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

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

by
Warren B. Ballard
Projects W-22-5 and W-22-6
Job 4.20R
June 1987

STATE OF ALASKA
Steve Cowper, Governor

DEPARTMENT OF FISH AND GAME
Don W. Collinsworth, Commissioner

DIVISION OF GAME
W. Lewis Pamplin, Jr., Director
Robert A. Hinman, Deputy Director

Additional copies of this report, or reports on other species covered in this series may be obtained from:

Publications Technician
ADF&G, Game Division
P.O. Box 3-2000
Juneau, AK 99802
(907) 465-4190

PROGRESS REPORT (RESEARCH)

State: Alaska

Cooperators: L. Adams, J. Coady, D. James, D. Larsen, R. Nelson, K. Roney, T. Smith

Project No.: W-22-5 W-22-6 Project Title: Big Game Investigations

Job No.: 4.20R Job Title: Demography of Noatak Grizzly Bears in Relation to Human Exploitation and Mining Development

Period Covered: 1 October 1985-30 November 1986

SUMMARY

In 1986 a population assessment of grizzly bears (Ursus arctos) in relation to human exploitation and mining development in and adjacent to the Noatak National Preserve was initiated. Forty-seven grizzly bears were captured in late May and early June 1986; 31 were radio-collared. Radio-collared bears were relocated on 278 occasions from fixed-wing aircraft during 1986. A portion of the 2,600-mi² study area will be intensively censused in 1987.

Key Words: density, grizzly bear, harvest rates, mining development, Noatak National Preserve, Ursus arctos.

CONTENTS

BACKGROUND

Alaska has the largest remaining populations of brown/grizzly bears (Ursus arctos) in the United States. Advancing human civilization has resulted in the extermination of many grizzly bear populations in the lower 48 states (Cowan 1972); to avoid similar declines in Alaska, management decisions and prediction of development impacts on bears must be based on sound biological data. Population assessments of Alaskan brown/grizzly bear populations have been conducted, or are ongoing, in southeast Alaska (Wood 1976; Schoen 1982; Schoen et al. 1981; and Schoen and Beier 1983, 1985, 1986), southcentral Alaska (Dean 1976; Spraker et al. 1981; Ballard et al. 1982; Miller and Ballard 1982a,b; Miller and McAllister 1982; Miller 1983, 1984, 1985; Miller et al., in press), Kodiak Island (Hensel et al. 1969, Smith and Van Daele 1984, Smith et al. 1985, Barnes 1985), the Alaska Peninsula (Glenn 1971, 1972, 1976; Glenn and Miller 1980; Glenn et al. 1976), northcentral Alaska Range (Reynolds and Hechtel 1983, 1984, 1985, 1986) and the North Slope of the Brooks Range (Crook 1971; Reynolds 1974, 1976, 1978, 1980, 1981, 1982; Reynolds and Hechtel 1982). Many other areas in Alaska, such as Game Management Unit (GMU) 23 in northwest Alaska, have not yet been studied.

Within recent years, bear harvests in northwest Alaska appeared to be increasing (ADF&G report to Alaska Board of Game, 1985). This suggests mortality could be increasing. Perhaps more importantly, large scale development of the Red Dog Mine is scheduled to begin in the early 1990's and this environmental disturbance could add to the negative factors affecting this population. No studies to determine population status of bears in GMU 23 have been conducted. Existing GMU 23 population estimates range from 570 to 2,300 bears (ADF&G report to Alaska Board of Game, 1985). These estimates are based on research conducted in GMU's 13, 20, and 26. GMU's 13 and 20 are located several hundred miles south and east of

GMU 23; bear populations in these units are probably not comparable to those in GMU 23 because of habitat and climatic differences. Similarly, bear density estimates for the northern Brooks Range (Reynolds 1982, in press) also may not be appropriate for use in GMU 23 due to differences in climate and vegetation. Regardless, northern Brooks Range studies suggested that a high bear density in optimum habitat was 1 bear/20 mi^2 (52 km^2) while low density in lesser quality habitat was 1 bear/80 mi^2 (207 km^2). This large range of density estimates provides an equally large range of GMU 23 population estimates. Such estimates in relation to known harvests suggest annual harvest rates ranging from less than 1% to 12%. Harvest rates of 2-4% have been considered sustainable for northern grizzly bear populations (Reynolds 1976; Sidorwicz and Gilbert 1981). The current range of population estimates and harvest rates is too broad for meaningful management decisions.

Traditionally, wildlife biologists in Alaska have monitored trends in bear populations by interpreting sex and age composition of the harvest. Often these samples are too small and/or identical sets of data can be interpreted as indicating exactly opposing trends. Presently, interpretation of harvest data is not reliable for assessing bear population trends. Several models exist for using harvest data to assess the status of bear population trends, but none have been tested and verified with real population data. A modified version of Tait's (1983) model is being tested (Miller and Miller 1986) but until that model is verified, the only method of determining actual harvest rates will be reliance on comparisons of population size derived from density estimates, in relation to known harvests. For many bear population studies reliable density estimates have been possible only after many years of monitoring a sample of radio-collared individuals. These studies are often not repeatable without great expense, and they do not result in an estimate of precision. However, reliable density or population size estimates are necessary to evaluate the impacts of both human exploitation and/or industrial development on bear populations.

Our current understanding of brown/grizzly bear population dynamics in relation to human developments is inadequate for developing rigorous management guidelines (see Schoen and Beier's research proposal). Other than Schoen and Beier's study in southeast Alaska, there have been no studies of bear/mining relationships. Accurate pre-project population data is needed so that changes in population size after development can be documented to provide a firm basis for mitigating future mining activities.

Recently, Miller and Ballard (1982a) and Miller et al. (in press) have utilized mark-recapture methods to provide an estimate of population density with a measurement of

precision. Such estimates, when compared with known harvest levels, can be used to generate harvest rates and/or can be used to measure long-term impacts on population trends by comparing density estimates over periods of time. This study will estimate several key population parameters prior to development; these parameters can then be compared with similar estimates after the mine becomes operational, and can also be used in assessing current harvest rates.

OBJECTIVES

To estimate density, structure, movements, and reproductive parameters of grizzly bears in the southwest Brooks Range (see Appendix A).

STUDY AREA

In consultation with management staff, a 2,600-mi² (6,700-km²) area of representative grizzly bear habitat within GMU 23 was selected for study. The area was bordered on the north by the summit of the Brooks Range, on the east by Kagvik Creek and the Kugururok River, on the south by the Noatak River and Jade Creek, and on the west by the Chukchi Sea and the Wulik River (Fig. 1). The area was selected for study in part because it encompasses the Red Dog Mine development project, and because a large proportion of the GMU 23 bear harvest occurs in the area.

Description of Mine Project

The Red Dog Mine Project is a joint venture between NANA Regional Corporation and Cominco Alaska, Inc. The project will consist of an open pit lead/zinc mine located on Red Dog Creek 131 km (82 mi) north of Kotzebue (Fig. 2). In addition to the mine the project will include tailing ponds, a mill, power plant, worker housing, water reservoir, 56 mi (90 km) of gravel road, a saltwater port, and several gravel borrow sites (EPA and USDI 1984). The project is expected to last at least 40 years and 225-250 employees will occupy the site at any 1 time. The transportation corridor will accommodate a railroad in future years. Easier human access to remote areas is expected to result in an increase in human use and additional "long-term increase in natural resource productivity in the western Brooks Range (e.g., hard rock minerals, coal, oil, and gas)" (EPA and USDI 1984).

Elevation of the study area ranges from sea level to over 4,000 ft (1,212 m). Topography ranges from flat near saltwater and major river systems in the south, grading into moderately sloping foothills, to steep, rocky mountains

separated by narrow valleys in the north. Much of the area is underlain by permafrost. The area is largely treeless except along the Noatak and Kelly River floodplains where varying densities of black and white spruce (Picea mariana and P. glauca) and cottonwood (Populus balsamifera) occur. At least 13 additional vegetation types occur within the study area (EPA and USDI 1984). These include closed and tall shrub, low shrub, open low shrub, dwarf mat and cushion tundra, sedge-grass tundra, tussock tundra, and alder (Alnus crispa) vegetation types.

The area is characterized by a polar maritime climate along the coast and a continental-type climate inland (EPA and USDI 1984). Summer temperatures range from 36-90 F and winter temperatures range to lows of -15 to -53 F. Extremely low winter temperatures occur less frequently in the mountains due to temperature inversions. Annual precipitation averages 10 inches (25 cm) along the coast to 20-30 inches (51-76 cm) in the mountains. Half of the precipitation occurs during July through September. Snow cover usually occurs from mid-October to mid-May. Caribou (Rangifer tarandus), moose (Alces alces), and Dall sheep (Ovis dalli) all occur within the study area. All of the major rivers and drainages provide habitat for fish. Arctic char (Salvelinus alpinus), arctic grayling (Thymallus arcticus), pink salmon (Oncorhynchus gorbuscha), and chum salmon (O. keta) are among the most important sources of food for bears. Salmon migration usually occurs from July through September each year.

