TERROR LAKE HYDROELECTRIC PROJECT

1982 BROWN BEAR STUDIES

1982 MOUNTAIN GOAT STUDIES

Roger B. Smith

Larry Van Daele

ALASKA DEPARTMENT OF FISH AND GAME

Submitted to the Alaska Power Authority

February, 1984

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REPORT ON BROWN BEAR STUDIES, 1982

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SUMMARY OF FINDINGS

A 5-year study to determine the impacts of construction and operation of the Terror Lake Hydroelectric Project on the brown bear population was begun in 1982. Seventy-six brown bears were captured in the Terror Bay and Kizhuyak Bay areas. Radio-collars were installed on 43 bears, 16 males and 27 females. Movements of the radio-collared bears were monitored during scheduled weekly flights.

Mean home range size for 15 males was 141.2 km^2 (range = 14-465 km^2), nearly 5 times the 29.9 km^2 (range = 6-132 km^2) mean home range size for 27 females. Females characteristically occupied drainages into either Kizhuyak Bay or Terror Bay, with considerable overlap into the Viekoda Bay drainages. Only 2 of 27 females (7%) ranged into both the Terror Bay and Kizhuyak Bay drainages. Two females ranged between the Viekoda Bay drainage and the Uganik Bay drainage, but no females ranged into the Ugak Bay area Males characteristically ranged over more than one major drainage, although most showed seasonal preferences for one drainage. The home ranges of 4 males spanned major portions of both the Kizhuyak and Terror drainages. Three males moved into the Saltery Creek area of Ugak Bay and a fourth male spent nearly the entire active season in the Ugak Bay drainages. Two males occupied both the Terror Bay and Uganik Bay drainages.

The existence of somewhat distinct subpopulations of bears in the Kizhuyak and Terror Bay drainages was indicated. Much overlap between the Terror Bay and Kizhuyak Bay bears occurred in the Viekoda Bay drainage, but relatively little movement into the Uganik Bay and Ugak Bay drainages occurred.

The population in the 1300 km^2 study area was estimated at 324 bears or 1 bear per 4 km^2. The density was higher than was previously estimated for the study area, but less than density estimates reported for the Karluk Lake area of southwestern Kodiak Island.

Recorded mortality in 1982 was 24 bears, 17 males and 7 females. Three bears were capture mortalities, 3 bears were killed in defense of life or

property and 18 bears were killed by sport hunters. Two radiocollared bears, both males, were killed in 1982.

The elevations at which radio-collared bears were located was a good indicator of seasonal habitat use. Although much variation occurred between individual animals, a general pattern was that bears moved to near sea level in late May and early June to forage on newly developing herbaceous vegetation. Bears generally moved upward as vegetation emerged at progressively higher elevations through early July. In mid-July bears began moving back down to feed on salmon and by mid-August most bears were located near coastal salmon streams. Bears dispersed from the Terror River salmon feeding area in early September. Some bears continued to feed on salmon in the Kizhuyak River until October. Bears were feeding on a mixed diet of berries, salmon and herbaceous vegetation by early September. Progressively higher elevations were occupied by bears after dispersal from salmon streams until denning began in late October.

Dense seasonal concentrations of bears occurred on salmon streams, the most important of which were the Terror River, Kizhuyak River, Hilary Creek and Barabara Lake drainages. Several bears used more than one salmon stream. The movements of 6 bears, all females appeared to be little related to the availability of salmon.

Females with cubs generally occupied higher elevations than did single bears. Males and females with cubs were most widely separated from early July through early August. Single bears began frequenting salmon streams earlier than did females with cubs which remained longer in alpine areas.

Alpine and sub-alpine habitat north of Terror River and west of Kizhuyak Bay was heavily used by bears from early July through early August. Females with cubs appeared to be more abundant than single bears during that period.

A representative sample of sex, age and reproductive classes of bears frequented the lower Kizhuyak River valley in 1982. Bears were commonly seen by construction personnel in the Kizhuyak River area during daylight

hours. Some alteration of approach routes to the lower Kizhuyak valley probably occurred near the camp and jetty, but the access road was not major barrier to bear movements. Some bears were active nocturnally in the Kizhuyak River valley, a suspected adaptation for avoiding the intensive construction activity. Other bears seemed to become habituated to construction activities and road traffic especially when feeding on salmon in the lower Kizhuyak River. Sequential locations of radio-collared bears indicated that no major alteration of interdrainage travel routes occurred.

The presence of an open garbage pit adjacent to the access road did not attract significant bear use. Occasional use of garbage disposal sites occurred elsewhere in the study area.

Infrequent summer feeding by a few unmarked bears occurred in the Terror Lake basin, but the area was considered to be only moderately important habitat compared to adjacent areas. Disturbance by construction activities may have caused some bears to avoid the Terror Lake area. One radio-collared bear was located in the impoundment area in 1982.

A cold, wet spring in 1982 retarded early development of vegetation and caused a widespread failure of the salmonberry crop and diminished elderberry production. The low availability of berries may have resulted in wider ranging movements of bears searching for food.

Dens of 34 bears located by radio-tracking had a mean elevation of 620 m (range = 152-1006 m). Previous studies suggested that alpine habitat above 610 m was not important for denning. An important denning area was located in a group of peaks 4 km northwest of Terror Lake. Eight bears denned there within an area of 4 km^2. Sixteen bears denned in the Kizhuyak Bay drainages, 17 denned in the Terror and Viekoda Bay drainages and one bear denned near Sharatin Bay. Previously known denning areas in the Kizhuyak Bay drainage were occupied in 1982, but 59% of the 17 bears denned above 430 m, which was previously considered the probable upper limit of denning habitat in that drainage.

Single bears were the first to emerge from dens in late March, followed by females with yearling or older cubs. Females with newborn cubs were the last to emerge. Females generally entered dens earlier than males, beginning in mid-October. At least 3 males were still active by 8 December, 1982.

Identifying the impacts of construction activities on the brown bear population in 1982 required many subjective judgements in interpreting the relationships between movements of individual bears and potential sources of disturbance. Without comparable pre-construction data on brown bear movements and home ranges it was not possible to establish clear cause and effect relationships. The continued use of the lower Kizhuyak River valley by both radio-collared and unmarked bears indicated that no large-scale population shifts occurred. Seventeen bears, 6 females and 11 males, had home ranges which intersected sites of active construction in 1982. None of the females and only one male had home ranges which included the Terror Lake dam site and impoundment area.

Although it was suspected that some bears avoided denning in the immediate area of construction near the Terror Lake dam site and near facilities being constructed on the west side of Kizhuyak River, no detectable large-scale shifts in denning could be documented in 1982. The den located closest to a construction site, that of a male, was only 0.6 km from the access road near the Rolling Rock Creek diversion. No dens were located in the Terror Lake impoundment area. Comparing April-May capture locations with den site locations for individual bears indicated that most bears returned to the general vicinity of their capture locations to den. The fact that bears denned in alpine habitats at higher mean elevations than predicted might be interpreted to indicate that disturbance from construction forced bears into marginal habitats to den. An explanation considered more likely is that more accurate den locations were obtained by radio-telemetry than by aerial surveys used in previous studies. Requirements for suitable den sites may be less specific than was previously thought. The use of relatively remote alpine habitats for denning seems to suggest that negative impacts of construction on denning may be less serious than was originally believed.

Conclusions about the impacts of construction activities on brown bear movements in 1982 should be considered tentative. More potential sources of disturbance can be expected in 1983 as construction activities are expanded The Kodiak and Port Lions transmission lines scheduled for construction in 1983 are significant potential sources of disturbance in the eastern drainages into Kizhuyak River and west of Kizhuyak Bay. Continued monitoring of the movements of radio-collared bears through the construction phase and into the operational phase of the project will be necessary to establish more definitely the impacts of the Terror Lake Hydroelectric project on the brown bear populations.

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INTRODUCTION AND ACKNOWLEDGEMENTS

Background

Studies to monitor the impacts of the construction and operation of the Terror Lake Hydroelectric project on several wildlife species were required by the Federal Energy Regulatory Commission (FERC) as a condition of the project license. The requirement for these studies was intended to partially mitigate the effects of the project on wildife habitat.

The potential negative impacts of the project on the brown bear population in the project area generated severe controversy among several governmental agencies and national conservation organizations. Because the Terror Lake project was located on the Kodiak National Wildlife Refuge, originally created to protect and preserve the habitat of the Kodiak brown bear (Ursus arctos), the proposed construction initially met opposition from the US Department of Interior, the Sierra Club, the National Wildlife Federation, and the Audubon Society. A negotiated settlement between the Kodiak Electric Association (KEA), the State of Alaska, the Department of the Interior and the several conservation organizations was ultimately reached in 1981 which allowed the project to proceed. Conditions of that settlement included the requirement for additional studies on several wildlife species, including brown bear.

The Alaska Department of Fish and Game contracted with the Alaska Power Authority (APA) to conduct a 5-year study on brown bears. The study was designed to monitor the impacts on brown bears during the 3-year construction period and for a minimum of 2 years after completion of the project.

Description of the Terror Lake Hydroelectric Project

The Terror Lake project is designed to provide a 20 MW coventional hydroelectric power source for the city of Kodiak. Terror Lake, a natural lake located 40 km southwest of Kodiak, will be raised by a 60 m high rockfill dam to occupy an area of 2520 ha. The length of the lake will be increased from

about 2 km to 7.5 km. Additional diversions will be constructed on three tributaries of the Kizhuyak River drainage. A 28 km long transmission line will be constructed through lower Kizhuyak River, Elbow Creek and the Buskin River drainages to reach Kodiak. A 8 km long powertunnel will be drilled underground to transport water to the Kizhuyak River drainage where the powerhouse will be located. A construction access road will be built to link Terror Lake with a jetty and staging area at Kizhuyak Bay.

Study Objectives

The purpose of the present study is to document actual changes in bear use of the area caused by construction and operation of the project and to evaluate the significance of these changes to the bear population.

A preliminary study concluded that brown bears would be negatively impacted during the construction phase and to a lesser extent during the operational phase of the project (Spencer and Hensel, 1980). The results of that study predicted that human disturbance during construction activities would cause bears to avoid traditional denning and feeding areas and travel routes. Displacement of bears into adjacent areas with already high bear densities was predicted to produce excessive competition for food and den sites as well as direct conflicts between bears. An overall temporary loss of habitat quality during construction as well as a smaller permanent loss of habitat was expected.

It was recognized that clear-cut answers about the effects of the Terror Lake project would be difficult if not impossible to provide. Pre-construction studies were not sufficiently detailed to serve as a basis for comparison. Actual construction of the project began in March 1982, shortly before the present study was initiated, which essentially eliminated the opportunity to acquire additional pre-construction data. Numerous other uncontrolled variables, particularly natural variability in individual bear behavior and environmental factors, were recognized to be important to correct interpretation of project impacts, but difficult to quantify.

The study objectives were:

1. To delineate and characterize the impact zone of the Terror Lake Project on brown bears.

2. To monitor changes in specific habitats such as major denning and feeding areas and travel routes.

3. To monitor changes in the number and sex and age composition of bears inhabiting the impact area.

4. To determine changes in movement patterns and activities of bears in response to construction activities.

The study is to be continued for a minimum of 5 years, 3 years during active construction and 2 years during the post-construction phase.

