TERROR LAKE HYDROELECTRIC PROJECT

REPORT ON BROWN BEAR STUDIES, 1983

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ALASKA DEPARTMENT OF FISH AND GAME

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SUMMARY OF FINDINGS

During the first 2 years of a 5 year study to determine impacts of the Terror Lake hydroelectric project's construction on brown bears, a total of 95 bears have been captured. Radio-collars have been placed on 63 individual bears in 2 years and radio-collared bears were re-located at scheduled weekly intervals from March through November.

Production of new cub litters by was lower than expected in 1983, suggesting a correlation with scanty berry production in 1982. Only 3 females, including one radio-collared bear, were observed with newborn cubs in the study area.

Eighteen brown bears, including 4 radio-collared animals, were confirmed mortalities in 1983. Sport hunting accounted for all but one mortality and a 6% annual rate of exploitation of adult bears was indicated.

Mean home range size for 16 males was 111.8 km^2 (range = 12.2-326.9 km^2). Mean home range size for 34 females was 30.2 km^2 (range = 7.0-159.3 km^2).

Statistically significant differences were noted in mean elevations occupied by maternal females and males until late July, a possible adaptation for avoiding potential predation on cubs during the breeding season.

Differences in seasonal movements and habitat use by individual radio-collared bears in 1982 and 1983 were believed to be primarily correlated with differences in seasonal availability of food sources. Use of alpine habitat and salmon streams declined, while use of brush-covered slopes where berries were abundant, increased in 1983.

Alpine ridges and peaks above 350 m was preferred denning habitat, with 51% of the dens located above 750 m. Mean elevation of 35 dens was 712 m (range = 275-1065 m). Females denned at higher elevations than did males. Females exhibited a higher fidelity to specific denning areas in successive years than did males. Nineteen of 23 females (83%) denned within 2.5 km of their previous year's dens.

Because construction activity was at its peak in 1983, with work in progress on all major project features, direct impacts of disturbance on brown bears were believed to have peaked also. Lacking pre-construction movement data, seasonal movements and home ranges of radio-collared bears in 1982 and 1983 were compared to draw correlations with the intensified construction activities present in 1983. The relative abundance and seasonal availability of food sources was an important factor which confounded attempts to correlate construction activities with movements of individual bears. One female with newborn cubs shifted from her 1982 home range in Watchout Creek to the Pestchani Creek drainage, which was suspected to have been a response to disturbance from construction of the Kodiak transmission line. Other bears exhibited more subtle changes in home ranges, none of which could be positively correlated with construction activities.

Frequent observations of bears by workers near project job sites and locations of radio-collared bears within the project area indicated that despite intensive helicopter traffic and other construction activities in 1983 several bears continued to use traditional activity areas. Seasonal and diel activity patterns may have been modified to avoid peak construction periods. Intensive helicopter traffic associated with construction of the Kodiak transmission line probably diminished use of salmon spawning areas in Kizhuyak River, although bears may have accommodated by adopting more nocturnal feeding patterns. Fifteen bears were radio-located within 1500 m of construction sites at least once in 1983. Denning characteristics appeared to be little affected by construction activities. Dens of individual bears were generally no more than 2.5 km apart in 1982 and 1983 and preferred denning habitat was similar in both years.

Although several close encounters between bears and workers were reported no direct mortalities of bears nor injuries to personnel occurred. Periodic indoctrination of project personnel about bear safety measures, few firearms among workers and occasional unauthorized harrassment of bears by helicopter pilots contributed to that record.

Unauthorized garbage disposal areas near job sites and the Kizhuyak construction camp attracted an unknown number of bears. The association of bears with these sources of food may produce future bear-human encounters within the project area or at other human habitations within the study area.

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INTRODUCTION AND ACKNOWLEDGEMENTS

Background

This report covers results of the 2nd year's study (1983) in a 5-year research project to monitor the impacts of the Terror Lake hydroelectric project on brown bears (Ursus arctos). Background information and the results of the 1st year of study were presented in Smith and Van Daele (1984). The study will be continued for a minimum of 5 years, 3 years during active construction and 2 years during the operational or post-construction phase.

The purpose of the study is to document changes in use of the study area by brown bears in response to construction and operation of the Terror Lake hydroelectric project. A pre-construction study by Spencer and Hensel (1980) identified several potential impacts on brown bears including displacement from denning areas, interference with travel routes, and reduced use of traditional feeding areas. Smith and Van Daele (1984) observed that a representative sample of sex and age classes of bears continued to use traditional feeding areas and travel routes in the Kizhuyak Bay and Terror Bay drainage in 1982, the first year of construction. The difficulty in correlating movements of individual bears with disturbance from construction activities lacking comparable pre-project data was emphasized by the latter authors.

Acknowledgements

Many individuals contributed to the research efforts and to the completion of the 1983 report. Additional field assistance was provided by B. Ballenger, R. Sellers, V. Barnes and N. Hunter. Mark Chihuly and E. Goodwin processed teeth and determined ages of captured bears. Suzanne Miller, D. Anctil and J. Wettin provided assistance in digitizing home range maps. Karl Schneider turned the bureaucratic wheels and contributed his editing and supervisory skills. Dan Timm offered useful advice, encouragement and administrative assistance. The assistance of C. Crouch in hiring and

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Hilary Van Daele contributed many hours of voluntary work in digitizing base maps.

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The help of P. Arsenault, D. Lodmell and other employees of Ebasco Services Inc. in securing lodging and other services was appreciated.

METHODS

Capture methods and techniques of data collection and analysis were similar to those described in Smith and Van Daele (1984). Brown bears were captured during 2-5 June 1983. Radio-collars were installed on adult bears and movements of radio-collared bears were monitored on a scheduled weekly basis from March through December, 1983.

DESCRIPTION OF THE STUDY AREA

The study area includes approximately 1300 km^2 of northern Kodiak Island, including principally the Kizhuyak Bay, Viekoda Bay, Sharatin Bay, Terror Bay and part of the northern Uganik Bay and northern Ugak Bay drainages (Fig. 1). A more complete description of the study area was reported in Smith and Van Daele (1984).

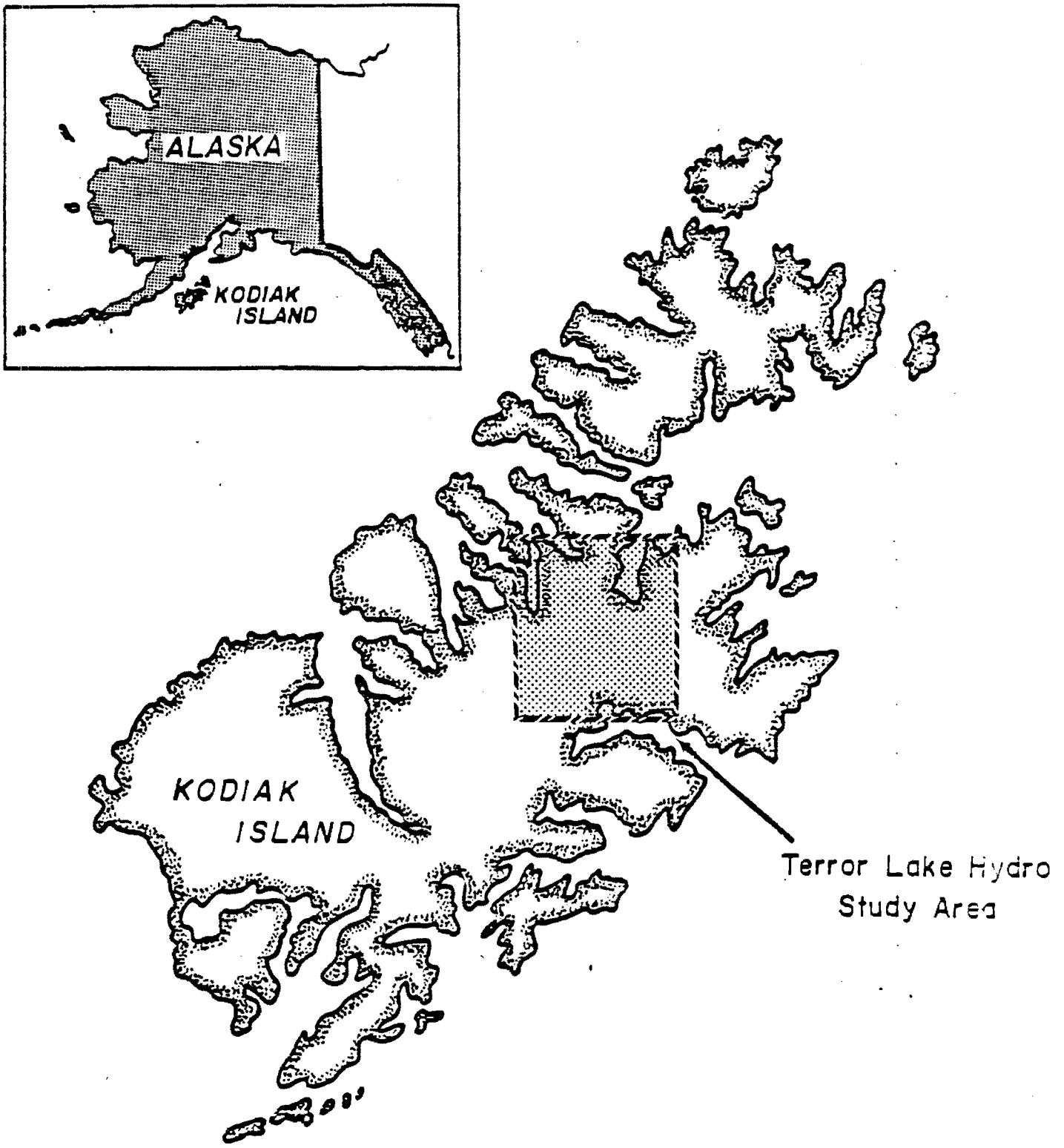

Figure 1. Location of the Terror Lake Hydroelectric Project study area, Kodiak, Alaska.

Description of the Terror Lake Project Construction

The Terror Lake project was designed to provide a 20 MW conventional hydroelectric power source for the city of Kodiak. Terror Lake, a natural lake 40 km southwest of Kodiak, will be impounded and the water transported via an 8 km long underground tunnel to the Kizhuyak River powerhouse. A 28 km long transmission line will connect the Kizhuyak River powerhouse with the town of Kodiak. A small feeder line will be built west of Kizhuyak Bay to supply the village of Port Lions. The project was begun in 1982 and is scheduled for completion in 1984.

Construction activity reached its peak in 1983 with work in progress on all major project features (Fig. 2). Excavation and construction of the embankment at the Terror Lake dam site was begun in early February and completed by late July. Concrete facing work on the dam was begun in early August and the dam was completed by late October. An access road along the northwest side of the Terror Lake dam was begun in May and completed by late August. Construction of the main powertunnel continued through 1983. The Terror Lake construction camp was removed by November.

Diversion works on Falls Creek and Shotgun Creek were completed by November. Construction of the Rolling Rock Creek diversion continued intermittently throughout the year. Construction of the penstock began in February and was finished by October. The powerhouse construction was begun by April and continued through 1983.

Transmission line construction was the major new development in the Kizhuyak Bay and Kizhuyak River areas in 1983. Right-of-way clearing for the Kodiak transmission line was begun in February and line construction continued through October. Portable excavation equipment was transported to remote transmission tower sites by helicopter. Tracked equipment was used for access along the right-of-way in lower Watchout Creek and Kizhuyak River. Helicopters were used extensively during all phases of the transmission line's construction. Peak helicopter use occurred from June through October, when up to 7 helicopters were often operating simultaneously in the

Figure 2. Chronology of Terror Lake hydro project construction activities 1983.

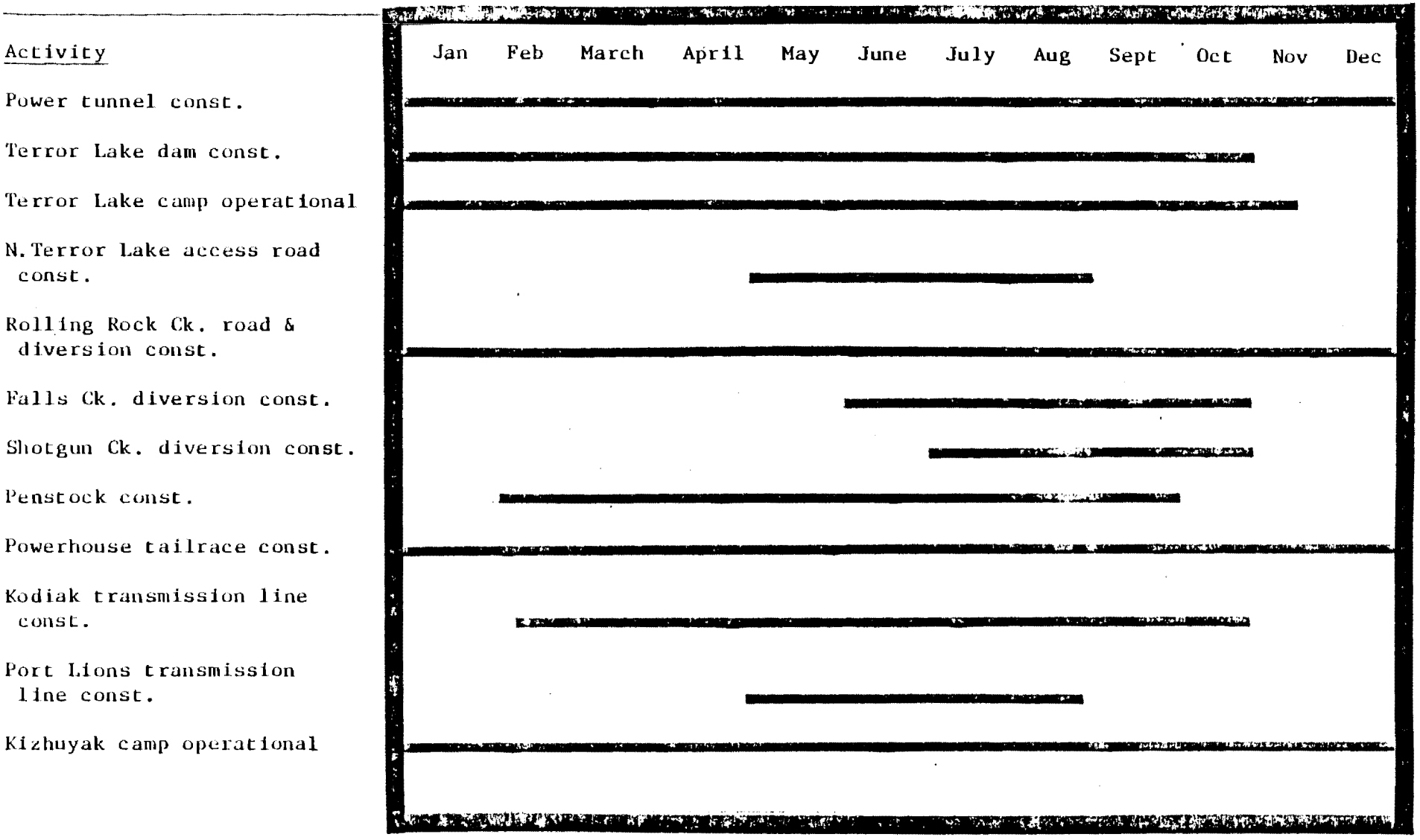

Table 1. Brown bears captured in Terror Lake study area as of July, 1983.

Bear no.	Sex	Age	Capture date	Ear tag no.(L/R)	Comments
001	F	3.5	4/22/82	1799/1784	Pre-estrus; radio failed by 8/20/83
002	M	15.5	4/22/82	1833/1835/1844	Ear radio attached w/duflex tag to right ear; ear radio last heard on 7/20/82.
003	M	5.5	4/22/82	1839/1842	Collar shed by 6/02/83
004	M	6.5	4/22/82	1836/1834	Collar shed by 10/20/83
005	F	13.5	4/23/82	1740/1744	w/006, 007; w/2 newborn cubs on 6/15/83
006	M	2.5	4/23/82	1825/1823	w/005, 007; killed by hunter on 5/30/82; aged at 3.5 in 1982
007	M	2.5	4/23/82	1819/1824	w/005, 006; killed by hunter on 5/18/83; aged at 3.5 in 1982
008	F	11.5	4/23/82	1739/1749	w/009, 010; suspected radio failure by 10/20/83
009	M	2.5	4/23/82	1820/1829	w/008, 010
010	F	2.5	4/23/82	1726/1735	w/008, 009
011	F	6.5	4/23/82	1728/1733	w/012, 013
012	F	1.5	4/23/82	1781/1732	w/011, 013
013	M	1.5	4/23/82	1814/1816	w/011, 012
014	M	6.5	4/23/82	1818/1847	Suspected radio failure by 9/08/83
015	F	7.5	4/25/82	1741/1743	Milk in pectoral mammae only; seen w/smaller bear, possibly weaned cub on 5/04/82
016	M	11.5	4/25/82	1809/1808	w/017; collar shed by 10/20/83
017	F	21.5	4/25/82	1789/1731	w/016
018	F	5.5	4/25/82	1747/1750	w/019; probably younger than cementum age, possibly 3.5 yr. cub of #019.
019	F	6.5	4/25/82	1736/1782	w/018; pre-estrus
020	F	6.5	4/25/82	1746/1738	pectoral mammae had milk; non-estrus
021	M	5.5	4/25/82	--	w/022; capture mortality
022	F	7.5	4/25/82	1729/1730	w/021; possibly pre-estrus
023	M	3.5	4/26/82	1805/1802	w/003; recaptured 6/02/83
024	M	7.5	4/26/82	1803/1810	
025	M	13.5	4/26/82	1840/1827	Collar shed by 7/05/82
026	M	5.5	4/26/82	1816/1813	killed on 8/15/82
027	M	13.5	4/27/82	1812/1822	Collar shed by 5/21/82; recaptured on 6/02/83; killed by hunter on 10/14/83
028	M	3.5	4/27/82	1837/1817	Killed by hunter on 5/03/83
029	F	17.5	4/29/82	not recorded	w/030, 031, 032; dead by 10/7/82, suspected shot by hunter

Table 1. (Cont'd). Brown bears captured in T. Lake study area as of July, 1983.

Bear no.	Sex	Age	Capture date	Ear tag no. (L/R)	Comments
030	M	2.5	4/29/82	1801/1804/1807	w/029, 031, 032; ear radio attached to left ear with duflex tag nos. 1804, 1807; suspected radio failure by 5/10/82.
031	M	2.5	4/29/82	1843/1821	w/029, 030, 032
032	M	2.5	4/29/82	1850/1806	w/029, 030, 031
033	M	3.5	5/01/82	1852/1853	Suspected radio failure by 5/20/83
034	F	13.5	5/02/82	1757/1755	w/035, 036; probable radio failure, last located 9/08/82.
035	F	2.5	5/02/82	--/1763	w/034, 036; ear radio apparently faulty, not relocated.
036	F	2.5	5/02/82	1765/1768	w/034, 035
037	F	4.5	5/02/82	1748/1788	w/038
038	F	3.5	5/02/82	1777/1797	w/037
039	M	2.5	5/02/82	--/1858	w/040, 041; ear radio; last located 5/21/82; aged at 3.5 in 1982 on 6/02/83
040	M	2.5	5/02/82	1854/1862	w/039, 041; aged at 3.5 in 1982; recaptured 6/02/83
041	M	2.5	5/02/82	1864/1841	w/039, 040; aged at 3.5 in 1982
043	F	4.5	7/22/82	1793/1745	Capture mortality
044	F	3.5	7/22/82	1796/1795	
045	M	5.5	7/22/82	1875/1863	Collar shed by 8/11/83
046	F	6.5	7/23/82	1769/1762	w/047 and 1-yearling not captured
047	F	1.5	7/23/82	1764/1773	w/046 and 1-sibling not captured
048	F	23.5	7/24/82	1794/1792	w/049, 050
049	M	1.5	7/24/82	1874/1830	w/048, 050
050	F	1.5	7/24/82	1780/1771	w/048, 049
051	F	8.5	7/24/82	1742/1791	w/052
052	F	1.5	7/24/82	1759/1761	w/051
053	F	8.5	7/24/82	--	w/054; capture mortality
054	M	1.5	7/24/82	1871/1860	w/053
055	F	13.5	7/24/82	1787/1766	w/056, 057, 058
056	F	0.5	7/24/82	1772/1753	w/055, 057, 058
057	M	0.5	7/24/82	1872/1867	w/055, 056, 058
058	M	0.5	7/24/82	1861/1856	w/055, 056, 057
059	M	3.5	7/25/82	1882/1887	
060	F	14.5	7/25/82	1718/1767	w/061, 062, 063

Table 1. (Cont'd). Brown bears captured in Terror Lake area as of July, 1983.