PROCEDURES

Bears were captured and processed using standard helicopter capture and processing methods used elsewhere in Alaska (Spraker et al. 1981, Ballard et al. 1982, Miller 1985, Reynolds and Hechtel 1985). Bears were immobilized with either etorphine hydrochloride (M99, Lemmon Co., Sellersville, Pa.) or phencyclidine hydrochloride (Sernylan [no longer manufactured]). After processing, the antogonist diprenorphine HCL (M50-50, Lemmon Co., Sellersville, Pa.) was administered in the hip area of bears immobilized with M99. Each bear was given an injection of bicillin to prevent infection associated with capture and processing. Each captured bear was sexed, weighed, measured, and individually marked with lip tattoos, duflex ear tags, and/or radio collars manufactured by Telonics (Mesa, Az.). Premolars were extracted from each adult (>1 year old) for aging according to methods similar to those described by Mundy and Fuller (1964). Blood samples were collected from each bear; serum was separated and stored for future analyses.

Radio-collared bears were periodically monitored from fixed-wing aircraft as funding and weather permitted. Date, time, number of associates, activity, and habitat type at each relocation were recorded on standard forms. If more than 1 bear was observed on an ungulate kill, one-half the kill was attributed to each bear. Subsequent bear movements and activities were used to select a census area within the larger study area. The latter area is scheduled to be censused in 1987 using methods described by Miller and Ballard (1982a) and Miller et al. (in press). The entire proposal is described in Appendix A.

RESULTS AND DISCUSSION

Forty-seven grizzly bears including 25 females (Table 1) and 22 males (Table 2) were captured from 31 May to 9 June 1986. One male was captured twice. Fifteen male and 15 female adult grizzlies were fitted with radio collars. Although cementum ages were not available for this report, 3 females and 2 males were cubs-of-the-year. On the basis of tooth wear, tooth eruption pattern, and association with large adults, at least 4 females and 4 males were estimated to be 1.5-3.5 years of age. Six family groups were observed. Of 13 adult females judged to be reproductively mature, 6 (46%) were lactating but were not accompanied by young when captured, suggesting high cub mortality. Observed cub litter size ($\underline{n}$ = 3) averaged 2.7.

Twenty-seven grizzly bears were immobilized with phencylidine hydrochloride (PHCL) and 21 with etorphine hydrochloride (M-99) (Tables 3 and 4). Average doses of 4.5 and 5.6 mls PHCL were required to immobilize female and male bears, respectively, whereas 3.5 and 4.4 mls of M99 were required for female and male bears, respectively. Average induction time for bears immobilized with PHCL was 19.7 min (SD = 15.7) while an average of 11.8 min (SD = 8.8) was required for bears immobilized with M99. Eight bears immobilized with PHCL and 6 with M99 required multiple doses due to incomplete injection of the dart or underdosing. Two adult females died as a result of capture. One adult (No. 013) that was immobilized with PHCL was mistakenly darted twice and probably died as a result of overdose. The other adult female (No. 036) that was immobilized with M99 was given a normal dosage and was dead within 2 minutes of induction. Both bears were in relatively poor physical condition.

Physical characteristics of captured grizzly bears are given in Tables 5 and 6. Sample sizes are too small for meaningful comparisons with other Alaskan populations. In-depth analyses will occur when age data are obtained and sample sizes are increased.

Movements and Status

Two hundred seventy-eight relocations were obtained for 31 adult grizzly bears during 1986 (Table 7). Each radioed bear was monitored an average of 9 relocations (range 2-14). Three bears (all large males) shed their collars shortly after being captured. Radio contact was temporarily lost with 4 bears for varying periods, probably due to mountainous terrain which prevented detection of radio signals and/or movements to areas not regularly searched. One female was probably shot, as its radio collar was retrieved from a guide's camp. As of 8 November 1986, radio collars were still functioning on 26 adults.

During summer 1986 radio-collared grizzlies were observed on 11.5 kills (Table 7). The kills were as follows: 4 adult moose, 3 calf moose, 2.5 unidentified species, and 2 adult caribou. At least one of the kills appeared old and death was probably due to causes other than bear predation.

Numbers of relocations obtained in 1986 were insufficient to quantify movements or home range use at this time. However, some general, as well as some unusual movement patterns were evident. Between late June and early July 1986 sow No. 021, which was captured in the headwaters of No Name Creek, moved approximately 60 km northwest to the Kukpowruk River. She remained in that area through summer and fall but returned to the capture area for denning. This latter movement pattern is of interest because it represents the only movement to the north side of the Brooks Range.

Generally, radio-collared grizzlies remained in the mountains or foothills through July. By early August several bears made distinct movements to creek and river bottoms, apparently to feed on salmon. These bears probably fished through early autumn and then moved back to higher elevation areas for denning.

Density

Most radio-collared bears had home ranges which occurred within the study area boundaries. Excluding sow No. 021, which moved to the north slope of the Brooks Range, radio-collared grizzlies occupied an additional 447 mi^2 (1,157 km^2) outside the study area. Based on observed movement patterns, numbers of captures, and numbers of nonduplicate sightings of unmarked bears, I estimate minimum bear density within the study area to be at 1/55 mi^2 (1/142 km).

RECOMMENDATIONS

Research should continue as outlined in Appendix A.

ACKNOWLEDGMENTS

A large number of individuals have participated in various aspects of this ongoing project and to all I express my sincere thanks. L. Adams (NPS), J. Coady (ADF&G), D. James (ADF&G), and M. Shaver (NPS) were instrumental in getting the project initiated. K. Roney (NPS) provided logistical support whenever it was needed and assisted with monitoring bears. L. Adams, L. Ayres, E. Hunnicutt, D. James, D. Larsen, R. Nelson, and T. Smith all participated with the capture and handling of bears. R. Bane (NPS), D. Graham (Kenai Air Alaska), D. James (ADF&G), J. Rood (Northwest Aviation), and T. Smith (ADF&G) all did excellent jobs of safely and efficiently piloting various types of aircraft. J. Coady, S. Machida, S. Peterson, and B. Townsend edited the manuscript. I. Parkhurst maintained accounting records and typed the manuscript.

LITERATURE CITED

Alaska Dep. Fish and Game. 1985. Report to Alaska Board of Game. Juneau, Alaska. 13pp.

Ballard, W. B., 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.

Barnes, V. G. 1985. Progress report - brown bear studies. U. S. Fish and Wildlife Service. Denver Wildl. Res. Centr. Unpubl. Rep. 38pp.

Cowan, I. Mct. 1972. The status and conservation of bears (Ursidae) of the world - 1970. In Bears -- Their biology and management. S. Herrero, ed. IUCN New Series 23:343-367.

Crook, J. L. 1971. Determination of abundance and distribution of brown bear (Ursus arctos) north of the Brooks Range, Alaska. M.S. Thesis. Univ. Alaska, Fairbanks. 78pp.

Dean, F. C. 1976. Aspects of grizzly bear population ecology in Mount McKinley Park. Int. Conf. Bear Res. and Manage. 3:111-119.

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

Glenn, L. P. 1971. Report on 1970 brown bear studies. Alaska Dep. Fish and Game. Fed. Aid in Wildl. Rest. Prog. Rep. Proj. W-17-2 and W-17-3. 67pp.

_____. 1972. Report on 1971 brown bear studies. Alaska Dep. Fish and Game. Fed. Aid in Wildl. Rest. Prog. Rep. Proj. W-17-7 and W-17-8. 109pp.

_____. 1976. Report on 1975 brown bear studies. Alaska Dep. Fish and Game. Fed. Aid in Wildl. Rest. Prog. Rep. Proj. W-17-7 and W-17-8. 4pp.

_____, and L. Miller. 1980. Seasonal movement of an Alaska Peninsula brown bear population. Pages 307-312 in C. Martinka and K. McArthur, eds. Bears--Their biology and management. Bear Biol. Assoc. Conf. Ser. No. 3.

_____, J. W. Lentfer, J. B. Faro, and L. H. Miller. 1976. Reproductive biology of female brown bears (Ursus arctos)--McNeil River, Alaska. Pages 381-390 in M.R. Pelton., J. W. Lentfer, and G. E. Folk, eds. Bears--Their biology and management. IUCN New Series Publication 40.

Hensel, R. J., W. A. Troyer, and A. W. Erickson. 1969. Reproduction in the female brown bear. J. Wildl. Manage. 33:357-365.

Miller, S. 1983. Big game studies. Vol. VI. Black Bear and Brown Bear. Phase II Prog. Rep. Susitna Hydroelectric Proj. Alaska Dep. Fish and Game. Anchorage. 99pp.

_____. 1984. Big game studies. Vol. VI. Black Bear and Brown Bear. 1983 Annual Rep. Susitna Hydroelectric Proj. Alaska Dep. Fish and Game. Anchorage. 174pp.

_____. 1985. Big game studies. Vol VI. Black Bear and Brown Bear. 1983 Annual Rep. Susitna Hydroelectric Proj. Alaska Dep. Fish and Game. Anchorage. 1974.

_____, and W. B. Ballard. 1982a. Density and biomass estimates for an interior Alaskan brown bear population. Can. Field-Nat. 96(4):448-454.

_____, and _____. 1982b. Homing of transplanted Alaskan brown bears. J. Wildl. Manage. 46:869-876.

_____, E. F. Becker, and W. B. Ballard. In press. Density and structure of black and brown-grizzly bear populations in Alaska estimated using modified capture-recapture techniques. Int. Conf. Bear Res. and Manage. 7:1986.

