season, it may still be more cost effective to use satellite PTT's in lieu of conventional telemetry, depending on project objectives.

During the past 2 years we have maintained from 30 to 40 conventional VHF transmitters on grizzly bears. Including commute time from Kotzebue to the study area, we were able to locate about 2 radio-collared bears per hour flight time in a PA-18 Supercub. At current commercial charter rates of $135 per hour, each bear relocation costs about $68, excluding costs of

radio collars and personnel. By comparison, costs for satellite collars and data processing during the 2nd season (i.e., using only relocation classes $\geq$ 1), the average cost per relocation was about $37. If we had not paid the data processing costs for the 2nd year when there were no data and dropped special processing, which appears warranted, the average cost per relocation would have been about $27. Therefore, on a basis of cost per relocation, satellite telemetry is much more cost-effective than conventional telemetry. More importantly, relocations are obtained consistently on a daily basis, regardless of inclement weather. These factors suggest that if the principal objectives of a project were to estimate home range sizes, movement patterns, and habitat utilization, then satellite telemetry is far superior to conventional telemetry. The primary limitations would be the numbers of bears that could be sampled because of the high cost per PTT; however, most studies that use conventional telemetry methods do not obtain enough relocations per season for each animal to properly measure home range sizes or movement patterns. For example, in this study the greatest number of relocations obtained for any bear using conventional telemetry was 22, an inadequate sample for most analyses. If on the other hand, other types of data, such as productivity and predation rates, are important project objectives, then conventional methods would be needed; however even in these cases the VHF unit on the satellite collar could be used using conventional telemetry techniques.

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LITERATURE CITED

Ballard, W. B. 1987. Demography of Noatak grizzly bears in relation to human exploitation and mining development. Alaska Dep. Fish and Game, Fed. Aid in Wildl. Rest. Prog. Rep. Proj. W-22-5 and W-22-6. Juneau. 45pp.

_____, S. D. Miller, and T. H. Spraker. 1982. Home range, daily movements, and reproductive biology of brown bear in southcentral Alaska. Can. Field-Nat. 96(1):1-5.

_____, K. E. Roney, D. N. Larsen, and L. A. Ayres. 1988. Demography of Noatak grizzly bears in relation to human exploitation and mining development. Alaska Dep. Fish and Game, Fed. Aid in Wildl. Rest. Prog. Rep. Proj. W-22-5 and W-22-6, Job 4.20. Juneau. 100pp.

_____, _____, and L. A. Ayres. 1989a. Demography of Noatak grizzly bears in relation to human exploitation and mining development. Alaska Dep. Fish and Game, Fed. Aid in Wildl. Rest. Prog. Rep. Proj. W-23-1, Study 4.20. Juneau. 58pp.

_____, _____, _____, and D. N. Larsen. 1989b. Application of mark-recapture techniques for assessing bear densities in relation to human exploitation and mining development. Int. Conf. Bear Res. and Manage. 8:In press.

_____, L. A. Ayres, S. G. Fancy, D. J. Reed, K. E. Roney, and M. A. Spindler. 1990. Demography and movements of wolves in relation to the western arctic caribou herd of northwestern Alaska. Alaska Dep. Fish and Game, Spec. Proj. Rep. Juneau. 150pp.

Environmental Protection Agency and U. S. Dept. of Interior. 1984. Impact statementRed Dog Mine Project. U. S. Environmental Protection Agency. Seattle, Washington. 290pp.

Fancy, S. G., L. F. Pank, D. C. Douglas, C. H. Curby, G. W. Garner, S. C. Amstrup, and W. L. Regelin. 1988. Satellite telemetry: a new tool for wildlife research and management. U.S.D.I., Fish and Wildl. Serv. Resource Publ. 172. Washington, D. C. 172pp.

Goodwin, E. A., and W. B. Ballard. 1985. Use of tooth cementum for age determination of gray wolves. J. Wildl. Manage. 49:313-316.

Harris, R. B., S. G. Fancy, D. C. Douglas, G. W. Garner, T. R. McCabe, and L. F. Pank. 1990. Track wildlife by satellite: current systems and performance. U.S.D.I., Fish and Wildl. Serv. Resource Publ. In press. Washington, D. C. 127pp.

Miller, S. D., E. F. Becker, and W. B. Ballard. 1987. Black and brown bear density estimates using modified capture-recapture techniques in Alaska. Int. Conf. Bear Res. and Manage. 7:23-35.

Reynolds, H. V. 1976. Northslope grizzly bears studies. ADF&G. Fed. Aid in Wildl. Rest. Final Report. Project W-17-6&7. Jobs 4.8R & 4.11R. Juneau. 20pp.

_____, and J. L. Hechtel. 1985. Population structure, reproductive biology, and movement patterns of grizzly bears in the northcentral Alaska Range. Alaska Dep. Fish and Game, Fed. Aid in Wildl. Rest. Prog. Rep., Proj. W-22-1. Job 4.16R. Juneau. 29pp.

Sidovovowicz, G. A., and F. F. Gilbert. 1981. The management of grizzly bears in the Yukon, Canada. Wildl. Soc. Bull. Vol. 9 No. 2. 129-135 pp.

Spraker, T. H., W. B. Ballard, and S. D. Miller 1981. Feeding behavior of Interior brown bears. Alaska Dep. Fish and Game, Fed. Aid in Wildl. Rest. Prog. Rep., Proj. W-17-10, W-17-11, and W-21-1. Job 4.13. Juneau. 57pp.

Taylor, Jr., W. P., H. V. Reynolds III, and W. B. Ballard. 1989. Immobilization of grizzly bears with tiletamine hydrochloride and zolazepam hydrochloride. J. Wildl. Manage. 53:978-981.

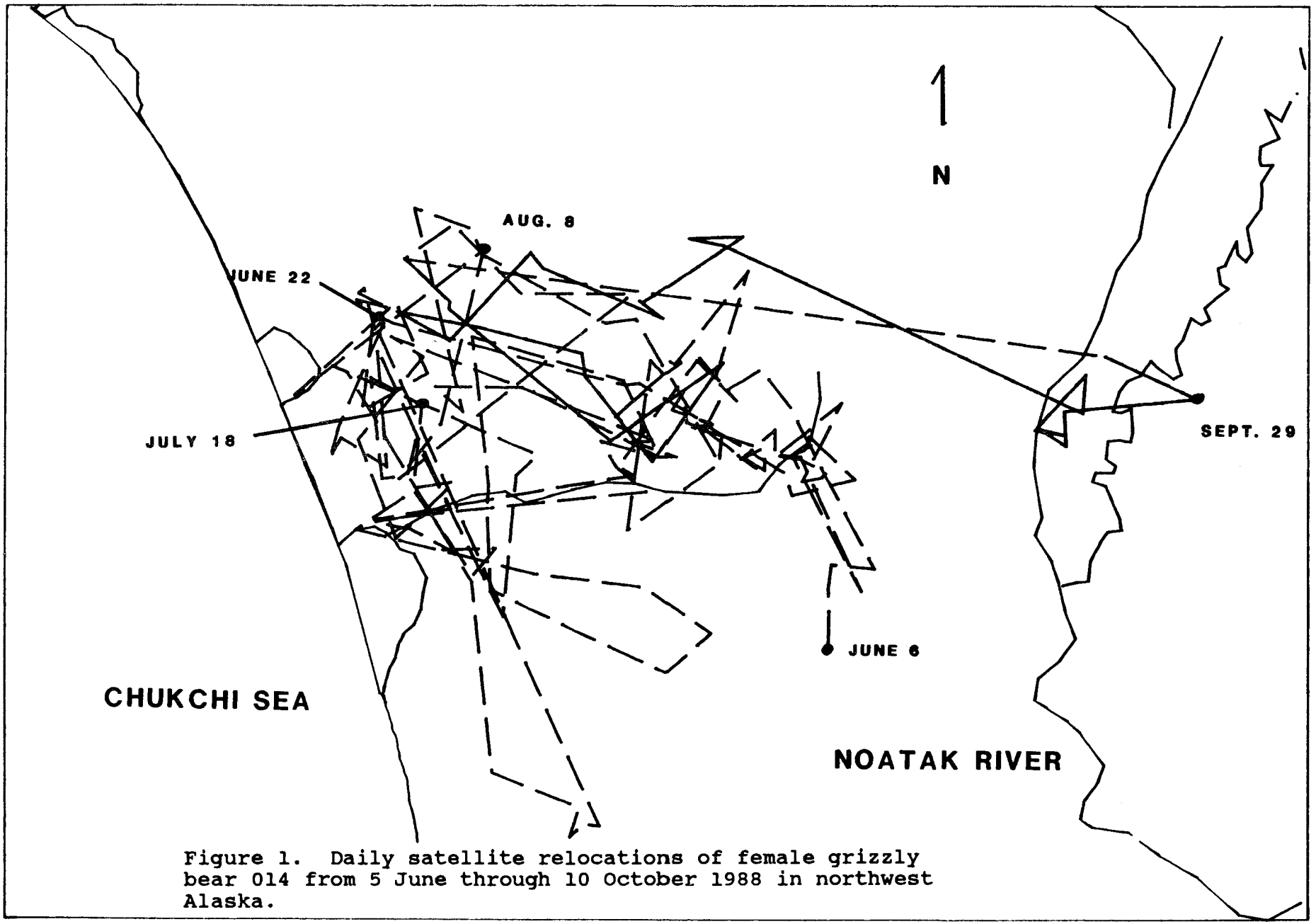

Figure 1. Daily satellite relocations of female grizzly bear 014 from 5 June through 10 October 1988 in northwest Alaska.