Bear no.	Sex	Age	Capture date	Ear tag no. (L/R)	Comments
061	F	0.5	7/25/82	1725/1723	w/060, 062, 063
062	F	0.5	7/25/82	1714/1716	w/060, 061, 063
063	F	0.5	7/25/82	1722/1715	w/060, 061, 062
064	F	20.5	7/25/82	1724/1719	w/065, 066
065	F	1.5	7/25/82	1798/1751	w/064, 066
066	F	1.5	7/25/82	1754/1758	w/064, 065
067	F	20.5	7/25/82	1785/1783	w/068, 069
068	F	1.5	7/25/82	1737/1775	w/067, 069
069	F	1.5	7/25/82	1760/1720	w/067, 068
070	F	4.5	7/26/82	1711/1706	
071	F	8.5	7/26/82	1707/1702	w/a 0.5 yr. old cub not captured
072	F	18.5	7/26/82	1786/1756	w/073 and a 0.5 yr. old cub not captured.
073	M	0.5	7/26/82	1870/1892	w/072 and a sibling not captured
074	F	17.5	7/26/82	1727/1752	w/075, 076
075	F	1.5	7/26/82	1717/1703	w/074, 076
076	M	1.5	7/26/82	1873/1845	w/074, 075
077	F	20.5	7/26/82	1779/1705	w/3-1.5 yr. old cubs not captured; suspected radio failure by 8/31/83
023*	M	4.5	6/02/83	1950/1802	w/080; recapture
027*	M	14.5	6/02/83	1812/1822	w/078; killed by hunter on 10/12/83; recapture
040*	M	3.5	6/02/83	1854/1862	recapture
078	F	8.5	6/02/83	2025/2001	w/027; estrus
079	M	14.5	6/02/83	1928/1933	breeding w/077
080	F	25.5	6/02/83	2065/2066	w/023; estrus; collar shed by 7/21/83
081	F	10.5	6/03/83	2067/2064	w/082, 083; non-estrus
082	F	2.5	6/03/83	2012/2015	w/081, 083
083	M	2.5	6/03/83	1930/1929	w/081, 082
084	M	12.5	6/03/83	1927/1926	collar shed by 10/12/83
085	F	4.5	6/03/83	2055/2054	non-estrus
086	F	8.5	6/03/83	1776/1712	w/087; non-estrus
087	F	1.5	6/03/83	2073/2058	w/086
088	F	9.5	6/04/83	2071/2072	w/089, 090; non-estrus
089	F	2.5	6/04/83	2016/2007	w/088, 090

Table 1. (Cont'd). Brown bears captured in Terror Lake study area as of July, 1983.

Bear no.	Sex	Age	Capture date	Ear tag no.(L/R)	Comments
090	F	2.5	6/04/83	2024/2005	w/088, 089
091	F	8.5	6/04/83	2056/2075	w/unmarked adult; estrus
092	F	5.5	6/05/83	2052/2074	w/093, 094; did not rejoin cubs; non-estrus
093	F	1.5	6/05/83	2006/2020	w/092, 094; aged by dentition; abandoned
094	F	1.5	6/05/83	2003/2023	w/092, 093; aged by dentition; abandoned
095	M	4.5	6/05/83	1907/1921	w/unmarked adult
096	F	7.5	6/05/83	2062/2069	estrus
027*	M	14.5	6/05/83	1812/1822	w/078; recaptured to adjust radio-collar; killed by hunter on 10/12/83.

* Recaptures

Elbow Creek to Kizhuyak River corridor between 0700 and 1800 hrs. Helicopters were used extensively for slingloading wet concrete from near Kodiak city to transmission line towers. Construction of the Port Lions transmission line was begun with right-of-way clearing in May, but main construction occurred in late July and August. Tracked vehicles and helicopters were used for access to the Port Lions line. The much simpler single pole design of that line required relatively little helicopter support and manpower than did the more complex Kodiak transmission line.

The largest work force of 480 people was active in late July when all phases of construction, including the 2 transmission lines, were in progress. By December 1983 the only major project features still under construction were the powertunnel, the powerhouse and the Rolling Rock Creek dam. The Terror Lake impoundment was being filled by late November.

RESULTS AND DISCUSSION

Sex and Age Composition of Captured Bears

Twenty-two brown bears were captured during 2-5 June, 1983. These included 6 adult males, 5 single females, 4 maternal females, and 7 cubs (Table 1). Three bears had been captured in 1982 (#'s 023, 027 and 040). Radio-collars were installed on 15 adult bears, 5 males and 10 females.

The ages of 5 adult males ranged from 3.5 to 14.5 years with a mean of 9.0 years. The 5 single females ranged from 4.5 to 25.5 years old with a mean of 10.9 years. The 4 maternal females ranged from 5.5 to 10.5 years old with a mean age of 8.5 years. The mean age for all 9 females was 9.8 years.

Six captured cubs were females (86%) and one was a male (14%). The 3 yearlings were females and 3 of the 4-2.5 year old cubs were females.

During the first 2 years of the study, 95 bears were captured. Radio-collars were put on 63 different bears. Thirty-seven bears had functional

radio-collars by December 1983. Twenty-five of the 43 bears (58%) originally radio-collared in 1982 were still being monitored by December 1983. Fifteen radio-collared bears were lost to the study in 1983, 10 males and 5 females. Four losses were from hunter kills and 6 were from shed radio-collars. Transmitter failure was suspected in 5 losses.

Reproductive Status

Breeding Activity

Paired adults were first observed on 19 May and several observations of paired and copulating bears were made during the 2-5 June 1983, tagging period. Paired adults were not observed after 12 July. These dates are consistent with the 1 May-15 July breeding season reported by Hensel et al. (1969).

Capture and handling of bears had little apparent effect on subsequent breeding activities. Male #027 was captured on 2 June while accompanied by female #078, which was also captured. When re-captured on 5 June, male #027 was again accompanied by female #078. Male #023 was captured with female #080 on 2 June. On 5 June he was seen copulating with an unmarked female. This male was accompanied by unmarked adults, presumably females, when observed on 15 June and 1 July. On 11 July, male #023 was seen again with female #080 and another unmarked adult bear, probably a female.

Cub Mortality and Survival

Determining survival rates of cubs is confounded by the difficulty of visually verifying the presence or absence of cubs accompanying maternal females. Several losses of cubs occurred subsequent to the last visual observations of family groups in 1982.

Female #055 lost 1 of 3 newborn cubs between 9 August 1982 and 19 May 1983. She lost another cub between 19 and 30 May 1983. Cumulative mortality through 1983 for newborn cubs of maternal females captured in 1982 was

Table 2. Reproductive status of radio-collared females in 1982, 83 and predicted reproductive status in 1984.

Bear No.	1984 age	Predicted 1984 status	1983 status	1982 status
005	15.5	w/2 yrlgs	w/2 cubs	weaned 2-2 yrs old
008	13.5	w/cubs	single; lost radio contact by 10/08	weaned 2-2 yrs old
011	8.5	w/cubs	single	lost litter of 2 yrlgs by 7/06
015	9.5	w/cubs	single	single; lactating on 4/25
017	23.5	w/cubs	single	single
018	7.5	w/cubs; first litter?	single	single
019	8.5	w/cubs; first litter?	single	single
020	8.5	w/cubs; first litter?	single	single
022	9.5	w/cubs	single	single
037	6.5	w/cubs; first litter	single	single
038	5.5	w/cubs; first litter	single	single
044	5.5	w/cubs; first litter	single	single
046	8.5	w/cubs	single	w/2 yrlgs on 9/29; w/1 yrlg on 10/07
048	25.5	single	w/2-2 yrs old	w/2 yrlgs
051	10.5	w/cubs	single	lost litter of 1 yrlg by 9/08
055	15.5	single or w/1-2 yrs old	w/2 yrlgs on 5/19; w/1 yrlg after 5/30	w/3 cubs on 8/09
060	16.5	single or w/2-2 yrs old	w/2 yrlgs	w/3 cubs on 8/09; w/2 cubs on 10/18
064	22.5	single	w/1-2 yrs old	w/2 yrlgs on 8/25
067	22.5	single	2/2-2 yrs old on 10/20; w/1-2 yrs old on 10/28	w/2 yrlgs
070	6.5	w/cubs	single	single
071	10.5	w/cubs	single	lost single cub by 9/30.
072	20.5	w/cubs	single	lost litter of 2 cubs by 10/29
074	19.5	w/cubs	weaned 2-2 yrs old by 7/01	w/2 yrlgs
077	21.5	w/cubs	weaned 3-2 yrs old by 5/28; breeding w/male #097 on 6/02; lost radio contact by 8/30	w/3 yrlgs

Table 2. (Cont'd). Reproductive status of radio-collared femal n 1982, 1983 and predicted reproductive status in 1984.

Bear No.	1984 age	Predicted 1984 status	1983 status	1982 status
078*	9.5	w/cubs	single; w/adult male #027 on 6/02; in estrus	---
080*	26.5	w/cubs	single; in estrus; w/male #023 on 6/02; shed collar by 7/21	---
081*	11.5	single	non-estrus w/2-2 yrs old on 6/03; weaned by 7/11	---
085*	5.5	single	single; non-estrus on 6/03	---
086*	9.5	single	lost single yrlg litter by 10/29	---
088*	10.5	single	w/2 - 2 yrs old	---
091*	9.5	w/cubs	single; in estrus w/1 adult on 6/04	---
092*	6.5	single or w/cubs	abandoned litter of 2-1 yr old on 6/05; w/adult male #095 on 7/01	---
096*	8.5	w/cubs	single; in estrus	---

* 1983 captures

67% (6 of 9). Smith and Van Daele (1984) reported that 4 of 9 cubs (44%) were lost in 1982.

Additional mortality was also recorded in litters of yearling or older cubs subsequent to the last date when the litters were seen in 1982. Female #046 had two yearlings on 29 September 1982, but only one yearling was seen on 7 October 1982. When this female was again observed on 8 May 1983, she was alone. Separation of 2.5 year old cubs from other females has not been noted prior to 21 May in this study. Whether these yearlings were weaned successfully or succumbed to natural mortality cannot be verified. Female #064 lost 1 of 2 yearlings between 25 August, 1982, and 13 June 1983. Female #067 lost 1 of 2-2.5 year old cubs between 20 and 28 October, 1983.

Two of 4 maternal females captured in 1983 lost litter members. Female #086 lost her litter of 1 yearling between 8 and 29 October. Female #092, a 5.5 year old, abandoned her litter of 2 yearlings immediately after the family group was captured. Since this was probably her first litter, this bear's relative inexperience was may have been a factor in the abandonment. Two small bears with earflags, possibly the abandoned yearlings, were seen by a crew working on the Kodiak transmission line in September 1983.

Determining whether to attribute the absence of 2.5 year old cubs after emergence to weaning or to mortality was somewhat subjective. If the 2.5 year old litters were observed with a sow immediately after emergence but the entire litters were missing after mid-July, they were considered to have been weaned. Three females (#'s 074, 077, 081) successfully weaned 7-2.5 year old cubs, with a mean litter size of 2.3. The weaning dates for the three litters of 2.5 year old offspring ranged between 28 May and 11 July. Weaning dates of 2.5 year old offspring reported in 1982 ranged from 21 May to 15 June (Smith and Van Daele 1984).

Four of 7 females with 2.5 year old young did not wean their litters in 1983. Females #'s 048, 064, 067 and 088 were observed with their young after mid-October, immediately prior to denning. One female with 3.5 year

old cubs was previously reported by Smith and Van Daele (1984), but those cubs were subsequently aged at 2.5 years. Most females with 2.5 year old cubs retained their cubs through the 3rd denning period in a study in progress on southwestern Kodiak Island (Victor Barnes, personal communication, 1984). The relatively high frequency of retaining cubs into their third year indicates that the mean interval between litters may be closer to 4 years than the "normal" 3-year interval suggested by Hensel et al. (1969).

Cub Production and Reproductive Status of Females

Fewer newborn cubs were produced by radio-collared females in 1983 than was expected. Only 1 of 13 (8%) females 4.5 years or older which were either single or had weaned young in 1982, produced cubs in 1983 (Table 2). Female #005, which weaned 2-2.5 year old young in 1982, had a litter of 2 cubs in 1983. Females #'s 001, 018, 037, 038, 044 and 070, which did not produce cubs, were 5.5 years old or less in 1982 and may not have bred. Hensel et al. (1969) reported that although breeding could occur in females as young as 3.5 years, 38% of 4.5 year old females and 20% of 5.5 year old females were not physiologically ready to conceive. The 1982 ages of the 6 remaining females which had been expected to produce cubs were 6.5 (#019, #020), 7.5 (#015, #022), 11.5 (#008) and 21.5 (#017). A 6.5 year old female (#011), which lost 2 yearling cubs by 6 July, 1982, near the end of the breeding season, did not produce cubs in 1983.

Including unmarked bears, only 3 litters of newborn cubs were observed in the study area in 1983, compared to 12 newborn cub litters in 1982. Less intensive searching was done in 1983 and use of alpine habitat, where family groups can be easily observed, appeared to be somewhat less in 1983. The low reproductive frequency of radio-collared females further suggests that a decline occurred, however.

This low cub production in 1983 coincidentally followed a poor berry crop reported in 1982 (Smith and Van Daele 1984). Miller (1983) suggested that low yearling survival could be correlated with a poor berry crop in the preceding season and that a pulse in cub production could be expected in the

second year following a berry crop failure. Bunnell and Tait (1981) state that female brown and black bears that gain insufficient weight prior to denning often fail to produce cubs. Although only circumstantial evidence suggests that the low cub production in 1983 was related to the 1982 berry failure, a "pulse" in cub production is predicted in 1984 (Table 2). Twenty-two of 33 radiocollared females could have cubs in 1983. However, 6 of these females were 4 to 5 years old in 1983, possibly too young to breed.

Mortality

Total verified mortality from all sources in the study area in 1983 was 18 bears, 15 males (83%) and 3 females (17%) (Table 3). All except one bear were legally killed by sport hunters.

The mortalities were relatively evenly distributed throughout the study area. The locations of the mortalities by drainage were; Viekoda Bay -- 2; Sharatin Bay -- 2; Kizhuyak Bay -- 3; Terror Bay -- 6; Ugak Bay -- 5.

Four mortalities of radio-collared bears were confirmed in 1983. Three males (#'s 007, 027, 028) were killed by hunters. Male #007, a 3.5 year old, was killed on 18 May, only 3.5 km from its capture site east of Kizhuyak Bay. That bear's sibling (#006) was killed by a hunter in May of the previous year. Male #027, first captured in 1982 in the Kizhuyak River drainage, was killed on 14 October 1983, in the Ugak Bay drainage near Saltery Lake, 16.5 km south of its original capture site. Male #028 was killed near Viekoda Bay on 3 May 1983, 18.5 km northwest of its 1982 capture site in upper Kizhuyak Bay.

Female #029, initially thought to have denned by 7 October 1982, was found dead in June 1983. Cause of death could not be determined from skeletal remains, but it was suspected that the bear was wounded by hunters shortly after the hunting season opened in October 1982.

Table 3. Brown bear mortality in Terror Lake study area, 1983.

Sealing Cert. No.	Age	Kill Date	Location	Comments
Males				
53104	3.5	4/15/83	Terror Bay	Hunter kill
53042	7.5	4/27/83	Sharatin Bay-Elbow Ck.	Hunter kill
58353	5.5	4/29/83	Ugak Bay-Wild Ck.	Hunter kill
53103	8.5	5/01/83	W. Viekoda Bay	Hunter Kill
53050	5.5	5/03/83	Head of Viekoda Bay	Hunter kill (#028)
53134	3.5	5/04/83	E.Terror Bay	Hunter kill
53138	3.5	5/04/83	Head of Terror Bay	Hunter kill
53137	5.5	5/14/83	Head of Terror Bay	Hunter kill
53135	3.5	5/13/83	E. Terror Bay	Hunter kill
58351	3.5	5/18/83	Kizhuyak Bay-Dovolno Pt.	Hunter kill (#007)
58352	4.5	5/22/83	Kizhuyak Bay-Kekur Pt.	Hunter kill
49484	5.5	10/09/83	Head of E. Kizhuyak Bay	Hunter kill
58366	14.5	10/14/83	Ugak Bay-Saltery Lk.	Hunter kill (#027)
58369	5.5	10/22/83	Ugak Bay-Saltery Lk.	Hunter kill
58390	4.5	10/30/83	Ugak Bay-Hidden Basin Ck.	Hunter kill
		mean age = 5.6 (n=15)		
		range = 3.5-14.5		
Females				
58362	18.5	9/30-10/07/82	Sharatin Bay	Suspect wounded by hunter (#029)
53136	4.5	5/08/83	Ugak Bay-Wild Ck.	Hunter kill
58374	4.5	10/27/83	Head of Terror Bay	Hunter kill
		mean age = 9.2 (n=3)		
		range = 4.5-18.5		

The ages of the 15 males killed were as follows: 3.5 years -- 5 (33%); 4.5 -- 2 (13%); 5.5 -- 5 (33%); 7.5 -- 1 (7%); 8.5 -- 1 (7%); 14.5 -- 1 (7%). The mean age of 15 males was 5.6 years.

Radio contact was lost with 5 bears in 1983 (#'s 001, 008, 014, 033, 077). Transmitter failure was suspected to have occurred.

The frequency of killing radio-collared bears provided an index to the exploitation rate by hunting. Bears which shed radio-collars or with which contact was lost were assumed to have remained in the study area and therefore available for harvest. Three bears were killed from a total of 53 radio-collared animals representing a 6% exploitation rate overall. None of 35 females was killed in 1983. Three of 18 radio-collared males were killed in 1983, an annual exploitation rate of 17%.

Thirty-two bears, 14 males and 18 single females, were eligible for harvest in spring 1983. Two male bears were killed, equivalent to 6% of the total available radio-collared bears or 14% of the available males. The capture of additional bears and weaning of young by some females, thereby making them legal to harvest, resulted in a total of 44 radio-collared bears, 16 males and 28 females, available for the fall season. Only 1 male was killed, 2% of the total and 6% of the available males.

Habitat Use and Seasonal Activity Patterns

Habitat Use Indicated by Elevations of Radio-collared Bear Locations

Elevations at which radio-collared bears are located throughout the year provide an estimate of the seasonal habitat use patterns of bears in the study area. In 1982, analysis of mean elevations indicated significant differences in the habitats used between seasons, sexes and reproductive statuses (Smith and Van Daele 1984). Further analysis and comparisons of 1982 and 1983 data confirmed the seasonal variations ($P<0.01$) and revealed that adult males and females with cubs exhibited the greatest degree of elevational separation ($P<0.02$). No significant differences were noted between the 1982 and 1983 mean elevations ($P>0.10$).

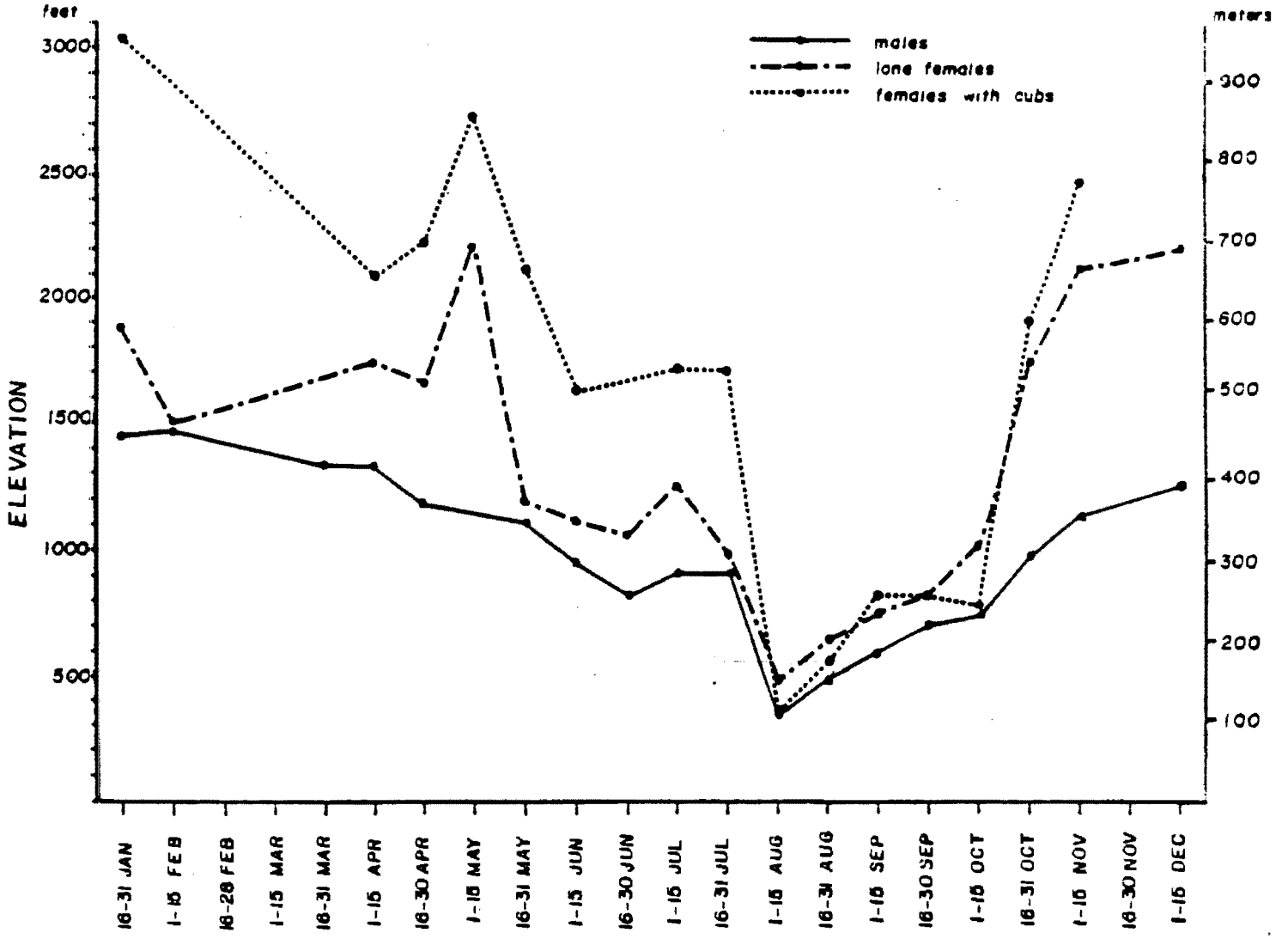

Figure 3. Mean seasonal elevations of radio-collared bears in Terror Hydro study area by sex/reproductive status, 1983.