_____, and S. M. Miller. 1986. Interpretation of bear harvest data. Alaska Dep. Fish and Game. Fed. Aid in Wildl. Rest. Prog. Rep. Proj. W-22-5. 11pp.

_____, and D. C. McAllister. 1982. Big game studies. Vol. VI. Black Bear and Brown Bear. Final Phase I Rep. Susitna Hydroelectric Project. Alaska Dep. Fish and Game. Anchorage. 233pp.

Mohr, C. O. 1947. Table of equivalent populations of North American small mammals. Am. Midl. Nat. 37:223-249.

Mundy, K. R. D., and D. R. Flook. 1973. Background for managing grizzly bears in the national parks of Canada. Can. Wildl. Serv. Rep. Ser. No. 22. 35pp.

Mundy, K. R. D., and W. A. Fuller. 1964. Age determination in the grizzly bear. J. Wildl. Manage. 28:8663-866.

Neu, C. W., C. R. Byers, and J. M. Peek. 1974. A technique for analysis of utilization-availability data. J. Wildl. Manage. 38:541-545.

Reynolds, H. 1974. North Slope grizzly bear studies. Alaska Dep. Fish and Game. Fed. Aid in Wildl. Rest. Prog. Rep. Proj. W-17-6. Jobs 4.8R, 4.11R. Juneau. 27pp.

_____. 1976. North Slope grizzly bear studies. Alaska Dep. Fish and Game. Fed. Aid in Wildl. Rest. Final Rep. Proj. W-17-6 and 7. Jobs 4.8R, 4.11R. Juneau. 20pp.

_____. 1978. Structure, status, reproductive biology, movement, distribution, and habitat utilization of a grizzly bear population in NPR-A. Final Rep. NPR-A 105(c). Studies to USFWS. Mimeo. 41pp.

_____. 1980. North Slope grizzly bear studies. Alaska Dep. Fish and Game. Fed. Aid in Wildl. Rest. Prog. Rep. Proj. W-17-11. Jobs 4.14, 4.15R. Juneau. 75pp.

_____. 1981. North Slope grizzly bear studies. Alaska Dep. Fish and Game. Fed. Aid in Wildl. Rest. Prog. Rep. Proj. W-21-1. Job 4.14R. Juneau. 27pp.

_____. 1982. Alaska Range grizzly bear studies. Alaska Dep. Fish and Game. Fed. Aid in Wildl. Rest. Prog. Rep. Proj. W-21-2. Job 4.16R. Juneau. 10pp.

_____. In press. Grizzly bear population biology in the western Brooks Range, Alaska. Int. Conf. Bear Res. and Manage. 6:1986.

_____, and J. L. Hechtel. 1982. North Slope grizzly bear studies. Alaska Dep. Fish and Game. Fed. Aid in Wildl. Rest. Prog. Rep. Proj. W-21-2. Job 4.14R. Juneau. 19pp.

_____, and _____. 1983. 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. 27pp.

_____, and _____. 1984. 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-22-2. Job 4.16R. Juneau. 30pp.

_____, and _____. 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-22-2. Job 4.16R. Juneau. 29pp.

_____, and _____. 1986. 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. Final Rep. Proj. W-21-2, W-22-2, W-22-3. and W-22-4. Job 4.16R. Juneau. 53pp.

Schoen, J. W. 1982. Brown bear habitat preferences and brown bear logging and mining relationships in southeast Alaska. Alaska Dep. Fish and Game. Fed. Aid in Wildl. Rest. Prog. Rep. Proj. W-22-1. Juneau. 44pp.

_____, O. C. Wallmo, and M. D. Kirchhoff. 1981. Wildlife-forest relationships: Is a reevaluation of old-growth necessary? Trans. N. Amer. Wildl. and Nat. Resource. Conf. 46:531-545.

_____, and L. R. Beier. 1983. Brown bear habitat preferences and brown bear logging and mining relationships in southeast Alaska. Alaska Dep. Fish and Game. Fed. Aid in Wildl. Rest. Prog. Rep. Proj. W-22-2. Juneau. 39pp.

_____, and _____. 1985. Brown bear habitat preferences and brown bear logging and mining relationships in southeast Alaska. Alaska Dep. Fish and Game. Fed. Aid in Wildl. Rest. Proj. W-22-3. 83pp.

_____, and _____. 1986. Brown bear habitat preferences and brown bear logging and mining relationships in southeast Alaska. Alaska Dep. Fish and Game. Fed. Aid in Wildl. Rest. Proj. W-22-4. 45pp.

Sidorowicz, G. A., and F. F. Gilbert. 1981. The management of grizzly bears in the Yukon, Canada. Wildl. Soc. Bull. 9(2):125-135.

Smith, R. B., and L. Van Daele. 1984. Terror Lake hydroelectric project. Report on brown bear studies, 1982. Alaska Dep. Fish and Game. 110pp.

_____, _____, and L. Metz. 1985. Terror Lake hydroelectric project. Report on brown bear studies, 1983. Alaska Dep. Fish and Game. 77pp.

Spraker, T. H., W. B. Ballard, and S. D. Miller. 1981. Game Management Unit 13 Brown Bear Studies. Fed. Aid in Wildl. Rest. Final Rep. Proj. W-17-10, W-17-11, and W-21-1. Job 4.13R. 57pp.

Tait, David E. N. 1983. An analysis of hunter kill data. Ph.D. Thesis, Univ. of British Columbia, Vancouver. 129pp.

Trent, T. T., and O. J. Rongstad. 1974. Home range and survival of cottontail rabbits in southwestern Wisconsin. J. Wildl. Manage. 38:459-472.

Wood, R. E. 1976. Movement and populations of brown bears in the Hood Bay drainage of Admiralty Island. Alaska Dep. Fish and Game. Fed. Aid in Wildl. Rest. Proj. W-17. 10pp.

PREPARED BY:

Warren B. Ballard
Game Biologist III

APPROVED BY:

W. Lewis Pamplin, Jr. /bt
Director, Division of Game

Research Chief, Division of Game

SUBMITTED BY:

John W. Coady
Regional Supervisor

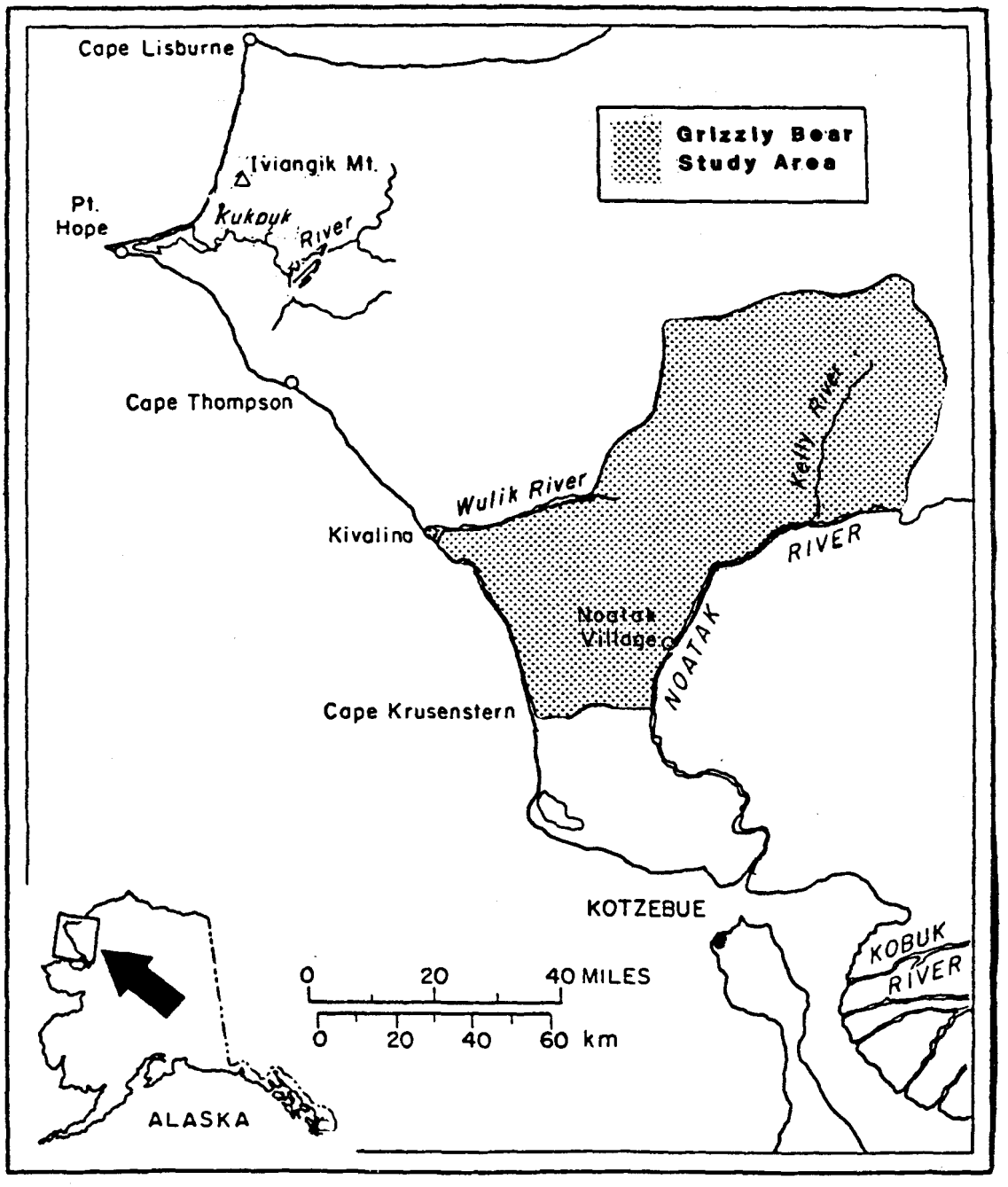

Fig. 1. Location and boundaries of grizzly bear study area in GMU 23 during 1986.