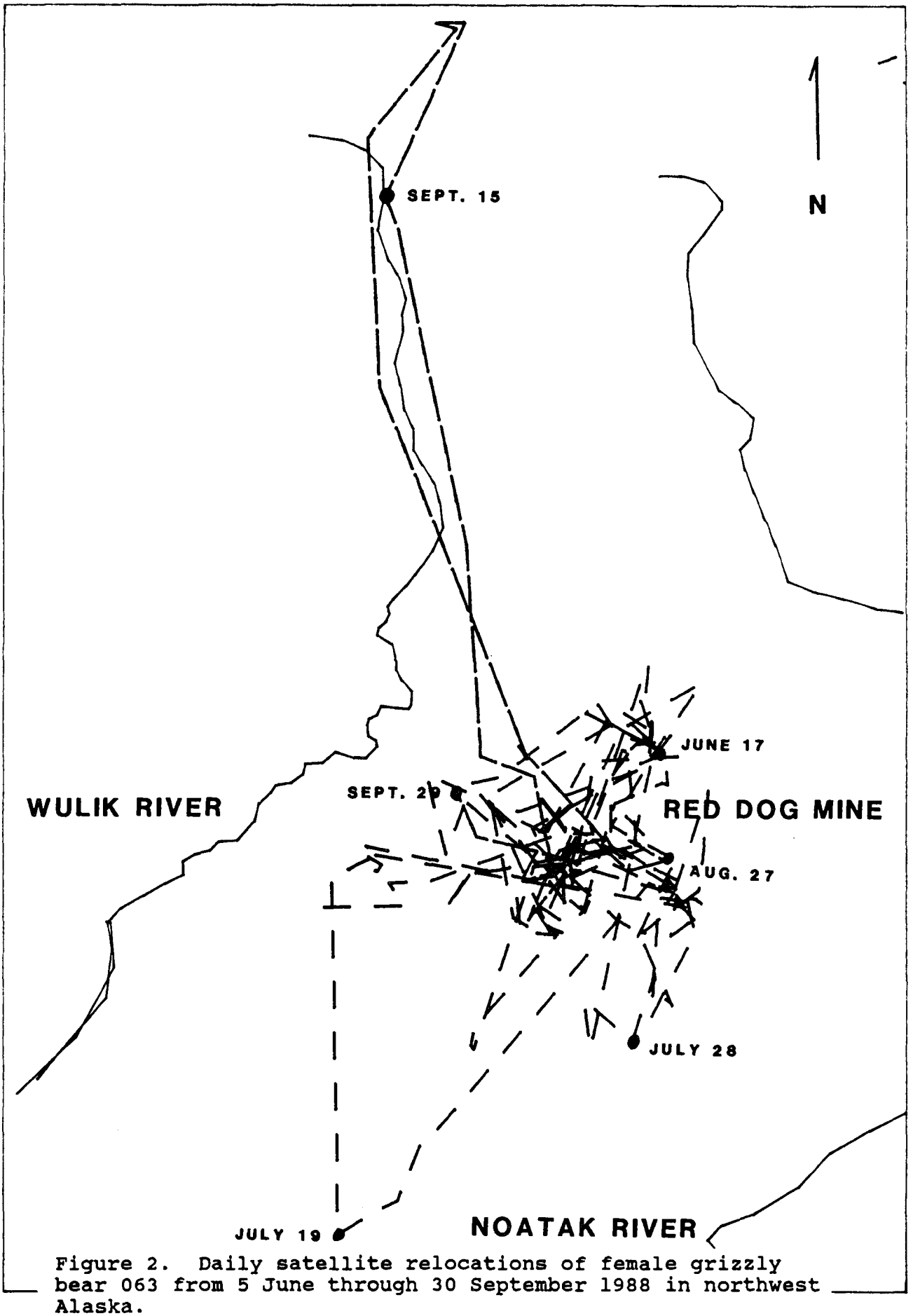

Figure 2. Daily satellite relocations of female grizzly bear 063 from 5 June through 30 September 1988 in northwest Alaska.

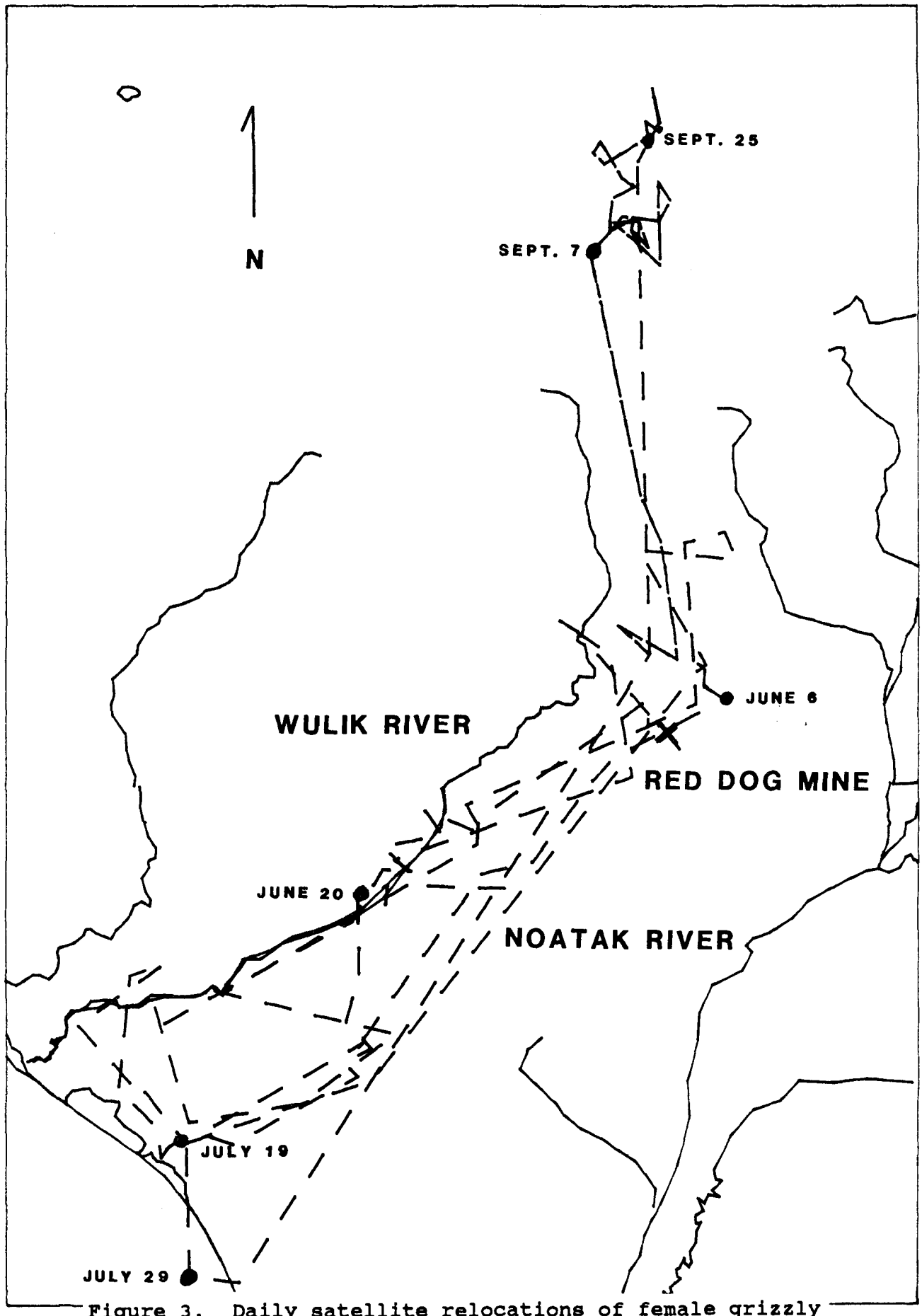

Figure 3. Daily satellite relocations of female grizzly bear 058 from 5 June through 9 October 1988 in northwest Alaska.

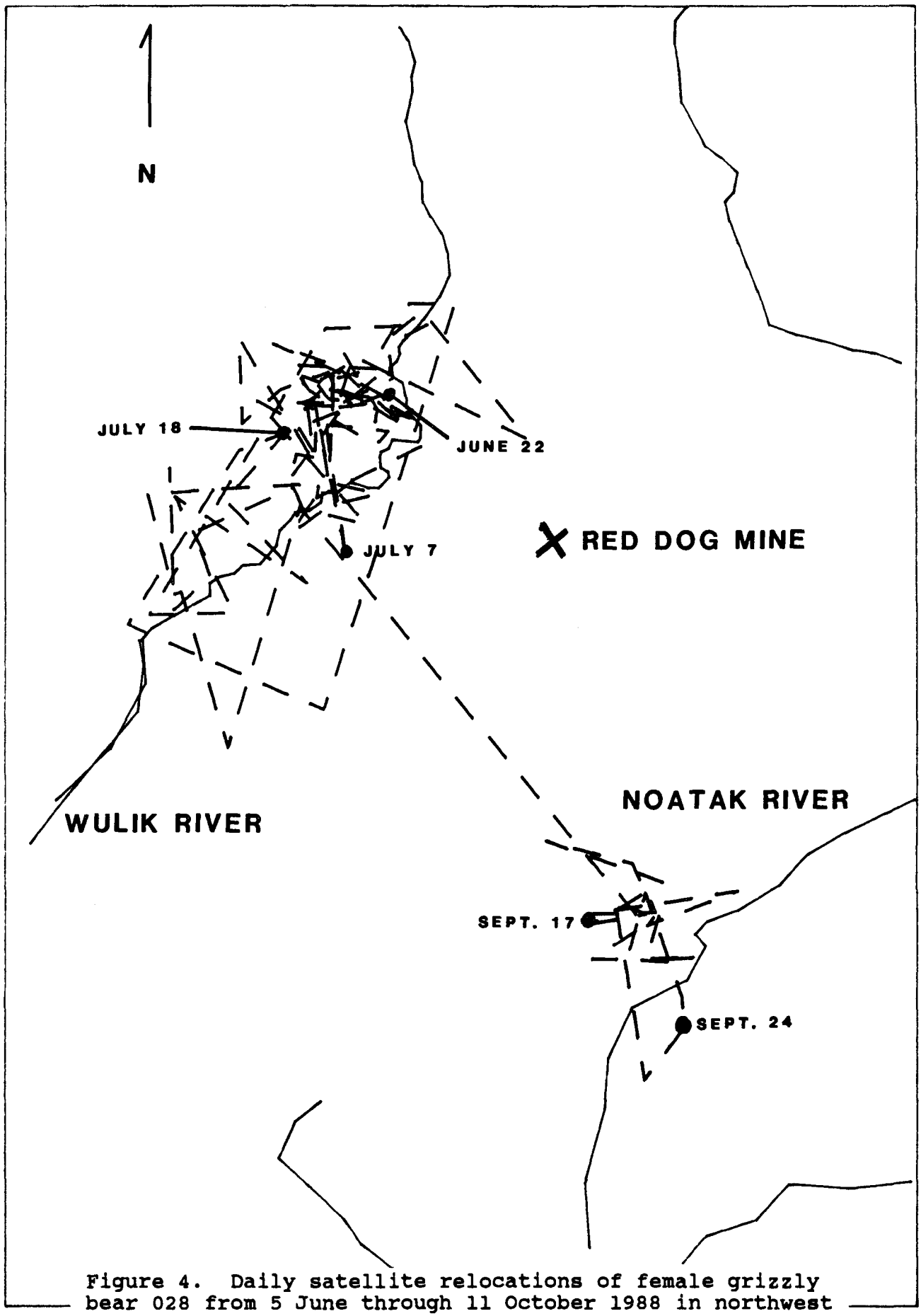

Figure 4. Daily satellite relocations of female grizzly bear 028 from 5 June through 11 October 1988 in northwest Alaska.