Several studies of brown bears on Kodiak Island have been done previously. Troyer (1961) reviewed management practices and the history of brown bear hunting. Troyer and Hensel (1964) discussed characteristics of a hunted brown bear population in the Karluk Lake drainage of southwestern Kodiak Island. Reproductive biology in Kodiak brown bears was covered by Hensel et al. (1969) and Erickson et al. (1968). Aspects of denning were discussed in Lentfer et al. (1972). Seasonal food habits of Kodiak brown bears was reported on by Clark (1957). Radiotracking was used to study habitat use and movements of bears in the Karluk Lake drainage (Berns and Hensel, 1972; Berns et al, 1977). Atwell et al. (1977) observed brown bear feeding behavior in alpine habitat in the Uganik Bay drainage of northwestern Kodiak Island. Eide (1965) studied brown bear predation on cattle on northeastern Kodiak Island.

Spencer and Hensel (1980) evaluated habitat use and population characteristics of brown bears in the Terror Lake hydro project area and discussed potential impacts of the project on brown bears. Most of the impacts were expected to result from disturbance during construction. Miller and McAllister

(1982) in assessing expected impacts of the Susitna River hydro project attributed the most serious impacts directly to the effects of inundating a relatively large and highly productive terrestrial area. Terror Lake in comparison occupies a high elevation basin, with relatively low fish and wildlife populations compared to adjacent coastal areas in Terror Bay and Kizhuyak Bay. The major impacts of the Terror Lake project were predicted to occur outside the area of inundation, in the Terror River and Kizhuyak River drainages.

Acknowledgements

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METHODS

Brown bears were captured using procedures described in Miller and McAllister (1982) and Spraker et al. (1981). A fixed-wing aircraft (Bellanca Scout) was used to locate bears and bears were immobilized from a Bell 206B helicopter. Etorphine (M99) and its antagonist diprenorphine (M50-50) were used for immobilization.

Standard morphological data were collected and blood and hair samples were collected to assess physiological condition. Blood samples were analyzed for condition indexes by Pathologists Central Laboratories, Seattle, Washington. Teeth were collected for aging according to procedures described by Johnson and Lucier (1975). Two lower premolars were collected from bears 2.5 years old or older and from some yearling bears.

Tattoos were applied to the upper lip, the lower lip and to the right groin. Numbered DuFlex hog tags (Fearing Mfg. Co., Inc., S. St. Paul, Minesota) were attached to both ears. Colored Saflag strips (Safety Flag Co., Pawtucket, Rhode Island) were attached with the ear tags to bears captured in July, 1983.

Bears estimated at 3.5 years old or older were fitted with radio-collars (Telonics, Mesa, Arizona). Most transmitters were equipped with mortality

sensors. Small ear radios were attached by Duflex hog tags to 3 sub-adult bears and to 1 adult bear

Bears were captured on 22 April-2 May and 22-26 July, 1982. The spring operation was directed at capturing bears in denning areas near planned Terror Lake Hydroelectric project developments in the Kizhuyak Bay and Terror Lake drainages. That operation was conducted during the brown bear hunting season and coastal hunting areas were generally avoided. The July capturing was done to increase the sample of family groups and to capture bears feeding in alpine areas and near salmon spawning streams. A list of bears captured in 1982 is presented in Table 1.

Radio-collared bears were located during scheduled weekly flights with fixed-wing aircraft (Bellanca Scout, Cessna-206). Movements of bears were monitored from the ground on 21-22 September near the construction access road along Kizhuyak River. Locations of radio-marked bears and of all unmarked bears observed were plotted on topographic maps (scale 1:63,360). Information on habitat, associations, activity and construction activities or other human disturbances were recorded using a format adapted from the Susitna Hydroelectric Project Studies. Habitat data collected for each bear observation included: slope, aspect, elevation, snow conditions and vegetative cover. A list of vegetative cover types was assigned by ocular assessment within a 1-2 hectare area surrounding each location. No analysis of vegetative cover data was done in 1982.

The home range polygons for each radio-collared bear with 5 or more locations are shown in Appendix 1 (Figures 4-46). Areas of home range polygons were measured with a compensating polar planimeter (Table 6). Portions of the home range polygons overlapping marine waterbodies were not included. Freshwater bodies were included to simplify area calculations.

Dens were located during reconnaissance flights in March and April, 1982, during radio-tracking flights, and incidental to other field activities. Den locations for radio-collared bears were plotted on topographic maps and data on den construction and habitat were collected.

DESCRIPTION OF STUDY AREA

The study area is located in the northwestern part of Kodiak Island, including principally the drainages into Kizhuyak Bay, Sharatin Bay, Viekoda Bay, Terror Bay, the upper drainages into Uganik Bay and the northwestern drainages of Ugak Bay (Fig. 1). The study area includes an area of approximately 1300 km^2. The environment of the study area is well-described in Hickock and Wilson (1979) and Spencer and Hensel (1980). The coastline is rugged with bedrock outcrops, steep bluffs, boulder-strewn beaches and headlands exposed to severe wave action. Broad deltas and extensive tidal flats occur at the mouths of Terror River and Kizhuyak River. The topography varies from rolling hills and gentle valleys northwest of Kizhuyak Bay to steeply ascending ridges and peaks along the tributaries into Kizhuyak and Terror Bays. The highest peak, Mt. Glotoff, rises to over 1340 meters and several peaks exceed 1000 m in elevation. The major central mountain range runs generally northeast-southwest along Kodiak Island. The effects of extensive glaciation can be seen in morainal deposits, cirques and eroded tributary valleys.

A maritime climate prevails on Kodiak Island with a mean annual temperature in Kodiak of 41°F and average annual precipitation of 62 in. per year, (Karlstrom, 1969). Overcast skies, high winds and precipitation frequently occur in the study area. Precipitation occurs primarily in the form of rain near sea level with snow occuring at higher elevations from October through April.

The vegetation of the study area was described Hickock and Wilson (1979) and the relationships of vegetation and brown bears were discussed in Spencer and Hensel (1980). A mosaic of shrubs, grasses and herbaceous plants occupy valleys and slopes to about 500 m. Dense thickets of alder (Alnus crispa sinuata), interspersed with patches of salmonberry (Rubus spectabilis), bluejoint (Calamagrostis canadensis) and fireweed (Epilobium angustifolium) dominate the lower slopes and ridges. Red elderberry (Sambucus callicarpa), devil's club (Echinopanax horridum), and ferns (Aythrium filix-femina) are abundant understory plants in the alder thickets. Extensive stands of willows (Salix spp.) occupy lowland valleys, drainages and

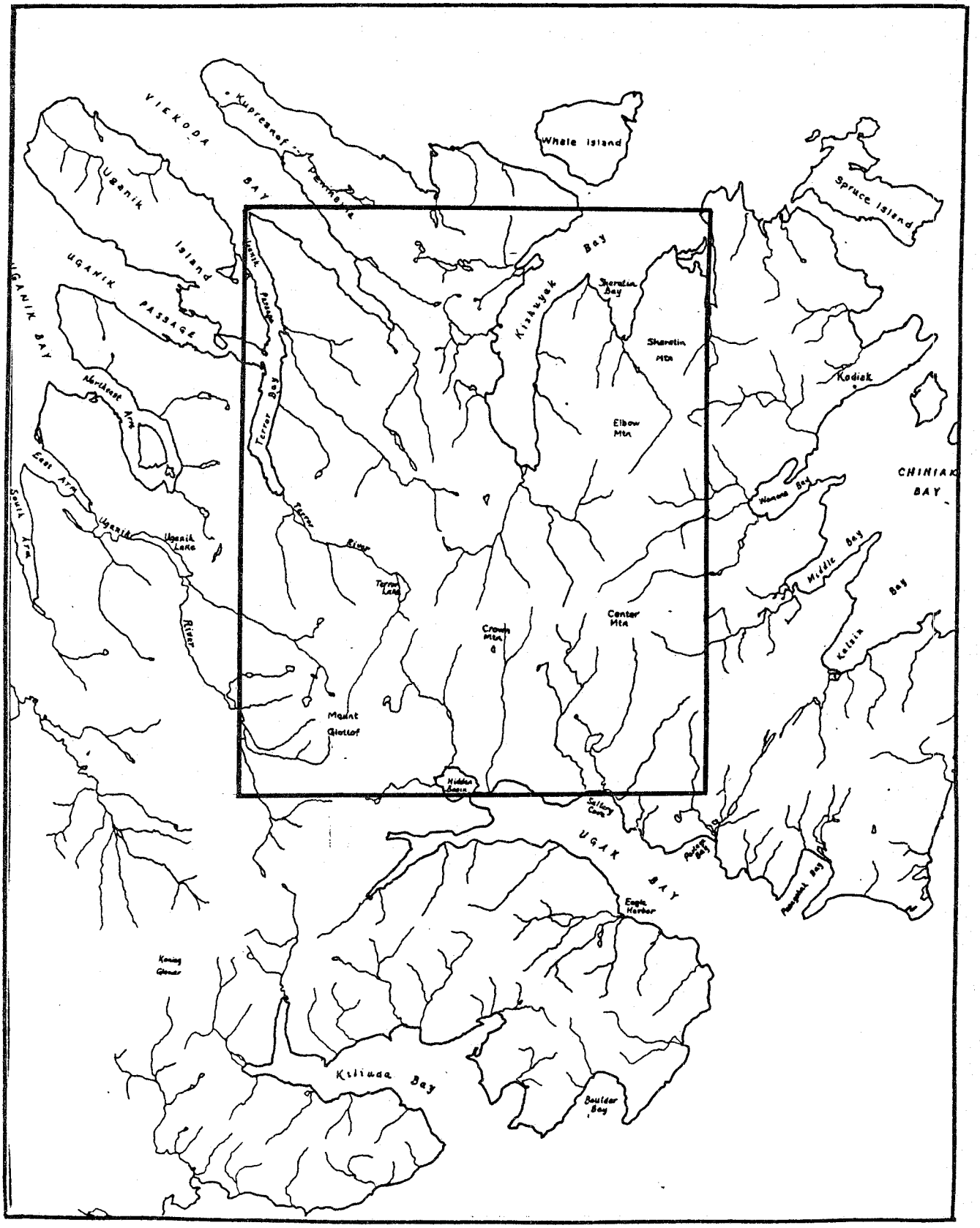

Figure 1. Location of the Terror Lake study area (1 cm = 4.22 km).

moist sites at higher elevations. Kenai birch (Betula papyrifera kenaica) are found in small groves and as scattered individual trees most commonly south and west of Kizhuyak Bay. Cottonwoods (Populus balsamifera) form the dominant overstory along Terror River, Kizhuyak River and other streams in the study area. Sitka spruce (Picea sitchensis) occurs in scattered stands in the northern part of the study area. Common herbaccous species include fireweed, cow parsnip (Heracleum lanatum), false hellebore (Veratrum viride), angelica (Angelica spp.), Indian paintbrush (Castilleja unalaschensis), lupine (Lupinus nootkatensis) and horsetail (Equisetum spp.).

The Terror River and Kizhuyak River deltas are characterized by extensive stands of lyme grass (Elymus arenarius) in drier sites. Adjacent marshy intertidal sites are covered with a thick growth of sedges, principally Carex lyngbyaei. A narrow band of lyme grass mixed with sedges in wetter areas typically occur at the mouths of creeks and intertidal lagoons throughout the study area.

The shrub-grass vegetation type characteristically diminishes in height with increasing elevation, grading into low willow thickets and tundra from 500 to 700 m. A sedge-forb meadow of predominatly Carex macrochaeta and C. podocarpa occupies moist areas. An ericaceous heath community of crowberry (Empetrum nigrum), blueberry (Vaccinium ulignosum alpinum), Luetkea pectinata and prostrate willows (Salix spp.) occupies drier sites. Above 1000 m poorly developed shallow, rocky soil and persistent snow restricts vegetative growth. Lichens, scattered mats of ericaceous heath, bare rock and snow predominate in this zone.