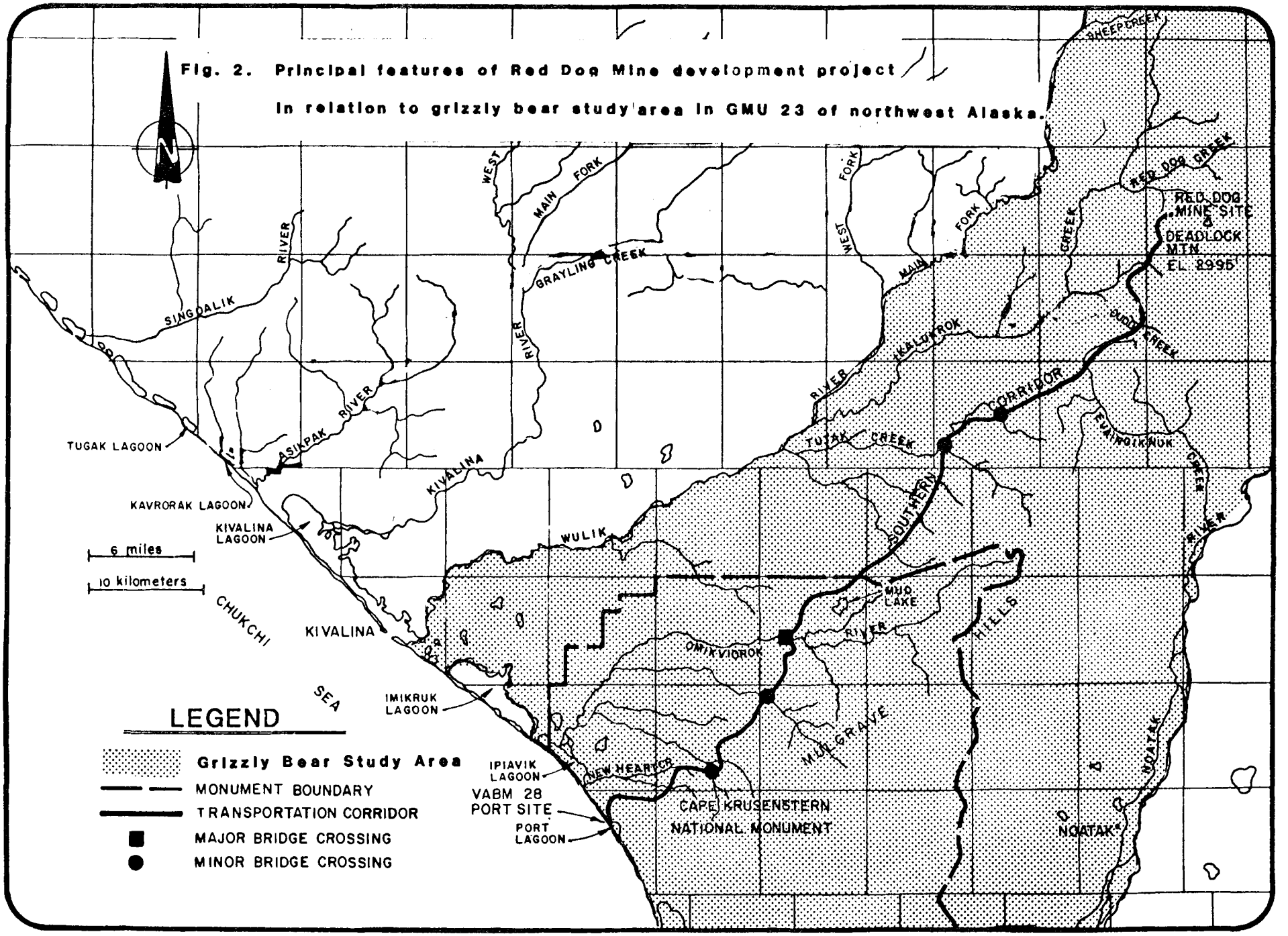

Fig. 2. Principal features of Red Dog Mine development project in relation to grizzly bear study area in GMU 23 of northwest Alaska.

Table 1. Date, location, reproductive and family status of female grizzly bears captured in the southwest Brooks Range of GMU 23 from 31 May through 9 June 1986.

Bear ID (tattoo)	Date of capture	Location	Number of cubs	Age of cubs	Lact.[a]	Repro. status[b]	Phys. cond.[c]
001[d,e]	05/31/86	Above Noatak Village	2	0.5	Y	2	3
002[d]	05/31/86	Mouth of Kelly River	0		N	1	2
004[d,f]	06/01/86	Omikviorok River	2	0.5	Y	2	3
005	06/01/86	Omikviorok River					
006[d]	06/01/86	Omikviorok River					3
008[d]	06/02/86	Middle Wulik River	0		N	3	1
009[d]	06/02/86	Opposite No Name Creek	0		Y	1	3
011[d]	06/03/86	Upper Jade Creek					1
013[d]	06/03/86	Upper Jade Creek - capture mortality	0		Y	2	4
014[g,d]	06/03/86	Upper Jade Creek	3	0.5	Y	2	4
018[d]	06/03/86	SE of Sivukat Mountain	0		Y	1	4
020[d]	06/04/86	Middle Wrench Creek	0		N	1	4
021[d]	06/03/86	Upper Wrench Creek	0		Y		2
022[d,h]	06/04/86	5 miles up Kelly River	1	1.5	Y	2	4
025[d]	06/04/86	Middle Kelly River	0		N	1	3
026[d]	06/04/86	Mouth Avan River	0		N	2	3
028[d]	06/05/86	Between Wulik River and Ikalukrok Creek	0		Y	2	3
032	06/05/86	Middle Ikalukrok Creek			N	2	4
033[i]	06/06/86	South of Kagvik Creek	0		N	1	4
036	06/07/86	Mulgrave Hills - Dead at capture	2	2.5	Y	1	4
038[d]	06/07/86	Mulgrave Hills	0		N		2
039[d]	06/07/86	Upper Rabbit Creek	0		Y	1	4
041[d]	06/08/86	Kelly River, Opposite mouth No Name Creek	0		N	1	4

Table 1. Continued.

Bear ID (tattoo)	Date of capture	Location	Number of cubs	Age of cubs	Lact.[a]	Repro. status[b]	Phys. cond.[c]
043[d]	06/09/86	Middle Ikalukrok Creek	0		N	1	2
047[j]	06/05/86	Middle Ikalukrok Creek	2	2.5	?	?	5

[a] Lactating: Y = Yes, N = No.
[b] Reproductive status: 1 = in estrus, 2 = not in estrus, 3 = pre-estrus.
[c] Condition: from 1 = good, to 5 = bad.
[d] Radio-collared.
[e] With 3 unmarked cubs at capture; with 2 cubs after capture.
[f] With 2 cubs (Nos. 005 and 006).
[g] With 3 cubs (Nos. 011, 015, and 016).
[h] i.e. 2 with one 1½(est.)-year-old (No. 23).
[i] Accompanied by two 2.5(est.)-year-olds (Nos. 037 and 038).
[j] Accompanied by two 2.5(est.)-year-olds (unmarked).

Table 2. Date, location, age, and physical condition of male grizzly bears captured in the southwest Brooks Range of GMU 23 from 31 May through 9 June 1986.

Bear ID (tattoo)	Date of capture	Location	Physical condition[a]
003[b]	05/31/86	Mouth of Kelly River	2
007[b]	06/02/86	Upper Ikalukrok Creek	1
010[b]	06/02/86	Opposite No Name Creek	
012	06/02/86	Upper Kelly River	1
012	06/08/86	No Name Creek	
015[c]	06/03/86	Upper Jade Creek	2
016[d]	06/03/86	Upper Jade Creek	2
017	06/03/86	Rabbit Creek	3
019[b]	06/04/86	SE of Sivukat Mountain	3
023	06/04/86	5 miles up Kelly River	4
024[b]	06/04/86	Middle Kelly River	2
027[b]	06/05/86	Middle Ikalukrok Creek	3
029[b]	06/05/86	Between Wulik River and Ikalukrok Creek	2
030[b]	06/05/86	Tutak Creek	2
031	06/05/86	Upper Wulik River	3
034[b]	06/07/86	South of Sivukat Mountain	4
035[b]	06/07/86	Mouth of No Name Creek	3
037	06/07/86	Mulgrave Hills	3
040[b]	06/07/86	Upper Rabbit Creek	2
042[b]	06/08/86	10 miles NW of Noatak	3
044[b]	06/08/86	Middle Ikalukrok Creek	2
045[b]	06/09/86	West of Sheep Mountain	3
046[b]	06/09/86	Mouth Wrench Creek	4

[a] Condition: 1 = good, to 5 = bad.
[b] Radio-collared.
[c] Cubs of sow No. 013.
[d] Subadult with sow No. 036.