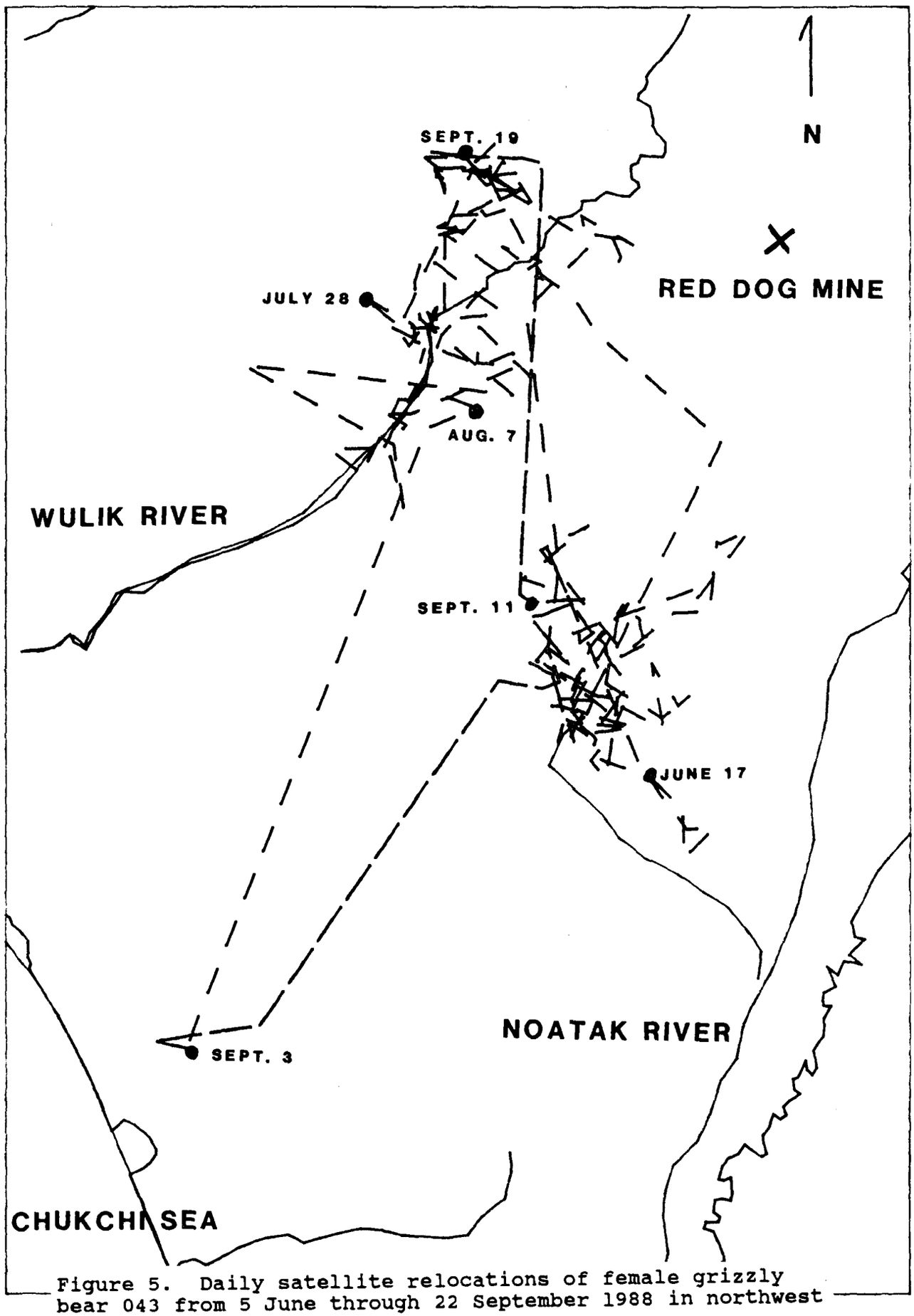

Figure 5. Daily satellite relocations of female grizzly bear 043 from 5 June through 22 September 1988 in northwest Alaska.

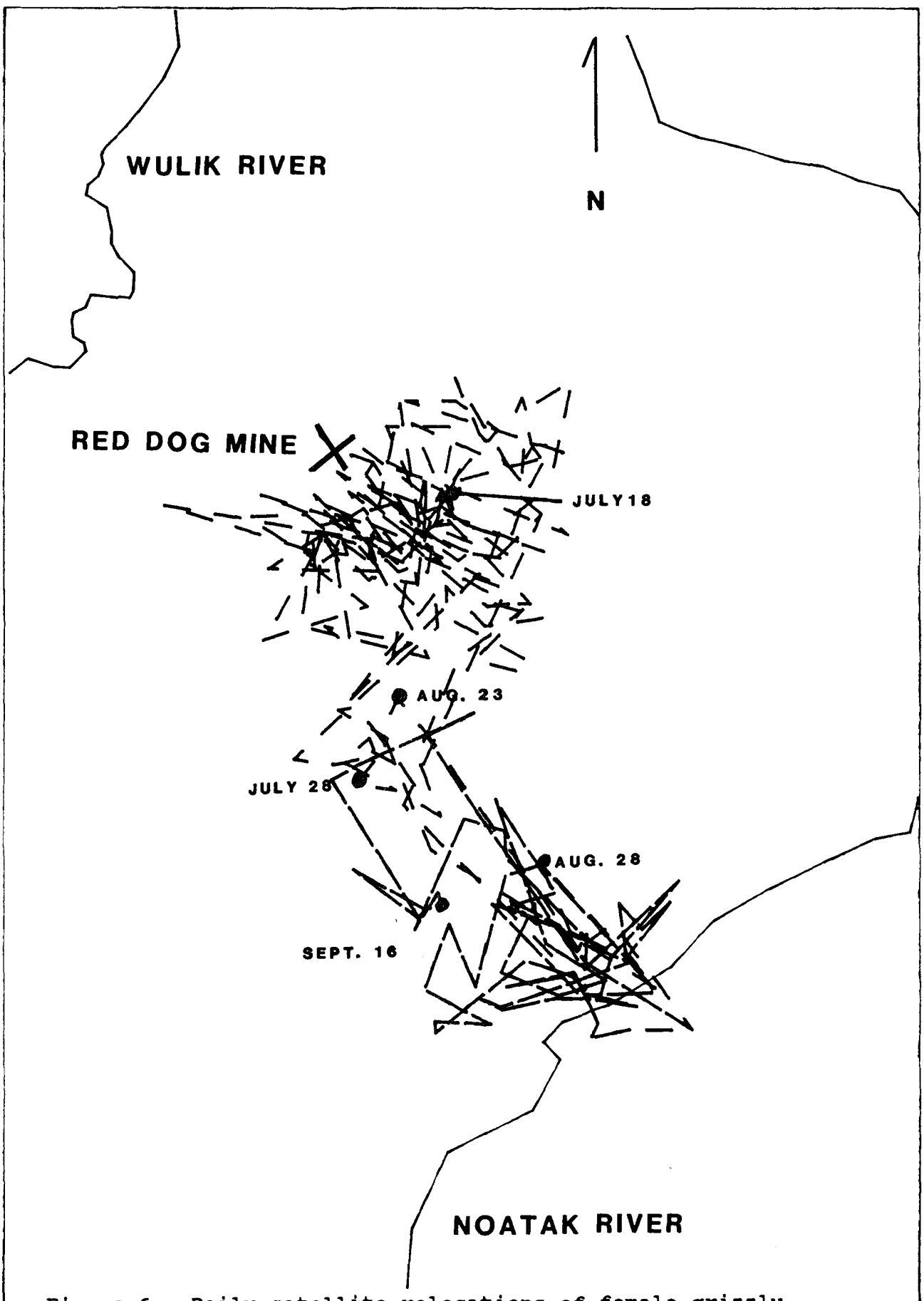

Figure 6. Daily satellite relocations of female grizzly bear 069 from 6 June through 11 October 1988 in northwest Alaska.

Table 1. Dates of capture, ages, weights, and physical measurements of female grizzly bears immobilized in northwest Alaska during 1986 through 1989.

Bear ID	Date	Age (yrs)	Weight[a] (kg)	Head length (mm)	Head width (mm)	Head length plus width (mm)	Neck (mm)	Total length (mm)	Heart girth (mm)
001	31 May 86	5.5	106.6	335.0	206.5	541.5	587.5	1733.6	1104.9
001	07 Jun 88	7.5		336.6	206.5	543.1	711.2	1727.2	1282.7
002	31 May 86	5.5	95.3	327.2	187.5	514.7		1803.4	
002	06 Jun 88	7.5		336.6	195.3	531.9	584.20	1727.2	
004	01 Jun 86	6.5	102.1	323.0	186.0	509.0		1866.9	1130.3
004	06 Jun 88	8.5	117.9	327.2	196.9	524.1	635	1714.5	
004	30 May 89	9.5	108.9	329.0	199.0	528.0	571.5	1651.0	1104.9
005	01 Jun 86	0.5	9.8	165.1	100.1	265.2	250.0	793.8	441.5
006	01 Jun 86	0.5	12.7	171.5	103.1	274.6	289.1	844.6	
008	02 Jun 86	4.5	95.3	306.3	193.8	400.1	520.7	1752.6	1060.5
008	07 Jun 88	6.5	104.3	330.2	200.2	530.4	647.7	1765.3	1092.2
009	02 Jun 86	13.5	112.5	325.0	215.0	540.0	609.6	1790.7	1162.1
009	31 May 87	14.5	129.3	346.1	215.9	562.0	736.6	1625.6	
009	29 May 89	16.5	104.3	330.2	215.9	546.1	647.7	1600.2	1117.6
011	03 Jun 86	0.5	6.0	155.7	95.3	251.0	247.7	660.4	
013	03 Jun 86	7.5	106.6	330.2	200.2	530.4	673.1	1879.6	1193.8
014	03 Jun 86	9.5	95.3	311.2	201.7	512.9	635.0	1803.4	1092.2
014	05 Jun 88	11.5	95.0	314.5	206.5	520.0			
018	03 Jun 86	8.5	145.2	316.0	222.3	538.3		1981.2	
020	04 Jun 86	5.5	63.5	295.4	171.5	466.9	616.0	1473.2	1117.6
020	07 Jun 88	7.5	170.0	314.0	180.0	494.0	533.4	1612.9	1066.8
021	03 Jun 86	12.5	113.4	335.0	217.4	552.4		1765.3	1358.9
021	08 Jun 88	14.5	230.0	335.0	218.0	553.0	578.0	1625.6	
022	04 Jun 86	8.5	97.5	330.0	220.2	550.2	584.2	1641.6	
022	06 Jun 88	10.5		331.7	215.9	547.6	508.0	1739.9	1085.9
025	04 Jun 86	12.5	102.1	323.9	211.1	535.0	584.2	1803.4	1117.6
025	06 Jun 88	14.5	90.7	323.9	209.6	534.5	552.5	1676.4	1079.5
026	04 Jun 86	3.5	56.7E	352.6					
028	05 Jun 86	9.5	117.9	381.0	215.7	596.9	660.4	1930.4	1016.0

Table 1. (continued)

Bear ID	Date	Age (yrs)	Weight[a] (kg)	Head length (mm)	Head width (mm)	Head length plus width (mm)	Neck (mm)	Total length (mm)	Heart girth (mm)
028	05 Jun 88	11.5		304.8	215.9	520.7	654.1		
032	05 Jun 86	3.5	62.6	282.7	149.4	432.1			
032	01 Jun 87	4.5	90.7	304.8	165.1	469.9	520.7	1524.0	
033	06 Jun 86	7.5	70.3	311.2	190.5	501.7	520.7	1701.8	889.0
036	07 Jun 86	0.0	106.6E	317.5	209.6	527.1	800.1	1828.8	1168.4
038	07 Jun 86	3.5	83.9	308.0	185.0	493.0	533.4	1676.4	990.6
039	07 Jun 86	8.5	124.7	301.8	209.6	511.4	609.6	1803.4	1143.0
039	07 Jun 88	10.5	117.9	339.0	210.0	549.0	590.6	1619.3	1168.4
041	08 Jun 86	6.5	84.4	317.5	198.4	515.9	660.4	1676.4	1079.5
041	08 Jun 88	8.5		311.2	190.5	501.7	596.9	1651.0	1009.7
043	09 Jun 86	17.5	125.2	328.7	203.2	531.9	647.7	1854.2	1117.6
043	05 Jun 88	19.5	102.1	322.3	200.2	522.5			
049	28 May 87	0.5	8.2						
051	28 May 87	4.5	102.1	311.2	184.2	495.4	609.6	1574.8	
052	29 May 87	14.5		335.0	210.0	545.0		1720.0	980.0
052	29 May 89	16.5	104.3	333.5	209.6	543.1	622.3	1866.9	1117.6
053	29 May 87	7.5	102.6	327.0	208.0	535.0		1660.0	1320.0
053	27 May 89	9.5	108.8	323.9	209.6	533.5	577.9	1689.1	1092.2
054	29 May 87	5.5	56.7	340.0	167.0	507.0		1415.0	1010.0
055	29 May 87	6.5	90.7	330.2	177.8	508.0	520.7	1606.6	1092.2
055	29 May 89	8.5	104.3	319.0	200.2	519.2	558.8	1727.2	1028.7
058	30 May 87	6.5	117.9	342.9	209.6	552.5		1562.1	
058	01 Jun 87	6.5							
058	05 Jun 88	7.5		369.8	222.3	592.1			
059	30 May 87	15.5	95.3	335.0	211.1	546.1	685.8	1651.0	
059	27 May 89	17.5	108.8	339.9	219.2	559.1	603.3	1778.0	1016.0
060	30 May 87	0.5	2.7						
061	30 May 87	0.5	3.6						
062	30 May 87	0.5	3.4						