Male bears exhibited similar seasonal habitat use patterns in 1982 and 1983 (Figure 3). Males moved progressively downward from their denning areas from April through June coincident with the greening of vegetation at lower elevations and the onset of breeding activity. A slight upward movement occurred in July as vegetation developed at higher elevations. A sharp downward movement was evident in early August, probably in response to the availability of salmon (Oncorhynchus spp.), and elderberry (Sambucus callicarpa) and salmonberry (Rubus spectabilis) fruits at lower elevations. Males gradually returned to higher elevations from late August through mid-October. In 1983, males used higher mean elevations than they did during that period in 1982. This suggested a decreased reliance on salmon and more use of higher slopes with an abundant berry crop in 1983.

Single adult females exhibited seasonal use patterns similar to those of adult males, but the females were observed at higher elevations throughout most of the year (Figure 3). In 1983, these differences approached statistical significance ($0.05<P<0.10$). During the beginning of the breeding season in late May, males and single females were observed at approximately the same mean elevation. As with males, single females were observed at slightly higher mean elevations in 1983 than during the same period in 1982.

Females with cubs showed the least overlap with males prior to August. At their closest approach during the first half of June, the difference in mean elevations between males and females with cubs was 205 m. That statistically significant difference ($P<0.02$) reflects the later emergence from dens of sows with cubs and a greater tendency to remain in alpine areas through mid-summer. The relatively wide separation between males and females with cubs during the breeding season probably favors cub survival by minimizing contact with potentially predatory males. Females with cubs made a rapid descent from a mean elevation of 215 m in the last half of July to 164 m in the first half of August. They remained near that elevation through August and began a steady ascent in elevation in September.

Seasonal Activities and Feeding

Seasonal habitat use patterns by radio-collared bears varied considerably between 1982 and 1983. Overall use of salmon streams was much less in 1983. Fewer bears frequented the major salmon spawning grounds in Terror River and Kizhuyak Bay in 1983 and peak bear numbers were present for a shorter period. Although certain bears were found near streams more frequently than others, the dense concentrations of bears seen on Terror River and Kizhuyak River in 1982, a year with low berry production, were not observed in 1983. Heavy crops of both salmonberries and elderberries present in 1983 apparently attracted bears to the lower and mid-elevations. Bears used alpine habitat less overall in 1983 compared to the use patterns observed in 1982.

Vegetative green-up on lower slopes occurred considerably earlier in 1983 than in 1982. By the third week of May well-developed vegetation was visible from sea level to 500 m elevation. Vegetation had only begun to leaf-out noticeably by that date in 1982. Bears were able to forage for vegetation over a much broader elevational range in late spring 1983 compared with the same period in 1982.

A comparison of 1982 and 1983 mean temperatures for April-June confirmed that the 1983 spring was much warmer, hence providing better growing conditions. Mean monthly temperatures recorded in Kodiak were 5.4°, 8.1°, and 11.1°C for the months of April through June, 1983, respectively. (U.S. Weather Service records). Mean monthly temperatures were 2.2°, 6.4° and 9.6°C for the comparable period in 1982.

Extremely high snowfall which occurred at higher elevations in the study area during the 1982-83 winter retarded development of alpine vegetation. Snow depths exceeded 5 m at the Falls Creek gauge adjacent to the construction access road between Terror Lake and Kizhuyak River (Table 4). At lower elevations rain predominated and only light snow accumulations occurred during the winter. The heavy snowpack appeared to have resulted in less availability of alpine vegetation in July and early August. The same general chronology of use of alpine habitat observed in 1982 also occurred in 1983, with bears

Table 4. Snow depth measurements in Terror Lake hydro project area, 1982 and 1983. (from U.S. Soil Conservation Service records).

	Date	Snow depth in cm (in)		Water equivalent in cm (in)	
Falls Creek gauge (elev. 605m; 1980ft)	1/19/82	239	(94)	97.8	(38.5)
	2/22/82	193	(76)	93.2	(36.7)
	4/13/82	254	(100)	113.5	(44.7)
	5/04/82	284	(112)	131.3	(51.7)
	2/15/83	371	(146)[A]	166.9	(65.7)[E]
	3/22/83	498	(196)	212.1	(83.5)
	4/25/83	526	(207)	250.7	(98.7)
Terror Lake gauge (elev. 442m; 1450ft)	1/19/82	99	(39)	40.6	(16.0)
	2/22/82	107	(42)	46.2	(18.2)
	4/03/82	130	(51)	54.6	(21.5)
	5/04/82	137	(54)	61.0	(24.0)
	1/19/83	89	(35)	93.2	(12.0)
	2/15/83	140	(55)[A]	59.7	(23.5)[E]
	3/22/83	203	(80)	91.4	(36.0)
	4/25/83	221	(87)	95.2	(37.5)

A - aerial reading
E - estimated

frequenting alpine areas from early July through early August. Overall use of alpine habitats appeared to have been less intensive in 1983 than in 1982, as bears begin frequenting the mid-slopes earlier, probably feeding on the abundant berry crop.

Bear use of alpine areas peaked in mid-July and began to decline slightly by 21 July. By 3 August only one radio-collared bear remained above 300 m elevation. Coincidentally ripening elderberries were highly conspicuous in the vegetative aspect by that date. Elderberry production was excellent in 1983 and salmonberries were abundant by mid-July throughout the study area.

Although returns of pink salmon (O. gorbuscha) were below Alaska Department of Fish and Game forecasts, good to excellent escapements of both chum (O. keta) and pink salmon occurred in most streams on Kodiak Island (ADF&G, 1983, Management Report). Low water levels and high water temperatures were believed to have resulted in unusually high natural mortality of salmon in streams on northern Kodiak Island. Low water also may have resulted in lower than usual escapement of coho salmon (O. kisutch) into some streams on northeastern Kodiak Island. Peak escapement counts for major streams in the study area are shown in Table 5.

Movements of bears into the salmon spawning areas in the southern tributaries of Barabara Lake were similar in 1982 and 1983. By the second week of July 1983, 9 radio-collared bears and several unmarked bears were frequenting the drainage, the only major source of sockeye salmon (O. nerka) in the study area north of Uganik Lake. By the second week of August most bears had dispersed as this sockeye salmon run declined.

The first activity near Terror River salmon spawning areas was noted during the 11 July flight when one radio-collared bear and an unmarked female with 2 yearling cubs were observed. On 21 July 3 radio-collared bears and 3 unmarked bears were near the stream and presumably fishing. By 3 August the Terror River population increased to 8 radio-collared bears in the lower 3 km of the river. By 11 August 7 radio-collared bears were still in the lower Terror River drainage, but some were located at elevations up to

Table 5. Peak salmon escapement counts in Terror Lake hydro study area, 1983.*

Stream name and number	Survey dates	No. pinks	No. chums	No. sockeye	No. coho
Terror River 253-331	7/26	4,000	---	---	---
	9/01	38,250	10,050		
Baumann Ck. 253-332	9/01	8,100	---	---	---
Clara's Ck. 253-333	9/01	1,200	---	---	---
E.Viekoda Ck. 253-322	9/01	None Seen	---	---	---
S.Viekoda Ck. 253-321	8/31	1,400	---	---	---
Pestchani Ck. 259-366	8/31	600	---	---	---
Barabara Ck. 259-363	7/11	-	---	3,300	---
	8/31	200	---	---	---
Hilary Ck. 259-364	8/27	400		---	---
Kizhuyak R. 259-365	7/31	200	---	---	---
	8/31	17,800	3,170	---	---
Elbow Ck. 259-371	7/26	2,000	5,000	---	---
	8/31	16,000	---	---	---
Saltery Ck. 259-415	8/09	11,000	---	---	---
	8/10	-	---	46,400	---
	8/23	-	5,000	---	---
	9/09	28,000	---	---	700

* From Kodiak Management Finfish Annual Report, 1983 - Alaska Department Fish and Game.

240 m. Ripening elderberries were noticeably more prominent from the air than had been noted during the previous week and it was suspected that bears were shifting from salmon to foraging on berries. On 20 August, 2 unmarked subadult bears were seen in the Terror River salmon spawning grounds and all the remaining 8 radio-collared bears were found along the slopes north of Terror River above 120 m elevation. Several individual radio-collared bears which were located near the salmon spawning areas in Terror River for several weeks in 1982, were found there only briefly or not at all in 1983. Peak salmon escapement counts for Terror River were comparable for the two years.

The first appearance of bears in the lower Kizhuyak River salmon spawning areas was noted during a 20 August flight. Two unmarked bears were seen walking along the tributaries west of the Kizhuyak River flats on that date and 4 radio-collared bears were located within 0.4 km of the flats. Small numbers of pink and chum salmon were present in the lower Kizhuyak River by 31 July (Prokopowich 1983). A peak escapement count made on 31 August 1983, tallied 17,800 pinks and 3,170 chums, somewhat below the 23,650 pinks and 6,800 chums counted on 31 August 1982, (unpubl. reports, Ak. Dept. Fish and Game, 1982, 1983). Bear trails between the Kizhuyak River and the lower slopes east of the flats were heavily used by August 30. Construction workers reported that fishing activity by bears in the lower Kizhuyak River was particularly intensive during the third week of September. Kizhuyak River was the only stream in the study area with significant fishing activity by late September and several radio-collared bears continued to frequent the area through mid-October. Only one radio-collared bear was located in the Saltery Creek drainage of Ugak Bay in 1983 during peak salmon spawning compared to 4 bears which frequented that stream in 1982 (Smith and Van Daele 1984).

Extremely low water levels were observed in Watchout Creek and Hilary Creek in August and September 1983. Dry conditions continued into early October when it was noted that some channels of Watchout Creek were nearly devoid of water. Those conditions probably resulted in lower than normal fishing activity by bears during late fall in the Kizhuyak River drainage.

Hilary Creek did not attract significant use by radio-collared bears in 1983 compared to the heavy use reported during the previous year by Smith and Van Daele (1984). Low water conditions may have resulted in reduced salmon escapement, but high availability of berries probably explained the decline in bear use. The lower slopes west of Kizhuyak Bay and south of Hilary Creek were occupied by several radio-collared bears during the peak of berry abundance in late July and August. Bears were commonly seen in August along the Port Lions transmission line corridor between Hilary Creek and Barabara Cove by crews constructing the line.

The Kizhuyak construction camp was visited periodically by one or more bears seeking garbage from June through September, 1983. Workers reported seeing the bears foraging in the metals disposal site on several occasions. The bears were attracted by food scraps discarded at the metals dump in violation of project license provisions. Bears were also seen foraging in unauthorized trash piles at several job sites, including the Kizhuyak tunnel portal, according to construction workers.

Two incidents of bears feeding on deer fawns were reported by construction workers in 1983. A bear was seen carrying a fawn on 1 August in the lower Kizhuyak River valley. A small adult bear was seen feeding on a deer fawn near the penstock on 1 September.

Movements and Home Range

Frequency of Observations of Radio-collared Bears

Brown bears were actually seen in 37% of the radio-locations made in 1983 (355 visual/954 radio-locations). A 33% observation frequency was reported in 1982 (Smith and Van Daele 1984). Bears were most frequently seen in June (71%; 56/79) and July (62%; 88/142), followed by May (48%; 45/93) and October (48%; 63/130). Maternal females were seen 40% of the time (79/197), followed by males at 38%; (103/274), and single females at 36%; (173/483).

Home Range Size

Mean home range size for 16 males with 5 or more radio-locations was 111.8 km^2 (range = 12.2 - 326.9 km^2) (Table 6). A greater mean home range size of 141.2 km^2 (range = 14-465 km^2) was reported for males in 1982 (Smith and Van Daele 1984). Among males, a 3.5 year old (#040) and a 14.5 year old (#079) shared the distinction for the smallest home range sizes with 32.4 and 32.9 km^2 respectively.

Mean home range size for 34 females with 5 or more radio-locations was 30.2 km^2 (range = 7.0-159.3 km^2) (Table 6). That compared closely to the 29.9 km^2 (range = 6-132 km^2) reported for females in 1982 (Smith and Van Daele 1984).

Comparing 1982 and 1983 home range sizes for 26 females revealed that 10 females (38%) had larger home ranges and 16 females (62%) had smaller home ranges in 1983. Four males (36%) had larger home ranges and 7 males (64%) had smaller home ranges in 1983. For both sexes 38% had larger home ranges and 62% of the bears had smaller home ranges in 1983.

Fourteen females (#'s 018, 019, 020, 022, 037, 038, 046, 048, 051, 055, 072, 085, 086, 088) which occupied mainly the Terror Bay drainage had a mean home range size of 36.8 km^2 (range = 9.1 - 159.3 km^2). Fourteen females (#'s 001, 005, 008, 011, 044, 060, 067, 070, 071, 074, 077, 078, 081, 091) which occupied Kizhuyak Bay drainages had a mean home range size of only 17.1 km^2 (range = 7.9-36.7 km^2). Terror Bay females also had larger mean home range sizes in 1982 (Smith and Van Daele 1984).

Mean home range size for 26 single females was 30.9 km^2 (range = 7.0-159.3 km^2). The only female with newborn cubs (#005) had an 8.5 km^2 home range. Seven females with yearling or older cubs had a 30.7 km^2 (range = 11.1 - 63.0 km^2) mean home range size.

Table 6. Home range sizes for brown bears in Terror Lake hydro study area, 1983 (bears with 5 or more locations).

Bear No.	Age	Observation period	No. locations	Home range size in km^2 (mi^2)	Comments
MALES (n=16)					
002	16.5	Jan.-Dec.	28	87.3 (33.7)	
003	6.5	Jan.-May	8	174.3 (67.3)	Shed collar
004	7.5	Jan.-Oct.	15	123.8 (47.8)	Shed collar
014	7.5	Jan.-Aug.	16	92.7 (35.8)	Lost signal
016	12.5	Jan.-Sept.	20	69.4 (26.8)	Shed collar
023	4.5	Jan.-Dec.	24	112.1 (43.3)	
024	8.5	Jan.-Dec.	22	208.5 (80.5)	
027	14.5	June-Oct.	15	53.3 (20.6)	Hunting mortality
028	4.5	Jan.-May	8	112.4 (43.4)	Hunting mortality
033	4.5	Jan.-April	6	12.2 (4.7)	Lost signal
040	3.5	June-Dec.	16	32.4 (12.5)	
045	6.5	Jan.-Aug.	18	24.1 (9.3)	Shed collar
059	4.5	Jan.-Dec.	22	157.5 (60.8)	
079	14.5	June-Dec.	16	32.9 (12.7)	
084	12.5	June-Oct.	12	326.9 (126.2)	Shed collar
095	4.5	June-Dec.	15	168.4 (65.0)	
		range =	6-15	12.2-326.9 km^2 (4.7-126.2 mi^2)	
		mean =	16.3	111.8 km^2 (43.2 mi^2)	
FEMALES (n=34)					
001	4.5	Jan.-Aug.	13	11.9 (4.6)	Radio failed
005	14.5	Jan.-Dec.	27	8.5 (3.3)	
008	12.5	Jan.-Oct.	19	15.0 (5.8)	Lost signal
011	7.5	Jan.-Dec.	22	24.9 (9.6)	
015	8.5	Jan.-Dec..	21	59.8 (23.1)	

Table 6. (Continued) Home range sizes for brown bears in Terror Lake hydro study area, 1983 (bears with 5 or more locations).

Bear No.	Age	Observation period	No. locations	Home range size in km^2 (mi^2)	Comments
FEMALES					
017	22.5	Jan.-Dec.	18	85.7 (33.1)	
018	6.5	Jan.-Dec.	21	20.2 (7.8)	
019	7.5	Jan.-Dec.	24	12.4 (4.8)	
020	7.5	Jan.-Dec.	21	29.8 (11.5)	
022	8.5	Jan.-Dec.	22	9.1 (3.5)	
037	5.5	Jan.-Dec.	22	25.8 (10.0)	
038	4.5	Jan.-Dec.	21	32.6 (12.6)	
044	4.5	Jan.-Dec.	27	25.4 (9.8)	
046	7.5	Jan.-Dec.	23	47.5 (18.3)	
048	24.5	Jan.-Dec.	23	38.2 (14.7)	
051	9.5	Jan.-Dec.	22	42.9 (16.6)	
055	14.5	Jan.-Dec.	22	11.1 (4.3)	
060	15.5	Jan.-Dec.	24	36.7 (14.2)	
064	21.5	Jan.-Dec.	24	63.0 (24.3)	
067	21.5	Jan.-Dec.	24	11.7 (4.5)	
070	5.5	Jan.-Dec.	21	7.0 (2.7)	
071	9.5	Jan.-Dec.	21	17.7 (6.8)	
072	19.5	Jan.-Dec.	22	32.6 (12.6)	
074	18.5	Jan.-Dec.	23	14.5 (5.6)	
077	21.5	Jan.-Aug.	16	8.4 (3.3)	Radio failed
078	8.5	June-Dec.	16	7.9 (3.0)	
080	25.5	June-July	5	9.5 (3.7)	Shed collar
081	10.5	June-Dec.	17	23.7 (9.1)	
085	4.5	June-Dec.	15	159.3 (61.5)	

Table 6. (Continued) Home range sizes for brown bears in Terror Lake hydro study area, 1983 (bears with 5 or more locations).

Bear No.	Age	Observation period	No. locations	Home range size in km^2 (mi^2)	Comments
FEMALES					
086	8.5	June-Dec.	17	28.7 (11.1)	
088	9.5	June-Dec.	15	25.5 (9.8)	
091	8.5	June-Dec.	14	26.5 (10.2)	
092	5.5	June-Dec.	17	17.9 (6.9)	
096	7.5	June-Dec.	16	35.3 (13.6)	
		range =	5-27	7.0-159.3 (2.7-61.4)	
		mean =	19.9	30.2 (11.7)	

Movements and Home Range of Females

Detailed examination of differences in movements by individual bears during the 2 years is done in this section in an attempt to distinguish the effects of construction activities on bear movements from normal movements in response to food availability and other natural occurrences. Although subjectivity is evident in these interpretations, this exercise will provide background useful for comparing pre- and post-construction movements of certain bears.

Fourteen females (#'s 001, 005, 008, 011, 044, 060, 067, 070, 071, 074, 077, 078, 081, 091) occupied home ranges located mainly in the Kizhuyak Bay drainage. These females were further characterized by occupying specific parts of the Kizhuyak drainage. Females #'s 005, 070 and 074 had home ranges centering in the Pestchani Creek area east of Kizhuyak Bay. Females #'s 001, 011, 044, 060, 077, 081 and 067 frequented the west side of Kizhuyak Bay primarily. Females #'s 008, 071, 078, and 091 had activity areas centered in the eastern tributaries of Kizhuyak River (Watchout Creek).

Female #005, a 13.5 year old bear with 2 newborn cubs, made a noticeable shift in its activity area in 1983. This bear's activity area in 1983 shifted northward from Watchout Creek to the Pestchani Creek drainage (Figure 7). After leaving its den on the ridge north of Watchout Creek in early June, she moved 2.5 km north near Pestchani Creek. She remained in alpine habitat in the same area through late July. From early August through September 1983 this bear occupied dense brushy habitat south of Pestchani Creek. During the comparable period in 1982 she was located near the east side of the Kizhuyak River flats, apparently feeding on salmon. Her closest radio-location to the Kizhuyak River flats in 1983 occurred in early August when she was about 2.5 km north near Dovolno Point. Although this bear's movements in August and September 1983, overlapped her 1982 home range to some extent, the 1983 activity area was largely separated from the transmission line corridor by the prominent ridge between the Pestchani Creek and Watchout Creek drainages. The bear's closest radio-location to the transmission line was 2.5 km northeast on 26 September 1983. This bear's selection of a den

Table 7. Locations of bears in Terror Lake study area within 500-1500 m of construction activities in 1982 and 1983.

Females	No. locations within 500 m		No. locations within 1500 m	
Bear No.	1982	1983	1982	1983
001	9	1	17	2
005	0	0	0	1
008	0	8	0	8
011	0	0	0	1
044	0	5	4	8
060	0	2	0	5
064	0	0	0	1
067	3	6	6	8
071	0	7	0	10
078	-	3	-	4
081	-	4	-	6
091	-	0	-	2
Males				
002	1	2	4	8
003	0	0	1	0
007	1	0	1	0
016	0	0	1	0
024	0	0	1	0
027	0	3	4	5
028	3	0	7	0
033	1	0	3	0
045	2	0	2	0
084	-	2	0	2
Unmarked Bears				
-	7	3	20	13

site on the south slope of Pestchani Creek was consistent with her apparent avoidance of the Watchout Creek drainage in 1983. Her 1982 den site was on the ridge north of Watchout Creek approximately 1.2 km south of the 1983 den.

The shift in home range by #005 was suspected to have been correlated with disturbance from construction activities. The high intensity of construction activities in lower Watchout Creek in 1983 was in extreme contrast to the relatively low activity level in 1982. Transmission line construction ctivities were in progress from February through October 1983, in Watchout Creek. Peak activity occurred from May through October. The possibility that the shift in home range was related to food availability or preference for berries over salmon as was discussed earlier in this report cannot be completely discounted, however.