Table 3. Weight, ear tag numbers, and statistics associated with capturing female grizzly bears in the southeast Brooks Range of GMU 23 during spring and early summer 1986.

Bear ID (tattoo)	Weight (lbs)	Left ear tag Color[a]/No.	Right ear tag Color[a]/No.	Drug[b]	Dose (cc)	Induction (min)	Location[c] of injection	Level of disturbance[d]	Level of sedation[e]
001	235	WD/2235	WD/2231	PHCL	3.0[f]	6	2	3	M
002	210	WD/2233	WD/2243	PHCL	6.0[f]	54	1	5	M
004	225	WD/2276	WD/2298	PHCL	3.0	11	1	2	M
005	022	WD/2236	WD/2270	PHCL	0.8	2	1	--	H
006	028	WD/2286	WD/2290	PHCL	0.8	2	1	--	--
008	210	WD/2282	WD/2296	PHCL	3.0[f]	6	7	2	M
009	248	WD/2300	WD/2287	PHCL	5.5[f]	40	7	3	H
013	235	Dead at capture		PHCL	10.0[f]	28	7	4	H
014	210	WD/2283	WD/2297	PHCL	5.5[f]	21	1	4	H
011	013	WD/2203	WD/2241	PHCL	1.0	--	1	5	L
018	320	WD/2291	WD/2295	PHCL	3.0	18	6	--	--
020	140	WD/2242	WD/2240	PHCL	3.0[f]	2	1	1	--
021	250	WD/2212	WD/2227	PHCL	5.5[f]	33	2	2	--
022	215	WD/2211	WD/2202	PHCL	3.0	7	1	2	M
025	225	WD/2292	WD/2293	PHCL	3.0	9	6	3	M
026		WD/2239	WD/2238	M-99	4.0	4	6	3	--
028	260	WD/2550	OD/2579	M-99	3.5	9	1	--	--
032	138	WD/2232	WD/2245	M-99	3.5	5	8	2	--
033	155	WD/2249	WD/2244	M-99	3.5	--	3	4	--
036		Dead at capture		M-99	3.5[f]	5	6	3	--
038	185	WD/2277	WD/2299	M-99	2.3[f]	25	1	5	--
039	275	WD/2204	WD/2210	M-99	2.5	4	3	2	--
041	186	WD/2234	WD/2228	M-99	3.5[f]	4	2	4	--
043	276	WD/2230	WD/2250	M-99	5.0[f]	13	2	5	--
047[g]				M-99	3.5	2	6	1	H

Table 3. Continued.

[a] OD = orange duflex, WD = white duflex.

[b] PHCL = phencylidine hydrochloride (Sernylan), M-99 = etorphine hydrochloride.

[c] 1 = rump, 2 = back, 3 = side, 4 = neck, 5 = head, 6 = tail, and 7 = rear leg.

[d] Level of disturbance: 1 = slight, 5 = run hard before immobilization resulted.

[e] Level of sedation: L = light, M = optimum, H = heavy.

[f] Multiple injections required for immobilization.

[g] Immediately released due to poor physical condition.

Table 4. Weight, ear tag numbers, and statistics associated with capturing male grizzly bears in the southeast Brooks Range of GMU 23 during spring and early summer 1986.

Bear ID (tattoo)	Weight (lbs)	Left ear tag Color[a]/No.	Right ear tag Color[a]/No.	Drug[b]	Dose (cc)	Induction (min)	Location[c] of injection	Level of disturbance[d]	Level of sedation[e]
003	412	OD/2530	OD/2534	PHCL	4.0	12	6	2	M
007	390	OD/2546	OD/2526	PHCL	4.0[f]	12	1	4	L
010	--	OD/2589	OD/2544	PHCL	5.5[f]	22	7	3	M
012	475	OD/2597	OD/2536	PHCL	5.0	11	1	1	M
012	--	Recapture		M-99	5.0	7	7	3	--
015	014	OD/2595	OD/2546	PHCL	1.0	--	1	5	L
016	016	OD/2593	OD/2538	PHCL	0.5	--	5	--	--
017	080	OD/2548	OD/2540	PHCL	2.5[f]	3	6	1	H
019	--	OD/2598	OD/2533	PHCL	6.0[f]	18	6	5	--
023	078	OD/2559	OD/2569	M-99	1.5[f]	6	6	2	M
024	435	OD/2591	OD/2537	PHCL	7.5[f]	--	3	4	M
027	335	OD/2553	OD/2558	PHCL	3.0	9	2	1	M
029	425	OD/2582	OD/2586	PHCL	5.0[f]	--	2	--	--
030	485	OD/2532	OD/2542	PHCL	10.0[f]	55	1	4	M
031	190	OD/2529	OD/2531	M-99	2.5	5	6	2	--
034	310	OD/2528	OD/2592	M-99	5.0	12	6	5	--
035	215	OD/2590	OD/2596	M-99	3.5[f]	4	6	1	M
037	--	OD/2549	OD/2547	M-99	2.5[f]	27	6	5	L
040	435	OD/2572	OD/2585	M-99	4.5[f]	16	1	2	--
042	230	OD/2527	OD/2600	M-99	5.0[f]	30	7	3	M
044	435	OD/2555	OD/2554	M-99	7.5[f]	23	1	3	--
045	390	OD/2588	OD/2535	M-99	4.0	9	2	3	--
046	405	OD/2575	OD/2562	M-99	4.0	10	1	3	--

Table 4. Continued.

[a] OD = orange duflex, WD = white duflex.

[b] PHCL = phencylindine hydrochloride (Sernylan), M-99 = etorphine hydrochloride.

[c] 1 = rump, 2 = back, 3 = side, 4 = neck, 5 = head, 6 = tail, and 7 = rear leg.

[d] Level of disturbance: 1 = slight, 5 = run hard before immobilization resulted.

[e] Level of sedation: L = light, M = optimum, H = heavy.

[f] Multiple injections required for immobilization.

Table 5. Physical characteristics of female grizzly bears captured in the southwest Brooks Range of GMU 23 during 1986.

Bear ID (tattoo)	Wt. (lbs)	Head length (mm)	Head width (mm)	Neck cir. (mm)	Body length (mm)	Heart girth (mm)	Upper canine ant-post[a] (mm)	Upper canine lab-ling[b] (mm)	Lower canine ant-post[a] (mm)	Lower canine lab-ling[b] (mm)	Percent hemoglobin	Packed cell volume
001	235	335	207	588	1734	1105	R17.3	R13.9	R20.3	R19.7	20.0	58.5
002	210	327	188	--	1803	--	U16.0	U11.4	U17.1	U12.3	18.0	53.5
004	225	323	186	--	1867	1130	R20.8	R14.9	R19.8	R13.2	20.0	49.0
005	022	165	100	250	794	442	--	--	--	--	17.5	42.5
006	028	172	103	289	845	--	--	--	--	--	17.0	45.0
008	210	306	194	521	1753	1061	L15.6	L11.6	L17.9	L12.4	18.5	55.5
009	248	325	215	610	1791	1162	--	--	--	--	17.0	44.0
011	013	156	95	248	660	--	--	--	--	--	16.0	42.0
013	235	330	200	673	1880	1194	R20.2	R14.1	R20.5	R17.4	20.0	51.5
014	210	311	202	635	1803	1092	R16.1	R12.1	L17.5	L12.6	17.0	46.0
018	320	316	222	--	1981	--	--	--	--	--	18.5	50.0
020	140	295	172	616	1473	1118	L20.6	L11.3	L17.1	L12.4	19.5	54.5
021	250	335	217	--	1765	1359	U17.1	U12.1	U17.3	U13.1	18.5	47.5
022	215	330	220	584	1642	--	R18.2	R10.9	R19.2	R13.0	19.1	47.3
025	225	324	211	584	1803	1118	--	--	--	--	19.9	55.0
026	--	353	--	--	--	--	--	--	--	--	--	--
028	260	381	216	660	1930	1016	R16.1	R10.0	R15.0	R09.8	20.0	52.0
032	138	283	149	--	--	--	L15.0	L11.9	L15.1	L12.4	17.5	49.5
033	155	311	191	521	1702	889	L17.7	L15.3	L14.9	L12.5	20.0	55.5
036	--	318	210	800	1829	1168	L18.4	L13.7	L18.7	L13.0	--	--
038	185	308	185	533	1676	991	--	--	--	--	19.5	49.5
039	275	302	210	610	1803	1143	L17.3	L13.7	L18.1	L12.5	19.0	48.0

Table 5. Continued.

Bear ID (tattoo)	Wt. (lbs)	Head length (mm)	Head width (mm)	Neck cir. (mm)	Body length (mm)	Heart girth (mm)	Upper canine ant-post[a] (mm)	Upper canine lab-ling[b] (mm)	Lower canine ant-post[a] (mm)	Lower canine lab-ling[b] (mm)	Percent hemoglobin	Packed cell volume
041	186	318	198	660	1676	1080	L15.2	L13.5	L17.1	L15.2	19.0	52.5
043	276	329	203	648	1854	1118	L16.3	L13.2	L15.2	L13.1	18.0	53.0
047[c]	--	--	--	--	--	--	--	--	--	--	--	--

[a] Ant. = anterior, post. = posterior.