Table 1. (continued)

Bear ID	Date	Age (yrs)	Weight[a] (kg)	Head length (mm)	Head width (mm)	Head length plus width (mm)	Neck (mm)	Total length (mm)	Heart girth (mm)
063	30 May 87	12.5	104.3	331.8	209.6	541.4	558.8	1739.9	
063	05 Jun 88	12.5	129.3	362.0	179.3	541.3		1854.2	1066.8
065	31 May 87	9.5	113.4	292.1	190.5	482.6		1651.0	1092.2
065	27 May 89	11.5	81.6	330.2	196.9	527.1	533.4	1651.0	990.6
066	31 May 87	3.5	59.0	298.5	165.1	463.6		1511.3	
067	31 May 87	4.5	104.3	319.1	193.7	512.8	635.0	1524.0	
067	28 May 89	6.5		317.5	190.5	508.0	609.6	1562.1	1130.3
069	02 Jun 87	10.5	111.1	336.6	204.8	541.4		1727.2	1092.2
069	06 Jun 88	11.5	104.3	339.9	209.6	549.5	596.9	1778.0	1022.4
070	02 Jun 87	3.5	90.7	317.5	190.5	508.0	546.1	1562.1	965.2
070	30 May 89	5.5		336.6	201.7	538.3	520.7	1657.4	1143.0
071	02 Jun 87	3.5	81.6E	301.6	182.6	484.2	584.2		
074	04 Jun 87	9.5	117.9	336.6	220.7	557.3	723.9	1702.1	
074	28 May 89			341.4	215.9	557.3	666.8	1606.6	1168.4
075	05 Jun 88	2.5	38.6	301.8	165.1	466.9	533.4	1549.4	939.8
077	06 Jun 88	0.5	9.5	165.1	098.6	263.7	241.3	838.2	457.2
079	06 Jun 88	0.5	7.5	158.8	098.6	257.4	254.0	711.2	406.4
080	06 Jun 88	0.5	6.8	152.4	098.6	251.0	228.6	635.0	457.2
081	06 Jun 88	10.5	113.4	350.8	204.7	554.5	622.3	1663.7	1124.0
085	07 Jun 88	0.5	6.8	155.7	095.3	251.0	228.6	698.5	
086	07 Jun 88	0.5	6.8	155.7	095.3	251.0	228.6	637.1	254.0
087	07 Jun 88		56.3	276.4	155.7	432.1		1358.9	787.4
090	07 Jun 88	0.5	10.0	168.4	104.9	273.3	254.0	749.3	406.4
092	08 Jun 88	1.5	21.7	215.9	122.2	338.1	355.6	1041.4	
095	08 Jun 88	6.5	90.7	330.2	185.7	515.9	568.5	1473.2	1060.5
096	09 Jun 88	14.5	93.0	327.2	184.2	511.4	622.3	1638.3	1003.3
097	09 Jun 88		114.7	311.2	200.2	511.4	635.0	1587.5	1066.8
098	09 Jun 88	15.5	104.3	317.5	209.6	527.1	609.6	1676.4	990.6
099	09 Jun 88	0.5	7.7	155.7	092.2	247.9	228.6	635.0	381.0

Table 1. (continued)

Bear ID	Date	Age (yrs)	Weight[a] (kg)	Head length (mm)	Head width (mm)	Head length plus width (mm)	Neck (mm)	Total length (mm)	Heart girth (mm)
102	28 May 89			335.0	225.6	560.6	762.0	1549.4	
103	28 May 89		149.6	344.4	208.0	552.4	685.8	1866.9	1206.5
104	28 May 89	1.5	36.3	227.1	136.7	363.8	419.1	1104.9	723.9
107	28 May 89	1.5	29.5	222.3	131.8	354.1	393.7	965.2	
109	29 May 89	1.5	31.7	208.0	127.0	335.0	355.6	1092.2	609.6
117	30 May 89		124.7	341.0	218.0	559.0	609.6	1676.4	
120	31 May 89		102.0	330.2	198.4	528.6	609.6	1587.5	1498.6

[a] Weight data denoted by an "E" represents estimated weights.

Table 2. Physical measurements, reproductive status, blood values, and ear tag numbers of female grizzly bears immobilized in northwest Alaska during 1986 through 1989.

Bear ID	Dates	Canine teeth				Status					Left ear tag[h]	Right ear tag	Drug used[i]
		Upper Ant-Post[a] (mm)	Upper lab-ling[b] (mm)	Lower Ant-Post (mm)	Lower lab-ling (mm)	L[c]	Rep[d]	Con[e]	HB[f]	PCV[g]			
001	31 May 86	R17.3	R13.9	R20.3	R19.7	Y	2	3	20.0	58.5	WD2235	WD2231	PHCL
001	07 Jun 88					Y	3	2	18.0	47.0	WD2231	WD2235	TELA
002	31 May 86	U16.0	U11.4	U17.1	U12.3	N	1	2	18.0	53.5	WD2233	WD2243	PHCL
002	06 Jun 88					N	3		15.0	48.0	R112	WD2243	TELA
004	01 Jun 86	R20.8	R14.9	R19.8	R13.2	Y	2	3	20.0	49.0	WD2276	WD2298	PHCL
004	06 Jun 88					Y	3	1	18.5	54.0	R186	R187	TELA
004	30 May 89					Y	3	2	17.0	50.0	R186	R187	TELA
005	01 Jun 86								17.5	42.5	WD2236	WD2270	PHCL
006	01 Jun 86							3	17.0	45.0	WD2286	WD2290	PHCL
008	02 Jun 86	L15.6	L11.6	L17.9	L12.4	N	3	1	18.5	55.5	WD2282	WD2296	PHCL
008	07 Jun 88					Y	2	3	18.0	47.0	R122	WD2296	TELA
009	02 Jun 86					Y	1	3	17.0	44.0	WD2300	WD2287	PHCL
009	31 May 87					Y	2	2			WD2300	WD2287	TELA
009	29 May 89	L15.1	L12.1	L15.7	L10.9	N		2	17.0	51.0	Y2300	Y2287	TELA
011	03 Jun 86							1	16.0	42.0	WD2203	WD2241	PHCL
013	03 Jun 86	R20.2	R14.1	R20.5	R17.4	Y	2	4	20.0	51.5	WD2237	WD2246	PHCL
014	03 Jun 86	R16.1	R12.1	L17.5	L12.6	Y	2	4	17.0	46.0	WD2283	WD2297	PHCL
014	05 Jun 88						3				WD228	R125	TELA
018	03 Jun 86					Y	1	4	18.5	50.0	WD2291	WD2295	PHCL
020	04 Jun 86	L20.6	L11.3	L17.1	L12.4	N	1	4	19.5	54.5	WD2242	WD2240	PHCL
020	07 Jun 88					Y	2	4	19.5	52.0	WD2242	WD2240	TELA
021	03 Jun 86	U17.1	U12.1	U17.3	U13.1	Y		2	18.5	47.5	WD2212	WD2227	PHCL
021	08 Jun 88					Y		2	15.5	43.0	R121	R120	TELA
022	04 Jun 86	R18.2	R10.9	R19.2	R13.0	Y	2	4	19.1	47.3	WD2211	WD2202	PHCL
022	06 Jun 88					Y	2		15.0	46.0	WD2211	WD2202	TELA
025	04 Jun 86					N	1	3	19.9	55.0	WD2292	WD2293	PHCL
025	06 Jun 88					Y	2	3	18.0	47.0	R124	R123	TELA

Table 2. (continued)

Bear ID	Dates	Canine teeth: Upper Ant-Post[a] (mm)	Upper labling[b] (mm)	Lower Ant-Post (mm)	Lower labling (mm)	Status: L[c]	Rep[d]	Con[e]	HB[f]	PCV[g]	Left ear tag[h]	Right ear tag	Drug used[i]
026	04 Jun 86					N	2	3			WD2239	WD2238	M 99
028	05 Jun 86	R16.1	R10.0	R15.0	R09.8	Y	2	3	20.0	52.0	OD2550	OD2579	M 99
028	05 Jun 88					Y	3	3	17.5	50.0	R2550	R2579	TELA
032	05 Jun 86	L15.0	L11.9	L15.1	L12.4	N	2	4	17.5	49.5	WD2232	WD2245	M 99
032	01 Jun 87					2	2	3	16.5	43.0	WD2232	WD2445	TELA
033	06 Jun 86	L17.7	L15.3	L14.9	L12.5	N	1	4	20.0	55.5	WD2249	WD2244	M 99
036	07 Jun 86	L18.4	L13.7	L18.7	L13.0	Y	1	4					M 99
038	07 Jun 86					N		2	19.5	49.5	WD2277	WD2299	M 99
039	07 Jun 86	L17.3	L13.7	L18.1	L12.5	Y	1	4	19.0	48.0	WD2204	WD2210	M 99
039	07 Jun 88					Y	2	2	17.5	44.0	WD2204	WD2210	TELA
041	08 Jun 86	L15.2	L13.5	L17.1	L15.2	N	1	4	19.0	52.5	WD2234	WD2228	M 99
041	08 Jun 88					Y	2	2	16.5	46.0	WD2234	WD2228	TELA
043	09 Jun 86	L16.3	L13.2	L15.2	L13.1	N	1	2	18.0	53.0	WD2230	WD2250	M 99
043	05 Jun 88					Y	3	2	17.5	52.0	WD2230	WD2250	TELA
049	28 May 87								17.0	40.3			TELA
051	28 May 87	L16.7	L13.8	L16.6	L12.8	Y	1	3	19.5	45.5	BL0762	BL0761	TELA
052	29 May 87					Y	2	4	18.0	42.8	BLO750	BL0749	TELA
052	29 May 89	L19.0	L13.5	L19.9	L12.81	Y	3	3	19.0	45.0	BL750	BL749	TELA
053	29 May 87					Y	2	2			BL0737	BL0736	TELA
053	27 May 89	R16.5	R11.8	17.35	12.05	Y	2	3	13.0	49.0	BL737	BL736	TELA
054	29 May 87					N	2	5	17.0	42.3	BL0753	BL0751	TELA
055	29 May 87					Y	2	5					TELA
055	29 May 89	L16.2	L12.2	L17.3	L13.3	Y	2	4	20.0	50.0	BL755	BL754	TELA
058	30 May 87					Y	2	4	17.5	45.8	BL0757	BL0758	TELA
058	01 Jun 87												TELA
058	05 Jun 88					Y	3	2	14.0	48.0	BL757	BL758	TELA
059	30 May 87					Y	2	5	20.0	44.5	BL0732	BL0733	TELA
059	27 May 89	R17.7	R13.4	R18.5	R14.4	Y	2	3	16.0	46.0	BL733	BL732	TELA

Table 2. (continued)