The 6 species of terrestrial mammals indigenous to Kodiak Island and the study area are brown bear, red fox (Vulpes vulpes), ermine (Mustela erminea), otter (Lutra canadensis), northern vole (Microtus oeconomus) and ground squirrel (Citellus undulatus) (Rausch, 1969). Several species of mammals have been successfully introduced and the most common species in the study area are the Sitka black-tailed deer (Odocoileus hemionius sitkensis), mountain goat (Oreamnos americanus), snowshoe hare (Lepus americanus), and beaver (Castor canadensis) (Burris and McKnight, 1973).

Four species of salmon occur in streams in the study area. Pink salmon (Oncorhynchus nerka) are the most abundant and widely distributed species. Chum (O. keta) and coho salmon (O. kisutch) are found in smaller numbers in most streams. Sockeye salmon (O. nerka) are found in the Saltery Lake, Barabara Lake and Uganik Lake drainages.

Results and Discussion

Sex and age composition of captured bears

A total of 76 bears was captured in 1982 (Table 1). The captures included 17 maternal females, 12 single females, 18 males and 29 cubs. Three capture mortalities occurred, including an adult male, a single female, and one maternal female.

Radio-collars were installed on 43 bears, 16 males and 27 females. Ear-radios were fitted on three sub-adult bears and one radio-collared adult male. Bears were captured during two periods. Forty-one bears were captured during a 22 April-2 May tagging period. Radio-collars were put on 14 males and 14 females. During a 22-26 July tagging period 35 bears were captured and radio-collars were put on 13 females and 2 males.

Sex and age composition of 29 captured cubs was: 0.5 year -- 3♂, 4♀; 1.5 year -- 4♂, 9♀; 2.5 year -- 4♂, 3♀; 3.5 year -- 2♂. The overall sex ratio of captured cubs was 13♂ (45%) and 16♀ (55%).

Eighteen males ranged from 3.5 to 15.5 years old with a mean age of 6.9 years. Twenty-nine females ranged from 3.5 to 23.5 years old with a mean age of 11.1 years. Twelve single females had a mean age of 6.6 years (range = 3.5-21.5 yr.). Seventeen maternal females had a mean age of 14.3 years (range = 6.5-21.5 yr.).

Estimated ages varied from cementum ages for several bears in the 1.5 to 3.5 year age classes. In these cases ages were assigned based on weight,

Table 1. Brown bears captured in Terror Lake study area in 1982.

Bear no.	Sex	Age	Capture date	Ear flag color	Ear tag no.	Comments
001	F	3.5	4/22/82	--	1799/1784	Pre-estrus
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	
004	M	6.5	4/22/82	--	1836/1834	
005	F	13.5	4/23/82	--	1740/1744	w/006, 007
006	M	3.5	4/23/82	--	1825/1823	w/005, 007; killed by hunter on 5/30/82.
007	M	3.5	4/23/82	--	1819/1824	w/005, 006
008	F	11.5	4/23/82	--	1739/1749	w/009, 010
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	
015	F	7.5	4/25/82	--	1741/1743	Milk in pectoral mammae only; seen w/smaller bear, possibly weaned cub on 5/4/83.
016	M	11.5	4/25/82	--	1809/1808	w/017
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	7.5	4/26/82	--	1805/1802	w/003; age estimated; no tatoos
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
028	M	3.5	4/27/82	--	1837/1817	

Table 1. (Cont'd). Brown bears captured in Terror Lake study area in 1982.

Bear no.	Sex	Age	Capture date	Ear flag color	Ear tag no.	Comments
029	F	17.5	4/29/82	--	not recorded	w/030, 031, 032
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.
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	
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 re-located.
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	3.5	5/02/82	--	--/1858	w/040, 041; ear radio; last located 5/21/82.
040	M	3.5	5/02/82	--	1854/1862	w/039, 041
041	M	3.5	5/02/82	--/pink	1864/1841	w/039, 040
043	F	4.5	7/22/82	red/green	1793/1745	Capture mortality
044	F	3.5	7/22/82	red/red	1796/1795	
045	M	5.5	7/22/82	orange/red	1875/1863	
046	F	6.5	7/23/82	green/red	1769/1762	w/047 and 1-yearling not captured
047	F	1.5	7/23/82	white/lt.blue	1764/1773	w/046 and 1-sibling not captured
048	F	23.5	7/24/82	white/red	1794/1792	w/049, 050
049	M	1.5	7/24/82	dk.blue/red	1874/1830	w/048, 050
050	F	1.5	7/24/82	orange/white	1780/1771	w/048, 049
051	F	8.5	7/24/82	white/white	1742/1791	w/052
052	F	1.5	7/24/82	dk.blue/orange	1759/1761	w/051
053	F	8.5	7/24/82	--	--	w/054; capture mortality
054	M	1.5	7/24/82	red/lt.blue	1871/1860	w/053
055	F	13.5	7/24/82	green/white	1787/1766	w/056, 057, 058
056	F	0.5	7/24/82	red/--	1772/1753	w/055, 057, 058
057	M	0.5	7/24/82	--/red	1872/1867	w/055, 056, 058
058	M	0.5	7/24/82	red/red	1861/1856	w/055, 056, 057
059	M	3.5	7/25/82	white/green	1882/1887	
060	F	14.5	7/25/82	lt.blue/green	1718/1767	w/061, 062, 063

Table 1. (Cont'd). Brown bears captured in Terror Lake study area in 1982.

Bear no.	Sex	Age	Capture date	Ear flag color	Ear tag no.	Comments
061	F	0.5	7/25/82	--/lt.blue	1725/1723	w/060, 062, 063
062	F	0.5	7/25/82	lt.blue/--	1714/1716	w/060, 061, 063
063	F	0.5	7/25/82	lt.blue/lt.blue	1722/1715	w/060, 061, 062
064	F	20.5	7/25/82	red/white	1724/1719	w/065, 066
065	F	1.5	7/25/82	white/dk.blue	1798/1751	w/064, 066
066	F	1.5	7/25/82	orange/dk.blue	1754/1758	w/064, 065
067	F	20.5	7/25/82	lt.blue/red	1785/1783	w/068, 069
068	F	1.5	7/25/82	green/lt.blue	1737/1775	w/067, 069
069	F	1.5	7/25/82	green/dk.blue	1760/1720	w/067, 068
070	F	4.5	7/26/82	lt.blue/dk.blue	1711/1706	
071	F	8.5	7/26/82	red/dk.blue	1707/1702	w/a 0.5 yr. old cub not captured
072	F	18.5	7/26/82	lt.blue/orange	1786/1756	w/073 and a 0.5 yr. old cub not captured.
073	M	0.5	7/26/82	red/orange	1870/1892	w/072 and a sibling not captured
074	F	17.5	7/26/82	dk.blue/lt.blue	1727/1752	w/075, 076
075	F	1.5	7/26/82	white/yellow	1717/1703	w/074, 076
076	M	1.5	7/26/82	lt.blue/lt.blue	1873/1845	w/074, 075
077	F	20.5	7/26/82	--/--	1779/1705	w/3-1.5 yr. old cubs not captured

tooth eruption, skull size and weaning dates, in addition to cementum age. Two yearling siblings, a female (#075) and a male (#076), both had 3 well-developed cementum lines. Apparently the third cementum line had been laid down earlier than usual (Enid Goodwin, pers. comm.).

Productivity and Cub Mortality

Seventeen of 29 females (59%) were accompanied by cubs when captured (Table 2). Four females had yearling litters, 9 females had 1.5 year old litters, 3 females had 2.5 year old litters and 1 female had a litter of 3.5 year old cubs. Mean litter size was: 0.5 yr. - 2.3 (range = 1-3); 1.5 yr. - 1.9 (range = 2-3); 2.5 yr.+ - 2.3 (range = 1-3). Hensel et al. (1969) reported mean litter sizes in Kodiak brown bears of 2.2 for cubs of the year and 2.0 for yearlings.

Female #015 was not associated with a cub when captured on 25 April, 1982. She was seen 9 days later with a smaller bear, possibly a recently weaned 2.5 year old cub.

The oldest maternal female (#048) was 23.5 years old. She had 2 yearling cubs. The two youngest maternal females (#011, #046) were 6.5 years old and each had a litters of 2 yearlings. These two bears apparently first bred successfully at 4.5 years. The age of first breeding for Kodiak brown bears is 3.5 years but 4.5 years is the most common age of the first successful breeding (Hensel et al., 1969).

Cub mortality was determined by visual observations of radio-collared females and their young (Table 3). Mortality for 9 cubs of the year was 44%, nearly identical to the 43% mortality recorded by Miller (1983) in the Susitna River area of southcentral Alaska. One female (#072) lost a litter of 2 cubs, one female (#071) lost a single cub litter and one female (#060) lost 1 of 3 cubs. A fourth female (#055) still had her complete litter of 3 cubs on 9 August when last seen.

Table 2. Litter size, age and sex of cubs produced by female brown bears captured in Terror Lake hydro study area, 1982.

FEMALES WITH 0.5 YR. CUBS

Litter Size	No. litters	Sex of cub	Total no. cubs
1	1	1 unk.	1
2	1	1M, 1unk.	2
3	2	2M, 4F	6
	4	3M, 4F, 2unk.	9

mean litter size = 2.3

FEMALES WITH 1.5 YR. CUBS

Litter Size	No. litters	Sex of cubs	Total no. cubs
1	2	1M, 1F	2
2	6	3M, 8F, 1unk.	12
3	1	3unk.	3
	9	4M, 9F, 4unk.	17

mean litter size = 1.9

FEMALES WITH 2.5 YR. CUBS

Litter Size	No. litters	Sex of cubs	Total no. cubs
2	2	1M, 3F	4
3	1	3M	3
	3	4M, 3F	7

mean litter size = 2.3

FEMALES WITH 3.5 YR. CUBS

Litter Size	No. litters	Sex of cubs	Total no. cubs
2	1	2M	2

mean litter size = 2.0

Table 3. Litter size, weaning and survivorship of offspring for female brown bears captured in 1982.

Bear no.	(age)	No. cubs	(sex)	Age of cubs	Status of cubs
005	(13.5)	2	(2M)	3.5	Weaned by 30 May; 1 cub killed by hunter on 30 May.
008	(11.5)	2	(1M,1F)	2.5	Weaned by 21 May.
011	(6.5)	2	(1M,1F)	1.5	Both lost by 6 July.
029	(17.5)	3	(3M)	2.5	Weaned by 20 May.
034	(13.5)	2	(2F)	2.5	Weaned by 15 June.
046	(6.5)	2	(1F, 1unk)	1.5	Both seen on 29 Sept.; 1 seen on 7 Oct.
048	(23.5)	2	(1M,1F)	1.5	Both seen on 17 Aug.
051	(8.5)	1	(1F)	1.5	Lost by 8 Sept.
053	(8.5)	1	(1M)	1.5	Female a capture mortality; cub status unknown.
055	(13.5)	3	(2M,1F)	0.5	All cubs seen on 9 Aug.
060	(14.5)	3	(3F)	0.5	2 cubs seen on 18 Oct.
064	(20.5)	2	(2F)	1.5	Both cubs seen on 25 Aug.
067	(20.5)	2	(2F)	1.5	Both cubs seen on 30 Sept.
071	(8.5)	1	(unk)	0.5	Lost cub by 30 Sept.
072	(18.5)	2	(1M, 1 unk)	0.5	Both cubs seen on 31 July; 1 cub seen on 16 Aug; both cubs lost by 29 Oct.
074	(17.5)	2	(1M,1F)	1.5	Both cubs seen at den on 29 Oct.
077	(20.5)	3	(3 unk)	1.5	All cubs seen on 18 Oct.