[b] lab. = labial, ling. = lingual.

[c] Processed by T. Smith.

Table 6. Physical characteristics of male grizzly bears captured in the southwest Brooks Range of GMU 23 during 1986.

Bear ID (tattoo)	Wt. (lbs)	Head length (mm)	Head width (mm)	Neck cir. (mm)	Body length (mm)	Heart girth (mm)	Upper canine ant-post[a] (mm)	Upper canine lab-ling[b] (mm)	Lower canine ant-post[a] (mm)	Lower canine lab-ling[b] (mm)	Percent hemoglobin	Packed cell volume
003	412	385	229	838	1829	1321	R21.5	R15.5	L20.4	L18.6	20.0	61.0
007	390	318	226	547	1664	1308	L20.2	L14.9	L20.8	L14.7	16.0	46.5
010	--	360	251	927	1892	--	R23.0	R17.7	R21.9	R15.3	20.0	58.5
012	475	311	257	800	2184	1384	L16.9	L20.8	L19.6	L15.7	17.5	47.5
015	014	152	108	248	660	--	--	--	--	--	18.0	43.0
016	016	162	95	279	680	--	--	--	--	--	17.0	39.5
017	080	235	138	381	1219	737	--	--	--	--	16.0	42.5
019	--	384	241	838	1753	1378	U22.1	U16.0	U26.6	U17.0	17.5	47.0
023	078	230	135	406	1270	--	--	--	--	--	18.0	49.0
024	435	340	248	775	2013	1283	L20.1	L15.0	L20.6	L14.8	20.0	54.5
027	335	340	223	686	2129	1245	L19.6	L18.8	L21.6	L14.1	20.0	53.5
029	425	368	323	889	2184	--	U21.4	U14.1	U22.8	U14.1	20.0	57.3
030	485	384	257	965	1676	1524	L23.6	L17.5	L22.4	L14.7	15.0	57.5
031	190	325	177	660	1778	927	L19.3	L13.7	L21.4	L14.4	20.0	59.5
034	310	343	210	660	1829	1118	L16.8	L12.0	L15.0	L12.0	17.5	54.0
035	215	342	187	559	1816	965	L19.7	L17.8	L20.4	L19.5	20.0	50.5
037	--	306	184	641	1613	--	U17.7	U15.4	U17.6	U15.7	--	--
040	435	347	239	851	2184	1321	--	--	--	--	20.0	55.0
042	230	310	178	610	1778	1041	R14.9	R13.0	R20.0	R13.2	17.5	54.0
044	435	365	230	876	1880	--	--	--	--	--	18.5	48.5

Table 6. Continued.

Bear ID (tattoo)	Wt. (lbs)	Head length (mm)	Head width (mm)	Neck cir. (mm)	Body length (mm)	Heart girth (mm)	Upper canine ant-post[a] (mm)	Upper canine lab-ling[b] (mm)	Lower canine ant-post[a] (mm)	Lower canine lab-ling[b] (mm)	Percent hemoglobin	Packed cell volume
045	390	365	222	673	1867	—	R21.1	R18.4	R23.4	R13.8	18.5	57.0
046	405	365	230	737	1867	—	R20.0	R14.4	R21.8	R13.4	20.0	52.5

[a] Ant. = anterior, post. = posterior.

[b] lab. = labial, ling. = lingual.

Table 7. Numbers of relocations, current status, and species of kill observed while monitoring radio-collared grizzly bears in the southwest Brooks Range of GMU 23 during 1986.

Bear ID (tattoo)	Number of relocations	Status as of 11/08/86	Associates	Kills observed
FEMALE				
001	13	Den site located.	With 3 0.5-yr-old cubs - 1 lost after capture.	
002	12	Den site located.	With #3 at capture.	0.5 unidentified kill[a]
004	13	Den site located.	With 2 0.5-yr-old cubs.	
008	14	Den site located.		
009	11	Den site located.	With #10 at capture - 09/13/86, with #46 06/09/86, with #12 06/21/86.	0.5 possible moose calf[a] 1 adult moose 0.5 unidentified kill[a]
014	11	Den site located.	With 3 cubs at capture, with 1 cub by 06/22/86.	
018	10	Probably shot between 08/22-09/13/86.	With #19 at capture, with #27 06/08/86.	0.5 calf moose
020	10	Den site located.	With 1 unmarked bear - 07/03/86.	1 adult caribou (old) 1 unidentified kill
021	8	Den site located.		

Table 7. Continued.

Bear ID (tattoo)	Number of relocations	Status as of 11/08/86	Associates	Kills observed
FEMALE - cont.				
022	10	Den site located.	With yearling #23.	
025	11	Den site located.	With #24 at capture, with #12 on 06/08/86, with 1 unmarked bear - 06/22/86.	
028	13	Den site located.	With #29 at capture - 06/09/86, with #32 on 06/05/86, with #44 on 06/22/86.	
039	9	Den site located.	With #40 at capture - 06/13/86, with 1 umarked bear - 06/21/86.	
043	5	Den site located or possible shed collar, missing from 07/03 - 09/13/86.	With #44 at capture.	0.5 adult caribou (old)[a]
041	8	Den site located.	With #35 at capture.	
MALE				
003	11	Den site located.	With #2 at capture.	

Table 7. Continued.

Bear ID (tattoo)	Number of relocations	Status as of 11/08/86	Associates	Kills observed
MALE - cont.				
007	10	Den site located.	With 2 unmarked bears - 08/14/86.	
010	10	Den site located.	With #9 at capture & 09/13/86, with #46 06/21/86.	1 yearling moose 0.5 undentified kill[a]
012	5	Shed collar 06/07/86, recaptured 06/08/86, shed collar 07/03/86.	With #25 06/08/86, with #9 06/21/86.	1 adult moose
019	2	Shed collar by 06/08/86.	With #18 at capture.	
024	6	Den site located, lost contact from 07/04-09/13/86.	With #25 at capture, with 1 uncollared bear - 06/21/86.	
027	4	Radio contact lost after 07/03/86.	With #18 on 06/08/86.	1 calf moose
029	10	Den site located.	With #28 at capture & 06/09/86.	1 adult moose
030	3	Shed collar by 06/21/86.		
034	10	Den site located.	With marked bear at capture.	

Table 7. Continued.

Bear ID (tattoo)	Number of relocations	Status as of 11/08/86	Associates	Kills observed
MALE - cont.				
035	6	Den site located, missing from 07/04-10/25/86.	With marked sow at capture, with #41 on 06/08/86, with 2 unmarked bears - 07/04/86, with 2 unmarked bear - 08/14/86.	
040	10	Den site located.	With #39 at capture & 06/13/86. with #42 08/04/86.	
042	10	Den site located.	With #40 08/04/86, with 2 unmarked (family group) 09/13/86.	
044	5	Den site located, missing from 07/03 to 10/04/86	With #43 at capture, with #28 06/22/86.	0.5 adult caribou (old)[a]
045	8	Den site located.		
046	10	Den site located.	With #9 at capture, with #10 06/21/86.	1 probable calf moose

[a] When number of adult bears observed on kill was >1 the carcass was divided proportionately to numbers of bears observed.

APPENDIX A. Plan of study for grizzly bear research in and adjacent to Noatak National Preserve.

WILDLIFE RESEARCH STUDY PLAN
Alaska Department of Fish and Game
Division of Game

STUDY TITLE: Demography of Noatak Grizzly Bears in relation to human exploitation and mining development.

THE PROBLEM:

1. Statement

Management of grizzly bears (Ursus arctos) in northwest Alaska requires scientific information, interagency cooperation, and public support. User demands and human impacts on bear populations in northwest Alaska are increasing. Industrial development such as the Red Dog Mine (potentially one of the largest lead-zinc mines in the world) threaten grizzly bear populations directly through habitat loss and alteration, and through increased mortality from more frequent bear-human contact and conflict. Subsistence and recreational hunting, and shooting of bears threatening property and lives of local residents continues to increase. Effective conservation and management of grizzly bears and mitigating impacts from mining development requires increased knowledge and baseline data on several important population parameters including population density, sex-age structure, productivity, movements, mortality factors, and levels of harvest.

2. Justification

This proposed study should be conducted for 2 reasons: (1) No studies to determine grizzly bear population status in GMU 23 have been conducted. The relationship of current reported harvest levels to population size is unknown. Population assessment studies conducted elsewhere in Alaska may not be applicable to GMU 23 because of differences in habitat quality, weather patterns, harvest levels, and a variety of other factors. The lack of definitive population data concerning all facets of GMU 23 grizzly bear populations increases the probability that bear populations are locally overharvested, or could be in the near future. (2) The Red Dog Mine is scheduled to begin production of ore in the early

1990's. At peak development the mine will be one of the world's largest lead-zinc mines. Aside from actual mine development, the project includes development of a saltwater port and construction of over 50 miles of road from saltwater inland to the mine. No baseline data exist to evaluate the impact of this large mining development on grizzly bears.

This study will provide game managers with an accurate estimate of bear density within representative habitats of the most important bear hunting areas within GMU 23. This density estimate, in comparison with known bear harvest levels, will provide an estimate of minimum harvest rates which can be used as a management guideline. The study will also provide baseline ecological data on an exploited grizzly bear population prior to development of one of the world's largest lead-zinc mines. The baseline data, particularly a precise bear density estimate, could be used to determine the impacts of mine development in future years.