The 8.5 km^2 home range of female #005 was 89% smaller in 1983 than in 1982. Miller (1983) suggested that female brown bears have smaller annual home ranges when accompanied by newborn cubs. Possibly female #005 required a higher level of security because of her maternal status in 1983.

Bear #008, a 12.5 year old single female, occupied a larger home range in 1983 than in 1982, but her main activity area remained in the upper drainages of Watchout Creek (Fig. 8). This bear was located within 500 m of active transmission line construction several times in 1983 (Table 7). One of 6 bears which may not have fed on salmon in 1982 (Smith and Van Daele 1984), #008 again indicated a preference for the mid-upper slopes well away from a salmon source. Her 1983 den site was within a few hundred meters of her April, 1982, capture location. Possibly the disturbance from transmission line construction contributed to her wider movements in 1983, but a major shift in activity area did not occur. This bear was not located after October 8.

Females #001 and 011 exhibited the least differences in their 1982 and 1983 activity areas among the females with home ranges on the western side of inner Kizhuyak Bay. Bear #001, a 4.5 year old single female, occupied the western side of the main Kizhuyak River drainage until her transmitter apparently failed in August, 1983 (Fig. 5). This bear was one of the most consistent occupants of the lower Kizhuyak River and the access road corridor in 1982 (Smith and Van Daele 1984). Female #011, a 7.5 year old single bear, used alpine habitat west of Kizhuyak River from April through early August in 1982 and 1983. She again moved into the Hilary Creek drainage in August, 1983, occupying the lower slopes south of Hilary Creek. She was not located closer than 0.8 km to a salmon source in 1983. This bear remained north and west of major construction sites in both 1982 and 1983.

Female #044, a 4.5 year old single female, occupied a larger home range in 1983 and her home range overlapped construction activities more extensively (Fig. 10). Her main activity area was located west and northwest of the Kizhuyak Bay jetty in both years, but she was located much closer to the Kizhuyak River flats in 1983. In late September and October she frequented the western side of the lower Kizhuyak River, where she probably fed on salmon. She was located on 3 occasions in August within 0.5 km of the Port Lions transmission line which was under construction.

Female #060, a 15.5 year old with 2 yearlings, occupied a similar activity area in both years (Fig. 11). This bear remained at high elevations west of Kizhuyak Bay until early August 1983, when she moved to near the western shore of Kizhuyak Bay north of the jetty. She continued to occupy the western side of Kizhuyak Bay during peak construction on the Port Lions transmission line in August. She was seen bedded with her cubs in the transmission line right-of-way on 20 August 1983, at 0950 hr. After at least 2 potentially threatening incidents between brown bears and transmission line construction crews which occurred in late July 1983, bears seen near worksites on the transmission line right-of-way were periodically harrassed by helicopter pilots. Bear #060 was not directly implicated in the confrontations with construction workers. The intensive helicopter traffic and possibly even active harrassment, did not result in her abandoning the area.

Female #067, a 21.5 year old with 2-2.5 year old cubs, retained a similar activity area northwest of the Kizhuyak Bay jetty (Fig. 12). Her 1983 home range was smaller, missing the movement into the Eagle Creek and lower Kizhuyak River vicinity which was observed in August and September, 1982. The intensive helicopter traffic associated with construction of the Port Lions transmission line may have deterred this bear's movement into salmon spawning areas in the Kizhuyak River. That this bear was located within 200 m of the Port Lions transmission line during peak construction activity in August, 1983, suggests that it was somewhat tolerant of heavy helicopter traffic, however. The comparatively greater abundance of berries as a food source in 1983 may have reduced this bear's dependence on salmon, thus eliminating the move to Kizhuyak River.

Nearly identical home ranges were occupied by female #077 in 1982 and 1983. This bear had the fourth smallest home range among females in 1983, an 8.4 km^2 area south of Barabara Cove. She was located within 1500 m of the Port Lions transmission corridor on 2 occasions in August, before a transmitter failure occurred. This bear's use of similar activity areas in both years suggests that transmission line construction was not a major disruptive factor, although undetectable shifts in diel and seasonal activity patterns within her home range may have occurred.

Two Kizhuyak Bay females had no close association with construction activities in either 1982 or 1983. Females #'s 070 and 074, had home ranges in Pestchani Creek north of Watchout Creek in both 1982 and 1983. Female #070, a 5.5 year old single bear, favored Pestchani Creek and the adjacent eastern slope of Kizhuyak Bay. She had the smallest home range for a female in 1983, only 7.0 km^2. Female #074, an 18.5 year old bear, exhibited a slight northward shift in its home range in 1983. Her home range was 67% larger in 1983, than in 1982 when she had 2-2.5 year old cubs. Although this bear's activities centered around Pestchani Creek in both years, she apparently favored the north side of Pestchani Creek over the south side which she frequented in 1982.

Female #071, a 9.5 year old single bear, occupied the Watchout Creek drainage and its home range included part of the Kodiak transmission line corridor (Fig. 13). This bear's home range was 38% larger in 1983, but included most of its 1982 home range. This bear, which had one newborn cub

before losing it in September 1982, may have ranged more widely as a single bear in 1983. After emerging from her den in late May she was first located near the junction of Watchout Creek and main Kizhuyak River within 200 m of a construction crew working on a transmission tower base. Subsequent locations indicated that she frequented salmon spawning areas in the Kizhuyak River from late July intermittently through late August. She was found within 500 m of the transmission line on 7 of 15 locations in 1983. This bear occupied the lower Kizhuyak River drainage much earlier and longer in 1983 than it did in 1982. This bear's more extensive use of the transmission line corridor during construction than prior to construction suggests that construction activities did not seriously disrupt her activities.

Three females captured in 1983 had home ranges which encompassed major project features in the Kizhuyak River drainage (#'s 078, 081, 091). Female #091, an 8.5 year old single bear, occupied a 26.5 km^2 home range in Watchout Creek (Fig. 19). Although this bear was most often located in the upper slopes south of the transmission line, she crossed the transmission line corridor several times between subsequent locations from late July through early September. Female #078, an 8.5 year old single bear, occupied the second smallest home range for females recorded in 1983, only 7.9 km^2 (Fig. 14). Her closest location to the transmission line was within 500 m on her 2 June capture date. She occupied alpine habitat north of the line through late July before moving to the lower slopes in upper Watchout Creek. This bear was not located closer than 1.5 km to the nearest salmon spawning area in 1983.

Female #081, a 10.5 year old which weaned a litter of 2-2.5 year old cubs by early July, had a home range closely associated with construction activities in 1983 (Fig. 15). This bear was captured with her cubs on 3 June, east of the main Kizhuyak River within about 1.5 km of the Kizhuyak construction camp and powerhouse site. She remained in subalpine habitat east of the camp throughout July when she moved to the lower Kizhuyak River. Radio-locations in August indicated that she fished in all the tributaries of Kizhuyak River, occupying the lower brushy slopes on both the eastern and western sides of the flats adjacent to the streams. She was seen crossing the access road from west to east near mile 1 of the access road at 1700 hr

on 16 August 1983, During a momentary lag in traffic the bear emerged from the brush, crossed the road and disappeared into a thicket below the road. She emerged from the brush and continued walking at a normal pace, disappearing in a cottonwood grove along Kizhuyak River. This bear was apparently quite tolerant of construction activities, having frequented the transmission line corridor, the construction camp area and the access road all year. Although she was most often found on the slopes east of the main Kizhuyak River, she frequented the immediate area of the construction camp and the access road to Kizhuyak Bay also.

Three additional females captured in 1983 ranged into the Kizhuyak Bay drainage, but were considered to be largely outside the construction impact zone. Female #080, a 25.5 year old single female, ranged from near Barabara Lake to the southern tributaries of Viekoda Bay before she shed her transmitter in late July. Female #096, a 7.5 year old single bear, occupied the southern tributaries into Viekoda Bay, except in July when she moved into Barabara Lake area where sockeye salmon were available. Bear #092, a 5.5 year old bear which abandoned her 2 yearlings after capture, occupied the Sharatin Bay drainage nearly exclusively. After spending most of August and September near salmon spawning areas on lower Elbow Creek, she moved west to den in upper Pestchani Creek.

Fourteen females occupied home ranges in the Terror Bay and Baumann Creek drainages in 1983 (#'s 018, 019, 020, 022, 037, 038, 046, 048, 051, 055, 072, 085, 086, 088). The activities of these bears, with few exceptions, were probably not directly affected by construction activities based on their distance to active construction and their relatively similar 1982 and 1983 home ranges. Although differences in seasonal movements between the 2 years were noted for several bears, it is suspected that the differences were mainly attributable to food availability, reproductive status or other factors unrelated to construction activities. Construction of the Terror Lake dam was the activity closest to the home ranges of these bears.

Two females captured in 1983 had home ranges located closest to the Terror Lake dam site. Female #088, a 9.5 year old with 2-2.5 year old cubs, was captured on 4 June approximately 2 km northwest of the dam (Fig. 18). That was her closest recorded location to the dam. She remained in alpine and subalpine habitat east and north of Den Mountain through late July. She then moved into the lower Terror River in August, where she favored mid-slopes from 250-400 m through mid-October. She denned on Den Mountain sometime after the end of October. Female #085, a 4.5 year old single bear captured 3 km west of Kizhuyak Bay on 3 June, remained in the headwaters of South Viekoda Creek through early July (Fig. 17). By 11 July she moved into the southern tributaries of Barabara Lake where sockeye salmon were present and remained there through early August. She moved back into the Viekoda drainage but returned to Barabara Lake at least once in early September. Between 8 and 21 October she moved 11 km south into the Terror River drainage to within 2.5 km of the Terror Lake dam. By 28 October she had moved another 5 km to a den at 1190 m, 4 km southwest of upper Terror Lake. Her den site was closer to Terror Lake than other dens of radio-collared bears. Her home range of 159.3 km^2, was the largest recorded for a female in 1983, a result of the long movement to the den site.

Female #046, a 7.5 year old single bear, occupied alpine habitat in upper Baumann Creek in July, 1982 and 1983. She had a much smaller home range in 1983, not having moved south into the Uganik Lake drainage as she did when she was accompanied by 2 yearlings in 1982. This bear was located once in early August 1983 near Terror River, but its subsequent locations were in brushy mid-elevations well away from salmon streams. The greater abundance of berries available in 1983 may have reduced this bear's use of salmon.

Female #038, a 4.5 year old single bear, had similar home ranges in 1982 and 1983, but in 1983 she favored mid-slopes of the lower Terror River, where berries were abundant, over the nearby salmon spawning areas.

Female #051 exhibited similar seasonal movements in 1982 and 1983, occupying a home range which included Terror River, upper Baumann Creek and a Den Mountain den site.

Female #055, a 14.5 year old with yearling cubs, had similar home ranges in 1982 and 1983. Her 11.1 km^2 home range in 1983 was only slightly smaller than the 14 km^2 home range she occupied in 1982. This bear was exclusively a resident of the Terror River drainage in both years. She occupied 2 main activity areas, one near the mouth of Terror River and one on the south slope of Den Mountain. She was found at higher elevations from early August to mid-September 1983, apparently preferring vegetation over salmon. She was observed feeding on elderberries on 3 August but may have alternately fed on salmon and vegetation in the lower Terror River through early September. Her 1982 and 1983 den sites were only about 0.2 km apart on Den Mountain.

Female #048, a 24.5 year old with 2-2.5 year old cubs, used alpine habitat north of Terror River through July in 1982 and 1983. She was located further north into the upper Baumann Creek drainage during that period in 1983 which resulted in a larger home range. Her 1982 and 1983 den sites on Den Mountain were only about 0.2 km apart. Consistent with seasonal activity patterns of other Terror River bears in 1983, this bear was more frequently located upstream and at higher elevations, indicating a preference for feeding on berries or other vegetation.

Female #037, a 5.5 year old single bear, was seldom located in alpine habitat during early summer in either 1982 or 1983, compared to other Terror River females. She moved into the lower Terror River in early July and remained there well into August in both years. Her close proximity to the stream indicated that she foraged extensively on salmon during this period. After mid-August 1983 she was located above 150 m, having apparently switched to feeding on berries or other vegetation. A movement not observed in 1982 occurred in late summer when she began visiting a site in upper Baumann Creek about 10 km north of Terror River. She moved to the Baumann Creek site after September 26 and was subsequently located near her 1982 den site on Den Mountain. By October 29 she had returned to the Baumann Creek site where she denned.

Female #022, an 8.5 year old single bear, occupied a 9.1 km^2 home range east of Terror Bay in 1983. She was located no closer than 1.5 km to the Terror River salmon spawning areas in 1983, a sharp contrast from the previous year when she was regularly located along the river from mid-July to September.

Female #072, a 19.5 year old single bear, occupied a similar activity area east of Terror Bay near Falls Creek in 1982 and 1983. It was unlikely that this bear used salmon to much extent in either 1982 or 1983 considering that her relatively small activity area was several kilometers from the nearest salmon stream.

Female #020, a 7.5 year old single bear, had a home range centered near lower Baumann Creek. For 1-2 weeks in mid-August, 1983, this bear was located near Viekoda Bay north of its usual activity area, a movement which resulted in a much larger 1983 home range. She was not located close to a salmon stream in either year and she denned in lower Baumann Creek in both 1982 and 1983.

Females #018 and #019, single females 6.5 and 7.5 years old respectively, again occupied similar home ranges in lower Baumann Creek and Clara's Creek. Neither bear was located near a salmon source and both bears denned in lower Baumann Creek in 1982 and 1983.

Female #017, a 22.5 year old single female, occupied two widely separated activity areas, a late spring-fall area in Baumann Creek and a summer site approximately 20 km west near East Point in Uganik Bay. Similar movements were reported in 1982 by Smith and Van Daele (1984).

Female #064, a 21.5 year old with a 2.5 year old cub, again used alpine habitat north of Terror River in July. She was located only once near lower Terror River in August, 1983. In 1982 she was located near Terror River for 2 weeks consecutively during peak salmon abundance in late August. Her movement into the Kizhuyak Bay drainage south of Hilary Creek by 11 August 1983, occurred at least 2 weeks earlier than did a similar movement in 1982. She denned in nearly identical locations on the north face of Den Mountain both years.

Female #086, an 8.5 year old with one yearling, was captured on 3 June 1983, north of Baumann Creek. She remained in alpine habitat near Baumann Creek through July. In late July or early August she moved 10 km northwest to near Rolling Point where she remained in subalpine habitat until mid-August. She frequented the lower Clara's Creek and Baumann Creek drainages from late summer until she denned on the north side of Baumann Creek in late November.

Female #015, an 8.5 year old single bear, ranged between Baumann Creek and the Barabara Lake drainage in both 1982 and 1983, although her seasonal movements were somewhat different each year. She moved into the Barabara Lake area by mid-July and remained there through late August, 1983. During the previous year she spent more time in alpine habitat before moving into the Barabara Lake area. She was located southeast of Barabara Lake in late July and August while the Port Lions transmission line was under construction. The close similiarity of this bear's home ranges in 1982 and 1983 suggest that she was little affected by the construction activity.

Movements and Home Range of Males

Complete movements data for 1982 and 1983 were obtained for only 4 males (#002, 023, 016, 059). Incomplete movements data were collected for 6 bears in 1983 (#'s 003, 004, 014, 028, 033, 045).

Bear #002, a 16.5 year old male, was a frequent inhabitant of areas with active construction in 1983 (Fig. 6). This bear, originally captured in the Rolling Rock Creek drainage in 1982, was the only radio-collared bear which denned within less than 1 km of construction activities in late 1982 (Smith and Van Daele 1984). Sometime after 5 February, 1983, this bear moved from north of Rolling Rock Creek to the southside of Rolling Rock Creek, where it was observed bedded under a prominent boulder on 17 March. Blasting activity had been occurring intermittently at the penstock site for at least several days previous to the latter date. Explosives were used on 19 March for avalanche control in upper Rolling Rock Creek. This bear was

observed still bedded under the boulder that day by project personnel. By 2 April he was radio-located several kilometers north of Rolling Rock Creek west of Kizhuyak Bay. Although disturbance from blasting and other construction activities might have contributed to the bear's relatively early emergence from a den, this bear did not abandon the Rolling Rock Creek area immediately. He was again located in the Rolling Rock Creek area on 30 May, 1983, but subsequently moved west to the upper Baumann Creek drainage. By 3 August he had returned to the west side of Kizhuyak Bay. He was located near salmon spawning areas in lower Kizhuyak River in September and October, during construction of the Kodiak transmission line. He had not denned by 14 January, 1984, when he was seen near the west shore of Kizhuyak Bay.

Male #003, a 6.5 year old bear, was radio-located at a suspected den site on 30 December, 1982, about 2.5 km west of the Kizhuyak Bay jetty. However, on 5 February, 1983, he was seen climbing a snow-covered slope about 2.5 km northwest of his previous location. He was located near Kizhuyak Bay on 2 April and by 10 April he had moved several kilometers southwest to lower Baumann Creek. This bear was probably active all winter. By 30 April he had moved into the Ugak Bay drainage, re-establishing a previously reported pattern of alternating movements between Ugak and Kizhuyak Bays (Smith and Van Daele 1984).

Male #004, a 7.5 year old bear, denned in the upper reaches of the Kizhuyak River drainage, but moved to the Terror River drainage shortly after he emerged from the den. He remained in the lower Terror River area from late July through mid-August, probably feeding on salmon. He shed his transmitter in mid-October in the upper Baumann Creek drainage. This bear did not move into the Saltery Creek drainage in 1983 as he did in September of the previous year.

Male #014, a 7.5 year old, had a home range of 92.7 km^2 in 1983, only about one third the size of his 1982 home range he ranged from Kizhuyak Bay southwest to Uganik Bay (Smith and Van Daele 1984). He frequented lower Terror River in April and May 1983, and in July was located south of Barabara Lake near a sockeye salmon stream. He moved west to near Viekoda

Bay in August, a period when he was located near salmon sources at Hilary Creek and Kizhuyak River in 1982. This westward shift in 1983 was possibly correlated with the Port Lions transmission line construction, but differences in food availability was a more likely explanation. The bear shed its transmitter and could not be relocated after August 30.

Male #016, a 12.5 year old, occupied a smaller home range which shifted somewhat northward in 1983. He was most often located in the South Viekoda Creek and Baumann Creek drainages in both 1982 and 1983. A pattern of periodic movements to the Saltery Creek drainage seen in August-October, 1982 had not developed by late August, 1983, when this bear was last located.

Male #023, a 4.5 year old, was not active near major project features in either 1982 or 1983. This bear's home range included mainly the Barabara Lake drainage south to Baumann Creek both years. He was less frequently found near the Port Lions transmission line corridor in 1983 than in 1982, but the shift was too subtle to suggest a negative correlation with construction. This bear was located on 8 October east of the Kizhuyak River flats during intensive construction activity on the Kodiak transmission line. The limitations of correlating movements of bears and construction activity by weekly observations were exemplified by this bear's movement of 8.5 km between successive daily locations on 20 and 21 October.

Male #027, a 14.5 year old, was first captured in 1982 but shed its transmitter within a month (Fig. 9). He was recaptured in June 1983, within 3 km of the original capture site in the Kizhuyak River drainage. This bear remained in the lower Watchout Creek area into early July. On 13 July he was located several kilometers south near Saltery Creek. By 21 July he had returned to his Kizhuyak River activity area. During August and September it remained near the eastern Kizhuyak River flats where he was probably feeding on salmon. He was usually located in brush thickets north of the transmission line during the period of intensive construction. Although he was not found on the stream during this period, extensive trails were visible between lower Watchout Creek and the adjacent hillside. Subsequent to September 26 he returned to Saltery Creek where he was killed by a hunter on 12 October.

Male #024, an 8.5 year old, had the second largest home range in 1983. He moved alternately between Terror River, Baumann Creek, South Viekoda Creek and Barabara Lake drainages. His closest location to construction activity was within 1 km of the Port Lions transmission line on 11 August.

Male #028, a 4.5 year old, was the male most frequently located near construction activities in Kizhuyak River in 1982 (Smith and Van Daele 1984). In 1983 he ranged farther northwest into the Viekoda Bay drainage where he was killed by a hunter on 3 May. His greater sexual maturity probably explained this bear's wider ranging movements in 1983.

Male #040, a 3.5 year old, occupied an activity area east of Kizhuyak Bay centered near Pestchani Creek in 1983. His 32.4 km^2 home range was one of the smallest recorded for a male. He apparently did not visit salmon streams in 1983. He was not located below 120 m elevation in 1983. His preference for higher elevations might have been related to avoidance of large adult bears. He was located in the Kizhuyak River drainage as close as 1 km to the transmission line corridor on July 1 and October 8. Construction activity might have deterred him from moving into the lower Kizhuyak River, but it did not result in complete avoidance of the drainage.

Male #045, a 6.5 year old, which was a frequent inhabitant of the lower Kizhuyak River in August and September, 1982, occupied a smaller home range centered in the southern tributaries of Barabara Lake in 1983. This bear shed its transmitter and was last seen near Barabara Lake on 11 August.

Male #079, a 14.5 year old, captured on 2 June 1983, had a home range of only 32.9 km^2. He was located no closer than 2.5 km to the Port Lions transmission line corridor. He was probably somewhat active all winter having been observed on 2 December 1983, and again on 14 January 1984.

Male #059, a 4.5 year old, occupied a 1983 home range nearly 3 times larger than his 1982 home range. He occupied an alpine area north of his Den Mountain den site through late July, much the same area he occupied in early summer 1982. By 3 August he had moved south several kilometers to

near Uganik Lake. He remained in the Uganik Bay drainage, ranging east into the Northeast Arm of Uganik Bay, where he denned. His movement into the Uganik drainage in 1983 was probably a dispersal movement related to increased sexual maturity.