Mortality in 9 litters totaling 17 yearlings was 18%. One female (#011) lost a litter of 2 yearlings and another female (#051) lost a litter with 1 yearling. None of the mortalities in cubs of the year or yearlings was considered to be related to capture.

One yearling (#054) was orphaned when its mother died as the result of capture. The yearling was marked with colored ear flags, but it was not observed after capture.

Breeding Activity

Suspected breeding activity was observed between 30 May and 14 June, 1982. Six pairs of adults observed on 30 May included one or more radio-collared bears. Female #022 was paired with male #025 and female #034 was paired with male #004. Female #001 was accompanied by an unmarked adult. Males #002, #024 and #033 were observed with unmarked adults. On 14 June females #015 and #017 were observed with adult bears presumed to be males. No paired adults were observed during the 5, 6 July flights nor during subsequent flights. Hensel et al. (1969) reported that breeding activity on Kodiak Island had been observed between May 1 and July 15.

Abundance

From March through December, 1982, 189 observations of apparently unmarked brown bears were recorded incidental to radio-tracking flights and during other field activities. When 2 or more bears were apparently interacting, such as mating adults or family groups, they were classified as a single observation. Some marked animals may have been included because all the bears were not approached closely enough to positively verify the absence of ear flags or radio-collars. The 189 incidental observations included 224 adults and 104 cubs of all ages, for a total of 328 bears. Fifty-three females with cubs were observed. A total of 171 single adults was seen.

A minimum population estimate for the study area was derived by totaling the captured bears and the unmarked bears in family groups considered to be unduplicated sightings. Duplicate incidental sightings of family

groups were eliminated by using dates and locations of observations, pelage characteristics and group size. By that method 25 distinct unmarked females with 50 cubs were recognized for a total of 75 unmarked bears in family groups. Seventeen captured maternal females were accompanied by 35 cubs, totaling 52 animals. The marked and unmarked bears in family groups totaled 127 animals. The 26 captured single bears and the 127 bears in identifiable family groups resulted in a minimum population estimate of 153 bears, not including 171 observations of single unmarked bears.

Spencer and Hensel (1980) estimated the population of the Kizhuyak and Terror drainages at 200 bears, but they did not delineate the exact boundaries of their study area. Their estimate was based on field observations indicating that about 33% of the bears in the population were in family groups. By applying the 33% ratio to the 66 bears they observed in unique family groups in 1980, an estimate of 200 bears was derived.

The extent of duplication in the 171 observations of single unmarked bears made in 1982 is unknown. Neither is it known how many unmarked bears in the study area were not observed in 1982. Considering that radio-collared bears with known locations were only seen 33% of the time in 1982, it is reasonable to assume that some unmarked bears were never observed. If it is assumed that duplicate observations of single unmarked bears were cancelled out by an equal number of unmarked single bears which were never observed, then the 171 single bears could be added to the minimum population estimate of 153 bears to derive an estimate of 324 bears. This estimate is considered to be closest to the actual population of the study area based on the available data.

Although the validity of the assumptions made to arrive at the population estimates which have been discussed can be questioned from several angles, the exercise indicated that the bear population is probably higher than was previously estimated. A density estimate of 1 bear per 4 km^2 was calculated for the 1300 km^2 study area based on the estimated population of 324 bears. Most of the bear observations were actually made in a smaller

area of only about 900 km^2, excluding the Ugak Bay drainages. A density estimate of 1 bear per 2.8 km^2 was derived for the smaller area. Troyer and Hensel (1964) reported a much higher density estimate of 1 bear per 1.6 km^2 in the Karluk Lake drainage.

MORTALITY

Total known mortality in the study area from all sources in 1982 was 24 bears, 17 males (71%) and 7 females (29%) (Table 4). Three bears, all males, were killed in defense of life or property. Eighteen bears, 13 males and 5 females, were killed by sport hunters. Three bears died as a result of capture, 1 male and 2 females.

The mean age of the 17 males was 5.0 years (range = 2.5-9.5). The mean age of 7 females was 8.5 years (range = 4.5-14.5).

Two radio-collared bears were killed in 1982. Bear #006, a 3.5 year old male captured on 23 April with its mother and a sibling, was killed by a hunter on 30 May, 3 km from its capture site in the Kizhuyak drainage. Bear #026, a 5.5 year old male, was killed on 15 August by the occupant of an outlying residence in the Northeast Arm of Uganik Bay after the bear became a nuisance. That bear was captured in the Terror River drainage on 26 April approximately 13 km from the kill site.

Both a spring and a fall hunting season were held in the study area in 1982. The spring season was open from April 1 - May 15 west of a line from Kizhuyak Bay to Hidden Basin and it continued through May 31 east of that line. The fall season opened on October 1 east of the Kizhuyak Bay-Hidden Basin line and on October 25 west of that line, continuing through November 30. Hunting effort was limited by issuing a fixed number of permits for the area west of the Kizhuyak Bay-Hidden Basin line. Hunting permits were not limited for the area east of that line.

Thirty-four of the 40 bears (85%) captured in April and May were single bears eligible for harvest during at least part of the 1982 spring hunt.

Table 4. Brown bear mortality in Terror Hydro study area, 1982.

Sealing Cert No.	Age	Kill Date	Location	Comments
Males				
49252	4.5	20 April	Terror Bay; near Naugolka Point.	Hunter kill
49299	5.5	21 April	Kizhuyak Bay; east side	Hunter kill
49254	3.5	23 April	Viekoda Bay; near Rolling Point	Hunter kill
49454	6.5	26 April	Terror Bay; Falls Creek	Capture mortality (#021)
49433	5.5	27 April	Wild Creek	Hunter kill
49430	2.5	28 April	Kizhuyak River; east side	Hunter kill
49251	8.5	29 April	Terror Bay; west side	Hunter kill
49283	2.5	12 May	Terror Bay; head of bay	Hunter kill
53052	3.5	30 May	Kizhuyak Bay; east side	Hunter kill
53056	5.5	16 Aug.	Northeast Arm Uganik Bay	DLP kill* (#026)
53058	4.5	2 Oct.	Sharatin Bay; west side	Hunter kill
53059	3.5	10 Oct.	Wild Creek	Hunter kill
53060	3.5	17 Oct.	Saltery Ck.	Hunter kill
53062	3.5	21 Oct.	Saltery Ck.	Hunter kill
53067	9.5	26 Oct.	Kizhuyak Bay; Port Lions	DLP kill
53068	7.5	27 Oct.	Kizhuyak Bay; Port Lions	DLP kill
53100	5.5	8 Nov.	Kizhuyak Bay; near Dovolno Point	Hunter kill

mean age = 5.0
range = 2.5-9.5

Table 4. (Cont'd). Brown bear mortality in Terror Hydro study area, 1982.

Sealing Cert No.	Age	Kill Date	Location	Comments
Females				
49253	10.5	23 April	Terror Bay; east side of Uganik Passage	Hunter kill
53053	4.5	22 July	Kizhuyak Bay; Barabara Lk.	Capture mortality (#043)
53054	7.5	24 July	Terror Bay; Falls Creek	Capture mortality (#053)
53057	7.5	8 Oct.	Wild Creek	Hunter kill
55243	8.5	14 Oct.	Kizhuyak Bay; Pestchani Pt.	Hunter kill
53080	14.5	24 Oct.	Kizhuyak Bay; east side	Hunter kill
53095	6.5	2 Nov.	Hidden Basin Ck.	Hunter kill
		mean age	= 8.5	
		range	= 4.5-14.5	

* Nuisance animal killed under State of Alaska "defense of life or property" provisions.

Only 1 of those bears was killed during the spring season. Forty-four of the marked bears were legal game in the fall season and none was killed.

Six mortalities were recorded from the Ugak Bay drainages and 18 were recorded from the Terror-Kizhuyak area in 1982.

Movements and Home Range

Frequency of Visual Observations of Radio-collared Bears

Visual observations of radio-collared bears were made for 33% of the 644 radio-locations in 1982 (Table 5). Bears were most frequently visually located during April (82%) and May (70%) before vegetation had fully developed. Visual locations were made least frequently in September when only 5% of the radio-located bears were observed.

Visual locations were highest for females with cubs (26%) followed by single males (25%) and single females (20%) (Table 6). The range in frequencies of visual observations for individual bears with 5 or more radio-locations was: males -- 25 - 57% (n=17); single females -- 8 - 53% (n=16); females w/cubs -- 8 - 40% (n=11).

Home Range Size

Mean home range size for 15 males with 5 or more radio-locations was 141.2 km^2 (range = 14 - 465 km^2) (Table 7). Four 3.5 year old males had a mean home range size of 50.9 km^2 (range = 30 - 77 km^2). Mean home range size for 8 males ranging from 5.5 to 15.5 years old was 229.8 km^2 (range = 82 - 465 km^2).

Mean home range size for 27 females with 5 or more radio-locations was 29.9 km^2 (range = 6 - 132 km^2) (Table 7). Eleven females (#s 001, 005, 008, 011, 044, 060, 067, 070, 071, 074, 077) were located only in the Kizhuyak Bay and upper Viekoda Bay drainages. Those bears had a mean home range size of 15.6 km^2 (range = 6 - 35 km^2). Eleven females (#'s 018, 019, 020, 022, 034, 037, 038, 048, 051, 055, 072) which ranged exclusively in the Terror

Table 5. Frequency of visual observations of radio-located brown bears in Terror Lake hydro study area, April-December, 1982.

	Males (n=17)		Single females (n=16)		Females w/cubs (n=11)		All bears (n=44)	
	visual/radio	Percent visual	visual/radio	Percent visual	visual/radio	Percent visual	visual/radio	Percent visual
April	7/8	88%	7/9	78%	---	---	14/17	82%
May	31/42	74%	33/49	67%	---	---	64/91	70%
June	6/11	54%	8/14	57%	---	---	14/25	56%
July	15/30	50%	27/43	63%	3/8	38%	45/81	56%
August	10/41	24%	8/62	25%	12/37	32%	30/140	21%
September	1/42	2%	0/56	0	6/41	15%	7/139	5%
October	3/23	13%	6/36	17%	8/22	36%	17/81	21%
November	11/24	46%	3/18	17%	4/20	20%	18/62	29%
December	1/5	20%	0/2	0	0/1	0	1/8	13%

$$\frac{\text{Total no. visual observations} = 210}{\text{Total no. radio-locations} = 644} = 33\%$$

Table 6. Frequency of visual observations of radio-collared brown bears with 5 or more radio-locations by sex and reproductive class, July-December, 1982.

	Males (n=17)	Single females (n=16)	Females w/cubs (n=11)	All bears (n=44)
No. visual locations / No. radio-locations	41 / 165	44 / 217	33 / 129	118 / 511
Percent visual locations	25%	20%	26%	23%

Table 7. Home range sizes for brown bears in Terror Lake Hydro study area, 1982 (bears with 5 or more observations).