3. Background

Population assessments of Alaskan brown-grizzly bear populations have been conducted, or are ongoing, in southeast Alaska (Wood 1976, Schoen 1982, Schoen et al. 1981, and Schoen and Beier 1983, 1985, 1986), southcentral Alaska (Dean 1976; Spraker et al. 1981; Ballard et al. 1982; Miller and Ballard 1982a,b; Miller and McAllister 1982; Miller 1983, 1984, 1985; and Miller et al., in press), Kodiak Island (Hensel et al. 1969; Smith and Van Daele 1984; Smith et al. 1985; Barnes 1985), the Alaska Peninsula (Glenn 1971, 1972, 1976; Glenn and Miller 1980; Glenn et al. 1976), northcentral Alaska Range (Reynolds and Hechtel 1983, 1984, 1985, 1986) and the North Slope of the Brooks Range (Crook 1971; Reynolds 1974, 1976, 1978, 1980, 1981, 1982; Reynolds and Hechtel 1982). For many of these studies population density has only been determined after many years of capture and long-term monitoring of radio-collared individuals. Such density and population estimates are often not repeatable without great expense, and they do not contain an estimate of precision. However, reliable density or population size estimates are necessary to evaluate the impacts of both human exploitation and/or industrial development on bear populations.

Recently, Miller and Ballard (1982) and Miller et al. (in press) have utilized mark-recapture methods to provide a quick estimate of population density with a measurement of precision. Such estimates, when compared with known harvest levels, can be used to generate harvest rates and/or can be used to measure long-term impacts on population trends by comparing density estimates over periods of time.

No studies to determine population status of bears in GMU 23 have been conducted. Existing Unit 23 population estimates range from 570 to 2,360 bears (ADF&G report to Alaska Board of Game, 1985). The estimates were based on research conducted in GMU's 13, 20, and 26. GMU's 13 and 20 are both located several hundred miles south of GMU 23 and those bear populations are not likely to be comparable to those in the SW Brooks Mountain Range due to habitat and climatic differences. Similarily, bear density estimates for the northern Brooks range (Reynolds 1981, 1982) may also not be appropriate for use in GMU 23 due to differences in climate and vegetation. Regardless, northern Brooks Range studies suggested that a high bear density in optimum habitat was 1 bear/20 mi^2 while low density in lesser quality habitat was 1 bear/80 mi^2. This large range of density estimates provides an equally large range of GMU 23 population estimates. Such estimates in relation to known harvest levels result in annual harvest levels ranging from less than 1% to 12%. Harvest levels of 2-4% have been considered sustainable for northern grizzly bear populations (Reynolds 1976; Sidorwicz and Gilbert 1981). The wide range of current harvest level estimates are inadequate for management decisions.

Traditionally, game managers in Alaska have monitored trends in bear populations by interpreting sex and age composition of the harvest. Often these samples are too small and/or identical sets of data can often be interpreted as indicating exactly opposing trends. Presently, interpretation of harvest data is not reliable for assessing bear population trends. Several models exist for using harvest data to assess the status of bear population trends, but none have been tested and verified with real population data. A modified version of Tait's (1983) model is being tested (see Miller and Miller research proposal) but until verified, the only method of determining actual harvest rates will rely

on comparison of density estimates converted to population size in relation to known reported harvests. The study will provide a bear density estimate within the most heavily hunted portion of GMU 23 which can then be converted to a population estimate for comparison with known harvest levels for estimating harvest rates.

Currently our understanding of brown-grizzly bear population dynamics in relation to human developments is inadequate for developing rigorous management guidelines (see Schoen and Beier's research proposal). Other than Schoen's and Beier's study, and this study, there have been no studies of bear-mining relationships. Accurate pre-project population data is needed so that changes in population size after development can be documented to provide a firm basis for mitigating future mining activities. This study will estimate several key pre-development population parameters which can then be compared with similar estimates in future years after development.

4. Literature Cited - See report.

STUDY GOAL

The purpose of this study is three-fold:

(1) To estimate the density of grizzly bears within representative habitat of GMU 23 and to apply the density estimate to areas of management significance, to derive population estimates for comparison with reported harvest levels (from sealing documents) within the study area. The derived harvest rate, when compared with allowable harvest rates from the literature, will provide an indication of whether the level of exploitation is sustainable.

(2) To better understand the population dynamics, distribution, and home range of grizzly bears within a portion of GMU 23.

(3) To provide baseline ecological, biological, and behavioral data on grizzly bear population processes including distribution, movements, habitat use, and home ranges within a selected study area prior to large-scale mining development.

Specific study objectives are as follows:

(1) To estimate sex and age structure of grizzly bears within a selected study area in and adjacent to the Noatak National Preserve.

(2) To determine general movement patterns and home ranges of adult grizzly bears in and adjacent to the Noatak National Preserve.

(3) To estimate spring density and population size within representative habitats in and adjacent to the Noatak National Preserve.

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

(5) To estimate and compare harvest levels of grizzly bears, within and adjacent to the Noatak National Preserve, with rates reported in literature.

Two principal hypotheses will be tested:

(1) Current reported grizzly bear harvest rates are within long-term sustained yield levels.

(2) Development of the Red Dog Mine will have no impact on Southwest Brooks Range grizzly bears.

EXPECTED RESULTS AND BENEFITS

When the study is completed we will be able to describe several key population parameters (density, sex-age structure, age of 1st reproduction, productivity, mortality, movements, home range size, and habitat use) of an exploited and previously unstudied grizzly bear population. This information will serve as baseline data for eventually measuring the impacts of mining development on the bear population. Estimated population size (converted from density estimate) within management units in comparison to known reported harvests will provide minimum harvest rates and serve as a basis for future management of GMU 23 grizzly bears.

A majority of the field work in this study will be completed by fall 1988. Additional low-intensity monitoring of bears will be conducted in 1989 and 1990 to measure productivity and survival of cubs and adults. The 1st 3 years of the study are largely funded by the U. S. National Park Service; their administrative guidelines require that the study duration be limited to 3 years. Therefore, 2 final reports will be prepared; the first will cover the 1st 3 years of study, while the second will cover the entire 5-year study. The last report will basically supplement the 1st report with additional productivity and survival data gathered in years 4 and 5.

To adequately assess changes in density and other population parameters of the grizzly bear population occurring as a result of development of the Red Dog Mine, the bear census, at least, and ideally, the measurement of movements, home ranges, and productivity should be repeated in 10-15 years.

STUDY APPROACH

The following jobs will be completed annually or periodically to accomplish the goals and objectives of this research study. Due to uncertainties concerning funding, several specific jobs may not be completed in their entirety. The following jobs are listed generally in order of priority.

Job 1.

To estimate the density of grizzly bears within a study area located within and adjacent to the Noatak National Preserve and the Red Dog Mine. A modified capture-recapture technique developed by Miller and Ballard (1982) and Miller et al. (1986) will be used to estimate spring bear density within the study area. Thirty adult bears will be captured, and radio-collared within a 2,500 mi^2 preliminary study area, using methods described by Ballard et al. (1982), and then monitored from fixed-wing aircraft using standard methods and data forms. Based upon subsequent movements of radioed bears, a smaller study area of about 800 mi^2 will be selected for the census. Half or more of the radio-collared bears marked during the 1st year will serve as the initial marked portion of the census population. Additional unmarked adults will be radio-collared as they are found during the census in year 2. The density estimate will have as tight a confidence interval as funding permits, i.e., ca. 80% CI. The initial density estimate will serve as baseline data for pre-mining development.

Job 2.

To estimate sex and age structure of grizzly bears in and adjacent to Noatak National Preserve. Sex and age structure of the bear population will be assessed during the census. Total number of bears captured will provide 1 estimate of sex-age structure. Other methods of estimating sex-age structure will be investigated. Ages of bears will be estimated from cementum annuli (Mundy and Flook 1973).

Job 3.

To estimate minimum human harvest rates of Noatak grizzly bears within the general study area. Sealing records and reliable observations of unsealed harvested bears will provide an annual minimum estimate of total bear harvest. Density

estimates obtained in Job 1 will allow calculations of population size within the study area (reliable estimate) and GMU 23 (as reliable as the habitat within the study area is representative of the unit). Comparison of total harvests with estimated population size will provide an estimate of minimum harvest rates. Comparison of the derived rates with those reported in the literature should provide a good indication of whether the bear population is being overharvested.

Job 4.

To estimate reproductivity interval, age of 1st breeding, and reproductive rates of Noatak grizzly bears. Monitoring of radio-marked females over a 5-year period will provide estimates of the above reproductive parameters.

Job 5.

To estimate natural mortality rates of Noatak grizzly bears. Natural mortality rates over a 5-year period will be estimated from radio-collared individuals using methods described by Trent and Rongstad (1974). Bears dying of natural causes will be examined as soon as practical to estimate cause of death. Minimum estimates of cub mortality will be made by comparing the number of cubs as they emerge from dens to the number of cubs still present when they reenter dens the following fall.

Job 6.