Male #084, a 12.5 year old, was captured on 3 June 1983, east of the Kizhuyak River construction camp. He was next located on 16 June about 2.5 km south of the construction camp. By 2 July he had moved south to near Saltery Lake in the Ugak Bay drainage, but he returned to the Kizhuyak drainage south of Watchout Creek by 13 July. On 11 August he was approximately 100 m above the access road 200 m north of the penstock where construction was in progress. On 30 August he was located near Falls Creek in Terror Bay, about 18 km west of the previous location. He remained in the Terror Bay area through late September and shed his transmitter by 12 October in lower Baumann Creek. This bear's 326.9 km^2 home range was the largest recorded for all the radio-collared bears in 1983.

The movements of male #084 between the Kizhuyak and Ugak Bay drainages suggest that the construction activity was not a serious barrier to using the passes between the two drainages. His close location to active construction at the penstock and several locations in the main Kizhuyak River drainage also indicates that he was tolerant of disturbance. His wide-ranging movements and large home range might suggest a response to disturbance from construction activity in the Kizhuyak drainage, but similar long and abrupt movements have been noted in other radio-collared males.

Male #095, a 4.5 year old, was captured on 5 June 1983, east of inner Kizhuyak Bay. He was located in the same area through 11 July, but by 21 July he had moved to upper Baumann Creek. By August 2 he had moved west of lower Terror River, where he remained through late October. By 11 November he had entered a den on Den Mountain north of Terror River. Although his movement from the Kizhuyak Bay area in June coincided with intensive construction on the Kodiak transmission line, the move probably represented normal dispersal of a young male reaching sexual maturity.

Incidental Bear Observations

One hundred sixty-eight apparently unmarked adults and family groups of bears were seen incidental to radio-tracking flights and other activities in 1983 (Table 8). A total of 195 bears was seen, including 95 single bears, 56 bears accompanied by other adult-sized bears, 17 females with young, and 27 young. The high incidence of bear sightings in June reflects the intensive aerial surveys done incidental to bear capturing operations that month (Table 8).

Distribution of the 168 adults and family groups observed was as follows: Kizhuyak Bay (east side)--22; Kizhuyak Bay (west side)--37; Viekoda Bay--14; Sharatin Bay--19; Ugak Bay--2; Uganik Passage-Terror Bay--71; Uganik Bay--3.

Denning

Den Site Characteristics

The predominant use of alpine habitat for denning observed in 1982 by Smith and Van Daele (1984) was verified in 1983. The mean elevation of 35 dens of radio-collared bears in 1983 was 712 m (range = 275-1065), higher than the 620 m (range = 152-1006 m) mean elevation of 34 dens reported in 1982 (Table 9). Seventeen of 35 dens (49%) were located within the 240-750 m range considered by Spencer and Hensel (1980) to bracket preferred denning habitat in the Terror Lake study area. Eighteen dens (51%) were located above 750 m.

Males denned at lower elevations than did females as was previously reported by Smith and Van Daele (1984). The dens of 30 females were located at a mean elevation of 733 m (range = 335-1065 m). The mean elevation of 5 dens of males was 712 m (range = 275-1005 m).

A comparison of den elevations for radio-collared bears in 1982 and 1983 revealed that 7 of 23 bears (30%) denned at lower elevations in 1983. The differences ranged from 32 m to 731 m with a mean of 276 m. The following bears denned at lower elevations in 1983: #'s 005, 037, 067, 070, 071, 024, 059. Fourteen bears (61%) denned at higher elevations in 1983, with increases

Table 8. Incidental observations of l ears in Terror Lake hydro study area by month in 1983.

	Single	With 1 or more adults	Female w/young					Adults
			w/1 coy	w/2 coy	w/1 yearling	w/2 yrl.+	w/3 yrl.	
January	1	0	0	0	0	0	0	1
February	0	0	0	0	0	0	0	0
March	1	0	0	0	0	0	0	1
April	5	3	0	0	0	0	0	8
May	8	9	0	0	1	1	0	19
June	24	31	0	0	2	3	0	60
July	22	9	0	1	3	1	0	36
August	18	2	1	0	2	0	1	24
September	6	1	0	0	0	0	0	7
October	9	1	0	0	0	0	1	11
November	1	0	0	0	0	0	0	1
December	0	0	0	0	0	0	0	0
Sub-total	95	56	1	1	8	5	2	168

Total no. adult-sized paired or single = 151
Total no. females w/young = 17
Total no. coy (cubs-of-year) = 3
Total no. yearlings + = 24
Total no. bears observed = 195

). Denning Characteristics for Brown Bears in the Terror Lake Study Area, 1983.

(age)	Emergence date - 1982-83 den	Entrance date - 1983-84 den	Elevation in m (ft) 1983-84 den	Location by drainage-1983	Distance between 1982 and 1983 dens (km)	Comments
5)	19-25 April	---	---	---		Lost signal by 8/20/83
.5)	2-4 June	20 Oct.-11 Nov.	730(2400)	Kizhuyak Bay-E.side	1.2	In a den on 10/28 about 0.8 km from den occupied on 11/11/83.
.5)	10-19 April	---	---	---	---	Lost signal between 10/8 & 10/20/83.
5)	30 April-8 May	20-28 Oct.	870(2850)	Terror Bay-upper Baumann Ck.	0.5	
5)	29 Oct.-2 April	29 Oct.-12 Nov.	395(1300)	Terror Bay-Baumann Ck.	0.5	
.5)	10-25 April	29 Oct.-12 Nov.	455(1500)	Terror Bay-Baumann Ck.	0.5	
5)	10-19 April	20-29 Oct.	455(1500)	Terror Bay-Baumann Ck.	1.1	
5)	10-19 April	12 Nov.-2 Dec.	580(1900)	Terror Bay-Baumann Ck.	2.0	
5)	15 Nov.-2 April	21 Oct.-12 Nov.	335(1100)	Terror Bay-Baumann Ck.	---	
5)	30 April-17 May	21 Oct.-12 Nov.	335(1100)	Terror Bay	0.2	
5)	10-19 April	12 Nov.-2 Dec.	410(1350)	Terror Bay-Baumann Ck.	4.0	Seen digging den on 11/12/83
.5)	30 April-8 May	28 Oct.-12 Nov.	1020(3350)	Terror Bay-Den Mtn.	0.4	
.5)	19-30 May	11 Nov.-2 Dec.	1020(3350)	Terror Bay-upper Baumann Ck.	1.7	
.5)	30 April-8 May	26-28 Nov.	1035(3400)	Terror Bay-Den Mtn.	1.2	Seen on 10/20 and 10/21/83 digging den; bedded beside den on 10/26/83; in den on 10/28/83.
4.5)	19-30 May	21-28 Oct.	1020(3350)	Terror Bay-Den Mtn.	0.1	

9. (Cont'd). Denning Characteristics for Brown Bears in the Terror Lake Study Area, 1983.

SS	Emergence date - 1982-83 den	Entrance date - 1983-84 den	Elevation in m (ft) 1983-84 den	Location by drainage-1983	Distance between 1982 and 1983 dens (km)	Comments
no.(age)						
).5)	17-19 May	21-28 Oct.	975(3200)	Terror Bay-Den Mtn.	0.2	On 10/26/83 emerged from a den and entered another den nearby.
14.5)	8-19 May	21-28 Oct.	915(3000)	Terror Bay-Den Mtn.	0.2	
15.5)	19-30 May	29 Oct.-12 Nov.	1065(3500)	Terror Bay-upper Baumann Ck.	3.6	
21.5)	30 May-15 June	28-29 Oct.	975(3200)	Terror Bay-Den Mtn.	0.1	Seen at 549 m (1800') walking uphill on 10/28/83; seen in den on 10/29/83.
21.5)	20-30 May	28 Oct.-Mar.13	550(1800)	Kizhuyak Bay-W. side	2.5	Seen on 10/28/83; in den on 10/29/83; moved 0.5 km to final den site by 3/13/84.
5.5)	8-17 May	20-28 Oct.	715(2350)	Kizhuyak Bay-E. side	0.1	
).5)	17-20 May	20 Oct.-12 Nov.	760(2500)	Kizhuyak Bay-E. side	2.2	
9.5)	19-25 April	12-29 Oct.	365(1200)	Terror Bay	2.3	Natural rock cavity; seen at den on 10/21/83.
8.5)	25-30 April	20-28 Oct.	730(2400)	Sharatin Bay	2.5	
21.5)	19-25 April	---	---	---	---	Lost signal by 8/30/83.
3.5)	---	28 Oct.-11 Nov.	810(2650)	Kizhuyak Bay-E. side	---	
0.5)	---	29 Oct.-11 Nov.	810(2650)	upper Kizhuyak R.	---	
.5)	---	21-28 Oct.	1190(3900)	Terror Lake	---	
3.5)	---	12 Nov.-2 Dec.	410(1350)	Terror Bay-Baumann Ck.	---	Probable rock cavity
).5)	---	28 Oct.-11 Nov.	785(2575)	upper Kizhuyak R.	---	
).5)	---	28 Oct.-2 Dec.	795(2600)	Kizhuyak Bay-Pestchani Ck.	---	Dug den seen on 12/02/83
.5)	---	12 Nov.-2 Dec.	425(1400)	Viekoda Bay	---	

9. (Cont'd). Denning Characteristics for Brown Bears in the Terror Lake Study Area, 1983.

o.(age)	Emergence date - 1982-83 den	Entrance date - 1983-84 den	Elevation in m (ft) 1983-84 den	Location by drainage-1983	Distance between 1982 and 1983 dens (km)	Comments
6.5)	5 Feb.-17 March	?	---	---	---	Seen on 1/14/84
.5)	?	---	---	---	---	Seen on 2/5/83; shed collar by 6/2/83.
.5)	30 April-17 May	---	---	---	---	Den opening visible in snow on 4/30/83; shed collar by 10/20/83.
.5)	10-19 April	---	---	---	---	Lost signal by 9/8/83.
2.5)	10-19 April	---	---	---	---	Lost signal by 10/20/83.
.5)	9 Dec.-2 April	2 Dec.-14 Jan.	455(1500)	Terror Bay-Baumann Ck.	---	
.5)	25-30 April	2 Dec.-?	425(1400)	Terror Bay-Falls Creek	12.4	Den opened when first located on 3/28/84.
.5)	10-19 April	---	---	---	---	Hunter kill on 5/3/83.
.5)	2-10 April	---	---	---	---	Lost signal by 5/8/83.
.5)	---	11 Nov.-2 Dec.	775(2550)	Kizhuyak Bay-Pestchani Ck.	---	
.5)	2-10 April	---	---	---	---	Shed collar by 8/11/83.
.5)	19-30 May	2 Dec.-14 Feb.	275(900)	NE Arm Uganik Bay	20.0	
4.5)	---	?	---	---	---	Seen on 1/14/84; possibly didn't den.
.5)	---	28 Oct.-11 Nov.	1005(3300)	Terror Bay-Den Mtn.	---	

ranging from 15 m to 691 m. The following bears denned at higher elevations in 1983: #'s 011, 017, 018, 019, 022, 038, 044, 046, 048, 051, 060, 064, 072, 074. Two bears (9%) denned at the same elevation in 1982 and 1983 (#'s 015, 055).

Fidelity to denning areas

Nineteen of 23 bears (83%), all females, returned to den within 2.5 km of their 1982 den sites (Table 9). Ten bears (#'s 011, 015, 017, 022, 038, 048, 051, 055, 064, 070) denned within 0.5 km of their previous den sites. A single female (#037), which denned on Den Mountain in 1982, denned 4.0 km north of that site in the Baumann Creek drainage in 1983. That was the greatest distance between successive den sites for a female.

The 2 males with known den locations for both years had much more widely separated den sites in 1982 and 1983. A 4.5 year old male (#059), which denned on Den Mountain in 1982, denned 20.0 km west in the Northeastern Arm of Uganik Bay in 1983. That bear shifted its previous home range from the Terror River drainage to occupy the Uganik Bay drainage almost exclusively in 1983. An 8.5 year old male (#024) occupied a den east of Terror Bay, 20.0 km north of its 1982 den site south of Terror River.

Distribution of Dens

The Terror Bay area contained 20 of 35 dens (57%) of radio-collared bears in 1983 (Figure 4). Dens of 8 bears (#'s 038, 046, 048, 051, 055, 064, 088, 095) were located in the Den Mountain peaks, previously identified by Smith and Van Daele (1984) as an important denning area. Six of those bears also denned on Den Mountain in 1982 (#'s 038, 046, 048, 051, 055, 064). The downstream 10 km of Baumann Creek contained dens of 8 radio-collared bears (#'s 015, 017, 018, 19, 020, 023, 037, 086). Two bears denned on the east side of Terror Bay (#'s 022, 024). One bear (#085) denned at 1190 m on a peak 4 km southwest of Terror Lake.

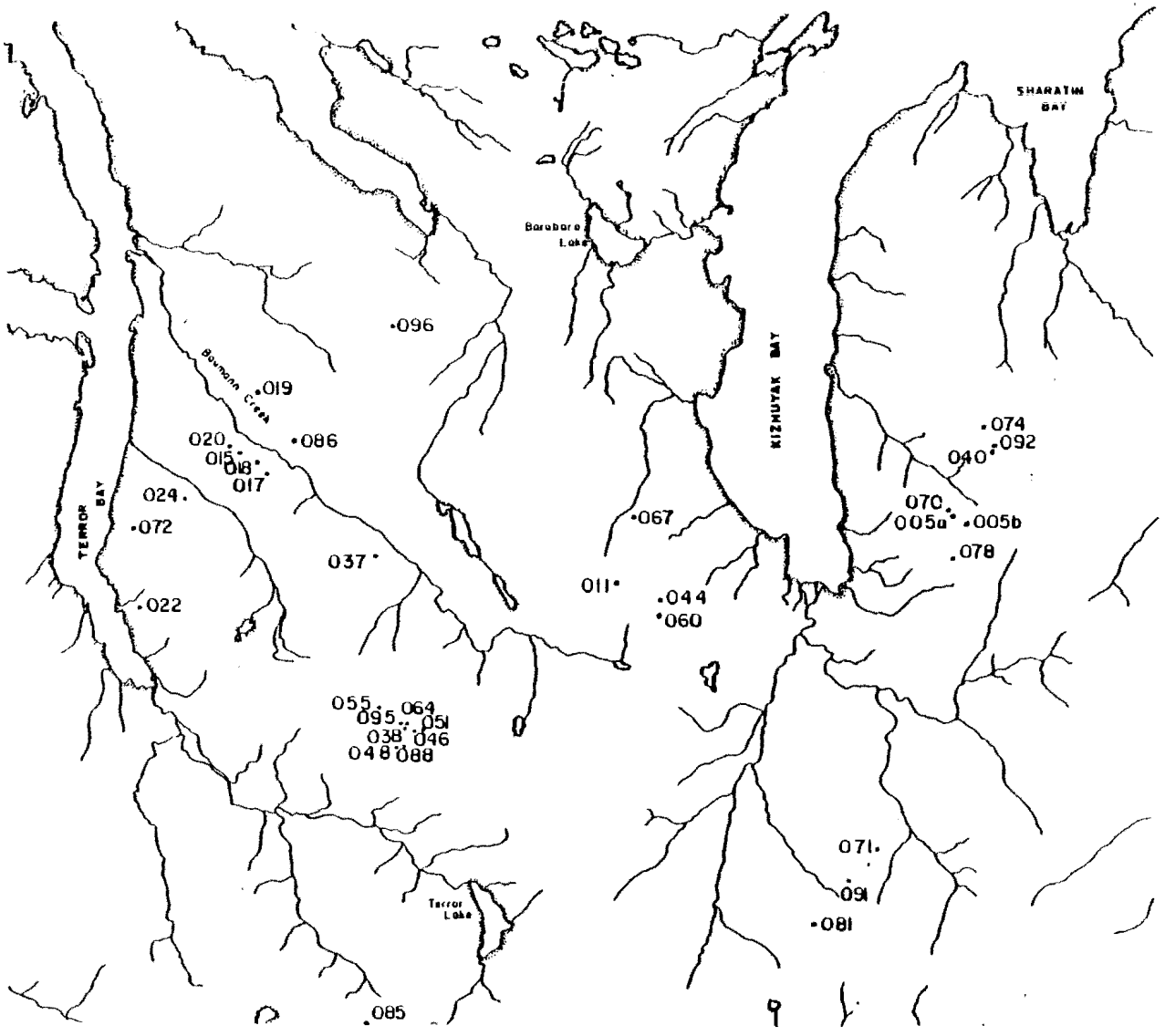

Figure 4. Den locations of radio-collared brown bears in the Terror Lake study area during the winter of 1983-1984.

Four bears (#'s 011, 044, 060, 067) denned on the mountain west of upper Kizhuyak Bay. Nine bears (#'s 005, 040, 070, 071, 074, 078, 081, 091, 092) denned in the mountains east of Kizhuyak Bay and Kizhuyak River. One bear (#096) denned in the South Viekoda Creek drainage and one bear (#059) denned on the west side of the Northeast Arm of Uganik Bay.

Chronology of den entrance and emergence

Radio-collared males emerged from dens earlier than did females (Table 9). Two of 11 males (18%) had emerged by 17 March but no females had done so. By 2 April, 2 of 25 females (8%) had emerged. By 19 April, 8 of 11 males (73%) had emerged compared to only 8 of 25 females (32%). By 8 May, 15 of 25 females (60%) had emerged compared to 9 of 11 males (82%). The last male to leave the den (#059) emerged between 19 and 30 May.

Single females emerged before maternal females as was previously noted by Smith and Van Daele (1984). Six of 25 radio-collared females (32%) were known to have left dens by 19 April. All were single animals. Two females with litters of 2-year old cubs had emerged by 30 April. The only female with cubs of the year (#005) left the den during 2-4 June.

Females entered dens earlier than did males confirming previous observations by Smith and Van Daele (1984). The earliest denning by a male (#095) occurred between 28 October and 11 November. The earliest denning by females occurred between 20 and 29 October. Ten of 30 females (33%) were believed to have denned during that period. Twenty-two of 30 females (73%) had denned by 12 November, similar to the 79% denning rate for females by 15 November 1982 (Smith and Van Daele 1984). The 8 remaining females had entered dens by 2 December. Only 1 of 7 males (14%) had denned by 12 November. Only 2 of 7 males (29%) had entered dens by 2 December.

Impacts of Construction

Maximum effects of short-term disturbances to brown bears should have occurred in 1983 when construction activity was at its peak. All major phases of construction were underway and the work force was at its maximum

size. Job sites were much more widely distributed throughout the project area in 1983. Construction of the Kodiak and the Port Lions transmission lines were the major new activities which were initiated in 1983. Intensive helicopter traffic occurred daily from May through November along the 28 km long transmission line corridor between the powerhouse in Kizhuyak River and the sub-station near the outskirts of Kodiak.

Smith and Van Daele (1984) pointed out the difficulty of correlating bear movements with construction disturbance lacking comparable pre-project movements data. With the 2nd year's data available, another dimension in analysis was opened by comparing movements of individual radio-collared bears bears in 1982 and 1983. Comparisons of 1982 and 1983 annual home ranges for individual radio-collared bears indicated that overall shifts in areas used by bears were relatively subtle. One maternal female (#005) shifted her home range into the next drainage north of the Kodiak transmission line, a movement thought to be correlated with the high level of helicopter traffic present in 1983. Shifts in home range by some bears suggested a negative correlation with construction activities in 1983. However, a comparison of 1982 and 1983 home ranges for other bears suggested a positive correlation.

Although differences in seasonal habitat use in 1982 and 1983 were noted for individual bears inhabiting the Terror Bay-Viekoda Bay drainages, none of those differences clearly resulted from project-related disturbance. The eastern boundary of one female's home range (#088) was with 2 km of the Terror Lake dam site. Another female (#085) apparently traversed Terror River about 2.5 km below the dam site while traveling from the South Viekoda Creek drainage to a den site 4 km southwest of the upper end of Terror Lake. That den site was the closest location of a radio-collared bear to the Terror Lake basin.

Construction workers reported occasional sightings of bears traveling and feeding in alpine and sub-alpine areas near the rock quarries north of the Terror Lake dam site. Spencer and Hensel (1980) previously reported

summer feeding activity by bears in that area, as did Smith and Van Daele (1984) who suggested that the Terror Lake vicinity is less heavily used than adjacent areas.

The impact zone of the Terror Lake construction activity could be expected to vary with the sensitivity of individual bears to disturbance. The relatively high frequency with which radio-collared bears were located along the southern slope of Den Mountain and in the lower Terror River valley indicates that a 3-5 km radius of the dam site would include the major zone of direct impacts on brown bears downstream from the dam. In alpine areas with relatively little escape cover, such as the access road between Terror Lake and Kizhuyak River, breaks in adjacent topographic features such as ridges and canyons provided the closest security. Compared to the intensive construction activity at Terror Lake and in the Kizhuyak River drainage, the approximately 10 km section of the construction access road transversing alpine habitat had a much lower level of activity. Breaks in the topography sufficient to obviate line-of-sight contact between the road and bears transversing the area were located within 0.5-2 km of the road. Spencer and Hensel (1980) identified the "primary impact area" generally as that area within line-of-sight of major project features.