Bear No.	Age at capture	Observation period	No. locations	Home range size (km^2)	Comments
MALES (n=15)					
002	15.5	April-December	23	186	
003	5.5	April-December	13	465	
004	6.5	April-December	13	322	
006	3.5	April-May	5	14	Hunting mortality
007	3.5	April-January	20	30	
014	6.5	April-January	21	278	
016	11.5	April-February	19	253	
023	7.5	April-December	24	82	Estimated age
024	7.5	April-February	21	115	
025	13.5	April-June	5	13	Shed collar
026	5.5	April-August	5	48	DLP mortality
028	3.5	April-January	21	77	
033	3.5	May-January	21	55	
045	5.5	July-February	15	138	
059	3.5	July-December	13	42	
		range =	5-24	14-465	
		mean =	15.9	141.2	
FEMALES (n=27)					
001	3.5	April-December	22	24	
005	13.5	April-January	18	17	
008	11.5	April-November	20	6	
011	6.5	April-January	23	35	
015	7.5	April-October	20	68	
017	21.5	April-October	20	93	
018	5.5	April-November	20	25	
019	6.5	April-February	22	17	
020	6.5	April-November	22	11	
022	7.5	April-February	21	13	
029	17.5	April-November	16	15	Possible shed collar
034	13.5	April-September	14	16	Suspected radio failure
037	4.5	May-November	19	28	
038	3.5	May-November	19	20	
044	3.5	July-February	13	16	
046	6.5	July-November	10	95	
048	23.5	July-January	12	9	
051	8.5	July-December	13	50	
055	13.5	July-December	11	20	
060	14.5	July-November	16	14	
064	20.5	July-November	11	132	
067	20.5	July-January	12	23	
070	4.5	July-January	14	8	
071	8.5	July-February	13	13	
072	18.5	July-January	14	22	
074	17.5	July-November	12	9	
077	20.5	July-February	14	7	
		range =	10-23	6-132	
		mean =	16.3	29.9	

Bay drainage, had a mean home range size of 21.1 km^2 (range = 9 - 50 km^2). Four females (#'s 015, 017, 046, 064) ranged between two or more major drainages and had a mean home range size of 96.8 km^2 (range = 68 - 132 km^2). Female #029 occupied the Sharatin Bay drainage exclusively and had a home range of 15 km^2.

Mean home range size of 16 single females was 25.8 km^2 (range = 6 - 94 km^2). Eleven females with cubs of all ages had a mean home range size of 35.9 km^2 (range = 9 - 132 km^2). Four females with cubs of the year had a mean home range size of 17.3 km^2 (range = 13 - 22 km^2) compared to 46 km^2 (range = 7 - 132 km^2) for 7 females with yearling cubs.

The mean home range size of males (141.2 km^2) was over 4 times larger than the mean home range size of females (29.9 km^2). Berns et al. (1977) reported that the home range size of males was approximately twice that of females in the Karluk Lake area of southwestern Kodiak Island. Table 8 compares home range sizes of bears in the Terror Lake study area with home range sizes of bears in the Karluk Lake area determined by Berns et al. Maternal females had larger home ranges than single females in the Terror Lake area, the reverse of the findings of Berns et al. Females with newborn cubs had much smaller home ranges (17.3 km^2) than did females with yearlings (46.5 km^2), but sample sizes were too small to determine the significance of this difference. Miller (1983) concluded that the same females in the Susitna River area of southcentral Alaska had smaller home ranges during years when they had newborn cubs.

Seasonal Chronology of Bear Movements

Movements of bears appeared to reflect changes in seasonal availability of food sources. The general pattern of movement was from denning areas to slopes near sea level in late May and early June. Development of vegetation was unusually late in 1982 because of prolonged cool weather in May and early June. The tidal flats at Terror and Kizhuyak Bays and the southerly exposed slopes at lower elevations had the earliest available growth of sedges, grasses and herbaceous vegetation. Nearly 3 weeks of

Table 8. Comparison of home range size by sex and reproductive class between Karluk Lake* and Terror Lake study areas.

	Home range size Karluk Lake area, 1967-1976 (km^2)*			Home range size Terror Lake area, 1982 (km^2)		
	mean	range	n	mean	range	n
males	24.4	2.6-49.2	7	141.2	14-465	15
single females	14.3	9.0-19.9	6	25.8	6-94	16
maternal females	10.6	0.5-36.2	17	35.9	9-132	11
females w/new-born cubs	---	---	---	17.3	13-22	4
females w/yearling cubs	---	---	---	46.5	7-132	7

* from Berns et. al. (1977)

rainy weather and low ceilings precluded radio-tracking flights during most of June. When weekly flights were resumed in early July, most bears had moved to higher elevations following the development of new vegetative growth. By late July bears began to congregate on the lower Terror River to feed on salmon. Bears in the Kizhuyak drainage didn't move down into salmon feeding areas until about mid-August. By late September bears had generally moved to higher elevations presumably to feed on berries and other vegetation. The upward elevational movement continued into the denning period beginning in late October.

Movements and Home Range of Females

Most females showed a strong fidelity to either the Kizhuyak Bay or to the Terror Bay and Viekoda Bay drainages. Only 2 of 27 females (7%) ranged into both the Kizhuyak Bay and Terror Bay drainages. In early August bear #015, a 7.5 year old female, moved from an alpine feeding area in the upper Viekoda Bay drainage to the Barabara Lake vicinity near Kizhuyak Bay (Fig. 14). It remained near salmon streams there until the last week of September, when it abruptly moved into the Terror Bay area. It remained in the Terror and Viekoda Bay drainages, finally denning in late October in the Baumann Creek drainage into Terror Bay.

Bear #064, a 20.5 year old female with 2 yearlings, occupied alpine habitat north of Terror River in July and early August (Fig. 40). By mid-August she had moved to the lower Terror River where salmon were available. After the first week of September she moved alternately between the Terror and Kizhuyak Bay drainages, finally denning on a peak north of Terror River.

Two females (#017, Fig. 16; #046, Fig. 34) ranged from the Viekoda Bay drainage westward through Terror Bay into the Uganik Bay drainage. Movements of these bears apparently had little relationship to the availability of salmon as a food source. During early August #046, a 6.5 year old female with 2 yearlings, moved from alpine habitat in upper Baumann Creek to the upper Uganik River area. This bear apparently by-passed Terror River when salmon were near peak availability on the way to upper Uganik River,

an area with few salmon. In late September it moved back into the upper Baumann Creek vicinity. This bear may have fed on salmon during its travels, but it was not radio-located closer than about 2 km to a salmon spawning area.

Bear #017, a 21.5 year old single female, occupied a small activity area of only about 6.5 km^2 in upper Baumann Creek from April through the first week of August. In mid-late August this bear moved a linear distance of 22 km from its former range in Baumann Creek to a coastal area near East Point in Uganik Bay. It remained there until late September when it abruptly moved back into its former range in upper Baumann Creek. The latter movement occurred within a 6 day period and covered a linear distance of 23 km. This bear apparently crossed Terror River during the peak of salmon availability in August and moved to a coastal location well removed from a salmon stream. This bear had 2 small seasonal activity areas about 20-25 km apart.

The home ranges of 15 females (#'s 011, 015, 017, 018, 019, 020, 022, 034, 037, 038, 048, 051, 055, 064, 072) included drainages into Terror Bay. The home ranges of these bears generally included lower Terror River, the slopes north and east of Terror River, and drainages into the east side of Terror Bay. Only 3 of the 15 bears (#034, 017, 046) occupied the area south and west of Terror River to much extent.

Three single females (#'s 018, 019, 020), had roughly congruent home ranges in the lower Baumann Creek vicinity about 6 km north of Terror River. Females #018 (Fig. 17) and #019 (Fig. 18). were located close to salmon spawning areas on lower Baumann Creek and Clara's Creek in August. Female #020 (Fig.19) was not located closer than 1.5 km to a salmon stream during this period. All three bears denned within less than 1 km of each other in Baumann Creek.

Female #072, a 18.5 year old sow with 2 yearlings, occupied the eastern slopes of Terror Bay north of Terror River (Fig. 44). This bear was generally located at elevations above 150 m and was found near a salmon stream only once in 12 observations.

Eleven females (#'s 001, 005, 008, 011, 044, 060, 067, 070, 071, 074, 077) had home ranges occupying primarily the Kizhuyak Bay drainages. Females #'s 005, 008, 070, 071 and 074 ranged over the drainages into the east side of Kizhuyak Bay and Kizhuyak River. Females #'s 001, 011, 044, 060 and 067 ranged mainly in the mountains on the western side of Kizhuyak Bay and Kizhuyak River. Female #077 occupied a small home range of 7 km^2 near Barabara Lake on the west side of Kizhuyak Bay (Fig. 46).

Six females had home ranges which intersected major features of the project which were under construction in the Kizhuyak Bay area in 1982. The home ranges of females #'s 001, 005, 008, 044, 067, and 071, intersected one or more of the following features: the construction access road; the Rolling Rock Creek powertunnel entrance; the Kizhuyak River construction camp; the Kizhuyak Bay storage area and jetty; and the Kodiak transmission line corridor. The home ranges of #'s 011, 060, 064 and 077 intersected only the Port Lions transmission line corridor. The southern boundaries of the home ranges of females #'s 070 and 074, located on the east side of Kizhuyak Bay, were within about 2 km of the Kodiak transmission line corridor and were considered to be within the zone of the project's influence.

Female #001, a 3.5 year old single bear, ranged at elevations above 150 m west of Kizhuyak River through late May (Fig. 4). It was located only once in mid-June, having moved to the tidal flats near Kizhuyak Bay. During July it occupied alpine habitat west of Kizhuyak River. From August through October it was found on slopes below 330 m on both the east and west sides of Kizhuyak River. It was suspected that this bear adopted a somewhat nocturnal pattern of feeding on salmon during this period. It was observed visually only once after it moved out of alpine habitat. Apparently this bear crossed the construction access road frequently to feed on salmon but retreated to heavy cover during the day. On one occasion it was radio-located in a dense alder strip approximately equidistant between the construction access road and a nearby salmon spawning area about 300 m east of the road.

Female #067, which was captured with 2 yearlings on 25 July in alpine habitat west of Kizhuyak River, moved to near Hilary Creek by 9 August (Fig. 41). Salmon were available in Hilary Creek at that time but this

bear had moved south to Eagle Creek drainage adjacent to the equipment storage area and jetty at Kizhuyak Bay by 23 August. It was suspected that this bear adopted a pattern of feeding on salmon in Eagle Creek during the night and that it moved into heavy cover about 1 km upstream during the day. This pattern probably continued until late September when she moved into the lower Kizhuyak River. On 22 and 23 September this bear and her 2 yearling cubs were observed from the access road fishing during daylight hours on the west side of Kizhuyak River. On 22 September the bears were observed intermittently for several hours. The bears could be seen easily from the road. Vehicular traffic was heavy on the access road and several construction workers stopped to watch the bears. By early October this bear moved to the upper slopes west of Kizhuyak Bay where she denned.

Bear #011, a 6.5 year old female, which lost both her yearling cubs by 6 July, occupied elevations above 150 m west of Kizhuyak Bay except for a brief period in late August (Fig. 12). This bear was located on 16 and 22 August near Hilary Creek where it was probably feeding on salmon. It subsequently moved to higher slopes south of Hilary Creek where it denned.

Bear #060, a 14.5 year old female with 3 cubs of the year, ranged mainly over the northern half of the mountain west of upper Kizhuyak Bay (Fig. 39). This bear moved from alpine habitat to near Hilary Creek by 16 August. It remained near Hilary Creek until early September when it again began frequenting the higher slopes.