To monitor movements and behavior of grizzly bears in relation to development of the Red Dog Mine. This job will evaluate the effects of road and mine development by monitoring changes in home range use, movements, and denning patterns of radio-collared bears during the 5-year period. Ideally, at peak development the bear census should be repeated to allow comparison of pre- and post-project bear distribution, density, and sex-age structure.

Job 7.

To determine seasonal distribution, habitat use, general movement patterns, and home range characteristics of Noatak grizzly bears. Approximately 50 adult radio-collared grizzlies captured during years 1-3 will be monitored at least twice per month during each year of the study. At each sighting the following data will be recorded: time, accuracy of the observation, vegetation type, slope, aspect, elevation, activity, and association. Total and seasonal home ranges will be determined using the minimum home range method (Mohr 1947) and other methods as appropriate. Habitat use will be

determined by sampling topographic maps to determine availability of slope, aspects, and elevations, and these will be compared with actual use by Chi-square analysis (Neu et al. 1974; Ballard et al. 1984, 1985).

Job 8.

To participate in conference and workshops.

Job 9.

To summarize data and write annual and final reports and appropriate technical and popular publications.

Personnel - See report.

Cooperators - See report.

GEOGRAPHIC LOCATION

GMU 23 area between Wulik, Kugururok, and Noatak Rivers.

RELATED FEDERAL PROJECTS

None.

REPORTING SCHEDULE

The annual Progress Report will be in Headquarters by February 28 in each year of the study.

The final report will be in Headquarters by 31 December 1990.

SCHEDULE

Years active	Job No.	Activity	Est. oper. costs	Est. man days/year
1-2	1	Delineate study area and census bear pop.	66,500	30
1-2	2	Estimate sex and age structure	34,000 and Job 1	4
1-5	3	Estimate minimum harvest rates	2,000	10
1-5	4	Estimate reproductive interval, age of 1st breeding, and reproductive rates	19,000	10
1-5	5	Estimate natural mortality rates	Included in Job 1	10
1-5	6	Monitor movements of bears in relation to mine development	15,000 and Jobs 2,5,& 7	--
1-5	7	Determine seasonal movements and distribution, habitat use, movement patterns and home range characteristics.	73,000	40
1-5	8	Participate in conference and workshops	7,500	5
1-5	9	Report writing	5,000	20
Total			222,000	129

ANNUAL BUDGETS BY FUNCTION AND AGENCY

Noatak Grizzly Bear Study Budget

Year 1 -- October 1, 1985 through September 30, 1986

Item	ADF&G	NPS-ARO	NPS-NWA
1. Aircraft - capture			
Helicopter:			
7 days @ $458 + $50 pilot per diem		$ 3,556	
45 hours @ $190/hr		8,550	
Spotter plane ADF&G Super Cub:			
40 hours @ $50/hr	$ 2,000		
Fuel:			
Jet fuel, 1,200 gallons @ $2.50/gal		3,000	
AV gas, 400 gallons @ $2.50/gal		1,000	
Fuel delivery to Noatak, $2.00/gal	1,600	1,600	
2. Aircraft - monitoring			
June through September, 32 hr/mo = 128 hrs total			
35 hours @ $57/hr, NPS C-185			$2,000
64 hours @ $5/hr, ADF&G PA-18	3,200		
29 hours @ $135/hr, charter		3,915	
3. Equipment and analyses			
Radio collars - retrofit 32 @ $200/ea	6,400		
Drugs: M99, 2 bears/vial = 15 @ $100	1,500		
M50-50, 4 bears/vial = 8 @ $100	800		
Darting equipment: 50 darts @ $23/dart		1,500	
Miscellaneous equipment		1,000	
Blood analyses: 30 bears @ $50/ea	1,500		
4. Travel and lodging			
Travel for PI (Nome-Kotzebue), 5 @ $200/ea	1,000		
Per diem (NPS facilities provided, 50 days @ $20/day)	1,000		
Per diem for tagging crew	1,200	1,200	
Totals	$20,200	$25,000	$2,000

Noatak Grizzly Bear Study Budget

Year 2 - October 1 through September 30, 1987

Item	NPS Funds Provided ADF&G	NPS-ARO	ADF&G
1. Aircraft - capture and census			
Helicopter:			
14 days @ $508/day		$7,112	
70 hours @ $190/hr	$9,700	3,600	
OAS 7% surcharge	1,430		
Spotter and tracking planes for census:			
3 spotter planes for census @ 7 hours/day plus 10% commute time. Also 8 hours/day for radio-tracking. Assumes following ADF&G aircraft available: Super Cub, PA-12, & C-185. 26 hours/day by ADF&G @ $50/hr = $1,300/day and 8.4 hrs @ $135/hr = $1,148 = $2,448/day x 14 days =	16,075	18,200	
Fuel:			
Jet fuel = 25 gal/hr x $70 hrs @ $2.50/gal	4,375		
AV gas = 5 gal/hr @ 34.4 hrs/ day x 14 days @ $2.50/gal	6,000		

Year 2 (continued):

Item	NPS Funds Provided ADF&G	NPS-ARO	ADF&G
2. Aircraft - monitoring			
Monitoring Oct-Nov 1986, half by ADF&G and half by commercial charter (18 hrs x $50/hr x 18 hrs x $135/hr)	1,650	1,650	
Monitoring during May-Sept 1987, excluding June. 1 flight/wk at 10 hrs/flight = 160 hrs (half by ADF&G @ $50/hr and half by commercial @ $135/hr)	9,400	5,400	
3. Equipment and Analyses			
Radio collars = 35 @ $300/collar	$5,250	$5,250	
Drugs		3,000	
Darting Equipment		2,000	
Blood Analyses		1,500	
4. Travel and Support			
Travel for PI Nome - Kotzebue, 5 @ $200/each	1,000		
Per diem (NPS facilities provided, 50 days @ $20/day)	1,000		
Per diem and lodging for tagging crew = 182 man-days @ $25/day	4,550		
Travel for PI to Fairbanks for biometric support	1,000		
Totals	$60,000	$12,142	$37,000

Noatak Grizzly Bear Study Budget

Year 3 - October 1, 1987 through September 30, 1988

Item	Amount of Funding
1. Aircraft - capture	
Helicopter:	
3 days @ $508/day and 20 hrs @ $190/hr	$ 5,324
Spotter plane = ADF&G Super Cub, 60 hrs @ $550/hr	3,000
Fuel:	
Jet fuel = 25 gal/hr x 20 hrs = 520 gal @ $2.50/gal	1,300
AV gas = 300 gal @ $2.50/gal	750
2. Aircraft - monitoring	
Monitoring Oct-Nov, half by ADF&G and half by commercial charter (20 hrs x $50/hr & 20 hrs x $135/hr)	3,700
Monitoring during May-Sept, excluding June. 1 flight/wk @ 10hrs/flight = 200 hrs. (half by ADF&G @ $50/hr and half by commercial charter @ $135/hr)	18,500
3. Equipment and Analyses	
Radio-collars = 10 @ $300/collar	3,000
Drugs	1,100
Darting Equipment	1,000
Blood Analyses	500

Year 3 (continued):

Item	Amount of Funding
4. Travel and Support	
Travel for PI Nome-Kotzebue, 5 @ $200/each	1,000
Per diem (NPS facilities provided, 50 days @ $20/day)	1,000
Per diem and lodging for tagging crews = 32 man-days @ $25/day	800
Travel for PI to Fairbanks for biometric support	1,000
Total	$41,974

Noatak Grizzly Bear Study Budget

Year 4 - October 1, 1988 through September 30, 1989

Item	Funding Source = ADF&G
1. Aircraft Monitoring	
Monitoring Oct-Nov	
10 hrs @ $170/hr	$1,700
Monitoring during May-Sept	
10 hrs/flight x 5 flights =	
50 hrs @ $170/hr	8,500
2. Travel and Support	
Travel for PI Nome-Kotzebue,	
5 @ $200/each	1,000
Per diem = 30 days @ $40/day	1,200
Total	$12,400

Noatak Grizzly Bear Study Budget

Year 5 - October 1, 1989 through September 30, 1990

Item	Funding Source = ADF&G
1. Aircraft Monitoring	
Monitoring Oct-Nov	
10 hrs @ $170/hr	$1,700
Monitoring during May-Sept	
10 hrs/flight x 5 flights =	
50 hrs @ $170/hr	8,500
2. Travel and Support	
Travel for PI Nome-Kotzebue,	
5 @ $200/each	1,000
Per diem = 30 days @ $40/day	1,200
Total	$12,400

Project No. W-22-6

Study No. 1YG - 4.20

Segment Period
From: Jan 1, 1987
To: June 30, 1987

WILDLIFE RESEARCH ANNUAL WORK PLAN

Alaska Department of Fish and Game

Division of Game

STUDY TITLE: Demography of Noatak Grizzly Bear in relation to human exploitation and mining development.

The following jobs will be active during this segment period.

Job No.	Activity	Est. man days
1	Census	30
2	Sex-age structure	4
3	Harvest rates	10
4	Reproduction	10
5	Mortality rates	10
6	Movements in relation to mining	--
7	Movements	40
8	Conference	5
9	Annual report	20
	Total	129

Costs:

Operating (excluding P/S)	27,530	
Salaries		
PFT GBIII @ 6 mos. (PCN 2127)	41,767	
	Total Cost:	$69,297
	Federal Share:	51,973
	State Share	17,324