The frequent passage of helicopters along the road corridor in the open, alpine areas potentially affected bear movements within a wider radius of the road, however. Although the project's mitigation plan required that helicopter traffic be routed to avoid heavily used brown bear habitat, close approaches to bears seen near flight corridors were made by pilots on occasion. Comparable approaches to brown bears made with helicopters during capture operations conducted in open terrain predictably resulted in bears fleeing to cover. A bear would sometimes travel several kilometers before it found suitable cover, depending on the duration of the pursuit and the initial flight route chosen by the bear. The significance of unauthorized helicopter pursuits to habitat use patterns by bears is unknown, but there is little doubt that helicopter pursuit influenced daily bear movements. The zone of direct impact on bears of helicopter activity in open alpine and subalpine habitat varied with the terrain, but a 5 km radius represents a minimum estimate.

Defining impacts of construction on bears in the Kizhuyak Bay drainage in 1983 required some subjectivity in interpreting differences in patterns of movement observed in 1982 and 1983 for individual bears. Several bears in the study area occupied home ranges judged to be outside the zone of direct impact from construction. The impact zone was much broader and construction was active longer in the Kizhuyak drainage compared to other parts of the study area in 1983. Construction of the main transmission line created a 28 km long impact zone stretching from the outskirts of the city of Kodiak to the powerhouse in Kizhuyak River. Another impact zone was created by construction of the 20 km long Port Lions transmission line near the western shore of Kizhuyak Bay. Construction of these 2 transmission lines was the major new activity initiated in 1983.

Locations of radio-collared bears in 1983, along with frequent sightings of bears by construction workers, indicated that bear density near construction sites was relatively high. Twelve radio-collared females and 3 radio-collared males were located at least once in 1983 within 1500 m of construction sites (Table 7). Seven females and 3 males were located within 500 m of construction sites at least once. Females #'s 008, 044, 071, 078 and 081 were located within 500 m of construction activities 3 or more times in 1983.

Three males (#'s 002, 027, 084) appeared to be relatively tolerant of construction activities based on their frequent locations near project sites. Disturbance was a possible factor in the early emergence of male #002 from its den, but the fact that it remained within 1-1.5 km of active construction at the tunnel portal for at least 4 consecutive winter months indicated that the bear was somewhat tolerant. Male #027 was located near salmon spawning areas in lower Watchout Creek for several weeks at the peak of construction activity on the Kodiak transmission line. Successive locations of male #084 indicated this bear periodically passed to within a few hundred meters or less of the construction camp while traveling between Saltery Creek and Kizhuyak River.

The presence of some bears near the transmission line corridor in 1983 does not discount the likelihood that distrubance did result in less overall

use of preferred habitat, including salmon spawning areas. Smith and Van Daele (1984) considered it highly likely that bears responded to disturbance in the lower Kizhuyak River by adopting crepuscular and nocturnal feeding patterns. It is suspected that was also the case in 1983 in lower Watchout Creek and Kizhuyak River where the transmission line crossed important areas used by bears feeding on salmon.

The shift in home range by female #005 from Watchout Creek to Pestchani Creek indicated that the direct impact zone from the transmission line had at least a 3-5 km radius. The frequent presence of several bears within 1500 m of the transmission line in 1983 suggests a narrower zone of direct impact, however.

The Port Lions transmission line was installed in a relatively short period with peak construction activity occurring in late July through August. During that period tracked vehicles and helicopters were used by crews erecting the line. Two radio-collared females (#'s 060, 067) were located within 500 m of the line at least twice during its construction. The cleared right-of-way probably attracted bears considering their habitual use of trails. The right-of-way paralleled the coast at a distance of only a few meters to about 0.2 km. Conversely the construction activity, including occasional active harrassment of bears with helicopters, undoubtedly disrupted normal movements and activities of bears within a few hundred meters of the line. The zone of direct impact from the construction of the Port Lions transmission line was apparently relatively narrow compared to that of the Kodiak transmission line, however. Several bears continued to use the slope immediately west of the line and the lowlands south of Barabara Lake. The minimum estimated zone of direct impact included the narrow band between the coast and the transmission line and a strip 1.5-2 km inland from the line. Bears were using lower slopes where elderberries and salmonberries were abundant at that time. Construction crews frequently saw bears along the Port Lions line corridor between Hilary Creek and Barabara Cove.

A comparison of 1982 and 1983 home range sizes for 8 females most closely associated with the project showed no obvious correlation with the differences in construction intensity. Four females (#'s 001, 005, 011, 067) had smaller home ranges in 1983 and 4 females (#'s 008, 044, 060, 071) had larger home ranges in 1983. With food a limiting factor, larger home range sizes might be expected if disturbance was preventing bears from using traditional feeding areas. With abundant food available, as it appeared to be in 1983, bears actively avoiding construction activities might have been able to subsist in smaller than usual home ranges.

Apparent differences in the availability of various food sources between 1982 and 1983 confounded attempts to correlate movements of individual bears with disturbance from construction activities. An apparent decline in the use of Hilary Creek for salmon fishing by bears in 1983 would appear to suggest that disturbance from construction of the Port Lions transmission was a factor. Poor salmon escapement because of low water levels and the higher abundance of berries in 1983 tends to discount disturbance as an explanation, however. Similar declines in bear use on lower Terror River and Kizhuyak River in 1983 also occurred which indicated that bears were feeding on the more abundant berry crop present in 1983.

Denning was considered by Spencer and Hensel (1980) to be the activity most sensitive to disturbance. The degree of fidelity to denning areas by individual bears was considered a good indicator of disturbance by Smith and Van Daele (1984). A high degree of fidelity to denning areas in successive years was indicated. Nineteen of 23 females (83%) had successive den sites separated by 2.5 km or less. The 1983 den site of female #005 was 1.2 km north of its 1982 den, a shift believed to be a response to disturbance from transmission line construction.

Den site characteristics were similar in both years, although the mean denning elevation was higher in 1983. With the exception of bear #005, a comparison of the elevations of dens occupied by marked bears in 1982 and 1983 did not reveal any obvious correlation with construction activities. Among 6 bears with home ranges centered near project features, 3 denned at

lower elevations (#'s 005, 067, 071) and 3 denned at higher elevations in 1983 (#'s 011, 044, 060). Alpine habitat was favored for denning in both years.

The frequent observations of brown bears by construction workers in 1983 indicated that at least some bears habituated to the construction activities and continued to use traditional feeding areas and travel routes. Bears were most often seen near the access road along lower Kizhuyak River, but bears were observed near every project feature. The possibility that some bears were sufficiently disturbed to have vacated the drainages where construction activities occurred cannot be ignored, but available data from radio-collared bears indicated that such occurrences were probably uncommon.

No direct mortalities of brown bears were known to have resulted from construction activities in 1983. Several encounters occurred between construction workers and bears, but none resulted in injuries to bears nor to workers. The active promotion of bear safety guidelines to the contractor by the project's environmental monitor contributed significantly to that record. The constractor's "no firearms" policy, which generally limited the carrying of firearms to supervisory personnel, also diminished the likelihood of an unwarranted bear kill. Surveying parties did carry firearms for protection. Workers on the transmission lines were also permitted to carry firearms. Several lectures on bear safety presented to workers by Alaska Department of Fish & Game and US Fish & Wildlife personnel contributed to an increased awareness of effective measures for avoiding bear confrontations. Unauthorized active harrassment of bears near work sites by helicopters probably helped prevent serious encounters also.

A direct impact of the construction activity on bears was their attraction to sites with improperly stored garbage. Several reports of bears visiting the Kizhuyak River construction camp were received in 1983. Bears were attracted to the waste metals dump, where a small but steady supply of waste foodstuffs continued to be disposed of in violation of the project license provisions. Odors and wind-blown paper contaminated by food from the incinerator facility were an additional attraction to bears. Bears were also observed visiting unauthorized trash burning pits at the Kizhuyak tunnel

portal entrance. It is likely that these bears will continue to seek food at the powerhouse or at other human habitations in the study area after construction is completed.

RECOMMENDATIONS

Continuation of the present methods of study are recommended for 1984, the 3rd and final year of the construction phase of the Terror Lake hydroelectric project.

Bears captured during the first year of the study should be re-captured to replace the radio-collars. Previously radio-collared bears which shed radio-collars or have failed transmitters should be re-captured.

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APPENDIX I. HOME RANGE MAPS FOR BROWN BEARS

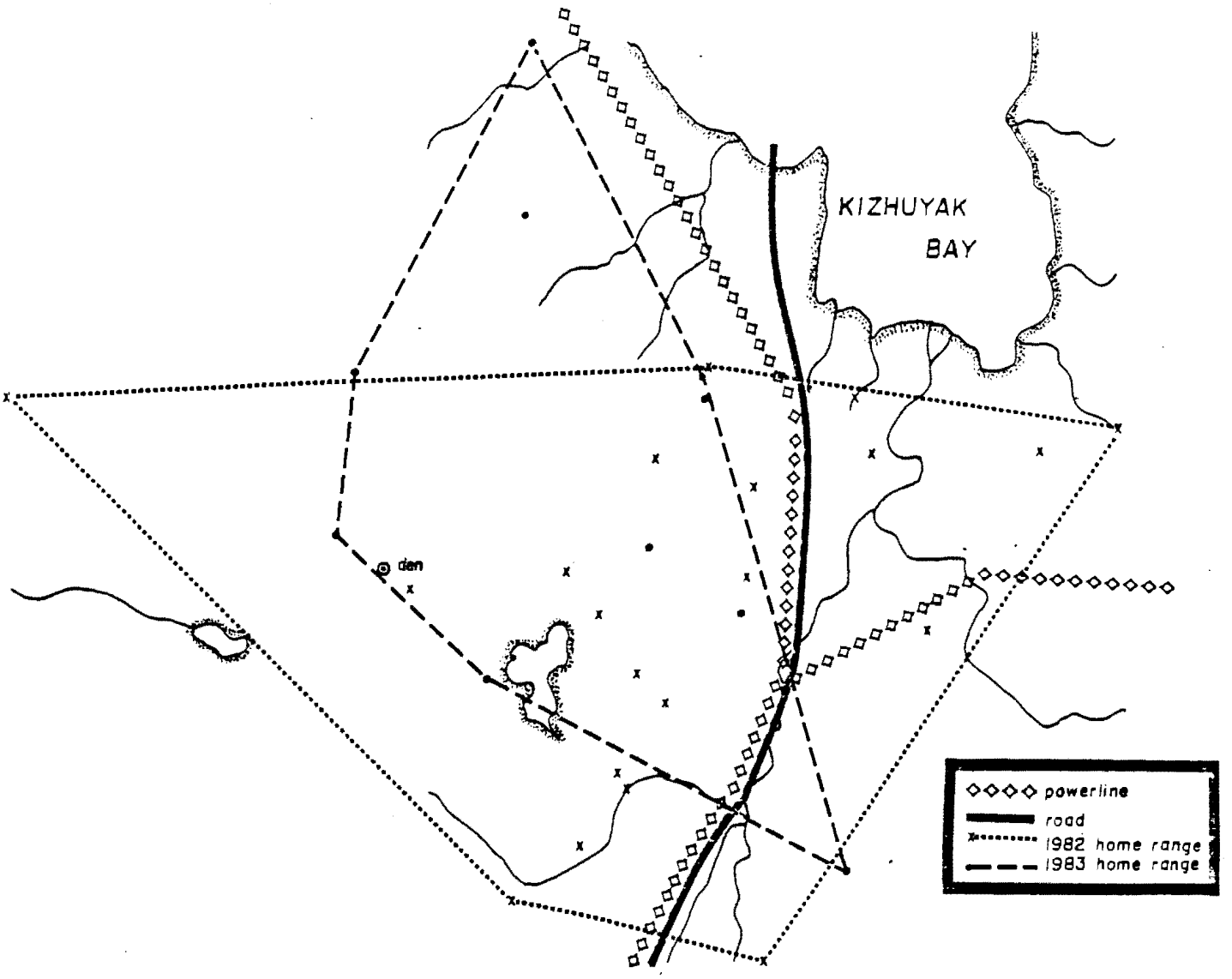

Figure 5. Point locations and home range for female brown bear #001 in 1982 and 1983. (Scale: 1cm = 0.5km).

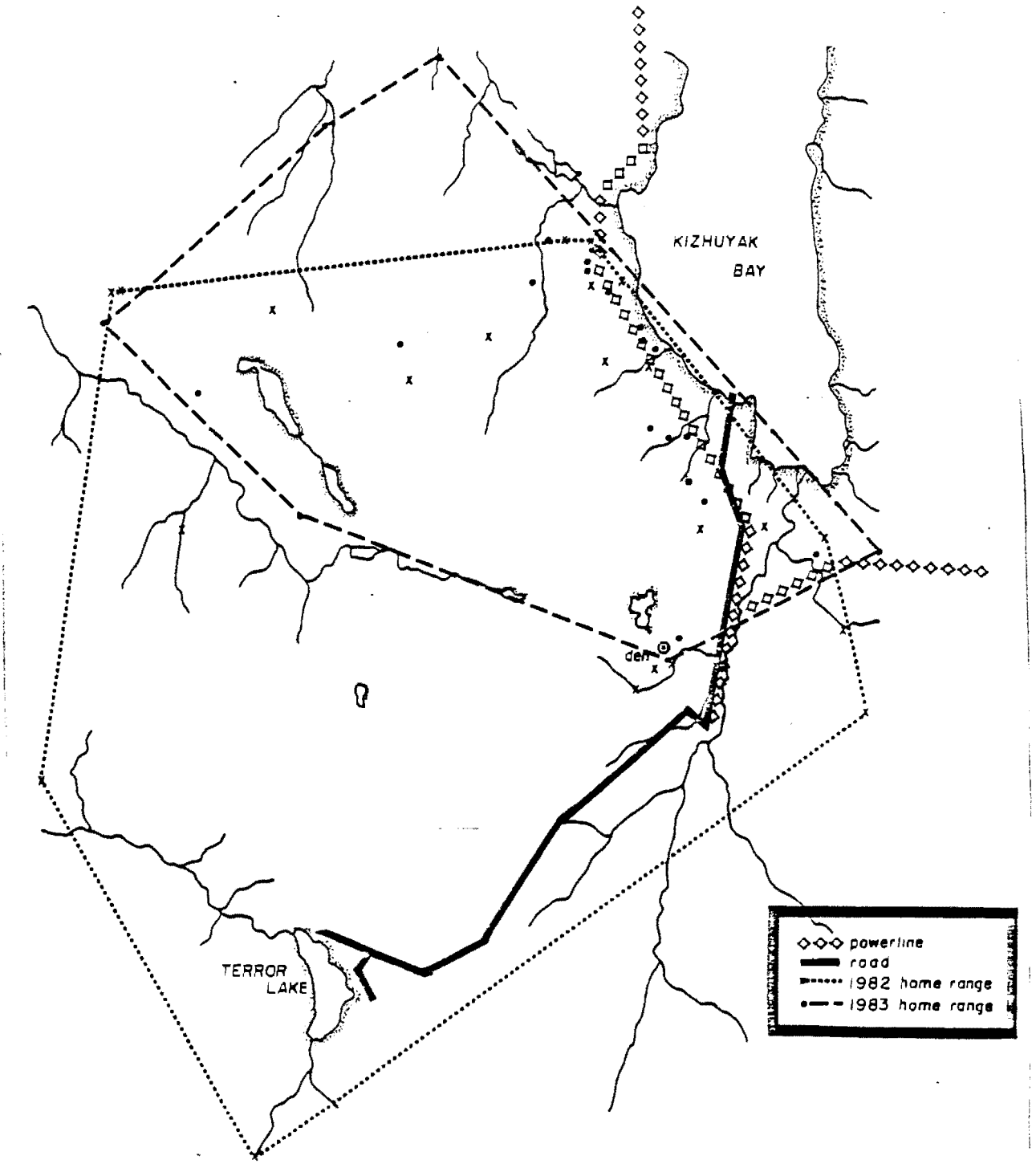

Figure 6. Point locations and home range for male brown bear #002 in 1982 and 1983. (Scale: 1cm = 1.2km).

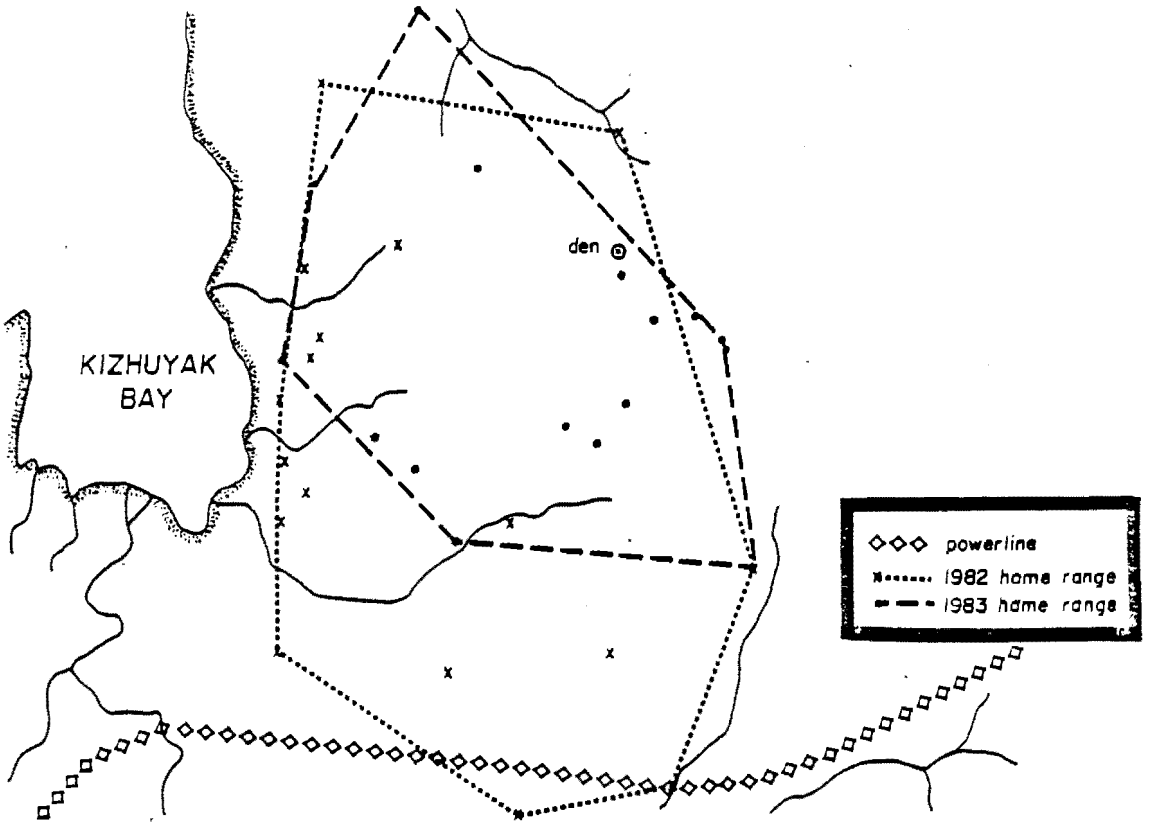

Figure 7. Point locations and home range for female brown bear #005 in 1982 and 1983. (Scale: 1cm = 0.5km).

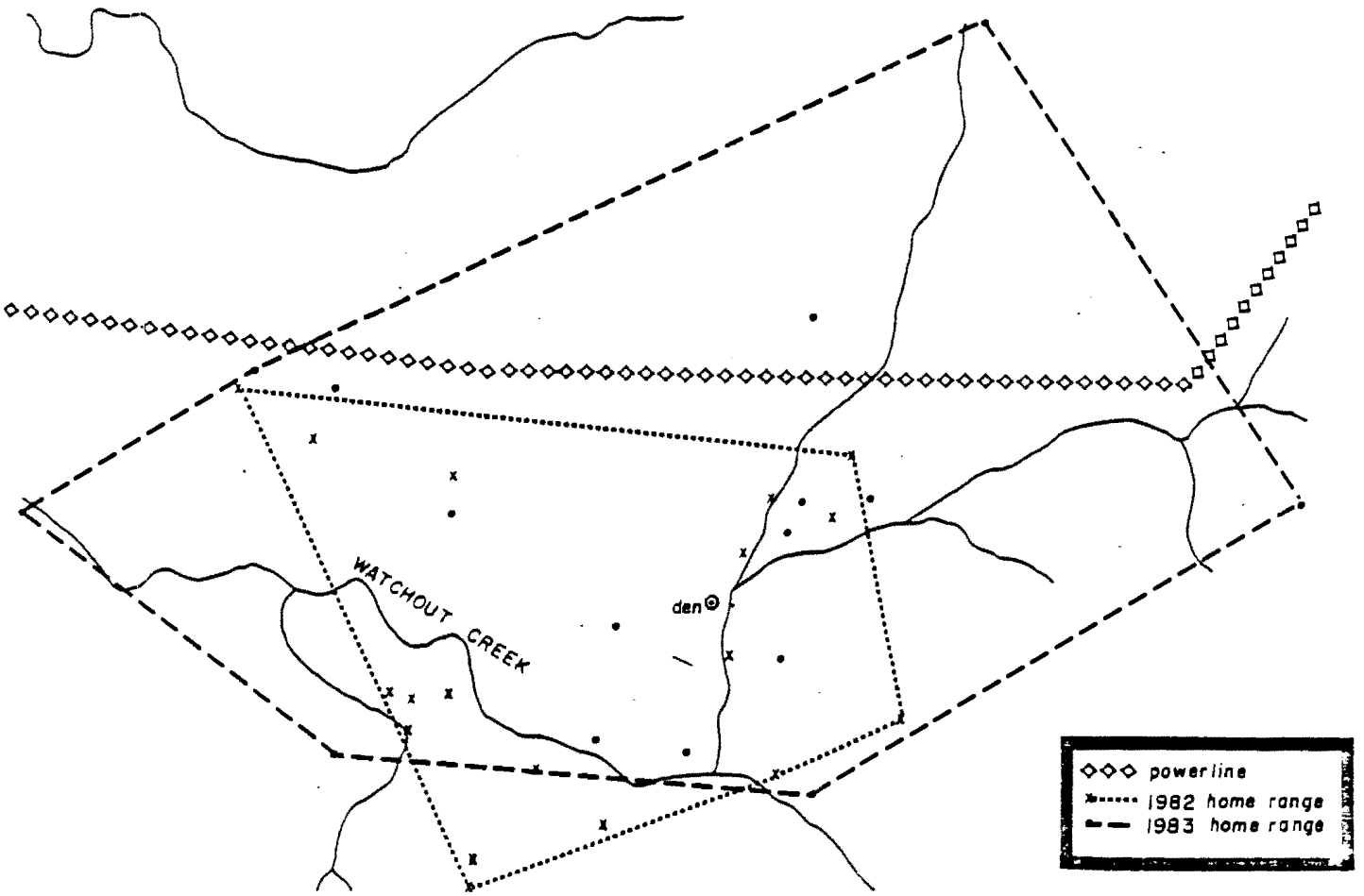

Figure 8. Point locations and home range for female brown bear #008 in 1982 and 1983. (Scale: 1cm = 0.4km).