Bear ID	Dates	Canine teeth				Status					Left ear tag[h]	Right ear tag	Drug used[i]
		Upper Ant-Post[a] (mm)	Upper lab-ling[b] (mm)	Lower Ant-Post (mm)	Lower lab-ling (mm)	L[c]	Rep[d]	Con[e]	HB[f]	PCV[g]			
060	30 May 87												TELA
061	30 May 87												TELA
062	30 May 87												TELA
063	30 May 87					Y	2		20.0	48.0	BL0748	BLO747	TELA
063	05 Jun 88					Y	3	3	17.5	53.0	BL748	BL747	TELA
065	31 May 87					Y	1	4	20.0	50.0	BL0729	BL0728	TELA
065	27 May 89	R17.6	R12.3	R18.7	R13.1	Y	3	4	17.5	50.0	BL729	BL728	TELA
066	31 May 87		L11.7	L15.6	L10.6	N	2	4	18.3	42.0	BL0745	BL0727	TELA
067	31 May 87					N	1	4	20.0	37.5	BL0738	BL0739	TELA
067	28 May 89					Y		2	15.5	41.0	BL738	BL739	TELA
069	02 Jun 87					Y	1	4	16.5	52.8	RD1273	RD1041	TELA
069	06 Jun 88					Y	2	3	17.0	47.0	R1273	R1041	TELA
070	02 Jun 87					Y	1	4	18.5	46.5	RD1274	RD1262	TELA
070	30 May 89	L17.6	L12.2			Y	2	4	20.0	54.0	R1274	R1262	TELA
071	02 Jun 87					N	1	4	18.0	43.5	RD1114	RD1287	TELA
074	04 Jun 87					y	4	3	19.0	45.5	BL0760	BL0764	TELA
074	28 May 89	L16.8	L13.0			Y	2		11.0	32.0	BL764	BL760	TELA
075	05 Jun 88					N	2	4			R199	R200	TELA
077	06 Jun 88										R550	R548	TELA
079	06 Jun 88					N			17.5	45.0	R1256	R574	TELA
080	06 Jun 88					N			16.5	40.0	R1288	R543	TELA
081	06 Jun 88					N	3	2	16.5	46.0	R184	R185	TELA
085	07 Jun 88								18.0	43.0	BL763	BL766	TELA
086	07 Jun 88								16.0	43.0			TELA
087	07 Jun 88					N	2		18.5	49.0	R110	R111	TELA
090	07 Jun 88								16.0	39.0	R109	R108	TELA
092	08 Jun 88							3	18.0	46.0	R196	R195	TELA
095	08 Jun 88					N	3	1	18.0	50.0	R116	R115	TELA

Table 2. (continued)

Bear ID	Dates	Canine teeth: Upper Ant-Post[a] (mm)	Upper lab-ling[b] (mm)	Lower Ant-Post (mm)	Lower lab-ling (mm)	Status: L[c]	Rep[d]	Con[e]	HB[f]	PCV[g]	Left ear tag[h]	Right ear tag	Drug used[i]
096	09 Jun 88					Y	3	4	19.0	51.0	R150	R149	TELA
097	09 Jun 88					Y	3	3	20.0	40.0	R134	R135	TELA
098	09 Jun 88					Y		3	18.0	43.0	R118	R117	TELA
099	09 Jun 88								18.0	42.0	R103	R104	TELA
102	28 May 89					Y	3	2			R28	R29	TELA
103	28 May 89	L17.5	L13.6	R18.0	R13.1	Y	3		19.0	57.0	R143	R144	TELA
104	28 May 89	L8.1						2	14.0	43.0	R139	R140	TELA
107	28 May 89	L7.4	L6.6	L6.4	L6.3			4	14.0	52.0	R35	R34	TELA
109	29 May 89	R3.9	R3.3	R4.8	R3.7			2	16.5	39.0	R42	R41	TELA
117	30 May 89					Y	2	3			R22	R21	TELA
120	31 May 89										R23	R24	TELA

a Ant. = Anterior, Post. = Posterior.
b lab. = labial, ling. = lingual.
c Lactating: Y = yes, N= no.
d Reproductive status: 1 = in estrus, 2 = not in estrus, 3 = pre-estrus, 4 = post-estrus.
e Condition: subjective evaluation from 1 = excellent through 5 = poor
f % hemoglobulin.
g Packed cell volume.
h OD = orange duflex, WD = white duflex, BL = blue roto, RD = red roto.
i PHCL = Phencylindire Hydrochloride (Sernylan); TELA = Tiletamine Hydrocholoride/ Zolazepan Hydrochloride mixture, also known as Telazol; M99 = Etorphine Hydrocholoride.

Table 3. Dates of capture, ages, weight, and physical measurements of male grizzly bears immobilized in northwest Alaska during 1986 through 1989.

Bear ID	Date	Age (yrs)	Weight[a] (kg)	Head length (mm)	Head width (mm)	Head length plus width (mm)	Neck circum. (mm)	Total length (mm)	Girth (mm)
003	31 May 86	7.5	186.9	384.3	228.6	612.9	838.2	1828.8	1320.8
003	28 May 89	10.5	170.1	363.5	239.8	603.3	762.0	1784.4	1536.7
007	02 Jun 86	8.5	176.9	317.5	225.6	547.1	547.1	1663.7	1308.1
010	02 Jun 86	11.5	222.3E	360.4	251.0	611.4	927.1	1892.3	
010	29 May 87	12.5							
012	02 Jun 86	12.5	215.5	311.2	257.3	568.5	800.1	2184.4	1384.3
012	08 Jun 86	12.5	215.5						
015	03 Jun 86	0.5	6.0	152.4	108.0	260.4	247.7	660.4	
016	03 Jun 86	0.5	7.0	162.1	95.3	257.4	279.4	679.5	
017	03 Jun 86	2.5	36.3	235.0	138.2	373.2	381.0	1219.2	736.6
019	04 Jun 86	11.5	181.4E	384.3	241.3	625.6	838.2	1752.6	1378.0
023	04 Jun 86	1.5	35.4	230.1	134.9	365.0	406.4	1270.0	
024	04 Jun 86	8.5	197.3	339.9	247.7	587.6	774.7	2013.0	1282.7
027	05 Jun 86	8.5	152.0	340.0	223.0	563.0	685.8	2120.9	1244.6
029	05 Jun 86	7.5	192.8	368.3	231.9	600.2	889.0	2184.4	
030	05 Jun 86	11.5	220.0	384.3	257.3	641.6	965.2	1676.4	1524.0
031	05 Jun 86	3.5	86.2	325.0	177.0	502.0	660.4	1778.0	927.1
031	04 Jun 87	4.5	102.1	335.0	193.7	528.7	577.9	1828.8	
031	08 Jun 88	5.5	140.6	357.1	204.7	561.8	596.9	1759.0	1155.7
034	07 Jun 86	5.5	140.6	342.9	209.6	552.5	660.4	1828.8	1117.6
034	05 Jun 88	7.5	172.3	368.3	220.7	589.0	673.1	1816.4	1168.4
035	07 Jun 86	5.5	97.5	342.0	187.0	529.0	558.8	1816.1	965.2
035	03 Jun 87	6.5	133.8	330.2	200.0	530.2		1778.0	
037	07 Jun 86	2.5		306.3	184.2	409.5	641.4	1612.9	
040	07 Jun 86	7.5	197.3	347.0	239.0	586.0	850.9	2184.4	1320.8
040	27 May 89	10.5	215.4	416.1	251.0	667.1	838.2	1905.0	1333.5
042	08 Jun 86	4.5	104.3	310.0	178.0	488.0	609.6	1778.0	1041.4
042	27 May 89	7.5	165.6	371.6	260.4	632.0	711.2	1962.2	1308.1
044	08 Jun 86	7.5	197.3	365.3	230.1	595.4	876.3	1879.6	

Table 3. (continued)

Bear ID	Date	Age (yrs)	Weight[a] (kg)	Head length (mm)	Head width (mm)	Head length plus width (mm)	Neck circum. (mm)	Total length (mm)	Girth (mm)
045	09 Jun 86	8.5	176.9	365.3	222.3	587.6	673.1	1866.9	
046	09 Jun 86	8.5	183.7	365.3	230.1	595.4	736.6	1866.9	
046	27 May 89	11.5	204.1	400.1	244.6	644.7	825.5		
048	28 May 87	0.5	10.0						
050	28 May 87	5.5	136.1	371.5	208.0	579.5	660.4	1759.0	1219.2
050	09 Jun 88	6.5	142.8	381.0	223.0	604.0	635.0	2032.0	1231.9
056	29 May 87	4.5	181.4	342.9	190.5	533.4	660.4		1143.0
056	29 May 89	6.5	192.8	368.3	241.3	609.6	685.8	1828.8	1193.8
057	30 May 87	3.5	147.4	320.7	184.2	504.9	558.8	1524.0	990.6
064	30 May 87	12.5	222.3	398.5	238.1	636.6		2070.1	1422.4
068	31 May 87	13.5	272.2E	374.7	260.4	635.1	863.6	2311.4	
072	02 Jun 87	6.5	179.2	360.4	222.3	582.7	736.6	1847.9	1295.4
072	27 May 89	8.5	204.1	379.5	242.8	622.3	781.1	1886.0	1676.4
073	04 Jun 87	5.5	126.1	360.4	204.8	565.2	685.8	1765.3	1257.3
073	08 Jun 88	6.5	165.5	369.8			673.1	1835.2	
076	06 Jun 88	0.5	10.4	171.5	101.6	273.1	254.0	876.3	457.2
078	06 Jun 88	0.5	13.2	174.8	104.9	279.7	279.4	762.0	457.2
082	07 Jun 88	9.5	72.6	279.4	165.1	444.5	508.0	1320.8	
083	07 Jun 88	9.5	231.3	400.1	251.0	651.1	863.6	2209.8	1422.4
084	07 May 88	0.5	11.3	168.4	098.6	266.0	241.3	800.1	
088	07 Jun 88	0.5	10.4	168.4	104.9	273.3	304.8	825.5	457.2
089	07 Jun 88	0.5	10.9	165.1	104.9	270.0	254.0	825.5	431.8
091	08 Jun 88		19.0	203.2	120.7	323.9	355.6	952.5	533.4
093	08 Jun 88	0.5	6.8						
094	08 Jun 88	0.5	6.8						
100	27 May 89	0.5	8.8	184.2	101.6	285.8	279.4	736.6	
101	27 May 89	0.5	11.3						
105	28 May 89	1.5	31.8	235.0	136.7	371.7	393.7	1117.6	
106	28 May 89	1.5	40.8	242.8	134.9	377.7	419.1	1200.2	711.2

Table 3. (continued)

Bear ID	Date	Age (yrs)	Weight[a] (kg)	Head length (mm)	Head width (mm)	Head length plus width (mm)	Neck circum. (mm)	Total length (mm)	Girth (mm)
108	29 May 89		172.4	369.0	214.0	583.0	863.6	1809.8	1219.2
110	29 May 89	1.5	43.1	247.7	139.7	387.4	406.4	1143.0	698.5
111	29 May 89	0.5	9.1	163.0	106.0	269.0	235.0	714.5	393.7
112	29 May 89	0.5	9.1	166.0	100.0	266.0	250.0	720.0	365.0
113	29 May 89		233.6	387.4	263.7	651.1	939.8	1917.7	1333.5
114	30 May 89	0.5	7.0	152.4	095.3	247.7	241.3	711.2	406.4
115	30 May 89	0.5	10.0	157.2	109.5	266.7	228.6	736.6	381.0
116	30 May 89			336.0	212.0	548.0	609.6	1701.8	1092.2
118	30 May 89	0.5	8.7	187.0	098.0	285.0	270.0	780.0	400.1
119	30 May 89	0.5	7.2	189.0	094.0	283.0	455.0	620.0	
121	31 May 89	0.5	9.0	168.4	115.8	284.2	254.0	689.1	406.4
122	31 May 89	0.5	9.3	198.4	109.5	307.9	247.7	663.7	419.1

[a] Weight data denoted by an "E" represent estimate weights.