Only one Kizhuyak Bay female, #070, a 3.5 year old captured east of Kizhuyak Bay, apparently did not frequent a salmon stream (Fig. 42). This bear remained in alpine habitat between 275 and 730 m until mid-August. It ranged at elevations between 90 and 425 m east of Kizhuyak Bay through early September. It moved into the Pestchani Creek drainage, occupying slopes between 150 and 210 m from mid-September to mid-October. Salmon were available in the lower 1-2 km of Pestchani Creek, but there was little evidence of trails between the creek and the upper slopes where #070 was located during this period.

Bear #008, a 11.5 year old female occupied a home range of only 5.8 km^2, the smallest home range of all the radio-collared bears (Fig. 11). This bear occupied the higher slopes in the easternmost branch of Kizhuyak River. It was located within 1-2 km of a salmon stream on two occasions in mid-August, but by late August it had moved back upstream into higher terrain where it remained to den. This bear's home range was on the main helicopter flight path to the construction camp in Kizhuyak River. Disturbance from helicopters may have discouraged this bear from feeding on salmon in the lower Kizhuyak River or the bear may have adopted a nocturnal pattern of movement to feed on salmon. It is also possible that this bear satisfied its food requirements with little or no reliance on salmon.

Movements and Home Range of Males

Males made much longer and seemingly more abrupt movements than did females. Wide ranging movements in May through July were directed toward breeding activities. Later movements appeared to be directed mainly toward specific food sources, particularly salmon. Movements between major drainages were common and males apparently used passes dividing drainages as well traveling directly over higher ridges irrespective of the rugged terrain. The mean home range size was over 4 times greater for males than for females, 141.2 km^2 for males compared to 29.9 km^2 for females.

Compared to females, males showed little fidelity to a single major drainage. Twelve of 15 radio-collared males were located in Kizhuyak Bay drainages at least once. Eight of the 15 males were located in Terror Bay drainages at least once.

Four males, #'s 002, 004, 014 and 016, had home ranges spanning both the Kizhuyak and the Terror drainages. Male #002, a 15.5 year old captured in Kizhuyak River, ranged widely over the Terror and Viekoda drainages from late May through early August (Fig. 5). Movements during this period were probably directed toward breeding. This bear returned to the Kizhuyak drainage in mid-August, occupying the lower Kizhuyak River and west side of Kizhuyak Bay until it denned less than 1 km from its capture site. It was most often located near Hilary Creek and lower Kizhuyak River where it

apparently fed on salmon intermittently until late October.

Male #007, a 3.5 year old, was located only in the Kizhuyak Bay drainage (Fig. 10). This bear was captured with its mother and a sibling, but the family separated shortly after capture. This bear's home range largely overlapped that of its mother, #005 (Fig. 8). Bear #007 had the smallest home range for a male, only 30 km^2.

Male #004, a 6.5 year old captured near Kizhuyak River, spent May through the third week of September in the Terror Bay drainage (Fig. 7). Its early seasonal movements paralleled those of #002 and were probably related to availability of breeding females. It remained near Terror River, probably feeding on salmon, until late September when it abruptly moved to Saltery Creek in Ugak Bay. That move covered a linear distance of nearly 30 km in a 7 day period. The bear remained near Saltery Creek, a shallow stream with abundant salmon, through early November. It moved back into upper Kizhuyak River to den.

Male #014, a 6.5 year old captured in the headwaters of Baumann Creek, divided its activities roughly equally between Kizhuyak, Terror, Viekoda, and Uganik drainages (Fig. 13). This bear was one of 3 males which moved into the Uganik drainage. It was located twice in early July near the headwaters of the Northeast Arm of Uganik Bay. It denned in the Viekoda Bay drainage north of Baumann Creek. Its home range of 278 km^2 was the third largest home range among 15 males.

Male #059, a 3.5 year old captured in upper Baumann Creek, spent August and early September near salmon spawning areas in lower Terror River (Fig. 38). In late September it moved into the pass west of lower Terror River and in early November it was found in the upper drainage into the Northeast Arm of Uganik Bay. It returned to north of Terror River to den by December. This bear had the second smallest home range for a male, only 42 km^2.

Male #026, a 5.5 year old captured in lower Terror River, was located on the west side of Terror Bay through mid-June (Fig. 24). It was not relocated again until it was killed as a nuisance in the Northeast Arm of Uganik

Bay on 16 August. The resident who killed the bear stated that it had been frequenting a nearby cannery garbage dump for several weeks.

Male #016, an 11.5 year old captured in Baumann Creek, alternated between Kizhuyak, Viekoda and Baumann Creek drainages until late July (Fig. 15). It was alternately found in Saltery Creek and Kizhuyak River through late September. By early November it had moved into upper Baumann Creek and denned west of Kizhuyak Bay by late December.

Movements into the Ugak Bay drainages were made by 4 males. No radio-collared females were located in the Ugak Bay drainages. Males #004, 016 and 045 were located only near Saltery Creek. Abundant sockeye and pink salmon and lesser numbers of chum and coho salmon were available there. Male #016 spent two periods at Saltery Creek, from late July to mid-August and from late September to early October. Male #004 arrived at Saltery Creek in late September and remained there until early November. The late summer arrival of #'s 004, 016 and 045 at Saltery Creek probably coincided with diminishing salmon availability in other drainages. These three bears also frequented salmon streams in Kizhuyak and Terror drainages.

Male #003, probably moved into Ugak Bay by mid-May shortly after its capture in the Kizhuyak drainage (Fig. 6). It had not been located for over 3 months when it was discovered at Saltery Creek on September 1. It ranged throughout the drainages north of Ugak Bay, from Saltery Creek east to Pasagshak Bay, until mid-November. This bear had a home range of 465 km^2, the largest home range recorded in 1982. It was located west of Kizhuyak Bay on December 30 in a suspected denning area.

Although the high availability of salmon in Saltery Creek was probably the primary attraction for bears, the presence of free-roaming cattle there may also have been a factor. Cattle predation was not observed, but heavy predation by bears was documented there in the past (Eide, 1965).

Eleven males had home ranges which included major features of the Terror Terror Lake Hydroelectric project which were under construction in 1982. The home ranges of #'s 002, 003, 004, 007, 014, 016, 023, 027, 028 and 045

intersected one or more of the following features: the construction access road; the Rolling Rock Creek powertunnel entrance; the Kizhuyak River construction camp; the storage area and jetty at Kizhuyak Bay; and the Kodiak transmission line corridor. The home range of #033 included only the transmission line corridor in Elbow Creek and Buskin Lake areas. The home ranges of #'s 002, 003, 014, 016, 023, 028 and 045 were intersected by the Port Lions transmission line which was not yet under construction.

The male most frequently located near construction activities in the Kizhuyak River area was #028, a 3.5 year old (Fig.26). This bear was found within 2.5 km of the construction access road on 6 of 20 locations. It remained in the immediate area of active construction from late August to early October. It was located in dense cover within 300 m of the road on several occasions, but it was seldom actually seen. It denned 2 km west of the Kizhuyak Bay jetty.

Male #045, a 5.5 year old, was also a frequent construction area occupant (Fig. 33). It was located in the lower Kizhuyak River and along the west side of Kizhuyak Bay between mid-August and late September. After spending early October at Saltery Creek, it returned to den west of Kizhuyak Bay.

Suspicion that bears in the Kizhuyak River area had adopted a nocturnal pattern of feeding on salmon were at least partly confirmed by radio-tracking from the ground on 21-23 September. Male #028 crossed the access road near mile 1 twice in the early evening on 21 September and it was active in the lower Kizhuyak River until about midnight. It hadn't changed its position from its suspected location in a dense patch of alders east of the access road by 0500 hr. on 22 September. A similar activity pattern was noted during the following 24 hr. period. This bear was not seen during the ground-tracking.

Male #045 exhibited a similar pattern of nocturnal activity, but it was active during the entire period of darkness from 2000 to 0500 hrs. on 21 and 22 September. It was again active during the late evening on 22 September and during the early morning on 23 September. It crossed the road from east

about an hour later. It continued to move about the lower Kizhuyak River until shortly after daylight on 23 September when ground-tracking was stopped.

Bear Movements in the Terror Lake Impoundment Area

The Terror Lake basin was probably used occasionally by traveling males in 1982. Only one radio-collared male had a home range which included the Terror Lake impoundment area. Bear #002, a 15.5 year old male, was observed on 21 May walking upstream about 2.5 km above Terror Lake. It was not located in the Terror Lake basin again in 1982. Bear #004, a 6.5 year old male, was not radio-located in the Terror Lake basin, but it was suspected to have traveled through the area between 23 and 30 September when it moved from lower Terror River to Ugak Bay.

None of the radio-collared females had home ranges which included the Terror Lake basin. Bear #048, a 23.5 year old female with 2 yearling cubs, was located 3.5 km northwest of the dam site on 8 October. That was the closest location of a radio-collared female to Terror Lake recorded in 1982.

Four adult bears were seen on 15 June on the northeast side of Terror Lake at about 500 m elevation. It was suspected that they were two breeding pairs. The 2 pairs were located about 300 m apart and all 4 bears were seen feeding on green vegetation. There had been no construction activity at the lake by that date. Spencer and Hensel (1980) estimated that 10 bears used the "immediate vicinity of Terror Lake in midsummer".

An unmarked female with a yearling cub was observed near the Terror Lake dam site in November by construction workers on several occasions. It was suspected that the bear may have denned nearby.

Status of Subpopulations

The existence of somewhat distinct subpopulations is suggested by the movements of brown bears in the study area in 1982. Although considerable overlap occurred in the home ranges of females, most females could be classified as inhabitants of either the Kizhuyak Bay or Terror Bay-Viekoda Bay

drainages. Only 2 of 27 females had home ranges overlapping both these major drainages. None of the radio-collared females moved south into the Ugak Bay drainages. Only 2 females moved from Terror Bay to the adjacent Uganik Bay drainage which has a large population of bears.

Males generally traveled widely between major drainages although some exhibited seasonal preferences for specific drainages. Although the home ranges of males frequently overlapped both the Kizhuyak and Terror drainages, no movements beyond the north side of Ugak Bay nor beyond the Northeast Arm of Uganik Bay were recorded.

Spencer and Hensel (1980) suggested that the Terror Lake study area may be a subpopulation relatively distinct from the Uganik Bay, Ugak Bay, and Chiniak Bay subpopulations. The findings of the current study generally supports those subpopulation boundaries, but even finer divisions of subpopulations within the study area were indicated by the home ranges of females in 1982.

Habitat Use and Feeding

Elevation and Seasonal Habitat Use

Changing seasonal availability of specific food sources most influenced the movements and habitat use patterns of brown bears. Although considerable variation was observed between individual bears a general pattern of habitat use emerged based primarily on elevational distribution of radio-collared bears. In late May after most bears had emerged from dens, lowlands where vegetation was greening-up, were heavily used. By late June bears had moved to higher elevations following development of vegetation along an altitudinal cline. By late July bears began moving to salmon streams, although several bears, mainly females with cubs remained in alpine areas until mid-August. Salmon was a major food source until mid-late September when bears began moving to higher elevations feeding on berries and other vegetation. A pattern of increasing elevational distribution continued until denning.

Spencer and Hensel (1980) described a similar pattern of seasonal habitat use by brown bears in the study area.

Accurate observations of bears' specific activities were difficult to obtain because radio-collared animals were infrequently seen and if seen, their normal activities had already been disrupted by the aircraft's approach. Most bears had been flushed from heavy cover and they were moving away from the aircraft when observed. Although some activity observations for undisturbed bears were obtained, no analysis of specific bear activities noted during radiotracking flights was done in 1982.