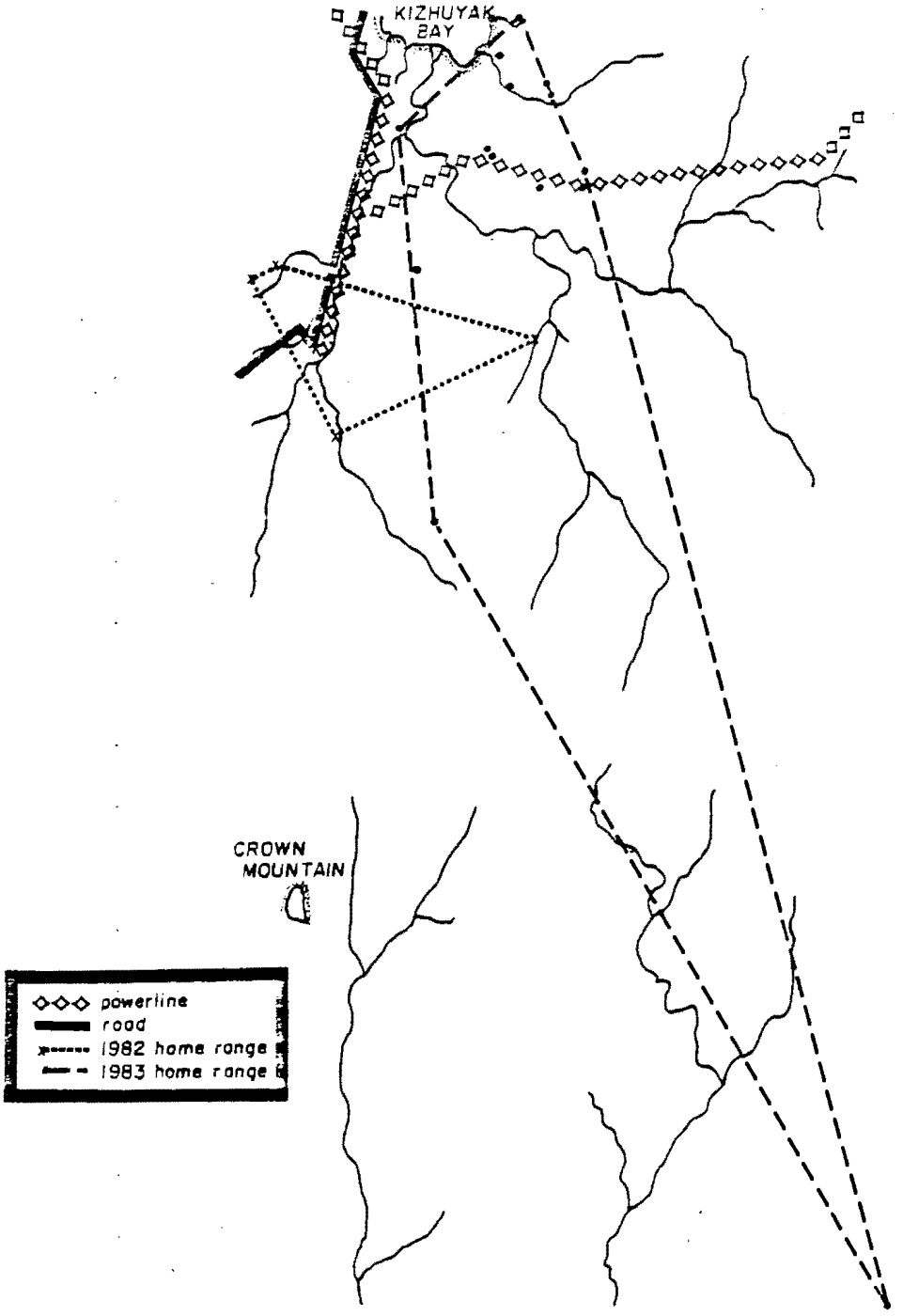

Figure 9. Point locations and home range for male brown bear #027 in 1982 and 1983. (Scale: 1cm = 1.2km).

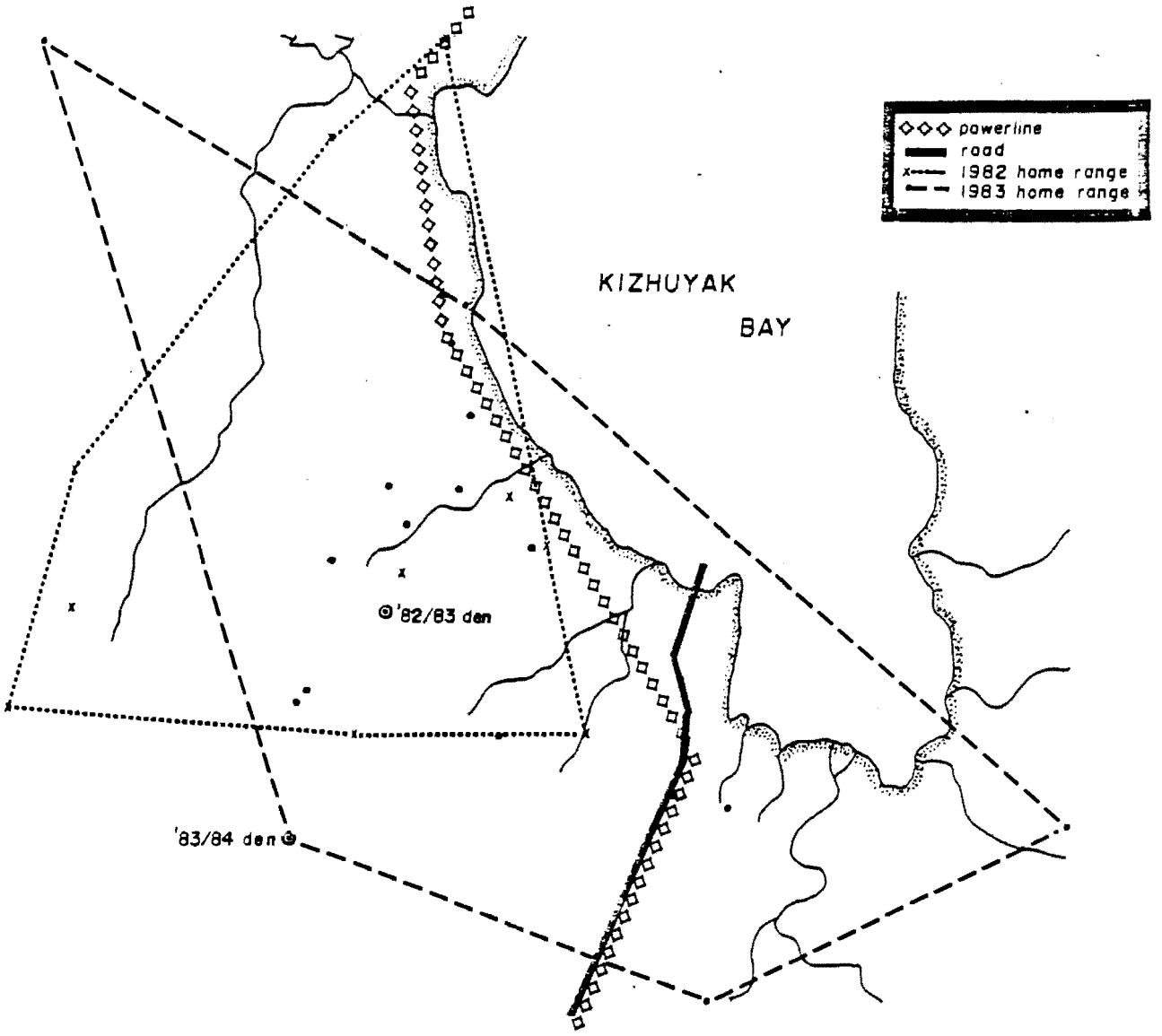

Figure 10. Point locations and home range for female brown bear #044 in 1982 and 1983. (Scale: 1cm = 0.6km).

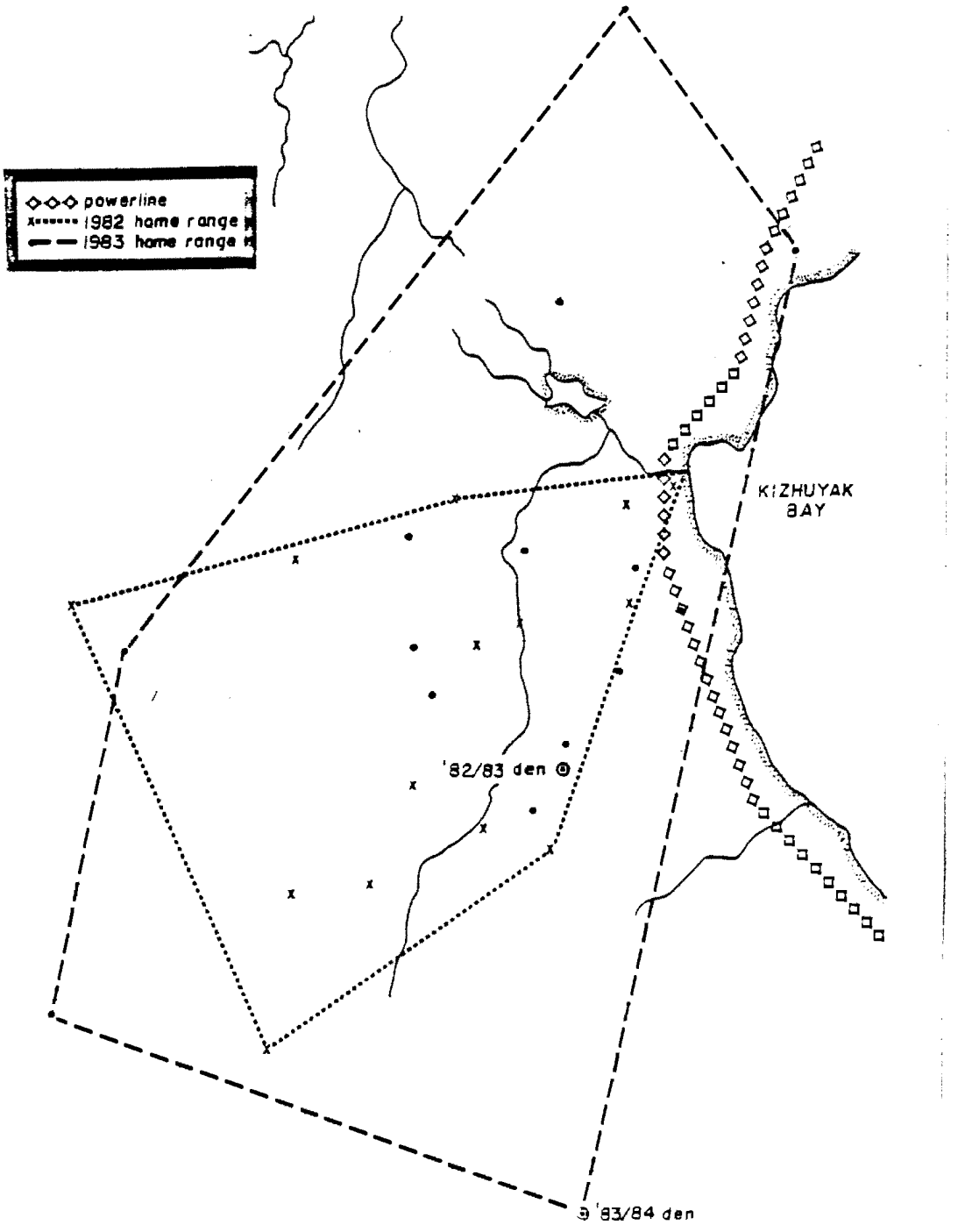

Figure 11. Point locations and home range for female brown bear #060 in 1982 and 1983. (Scale: 1cm = 0.6km).

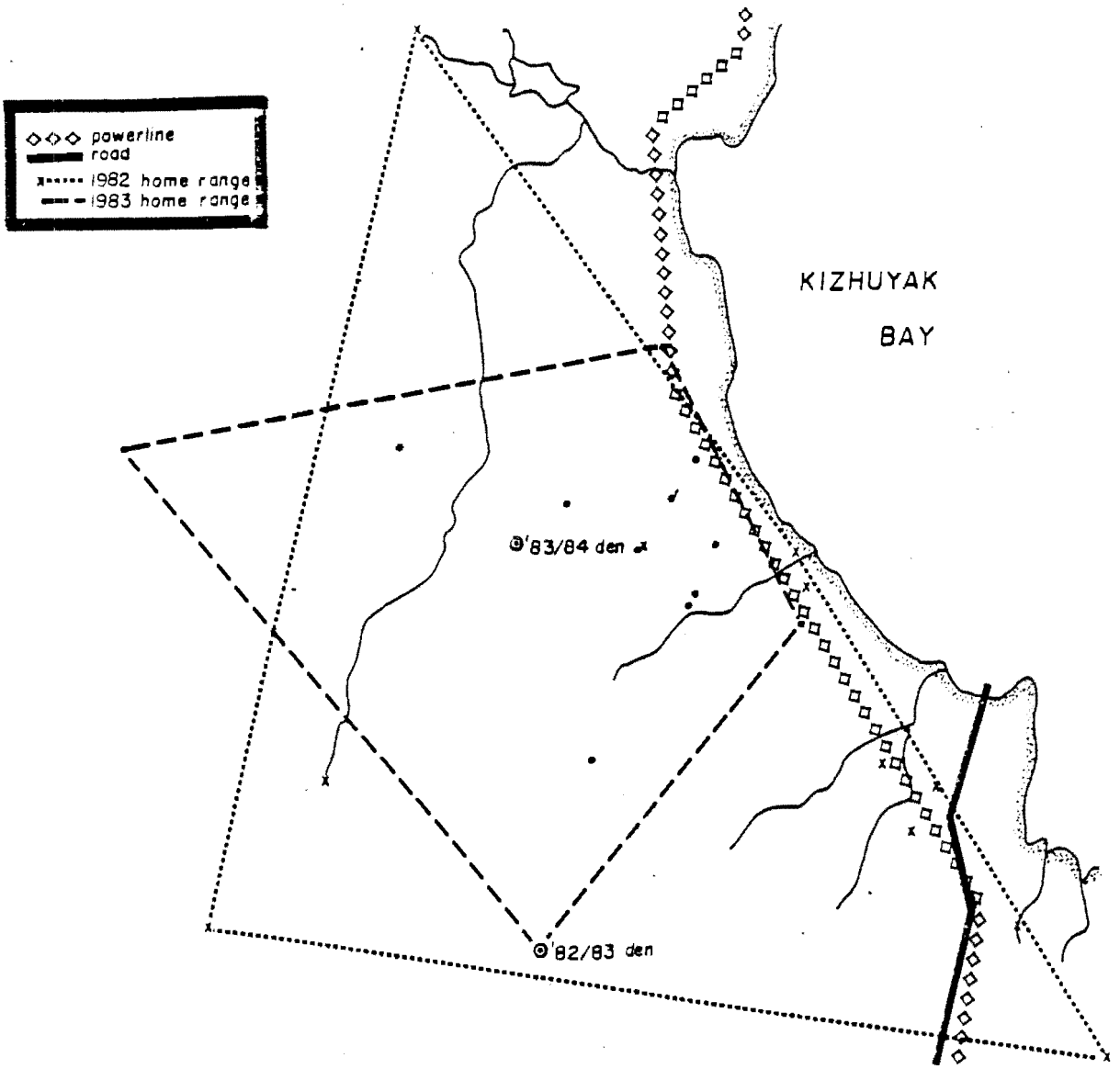

Figure 12. Point locations and home range for female brown bear #067 in 1982 and 1983. (Scale: 1cm = 0.5km).

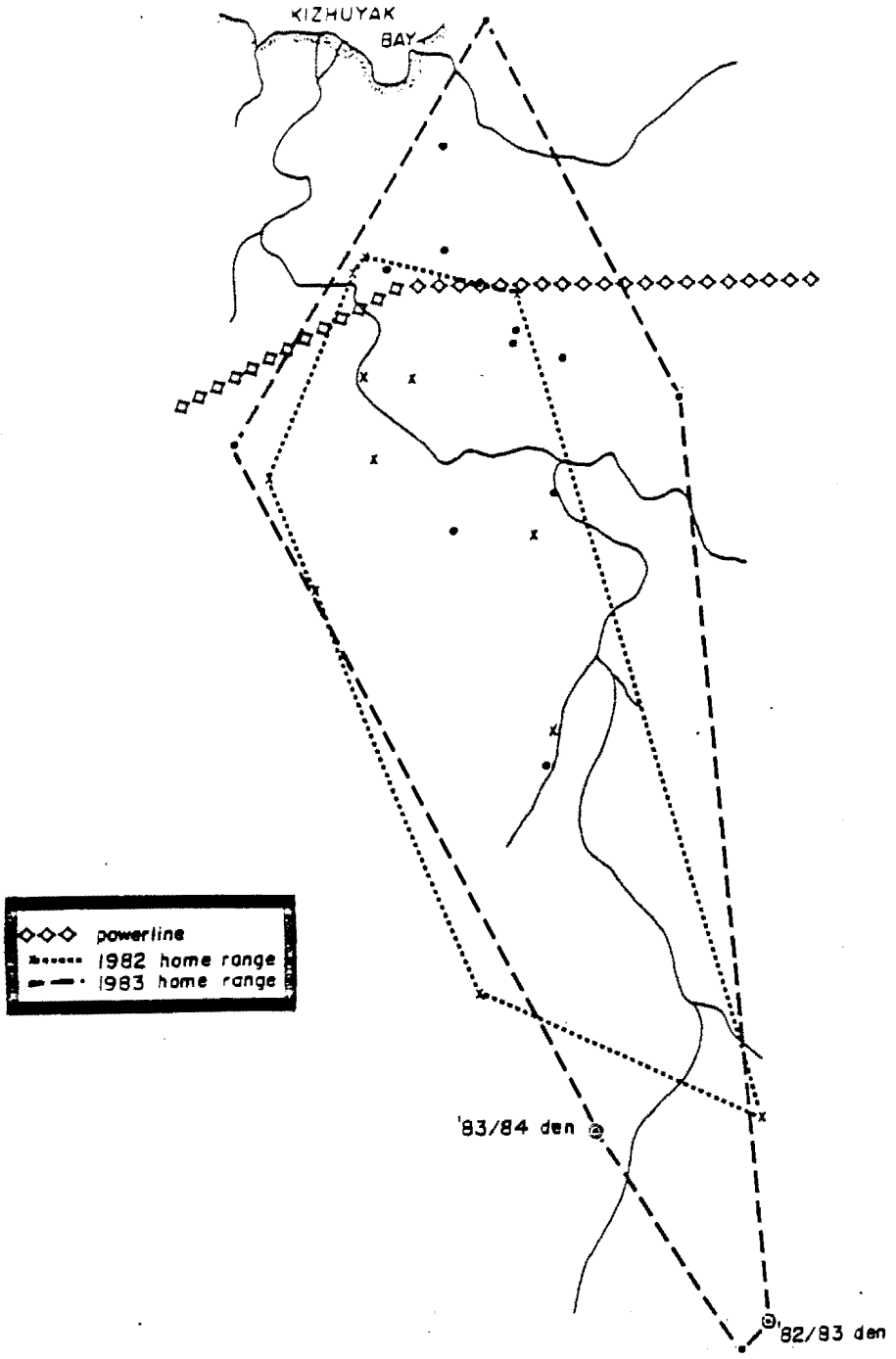

Figure 13. Point locations and home range for female brown bear #071 in 1982 and 1983. (Scale: 1cm = 0.6km).