Table 4. (continued)

Bear ID	Date	Canine teeth: Upper Ant-Post[a] (mm)	Upper Lab-ling[b] (mm)	Lower Ant-Post (mm)	Lower lab-ling (mm)	Con[c]	HB[d]	PCV[e]	Left ear tag[f]	Right ear tag	Drug used[g]
042	27 May 89					2	20.0	49.0	R2527	R145	TELA
044	08 Jun 86					2	18.5	48.5	OD2555	OD2554	M 99
045	09 Jun 86	R21.1	R18.4	R23.4	R13.8	3	18.5	57.0	OD2588	OD2535	M 99
046	09 Jun 86	R20.0	R14.4	R21.8	R13.4	4	20.0	52.5	OD2575	OD2562	M 99
046	27 May 89								R2575	R2562	TELA
048	28 May 87						17.8	42.3			TELA
050	28 May 87	L19.8	L18.3	L20.4	L13.4	1	19.5	47.5	BL0773	BL0774	TELA
050	09 Jun 88					3	20.0	51.0	BL773	R148	TELA
056	29 May 87					2	20.0	42.5	BL0771	BL0756	TELA
056	29 May 89	R20.5	R18.4	17.0	12.8	3	18.5	49.0	BL771	BL756	TELA
057	30 May 87					4	18.5	53.3	BL0734	BL0735	TELA
064	30 May 87					4	20.0	53.0	BL0746		TELA
068	31 May 87					4	20.0	50.0	BL0740	BL0730	TELA
072	02 Jun 87					3	20.0	46.0	RD0571	RD0575	TELA
072	27 May 89	R20.2	R14.0	20.4	15.0	1	18.0	43.0	R571	R575	TELA
073	04 Jun 87					4	20.0	51.5	BL0726	BL0743	TELA
073	08 Jun 88					2	19.0	53.0	BL726	BL743	TELA
076	06 Jun 88								R544	R545	TELA
078	06 Jun 88						15.0	39.0	R546	R547	TELA
082	07 Jun 88					3	16.5	43.0	R197	R198	TELA
083	07 Jun 88					2	19.5	53.0	R183	R182	TELA
084	07 May 88						17.0	43.0	R1255	R542	TELA
088	07 Jun 88					3	17.0	39.0	R B175	R1298	TELA
089	07 Jun 88						17.0	42.0	R1297	R1272	TELA
091	08 Jun 88					3	17.0	46.0	193	194	TELA
093	08 Jun 88					1			R107	R106	TELA
094	08 Jun 88								R102	R101	TELA
100	27 May 89						6.0	33.0	R130	R130	TELA

Table 4. Physical movements, reproductive status, blood values, and ear tag numbers of male grizzly bears immobilized in northwest Alaska during 1986 through 1989.

Bear ID	Date	Canine teeth				Con[c]	HB[d]	PCV[e]	Left ear tag[f]	Right ear tag	Drug used[g]
		Upper Ant-Post[a] (mm)	Upper Lab-ling[b] (mm)	Lower Ant-Post (mm)	Lower lab-ling (mm)						
003	31 May 86	R21.5	R15.5	L20.4	L18.6	2	20.0	61.0	OD2530	OD2534	PHCL
003	28 May 89					2	20.0	65.0	R141	R142	TELA
007	02 Jun 86	L20.2	L14.9	L20.8	L14.7	1	16.0	46.5	OD2546	OD2526	PHCL
010	02 Jun 86	R23.0	R17.7	R21.9	R15.3		20.0	58.5	OD2589	OD2544	PHCL
010	29 May 87										TELA
012	02 Jun 86	L16.9	L20.8	L19.6	L15.7	1	17.5	47.5	OD2597	OD2536	PHCL
012	08 Jun 86										M 99
015	03 Jun 86					2	18.0	43.0	OD2595	OD2546	PHCL
016	03 Jun 86					2	17.0	39.5	OD2593	OD2538	PHCL
017	03 Jun 86					3	16.0	42.5	OD2548	OD2540	PHCL
019	04 Jun 86	U22.1	U16.0	U26.6	U17.0	3	17.5	47.0	OD2598	OD2533	PHCL
023	04 Jun 86					4	18.0	49.0	OD2559	OD2569	M 99
024	04 Jun 86	L20.1	L15.0	L20.6	L14.8	2	20.0	54.5	OD2591	OD2537	PHCL
027	05 Jun 86	L19.6	L18.8	L21.6	L14.1	3	20.0	53.5	OD2553	OD2558	PHCL
029	05 Jun 86	U21.4	U14.1	U22.8	U14.1	2	20.0	57.3	OD2582	OD2586	PHCL
030	05 Jun 86	L23.6	L17.5	L22.4	L14.7	2	15.0	57.5	OD2532	OD2542	PHCL
031	05 Jun 86	L19.3	L13.7	L21.4	L14.4	3	20.0	59.5	OD2529	OD2531	M 99
031	04 Jun 87					4	20.0	53.0	OD2529	OD2531	TELA
031	08 Jun 88					3	20.0	55.0	R113	R114	TELA
034	07 Jun 86	L16.8	L12.0	L15.0	L12.0	4	17.5	54.0	OD2528	OD2592	M 99
034	05 Jun 88					1	20.0	54.0	R2528	R2592	TELA
035	07 Jun 86	L19.7	L17.8	L20.4	L19.5	3	20.0	50.5	OD2590	OD2596	M 99
035	03 Jun 87					4	18.0	46.0	OD2590	OD2596	TELA
037	07 Jun 86	U17.7	U15.4	U17.6	U15.7	3			OD2549	OD2547	M 99
040	07 Jun 86					2	20.0	55.0	OD2572	OD2585	M 99
040	27 May 89	R21.36	R14.32	R18.05	R15.62	1	17.0	50.0	R027	R026	TELA
042	08 Jun 86	R14.9	R13.0	R20.0	R13.2	3	17.5	54.0	OD2527	OD2600	M 99

Table 4. (continued)

Bear ID	Date	Canine teeth: Upper Ant-Post[a] (mm)	Upper Lab-ling[b] (mm)	Lower Ant-Post (mm)	Lower lab-ling (mm)	Con[c]	HB[d]	PCV[e]	Left ear tag[f]	Right ear tag	Drug used[g]
101	27 May 89								R132	R131	TELA
105	28 May 89					3	13.0	34.0	R30	R31	TELA
106	28 May 89	R7.2	R7.9	R9.6	R8.7	3	16.0	52.0	R138	R126	TELA
108	29 May 89	R17.8	R14.9	R20.0	R17.7	2			R37	R38	TELA
110	29 May 89					2	16.0	43.0			TELA
111	29 May 89						15.0	36.0	R33	R32	TELA
112	29 May 89						14.5	39.0	R45	R43	TELA
113	29 May 89	L22.76	L16.65	R20.53	R18.83	1	17.0	50.0	R47	R49	TELA
114	30 May 89						14.0	41.0	R12	R11	TELA
115	30 May 89						14.5	41.0	R14	R13	TELA
116	30 May 89	17.1	11.1								TELA
118	30 May 89								R20	R19	TELA
119	30 May 89					3			R18	R17	TELA
121	31 May 89						18.0	46.0	R02	R01	TELA
122	31 May 89						15.0	40.0	R13	R14	TELA

a Ant. = anterior, Post. = posterior.
b lab. = labial, ling. = lingual.
c Condition = subjective evaluation from 1 = excellent through 5 = poor.
d % hemoglobin.
e Packed cell volume.
f OD = orange duflex, WD = white duflex, BL = blue roto, RD = red roto.
g PHCL = Phencylindine Hydrocholoride (Sernylan); TELA = Tiletamine Hydrocholoride/zolazepan hydrochloride mixture (Telazol); M99 = Etorphine Hydrochloride.

Table 5. Summary of numbers of relocations, reproductive history, and status of female grizzly bears captured in the southwest Brooks Mountain Range of GMU 23 during 1986 - 1988.

Bear ID (tattoo)	No. of relocations 1986	1987	1988	1989	Status	Reproductive history
001*	13	10	11	6	Hunting mortality 8/89.	w/3 cubs at capture, w/2 cubs 5/86, 10/86, w/2 1.5 yr olds 5/87, 10/87, alone 5/88, 10/88, w/3 COY 5/89.
002*	12	15	11	2	Slipped collar 5/26 and 6/13/89, unknown.	Alone - 5/86, 10/86, 5/87, 10/87, 6/88, 9/88,
004*	13	18	11	12	Active, 1989 den site not located.	w/2 cubs 6/86-10/86, w/2 1.5 yr olds 5/87-10/87, w/2-2.5 yr olds, alone 5/89 10/89.
005					Cub of sow 04, separated by 6/8/88.	4/88, alone 10/88
006					Cub of sow 04, separated from sow by 6/8/88.	
008*	14	19	10	8	Active, 1989 den site not located.	Alone-6/86, 10/86, 5/87, 9/87, w/1 COY 6/88, 9/88 w/1 yrl. 5/89, 11/89.
009*	11	14	6	7	Hunting mortality 9/89.	Alone -6/86,10/86, 5/87, 10/87, w/2 COY-5/88, 10,88, w/2 yrl. 5/89.
011					Missing after capture (possible post-capture mortality).	
013					Capture mortality 6/86.	

Table 5. Continued

Bear ID (tattoo)	No. of relocations 1986	1987	1988	1989	Status	Reproductive history
014*	11	15	14	7	Active, 1989 den site located on 11/13/89.	w/3 cubs at cap, lost 2, w/1 cub 10/86, w/1 1.5-yr old 5/87, lost after 5/28/87, alone 5/88, 10/88, w/3 COY 5/89, w/2 COY 10/89.
018*	10				Hunting mortality 10/02/86.	
020*	10	22	13	5	Active, 1989 den site located on 10/26/89.	Alone 6/86, 10/86, 5/87, 10/87, w/2 COY 5/88, 10/88, w/1 yrl. 5/89, 10/89.
021*	8	11	10	5	Active, 1989 den site not located.	Alone 6/86, 10/86, w/4 cubs 5/87, lost 1 5/28 and 6/18, w/3 cubs 10/87, w/2 yrls 6/88[a], 9/88, 5/89, alone 10/89.
022*	10	21	13	8	Active, 1989 den site not located.	w/1 1.5 yr old 6/86, 10/86, w/1 2.5 yr old 5/2/87, missing 5/2 and 5/16/87. Alone 10/87, w/2 COY 5/88, w/1 COY 10/88, w/1 yrl. 5/89, 10/89.
025*	11	8	7	7	Active, 1989 den site located on 10/26/89.	Alone 6/86, 10/86, 5/87, 10/87, w/2 COY 5/88, 10/88, w/2 yrl. 5/89, 10/89.
026					Unknown after capture.	

Table 5. Continued

Bear ID (tattoo)	No. of relocations 1986	1987	1988	1989	Status	Reproductive history
028*	13	22	9	9	Active, 1989 den site not located.	Alone 6/86, 10/86; w/2 cubs 5/87 lost 1 7/7-7/16, may have lost other 9/30-10/13, alone 5/88, 9/88, w/3 COY 5/89, 10/89.
032*		7			Recap 6/87 w/breakaway collar, off by 8/12/87. Unknown.	
033					Unknown after capture.	
036					Capture mortality.	
038					Unknown after capture.	
039*	9	16	12	7	Active, 1989 den site not located.	Alone 6/86, 10/86, 5/87, 10/87, w/3 COY 5/88, 9/88, w/3 yrls. 5/89, 10/89.
041*	8	13	12	9	Active, 1989 den site located on 11/13/89.	Alone 6/86, 10/86, 5/87, 10/87, w/2 COY 5/88, 10/88, w/2 yrl. 5/89, 10/89.
0043*	5	20	11	5	Active, 1988 den site located on 11/13/89.	Alone 6/86, 10/86, 5/87, 1/87, 5/88, 9/88, 5/89, 10/89.
047					Unknown after capture.	
049					Cub of sow 28, unknown in 1988.	