The best indirect indicator of activity and habitat use patterns was the elevational distribution of the radio-collared bears. The general pattern of movement after emergence from dens was toward lower elevations in late May and early June. The mean elevation of 41 radio-locations of bears made in the first half of June was 163 m (Table 9). Bears were concentrated on southerly exposures near sea level where the vegetation first developed. Nearly 3 continuous weeks of rainy weather precluded tracking flights during late June. When flights were resumed in early July, bears had moved upslope following the development of new vegetative growth. The mean elevation of 47 locations made in the first half of July was 329 m.

Differences in seasonal distribution by elevation between females with cubs and single bears of both sexes were noted. Females with cubs occupied higher mean elevations than did males during most of the year (Table 9). Males and females with cubs were most widely separated in July and early August. During the last half of July, 9 locations of males had a mean elevation of 313 m compared to 514 m for 11 locations of females with cubs. The males and single females were beginning to appear on the lower Terror River to feed on salmon by the last week of July. Females with cubs tended to remain at higher elevations at that time where they were observed feeding on alpine vegetation. Females with cubs were conspiciously abundant in the alpine region north of Terror River and west of Kizhuyak Bay during the 21-26 July, 1982 tagging period.

Table 9. Means and ranges in elevation of radio-collared brown bears by half-month, April-December, 1982.

	Mean elevations of males (meters)	Range in elevations of males (meters)	N	Mean elevations of females (meters)	Range in elevations of females (meters)	N	Mean elevation of females w/cubs (meters)	Range in elevation of females w/cubs (meters)	N	Mean elevations of single females (meters)	Range in elevation of single females (meters)	N	Mean elevations of all bears (meters)	Range in elevation of all bears (meters)	N
15-30 April	259	76-762	21	279	168-762	20	310	168-762	6	266	168-366	14	269	76-762	41
1-15 May	339	61-1006	18	321	91-1006	34	396	91-1006	7	290	91-854	17	329	61-1006	42
16-31 May	264	61-930	25	302	61-655	28	394	61-655	6	277	61-610	22	284	61-930	53
1-15 June	179	6-488	11	152	0-564	25	564	564	1	120	0-396	13	163	0-564	25
16-30 June	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
1-15 July	266	30-473	19	372	15-640	28	518	396-640	2	361	15-610	26	329	30-640	47
16-30 July	313	30-610	9	441	0-762	20	514	46-762	11	351	0-732	9	401	0-762	29
31 July-15 Aug.	177	6-915	18	318	0-762	52	357	15-762	22	289	0-762	30	282	0-915	70
16 Aug.-1 Sept.	104	15-274	33	128	15-549	78	148	15-549	31	116	15-488	47	121	15-549	111
2-14 Sept.	130	15-213	12	134	0-366	28	107	0-183	12	153	15-366	16	132	0-366	40
15-30 Sept.	127	15-396	21	253	0-671	46	273	0-671	18	239	9-610	28	213	0-671	57
1-15 Oct.	192	15-457	12	297	15-457	26	362	122-457	11	249	15-457	15	264	15-457	38
16-31 Oct.	306	30-732	11	369	15-915	34	401	15-915	13	348	152-716	21	353	15-915	45
1-14 Nov.	291	46-793	16	462	122-1037	27	482	122-1037	14	439	183-884	13	398	46-1037	43
15-30 Nov.	280	91-579	8	425	15-838	9	282	15-579	4	540	335-838	5	357	15-838	17
1-15 Dec.	335	305-366	2	343	183-503	2	---	---	---	343	183-503	2	339	183-503	4
16-31 Dec.	498	427-518	3	366	366	1	366	366	1	---	---	---	465	366-518	4

During the last half of August and the first half of September all classes of bears occupied areas with a mean elevation of 153 m or less. Bears of all sex and age classes were concentrating on salmon streams and on lower slopes where berries were ripening.

Bears in the Kizhuyak drainages generally arrived at salmon streams about mid-August, some 2-3 weeks later than they did at Terror River. Salmon were available in large numbers earlier in Terror River than they were in the Kizhuyak drainages. An exception was the Barabara Lake system in Kizhuyak Bay where a sockeye salmon run began attracting bears by mid-July.

By the first week of September bear activity on the lower Terror River began to decline noticeably. The bears were ranging farther from the river to feed on berries and other vegetation. By 30 September all the radio-collared bears had moved to higher elevations well away from Terror River. Some bears continued to feed on salmon in the Kizhuyak drainages into early October. A pattern of increased use of higher elevations continued as bears began entering dens by early November.

Feeding on Salmon

The most dense seasonal concentrations of brown bears occurred near salmon streams in the study area. Seasonal availability and abundance of salmon appeared to be a major factor in brown bear movements in 1982. Escapements of pink salmon were average to somewhat below average and both chum and coho salmon escapement were above average in most streams on northeastern Kodiak Island in 1982 (Larry Malloy, ADF&G, pers. comm.). Figure 2, illustrates the major salmon streams used by brown bears in the study area and Table 10 shows peak salmon escapement counts in 1982.

The 4 drainages most heavily used by brown bears in 1982 were Terror River, Kizhuyak River, Barabara Lake and a small creek 3 km south of Barabara Lake named Hilary Creek. Terror River, which has the largest runs of pink and chum salmon in the study area, was visited by radio-collared bears from the last week of July until late September. As many as 10 radio-collared

Table 10. Peak salmon escapement in Terror Lake Hydro study area, 1982.*

Stream name and number	Survey dates	No. pinks	No. chums	No. sockeye	No. coho
Terror River 253-331	7/30	7,000	3,600	---	---
	8/31	33,500	12,900	---	---
Baumann Creek 253-332	7/25	400	---	---	---
	8/25	4,000	---	---	---
Clara's Creek 253-333		NO SURVEY			
East Viekoda Creek 253-322	7/25	200	---	---	---
Pestchani Creek 259-371	8/25	350	---	---	---
Barabara Creek 259-363	7/30	---	---	1,200	---
	8/25	300	---	---	---
	10/15	---	---	---	350
Hilary Creek 259-364	8/31	2,700**	---	---	---
Kizhuyak River 259-365	8/31	23,650	6,800	---	---
	10/14	---	---	---	100
Elbow Creek 259-371	7/25	2,000	---	---	---
	8/25	13,000	---	---	---
	7/30	---	2,000	---	---
	8/31	---	4,000	---	---
	10/14	---	---	---	150
Saltery Creek 259-415	7/26	5,500	---	28,000	---
	8/27	25,000	---	---	---
	7/30	---	5,000	---	---
	8/31	---	8,000	---	---
	11/02	---	---	---	2,176

* From Kodiak Management Area Finfish Annual Report, 1982 - Alaska Department of Fish and Game

** 2,500 at mouth and 200 in stream

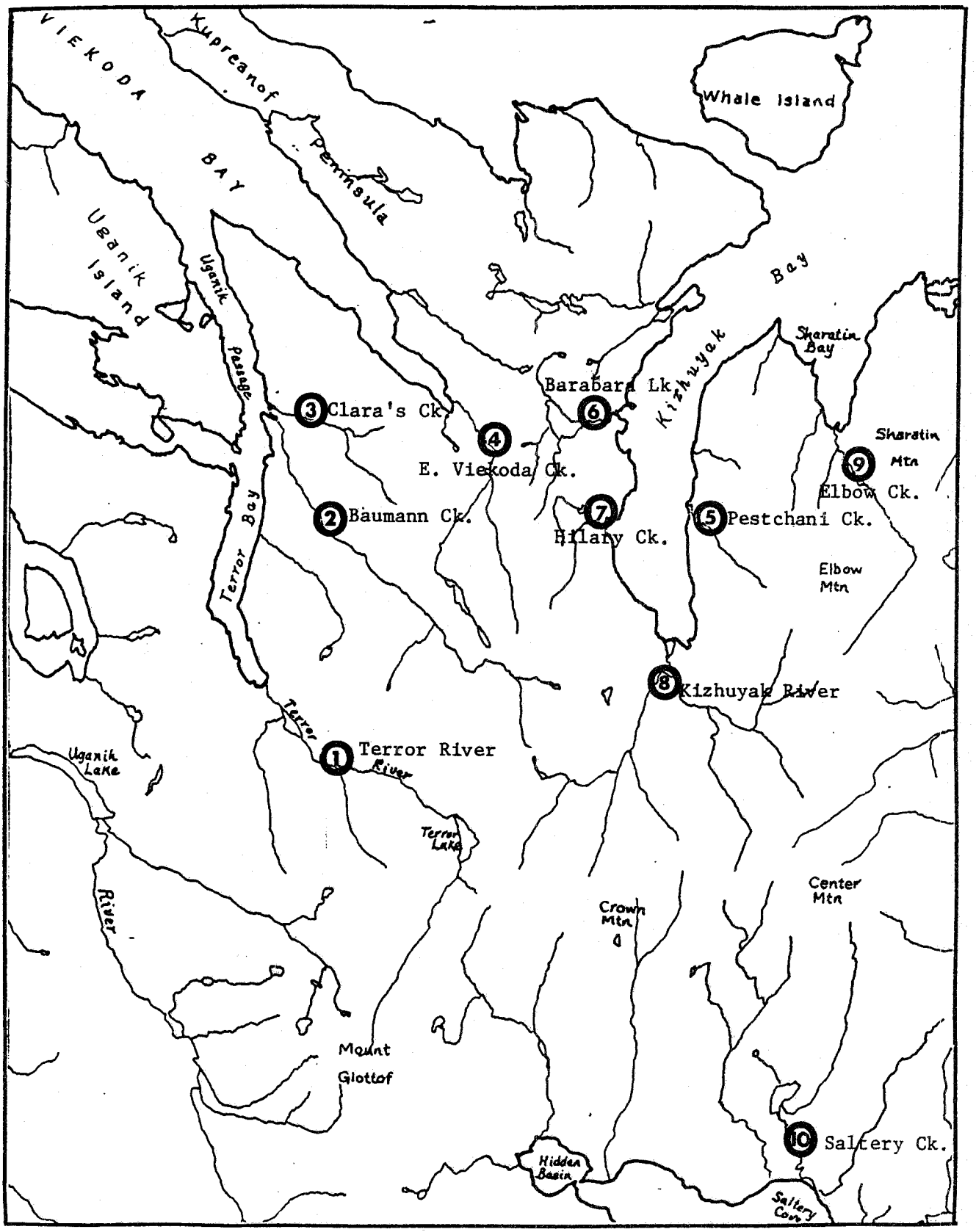

Figure 2. Major salmon streams used by brown bears in 1982 (1 cm = 2.55 km).

bears and several unmarked bears were located near this stream during August.

The Kizhuyak River drainage rated second to Terror River in bear abundance in 1982. By mid-August chum salmon were present in small spring-fed sloughs near the Kizhuyak River delta and both pink and chum salmon had moved into the main river in small numbers. A few bears began feeding on salmon by the first week of August, but peak bear activity occurred in late August and early September.

Hilary Creek received surprisingly high use considering the small salmon run it supported. The creek is shallow and easily fished by bears. It has nearly a closed tree canopy along the lower 1 km which is most heavily used by bears. Cover adjacent to the stream is extremely dense, providing excellent security for bears. Six radio-collared bears were located near this stream in mid-August.

The shallows on the south side of Barabara Lake and the lake's tributary streams attracted a few bears as early as mid-July. Several bears were observed along these streams during the 21-26, July capture period. Sockeye salmon began moving into the tributary streams by the last week of July and up to 4 radio-collared bears were located there by early August.