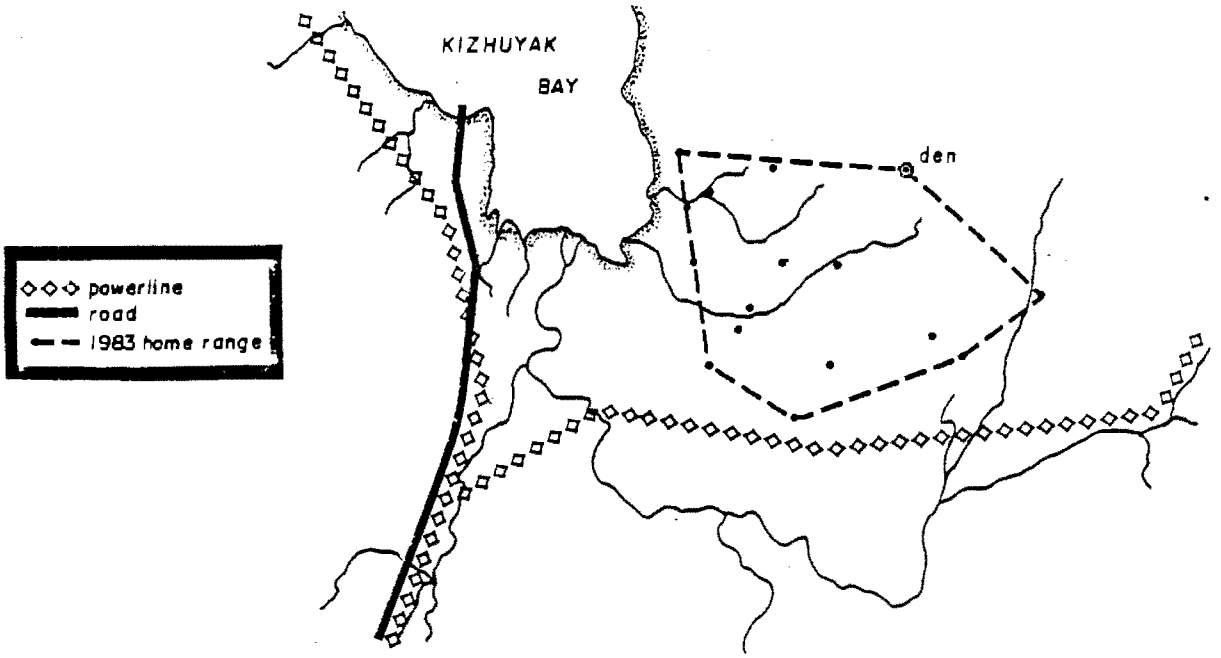

Figure 14. Point locations and home range for female brown bear #078 in 1982 and 1983. (Scale: 1cm = 0.8km).

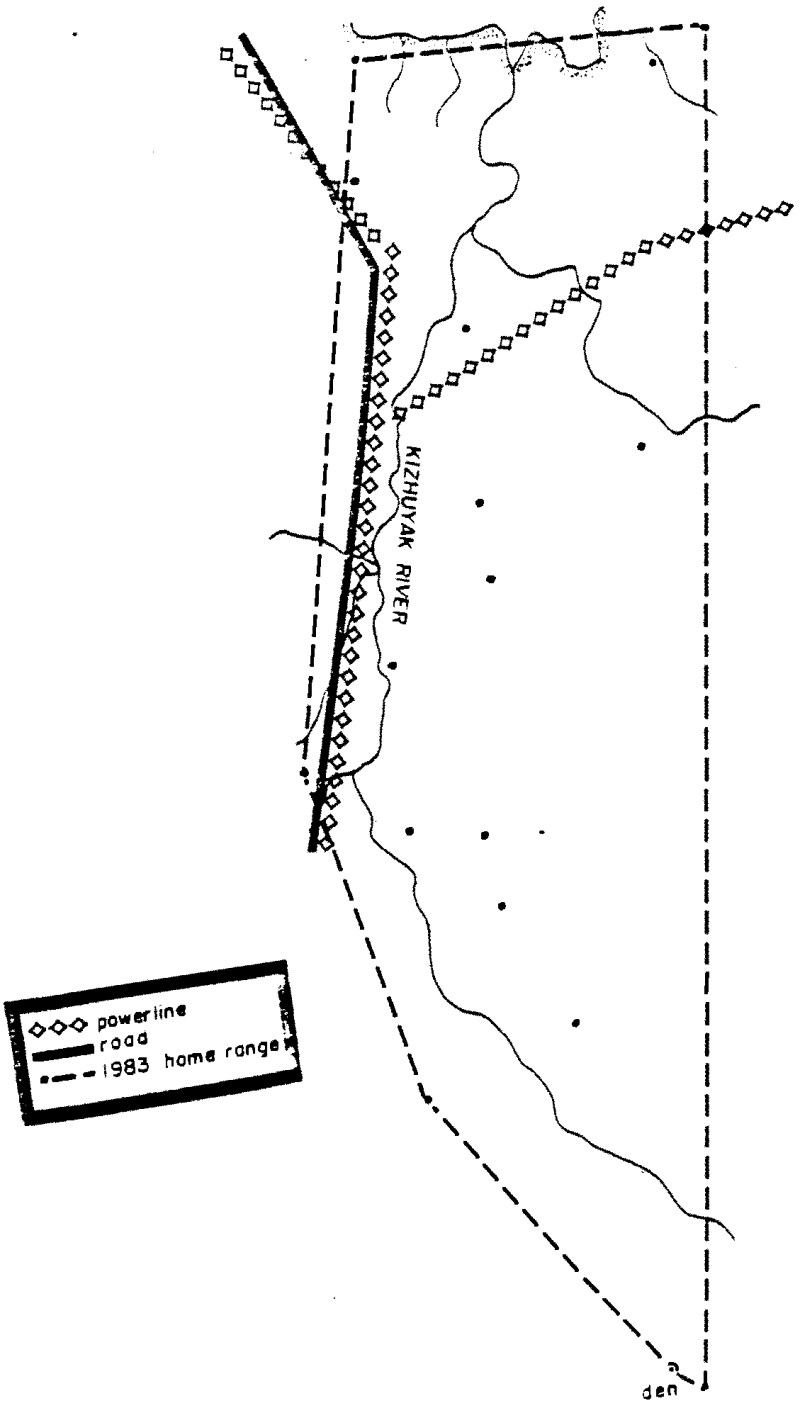

Figure 15. Point locations and home range for female brown bear #081 in 1982 and 1983. (Scale: 1cm = 0.6km).

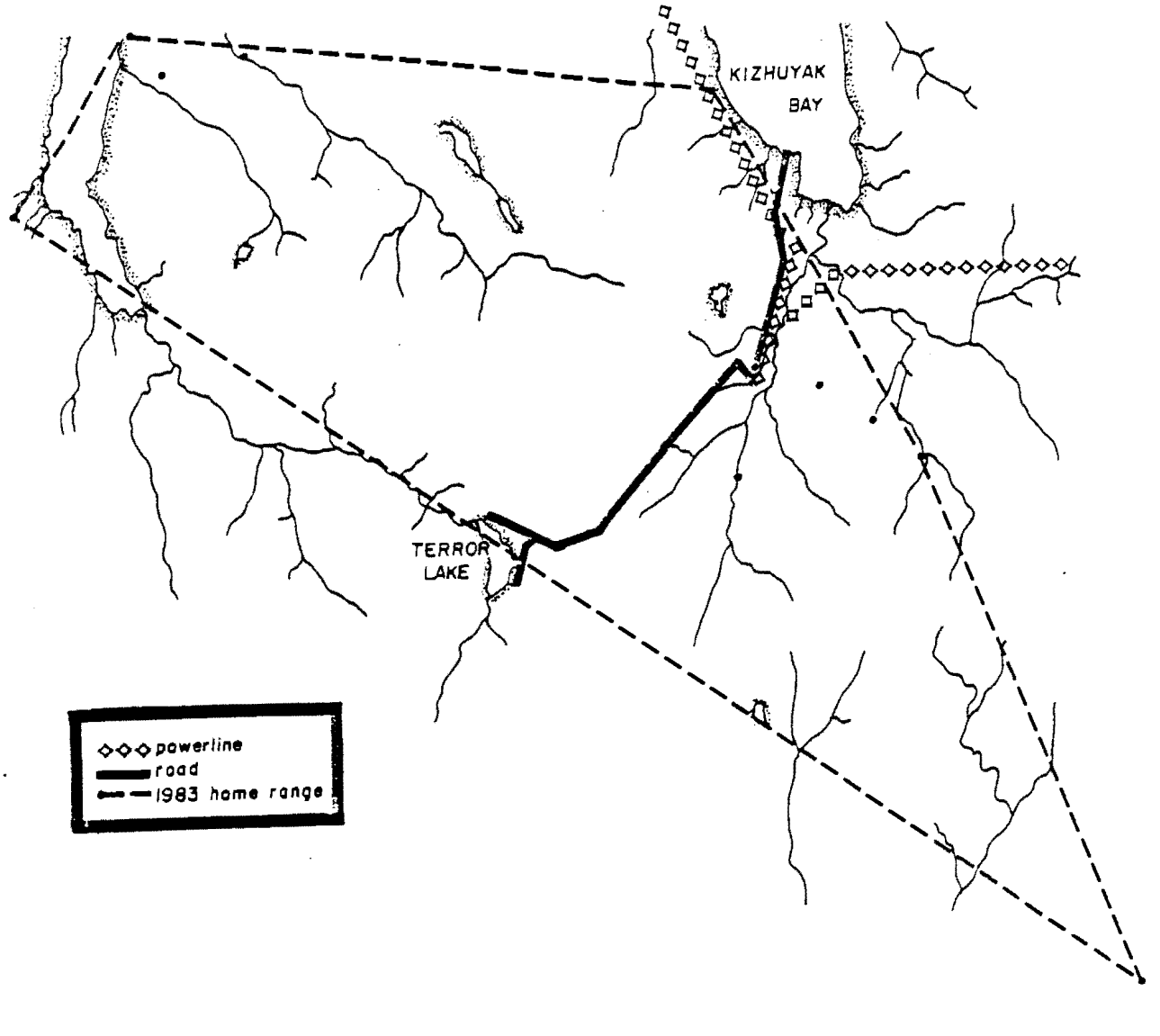

Figure 16. Point locations and home range for male brown bear #084 in 1982 and 1983. (Scale: 1cm = 1.9km).

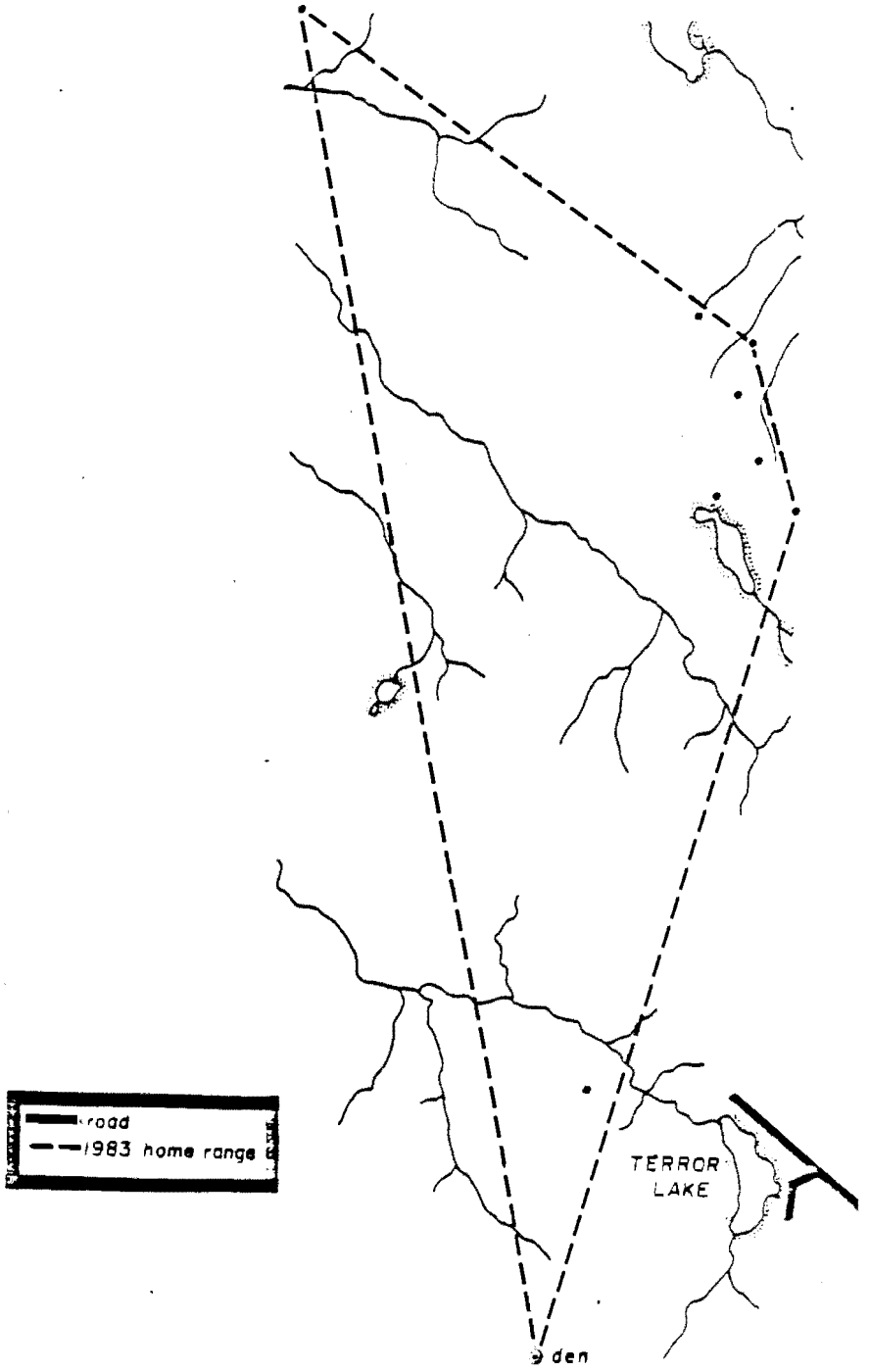

Figure 17. Point locations and home range for female brown bear #085 in 1982 and 1983. (Scale: 1cm = 1.4km).

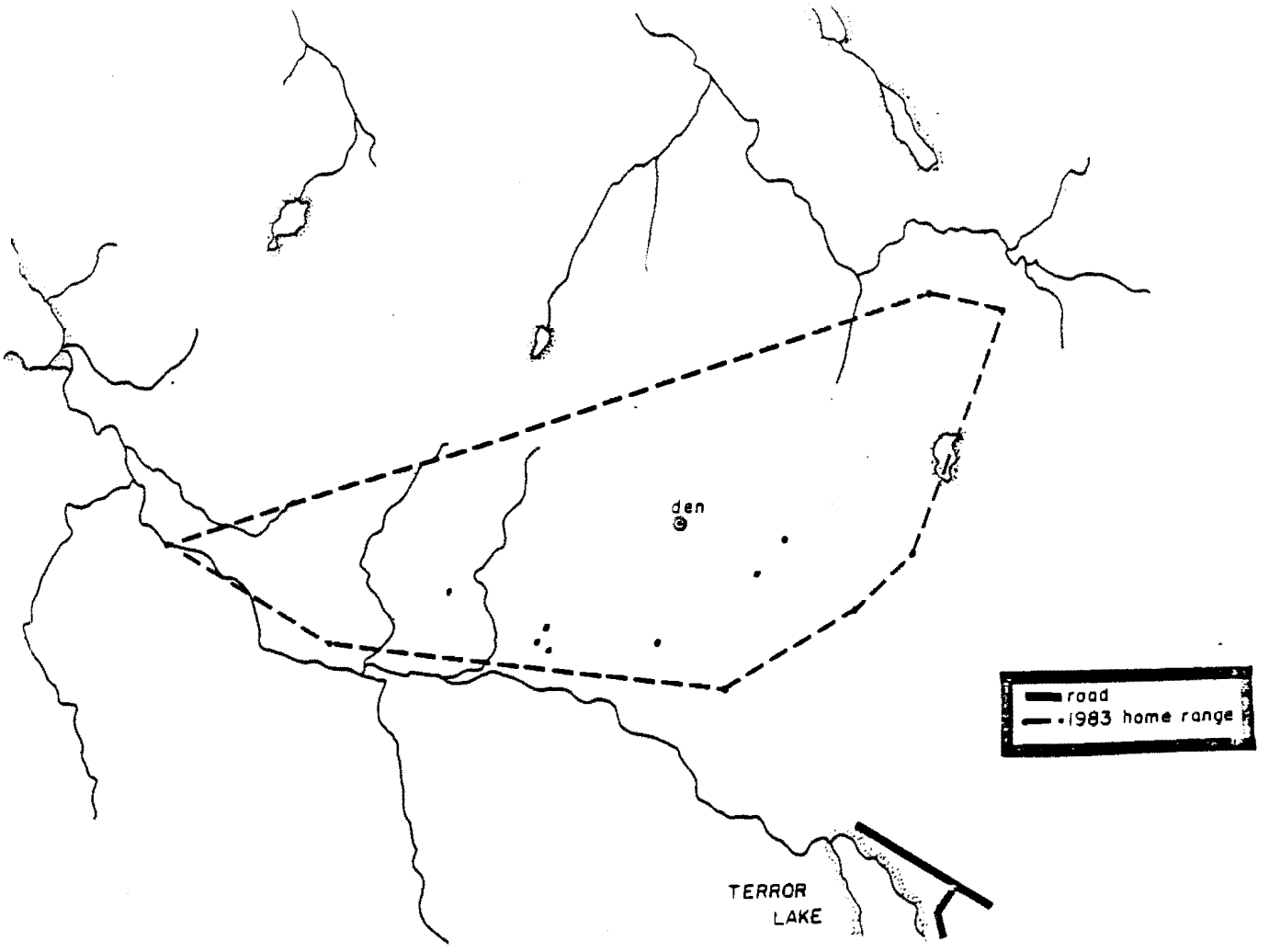

Figure 18. Point locations and home range for female brown bear #088 in 1982 and 1983. (Scale: 1cm = 0.8km).

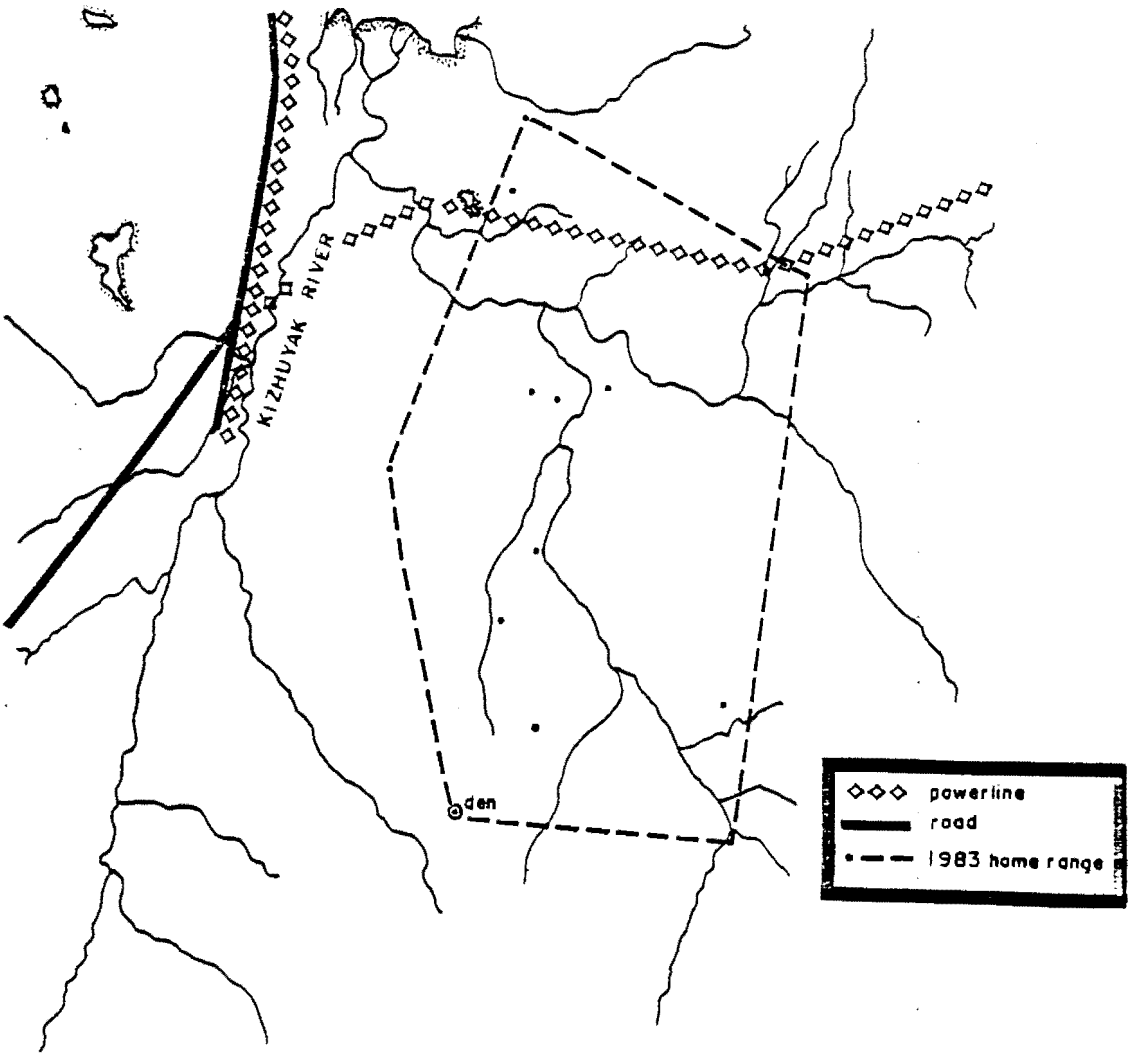

Figure 19. Point locations and home range for female brown bear #091 in 1982 and 1983. (Scale: 1cm = 0.9km).