Table 5. Continued

Bear ID (tattoo)	No. of relocations 1986	1987	1988	1989	Status	Reproductive history
051*		2			Slipped collar between 5/30 and and 6/4/87, unknown.	Unknown after capture.
052*		7	4	5	Active, 1989 den site located on 10/26/89.	w/2 1.5 yr olds 5/87, 8/87 w/2 2.5 yr olds 5/88, 9/88, alone 5/89, 10/89.
053*		15	7	7	Active, 1989 den site located on 10/21/89.	w/1 1.5 yr old 5/87, 10/87, w/1 2.5 yr old 5/88, Alone 9/88, w/2 COY 5/89, 10/89.
054					Capture mortality	
055*		17	11	10	Hunting mortality 10/89.	w/3 1.5 yr olds 5/87, lost 1 9/15 and 10/8/87, 2 yrls 10/87, w/1 2.5 yr old 5/88, alone 9/88, w/2 COY 5/89.
058*		16	10	5	Active, 1989 den site located on 11/13/89.	w/3 1.5 yr olds 5/87, 10/87, w/3 2.5 yr olds 5/88, alone 10/88, 5/89, 10/89.
059*		9	7	6	Active, 1989 den site located on 11/08/89.	w/3 cubs 5/87, 10/87, w/3 yrls 6/88, 9/88,w/3-2.5 yrl. 5/89, 10/89.
060					Cub of sow 059	
061					Cub of sow 059	
062					Cub of sow 059	

Table 5. Continued

Bear ID (tattoo)	No. of relocations 1986	1987	1988	1989	Status	Reproductive history
063*		19	11	3	Missing after 06/13/89.	w/2 1.5 yr olds, 5/87 and 10/87, w/2 2.5 yr olds 5/89.
065*		16	5	7	Active, 1989 den site located on 11/13/89.	Alone 5/87, 10/87, 5/88, 10/88, 5/89, 10/89.
066*		9			Breakaway collar, dropped 8/19 and 9/9/87, unknown.	Unknown after 8/19/87.
067*		17	10	10	Active, 1989 den site located on 11/13/89.	Alone 5/87, 10/87, w/2 COY 5/88, 9/88, w/2 yrl. 5/89, 10/89.
069*		16	12	8	Active, 1989 den site not located.	Alone 6/87, 10/87, w/2 COY 5/88, 9/88, w/2 yrl. 5/89, 10/89.
070*		16	8	9	Active, 1989 den not located.	Alone 6/87, 10/87, 5/88 10/88, w/2 COY 5/89, alone ? 10/89.
071*		12			Missing after 9/15/87.	Alone 6/87.
074*		14		10	Active, 1989 den not located.	Alone 6/87, 10/87, w/3 COY 5/88, 10/88, w/3 yrl. 5/89, w/2 yrl. 10/89.
075					2.5 yr old of sow 58, unknown after capture	
077					Cub of sow 69	

Table 5 Continued

Bear ID (tattoo)	No. of relocations 1986	1987	1988	1989	Status	Reproductive history
079					Cub of sow 25	
080					Cub of sow 25	
081*			7		Active, 1989 den not located.	Alone 6/88, w/ 1 COY 5/89 10/89.
085					Cub of sow 20.	
086					Cub of sow 20.	
087					Unknown after capture.	
092					Cub of sow 21.	
095*			4	5	Active, 1989 den site not located.	Alone 6/88, 10/88, 5/89, 10/89.
096*			5	7	Active, 1989 den site not located.	Alone 6/88, 10/88, 5/89, 10/89.
097*			4	9	Active, 1989 den site located on 11/13/89.	Alone 6/88, 9/88, w/2 COY 5/89, 10/89.
098*			3	6	Active, 1989 den site located on 11/13/89.	w/1 COY 6/88, 9/88,w/1 yrl. 5/89, 10/89.
099					Cub of sow 98.	
102*				9	Active, 1989 den site located on 11/13/89.	Alone 5/89, 10/89.

Table 5. Continued.

Bear ID (tattoo)	No. of relocations 1986	1987	1988	1989	Status	Reproductive history
103*				8	Active, 1989 den site located on 11/13/89.	Alone 5/89, 10/89.
104					Yrl. of Sow 67.	
107					Yrl. of Sow 74.	
109					Yrl. of Sow 09.	
117*				9	Active, 1989 den site not located.	W/2 COY 5/89, 10/89.
120*				5	Active, 1989 den site not located.	W/2 COY 5/89, 10/89.
Total	158	416	258	242		

* Radio-collared
[a] Observed copulating with unmarked male on 5/21/88

Table 6. Summary of number of relocations and status of male grizzly bears in the southwest Brooks Mountain Range of GMU 23 during 1986 - 1989.

Bear ID (tattoo)	No. of relocations 1986	1987	1988	Status of den entrance 1988
003*	11	15	9	Hunting mortality 09/06/89
007*	10	1		Hunting mortality 09/16/87
010*	10	9		Slipped collar 5/87, recap 5/87, slipped 10/87
012*	5			Slipped collar 6/86, recap 6/86, slipped 8/86
015				Cub of sow 14, missing after capture - capture mortality
016				Cub of sow 14, assumed dead, missing after 5/28/87, see sow 014
017				Unknown after capture
019*	2			Slipped collar by 6/8/86
023				Unknown after capture
024*	6	9		Slipped collar 8/12/87
027*	4			Missing after 7/3/86
029*	10			Hunting mortality 4/21/87
030*	3			Hunting mortality 4/19/87
031*		10	1	Hunting mortality 09/16/89

Table 6. Continued.

Bear ID (tattoo)	No. of relocations 1986	1987	1988	Status of den entrance 1988
034*	10	21	1	Collar removed on 6/5/88
035*	6	6		Suspected mortality from unknown causes by 10/9/87
037				Hunting mortality 9/87
040*	10	16	9	Collar removed 05/27/89
042*	10	18	11	Collar removed 05/27/89
044*	5			Hunting mortality 4/23/87
045*	8	13		Slipped collar 7/1 and 7/6/87
046*	10	15	10	Collar removed on 05/27/89
048				Cub of sow 28, killed by hunter on 9/19/88
050*		2	3	Collar removed on 6/9/88
056*		15	12	Collar removed on 05/29/89
057*		10		Hunting mortality 9/88
064*		18	6	Slipped collar between 7/15 and 7/27/88

Table 6. Continued.

Bear ID (tattoo)	No. of relocations 1986	1987	1988	Status of den entrance 1988
068*				Slipped collar between 6/2 and 6/3/87
072*		10	5	Collar removed on 05/27/89
073*		9	4	Collar removed on 6/8/88
076				Cub of sow 69
078				Cub of sow 22
082				Unknown after capture
083				Unknown after capture
084				Cub of sow 8
088				Cub of sow 39
089				Cub of sow 39
090				Cub of sow 39
091				Cub of sow 21
093				Cub of sow 41
094				Cub of sow 41
100				Cub of Sow 53
101				Cub of Sow 53
105				Cub of Sow 74
106				Cub of Sow 74

Table 6. Continued.

Bear ID (tattoo)	No. of relocations 1986	1987	1988	Status of den entrance 1988
108				Adult, marked 05/29/89
110				Yrl. of Sow 09
111				Cub of Sow 55
112				Cub of Sow 55
113				Adult, marked 05/29/89
114				Cub of Sow 70
115				Cub of Sow 70
116				Adult, marked 05/30/89
118				Cub of Sow 117
119				Cub of Sow 117
121				Cub of Sow 120
122				Cub of Sow 120
Total	120	197	71	

*Radio-collared

Table 7. Summary of litter sizes and subsequent losses of offspring for radio-collared adult (≥3-yr-olds) female grizzly bears captured in the southwest Brooks Mountain Range of GMU 23 during 1986 through 1989.

Bear ID	Year	Age	Barren		Cubs		Yearlings		2.5 yr olds	
			EM[a]	ENT[b]	EM[a]	ENT[b]	EM[a]	ENT[b]	EM[a]	ENT[b]
001	1986	5.5			3[c]	2				
	1987	6.5					2	2		
	1988	7.5	x	x						
	1989	8.5			2	Dead				
002	1986	5.5	x	x						
	1987	6.5	x	x						
	1988	7.5	x	x						
	1989	8.5	x	Dead						
004	1986	6.5			2	2				
	1987	7.5					2	2		
	1988	8.5		x					2	
	1989	9.5	x	x						
008	1986	13.5	x	x						
	1987	14.5	x	x						
	1988	15.5			1	1				
	1989	16.5					1	1		
009	1986	14.5	x	x						
	1987	15.5	x	x						
	1988	16.5			2	2				
	1989	17.5					2	Dead		
013	1986	7.5	x	Dead						
014	1986	9.5			3[c]	1				
	1987	10.5					1	0		
	1988	11.5	x	x						
	1989	12.5			3	2				

Table 7. Continued

Bear ID	Year	Age	Barren		Cubs		Yearlings		2.5 yr olds	
			EM[a]	ENT[b]	EM[a]	ENT[b]	EM[a]	ENT[b]	EM[a]	ENT[b]
018	1986	8.5	x	Dead						
020	1986	5.5	x	x						
	1987	6.5	x	x						
	1988	7.5			2	2				
	1989	8.5					1	1		
021	1986	12.5	x	x						
	1987	13.5			4	3				
	1988	14.5					2	2		
	1989	15.5	x	x						
022	1986	8.5					1	1		
	1987	9.5							1	x
	1988	10.5			2	1				
	1989	11.5					1	1		
025	1986	12.5	x	x						
	1987	13.5	x	x						
	1988	14.5			2	2				
	1989	15.5					2	2		
026	1986	3.5	x							
028	1986	9.5	x	x						
	1987	10.5			2	0				
	1988	11.5	x	x						
	1989	12.5			3	3				
032	1986	3.5	x	x						
	1987	4.5	x	x						
033	1986	7.5	x							

Table 7. Continued

Bear ID	Year	Age	Barren		Cubs		Yearlings		2.5 yr olds	
			EM[a]	ENT[b]	EM[a]	ENT[b]	EM[a]	ENT[b]	EM[a]	ENT[b]
036	1986	Ad.	x							
038	1986	3.5	x							
039	1986	8.5	x	x						
	1987	9.5	x	x						
	1988	10.5			3	3				
	1989	11.5					3	3		
041	1986	6.5	x	x						
	1987	7.5	x	x						
	1988	8.5			2	2				
	1989						2	2		
043	1986	17.5	x	x						
	1987	18.5	x	x						
	1988	19.5	x	x						
	1989	20.5	x	x						
047	1986	Unk							2[d]	
051	1987	4.5	x							
052	1987	14.5					2[d]	2		
	1988	15.5							2	
	1989	16.5	x	x						
053	1987	7.5					1[d]	1	1	
	1988	8.5		x						
	1989	9.5	2	2	2	2				
054	1987	5.5	x							

Table 7. Continued

Bear ID	Year	Age	Barren		Cubs		Yearlings		2.5 yr olds	
			EM[a]	ENT[b]	EM[a]	ENT[b]	EM[a]	ENT[b]	EM[a]	ENT[b]
055	1987	6.5					3[d]	2		
	1988	7.5		x					1	
	1989	8.5			2	2				
058	1987	6.5					3[d]	3		
	1988	7.5		x					3	
	1989	8.5	x	x						
059	1987	15.5			3	3				
	1988	16.5					3	3		
	1989	17.5							3	3
063	1987	12.5					2[d]	2		
	1988	13.5		x					2	
	1989	14.5	x	x						
065	1987	9.5	x	x						
	1988	10.5	x	x						
	1989	11.5	x	x						
066	1987	3.5	x	x						
067	1987	.4.5	x	x						
	1988	5.5			2	2				
	1989	6.5					2	2		
069	1987	10.5	x	x						
	1988	11.5			2	2				
	1989	12.5					2	2		
070	1987	3.5	x	x						
	1988	4.5	x	x						
	1989	5.5			2	2				

Table 7. Continued

Bear ID	Year	Age	Barren		Cubs		Yearlings		2.5 yr olds	
			EM[a]	ENT[b]	EM[a]	ENT[b]	EM[a]	ENT[b]	EM[a]	ENT[b]
071	1987	3.5	x	x						
074	1987	9.5	x	x						
	1988	10.5			3	3				
	1989	11.5					3	2		
081	1988		x	x						
	1989				1	1				
087	1988		x							
095	1988		x	x						
	1989		x	x						
096	1988		x	x						
	1989		x	x						
097	1988		x	x						
	1989				2	2				
098	1988				1	1				
	1989						1	1		
102	1989		x	x						
103	1989		x	x						
117	1989				2	2				
120	1989				2	2				

Table 7. Continued.

Bear ID	Year	Age	Barren EM[a]	Barren ENT[b]	Cubs EM[a]	Cubs ENT[b]	Yearlings EM[a]	Yearlings ENT[b]	2.5 yr olds EM[a]	2.5 yr olds ENT[b]
		Mean =			2.22	1.96	1.91	1.76	1.89	
		SD =			0.70	0.75	0.75	0.77	0.78	
		M =			27	24	22	21	9	

[a] EM = Size of litter at emergence from den in spring.

[b] ENT = Size of litter at den entrance in autumn.

[c] Capture related mortalities.

[d] Offspring age estimated.

Table 8. Summary of known status of 122 marked grizzly bears from 1986 through 1989 in the southwest Brooks Mountain Range, Alaska.

		Status unknown					
	Alive	Slipped collars	Missing	Collars removed	Capture mortality	Hunting mortality	Unknown mortality
Radio-collared adults							
Males		7	1	8	0	7	1
Females	29	2	3	0	0	4	0
Marked adults (uncollared)							
Males	0	0	7	0	0	1	0
Females	0	0	7	0	3	0	0
Marked young (uncollared)							
Males	17	N/A	7	N/A	0	1	0
Females	11	N/A	6	N/A	0	0	0
Totals							
All males	17	7	15	8	0	9	1
All females	40	2	16	0	3	4	0
All bears	57	9	31	8	3	13	1

Table 9. Description of location quality index (QQ) used with locations obtained from PTT's with regular, non-quaranteed, and special animal processing by Service Argos.

nl or LQ	QQ Index	Description
3	9	Equivalent to NQ=3. 5 messages received used in calculation of position over 420 second duration. Internal consistency >0.15 Hz, satellite must achieve a maximum elevation between 22-55 degrees above horizon relative to PTT. Location reportedly accurate within 150 meters or 68% of occasions.
2	8	Equivalent to NQ=2. At least 5 messages must be received and used in calculation position over 420 second duration. The satellite must achieve maximum elevation of 17-78 degrees above horizon relative to ptt. Location reportedly accurate within 350 meters or 68% of occasions.
1	7	Equivalent to NQ=1. At least 5 messages must be received 240 second or 4 messages over 420 seconds. Provides a non-quaranteed location but not necessarily of low quality.
0	6	≥4 messages but a pass duration less than 240 seconds.
0	5	Doppler point of inflection does not belong to the pass or mid-term oscillator drift is high.
0	4	3 messages. Previous location <12 hours old.
0	3	3 messages. Previous location <12 hours old.
0	2	2 messages. Previous location <12 hours old.
0	1	2 messages. Previous location >12 hours old.
	0	Location impossible. Geometric initialization failed.
	-1	Location rejected. Distance from ground track.

Table 9. (continued)

nl or LQ	QQ Index	Description
	-2	Location rejected. Internal consistency of the least square fit too high.
	-3	Location rejected. Long term oscillator drift too high.
	-4	Location rejected. Location computation failed or choice of correct solution uncertain.

Table 10. Summary of numbers of overpasses (collar visible to satellite), relocations (fixes) and behavioral data sets (hits) obtained from platform transmitter terminals (satellite radio-collar) deployed on female grizzly bears in northwest Alaska from early June through October 1988.

PTT	Argos bear ID	Study ID	Initiation - termination of transmission	Months	Year	Overpasses	Fixes	Hits
100900	01	14	Jun 05	Jun	88	172	119	942
				Jul	88	144	96	558
				Aug	88	123	9	390
				Sep	88	114	62	354
			Oct 10	Oct	88	40	21	100
			Subtotal			593	307	2,344
10901	02	63	Jun 05	Jun	88	163	103	779
				Jul	88	163	111	688
				Aug	88	149	19	478
			Sep 30	Sep	88	115	67	368
				Oct	88	0	0	0
			Subtotal			590	300	2,313
10902	03	58	Jun 05	Jun	88	158	77	556
				Jul	88	135	69	420
				Aug	88	107	4	281
				Sep	88	144	76	411
			Oct 09	Oct	88	42	26	114
			Subtotal			586	252	1,782

Table 10. (continued)

PTT	Argos bear ID	Study ID	Initiation - termination of transmission	Months	Year	Overpasses	Fixes	Hits
10903	04	28	Jun 05	Jun	88	125	81	556
				Jul	88	155	104	566
				Aug	88	154	17	453
				Sep	88	115	65	315
			Oct 11	Oct	88	28	12	54
			Subtotal			577	279	1,944
10904	05	43	Jun 05	Jun	88	192	122	953
				Jul	88	178	126	726
				Aug	88	140	12	479
			Sep 22	Sep	88	86	49	289
				Oct	88	0	0	0
			Subtotal			596	309	2,447
10905	06	69	Jun 06	Jun	88	176	117	858
				Jul	88	193	144	828
				Aug	88	200	20	863
				Sep	88	171	105	634
			Oct 11	Oct	88	55	32	207
			Subtotal			795	418	3,390
			Grand Total			3,737	1,865	14,220

Table 11. Numbers and quality of relocations obtained from satellite transmitters deployed on grizzly bears in northwest Alaska during 1988.

PTT	Quality of relocation[a]	Month						Totals
		May[b]	Jun	Jul	Aug	Sep	Oct	
10900	3	9	9	3	0	0	0	12
	2	11	32	12	0	1	0	45
	1	0	47	45	6	29	5	132
	0		31	36	3	32	16	118
	Subtotal	20	119	96	9	62	21	307
10901	3	9	7	1	0	0	0	8
	2	12	29	23	2	2	0	56
	1	0	42	49	8	33	0	132
	0		25	38	9	32	0	104
	Subtotal	21	103	111	19	67	0	300
10902	3	1	1	0	0	0	0	1
	2	11	17	2	0	3	0	22
	1	0	28	30	0	30	6	94
	0		31	37	4	43	20	135
	Subtotal	12	77	69	4	76	26	252
10903	3	0	1	0	0	0	0	1
	2	23	23	12	1	2	0	38
	1	0	28	42	3	18	1	92
	0		29	50	13	45	11	148
	Subtotal	23	81	104	17	65	12	279

Table 11. (Continued)

PTT	Quality of relocation[a]	Month May[b]	Jun	Jul	Aug	Sep	Oct	Totals
10904	3	0	3	0	0	0	0	3
	2	12	27	22	1	2	0	52
	1	0	64	60	3	27	0	154
	0		28	44	8	20	0	100
	Subtotal	12	122	126	12	49	0	309
10905	3	1	1	0	0	1	0	2
	2	19	17	30	5	8	4	64
	1	0	69	64	8	56	16	213
	0		30	50	7	40	12	139
	Subtotal	20	117	144	20	105	32	418
Totals	3	20	22	4	0	1	0	27
	2	88	145	101	9	18	4	277
	1	0	278	290	28	193	28	817
	0		174	255	44	212	59	744
	Totals	108	619	650	81	424	91	1,865

[a] Refer to Table 9.

[b] Collars yet not deployed; not included in totals.

Appendix. Letter sent to Department of Environmental Conservation describing how satellite transmitters were used to evaluate frequency of grizzly bear visits to the Red Dog Mine in northwest Alaska 1988.

April 1, 1990

Mr. Simon Mawson
Alaska Department
Environmental Conservation
320 E. Front Street
Nome, AK 99762

Dear Mr. Mawson:

This letter is in response to your verbal request for backup information and documentation of problems with grizzly bears at the Red Dog Mine garbage dump and why we believe the dump should be fenced.

Attached are copies of several memos and field notes authored by several agency staff members who have worked on the NW Alaska grizzly bear study. These memorandums document numerous observations and reports of bears and other wildlife feeding at the Red Dog mine garbage dump. Although I personally have not made an attempt to document the presence of wildlife at the dump on every trip that I have made to the areas, I can not think of a single instance when I have not observed at least several birds (i.e., ravens and seagulls) in the dump area. If there were no food available at the dump for wildlife to feed on then I would expect to see no birds at the site. Clearly, if birds are attracted to the site for feeding then mammals such as foxes and grizzly bears would be attracted as well. Observations by yourself, Robus, Ott, Ayres, Roney, and a number of others support this contention. Also, several informers who wish to remain anonymous have indicated that several grizzly bears were visiting the camp in 1988 and 1989 on a regular basis.

During early summer 1988 we fitted 6 sow grizzly bears with satellite radio collars in an attempt to monitor how bears

respond to the mine development. Bears which were equipped with these collars were selected because they used areas in 1986 and 1987 which included part of the mine site. The satellite collars were programmed to transmit daily during 1988 and 1989 for a 6 hour period beginning at 0800 Alaska standard time. Unfortunately, all 6 collars failed during 1989 and consequently we only have data for 1988. Since the collars only transmit for a 6 hour period we can not account for the entire daily activities of these bears. For this analysis I assumed that if a bear was present within a few miles of the dump or at the dump then there was a strong probability that the bear was attracted to the area for food. Three of 6 satellite collared bears were at the dump or within 2 miles of it on 144 (15%) of 946 relocations collected from 6 June through mid-October 1988. One bear visited the site regularly throughout the summer and autumn (73 of 291 relocations) while the other two bears visited the area only during June and July. If these 6 bears were a representative sample of adult female bears in the area (there is no reason to believe that they were not) then it is reasonable to conclude that several grizzly bears are using the Red Dog Mine garbage dump on a regular basis.

The Division of Wildlife Conservation has always advocated that any and all industrial developments within previously undeveloped areas be extremely cautious of how they dispose of garbage. We have advocated that new industrial developments be required to incinerate all trash. Several comparisons have been made on the numbers of reported bear problems in camps which incinerate their trash versus those that have not. These comparisons include the Transalaska pipeline (paper by Dr. Erick Folleman and John Hectel) and mining developments in Southeastern Alaska (memos and correspondence attached from John Schoen). There have been significantly fewer problems in camps which have incinerated their trash versus those that have not. Although the Red Dog Mine attempts to incinerate most of their trash, their incinerator has had mechanical problems from time to time and more importantly there has always been some garbage which winds up in the dump without being incinerated. Even garbage which has been incinerated still contains edible food items which could attract bears (see my attached memorandum). All of this results in a significant attractant for wildlife. The best solution to this problem is to continue to strive for complete incineration of garbage but also to fence (bear-proof) the dump to prevent access to garbage not incinerated or incompletely incinerated.

This summer will be the 3rd year that bears and other wildlife will be attracted to the Red Dog Mine dump site. Unless something is done to resolve this recurring problem it will only get worse. The cost of insisting upon complete incineration of

garbage accompanied by construction of a bear-proof fence will seem pitifully cheap in relation to the lawsuits which will occur if someone is mauled and injured by a bear that was attracted to the site because of improper garbage disposal.

Sincerely,

Warren Ballard
Wildlife Biologist

Att:

Federal Aid Project
funded by your purchase of
hunting equipment