Several bears used more than one salmon stream. Movements of bears between streams may have been related to changes in the availability of salmon between drainages. This aspect was covered in more detail in the section on bear movements.

Considerable variation occurred in the date of first arrival, duration and location of salmon feeding activity between individual bears occurred. Some bears relied much more heavily on salmon than others did based on the bears' proximity to streams. Although all radio-collared bears moved to lower elevations near the coast for at least brief periods, a few bears apparently spent relatively little time near salmon streams. It was suspected that 6 radio-collared bears, all females, largely ignored salmon as a food source.

The possibility that these bears fed at night and moved several km to escape cover cannot be completely discounted, however. Schoen et al. (1983) found that some bears on Admiralty Island, Alaska, remained at high elevations without descending to coastal salmon streams.

Feeding on Vegetation

Heavy snows and colder than normal temperatures in April resulted in relatively late development of vegetation in 1982. Approximately 50 cm of snowfall were recorded in April and the mean temperature was 0.9°F below normal for the month (National Weather Service, Kodiak, Alaska). Not until late May did vegetation begin to leaf out noticeably. Snow cover remained nearly complete above 150 m by late May. Although May temperatures were 0.3°F above normal, only 7 days were recorded without measureable rainfall. June temperatures were 0.5°F below normal and rain occurred for nearly three continuous weeks.

Freezing weather and snows in April severely damaged salmonberry plants resulting in nearly a complete failure of the salmonberry crop throughout the Kodiak Island area. Plants growing at higher elevations which were probably still insulated by snow cover did produce some berries. Berry production by red elderberry also appeared to be unusually low. Berries of both species are favored foods of brown bears (Clark, 1957). The poor berry crop probably resulted in heavier dependence by bears on other food sources, including salmon in 1982.

The extensive alpine area north of Terror River and west of Kizhuyak Bay supported a high numbers of bears from early July through early August. Radio-collared bears were easily observed in that area and they were frequently seen feeding on vegetation. Twelve adult bears, including 9 females with cubs, were captured in that area during the 20-25 July, 1982, tagging period. Bears were apparently feeding on sedges and herbaceous vegetation as was previously observed in the Uganik Bay drainage by Atwell (1980). Atwell determined that bears fed nearly exclusively on new growth of a sedge, Carex machrochaeta, for about 5-6 weeks in July and August. Because much of

the Terror Lake study area is lower in elevation and has less extensive alpine areas with pure stands of C. machrochaeta than Atwell's study area, bears in the Terror Lake study area probably fed on a wider variety of plant species.

Dense fields of sedges, primarily C. lyngbyaei, which dominate the intertidal flats at the mouths of Terror and Kizhuyak Rivers were fed on extensively in late spring and intermittently throughout the summer. Less extensive areas of this habitat type are found at the mouths of most creeks throughout the study area. Radio-collared bears were less frequently observed in the intertidal areas of Kizhuyak River than at the Terror River flats. Field examination confirmed that bears continued to graze on sedges and other herbaceous vegetation in the intertidal areas of Kizhuyak Bay in 1982 despite extensive construction activity. The extent of feeding activities in the Kizhuyak flats was probably reduced because of disturbance from extensive helicopter use and vehicular traffic on the access road, but lack of comparative pre-construction information on bear movements makes that conclusion somewhat tentative.

Bears were feeding on a variety of other foods besides salmon in early September. Bear scats and other signs of feeding observed along Kizhuyak River and Hilary Creek indicated that bears were feeding heavily on red elderberry, devils club berries, sedges and other herbaceous vegetation. Remains of freshly consumed salmon were also abundant confirming that bears were eating a mixed diet of fish and vegetation.

Feeding at Garbage Dumps

From March until late September all wet garbage and paper from the construction camp was burned in an open pit in violation of project license stipulations. A fuel-fired incinerator was in operation by October 1. Fortunately, the garbage pit which was located at the edge of the road at about mile 1 south of Kizhuyak Bay, attracted little or no bear use. Male #028 was suspected to have used the pit to some extent. That bear was located within a few meters of the burn pit on the night of 27 September, 1982, during ground radio-tracking. The bear approached to within 15-20 meters of the

pit and was heard vocalizing and moving in the brush across the road for about 20 minutes. The bear finally crossed the road south of the pit and didn't return to the pit that night. Other bears may also have visited the burn pit without being detected.

Other garbage disposal sites in the study area also attracted bears to some extent. A resident of the village of Port Lions reported that a radio-collared bear was seen frequenting the town's garbage dump during summer and fall, 1982. Male #028, which was occasionally located on the outskirts of Port Lions, was probably the bear visiting the dump. Bears frequent the Port Lions dump regularly and several bears have been killed there in past years according to Alaska Department of Fish and Game records. Two bears killed as nuisances in Port Lions in 1982 were probably initially attracted to the dump. Male #026 was killed during a visit to a cannery dump in Uganik Bay in August, 1982.

Interactions with Sitka Black-tailed Deer

Sitka black-tailed deer were abundant throughout the study area and it is suspected that brown bears prey opportunistically on deer. One unconfirmed report was received in 1982 that construction personnel had seen a brown bear dragging a dead deer west of Kizhuyak River. Deer were frequently observed from the air as close as 100 m to brown bears. Neither the deer nor the bears appeared to be aware of the other species' presence; or if aware they exhibited no apparent interest in the other's activities.

Increasing evidence indicates that fall movements of brown bears on Kodiak Island may be influenced by deer hunting activities (Smith, 1983). Several hundred deer were estimated to have been killed by hunters in the study area in 1982 during a 1 August - 31 January hunting season. The incidence of bears scavenging at kill sites and in deer hunting camps has increased over the past few years. One hunting party reported that in late November bears consumed several deer which had been cached in a tree near Hilary Creek. A bear killed in defense of life or property in the village of Port Lions was reportedly attracted by deer meat stored near a residence.

Although some bears are apparently attracted to deer hunting activities, it is suspected that other bears may alter their movements to avoid hunters. Two deer hunters reported being charged by female #077 on 7 November, 1982, south of Barabara Lake. The bear was observed with 3 yearling cubs in rugged sub-alpine habitat adjacent to a popular coastal deer hunting area. The bear apparently charged the hunters in defense of the cubs. Because most deer hunting activity occurs within 2-3 km of the coast, bears could easily avoid hunters by moving beyond that range.

Denning

Den Entrance and Emergence

Bears began emerging from dens in late March. Eleven bears were observed during a flight on 27 March, 1982 (Table 11). These bears were located at elevations ranging from 213-610 m. Dens of the bears could not be located. A heavy snowfall which occurred on 24 March had probably covered the den entrances. Subsequent aerial surveys on 5 and 18 April indicated that relatively few additional bears had emerged from dens.

Single bears emerged earliest. Only 2 of 21 (10%) adult-sized bears observed during the March and April aerial surveys were maternal females. A female with 2 yearling or older cubs was observed on 5 April in Baumann Creek. Maternal females were conspicuously scarce during the 22 April - 2 May tagging period. Only 5 of 33 adult bears captured were maternal females and none had litters of newborn cubs. No sows with newborn cubs were observed during extensive flights throughout the study area during the spring capture period. The first observation of a sow with a newborn cub was made in the Kizhuyak River drainage on 15 June, 1982. Troyer and Hensel (1969) previously reported similar findings on the sequence of emergence.

The earliest date bears entered dens was about mid-October (Table 12) Only 2 radio-collared bears, both single females, had denned by October 29. Den entrance dates could not be precisely determined because inclement weather

Table 11. Composition of brown bears recently emerged from dens from 3 aerial surveys, 1982.

Survey date	Single	Maternal female	1 yr.+ cubs	Total
3/27/82	11	0	0	11
4/05/82	6	1	2	9
4/18/82	2	1	2	5
	19 (76%)	2 (8%)	4 (16%)	25

Table 12. Den site characteristics for brown bears in the Terror Lake Hydro study area in the 1981-82 winter.

FEMALES

Bear no. (age)	Entrance date	Elevation (meters)	Location by drainage	Comments
001 (3.5)	4-15 Nov.	915	Kizhuyak Bay-west side	
005 (13.5)	18 Oct.-15 Nov.	762	Kizhuyak Bay east side	
008 (11.5)	29 Oct.-11 Nov.	244	Kizhuyak Bay-east side	
011 (6.5)	4 Nov.-17 Jan.	854	Terror Bay-Baumann Ck.	
015 (7.5)	18-29 Oct.	396	Terror Bay-Baumann Ck.	May be a rock den; radio signal hard to pinpoint
017 (21.5)	7-29 Oct.	427	Terror Bay-Baumann Ck.	Signal from dug den under rock overhang on 10/29/82
018 (5.5)	29 Oct.-15 Nov.	335	Terror Bay-Baumann Ck.	Signal apparently from rock crevice on 11/15/83
019 (6.5)	15 Nov.-9 Dec.	457	Terror Bay-Baumann Ck.	
020 (6.5)	15 Nov.-?	---	Terror Bay-Baumann Ck.	Located in Baumann Ck. on 11/15/82 and 4/02/83
022 (7.5)	29 Oct.-15 Nov.	305	Terror Bay	
037 (4.5)	7 Oct.-4 Nov.	884	Terror Bay-Den Mtn.	
038 (3.5)	7 Oct.-2 Nov.	945	Terror Bay-Den Mtn.	
044 (3.5)	29 Oct.-15 Nov.	640	Kizhuyak Bay	
046 (6.5)	4 Nov.-10 April	854	Terror Bay-Den Mtn.	
048 (23.5)	2-4 Nov.	915	Terror Bay-Den Mtn.	Dug den seen on 11/4/82
051 (8.5)	29 Oct.-4 Nov.	945	Terror Bay-Den Mtn.	
055 (13.5)	7 Oct.-4 Nov.	915	Terror Bay-Den Mtn.	

Table 12. (Cont.) Den site characteristics for brown bears in the Terror Lake Hydro study area in the 1981-82 winter.

Bear no. (age)	Entrance date	Elevation (meters)	Location by drainage	Comments
060 (14.5)	4-15 Nov.	366	Kizhuyak Bay-west side	
064 (20.5)	29 Oct.-4 Nov.	945	Terror Bay-Den Mtn.	Seen at hole in snow on 10/29/82
067 (20.5)	18 Oct.-4 Nov.	1037	Kizhuyak Bay west side	
070 (4.5)	11 Nov.-17 Jan.	762	Kizhuyak Bay-east side	
071 (8.5)	15 Nov.-5 Feb.	838	Kizhuyak Bay-east side	
072 (18.5)	15 Nov.-17 Jan.	152	Terror Bay	
074 (17.5)	29 Oct.-11 Nov.	213	Kizhuyak Bay-Pestchani Ck.	
077 (20.5)	15 Nov.-30 Dec.	305	Kizhuyak Bay-west side	
MALES				
002 (15.5)	15 Nov.-30 Dec.	427	Kizhuyak Bay-west side	
003 (5.5)	?	---	Kizhuyak Bay	Active on 2/5/83;probably denned intermittently
004 (6.5)	15 Nov.-19 April	793	Kizhuyak Bay-east side	
007 (3.5)	29 Oct.-15 Nov.	747	Kizhuyak Bay-Pestchani Ck.	
014 (6.5)	9 Dec.-17 Jan	427	Terror Bay	
016 (11.5)	15 Nov.-30 Dec.	519	Kizhuyak Bay-west side	
023 (7.5)	9 Dec.- ?	---	---	Active on 12/9/82
024 (7.5)	4 Nov.-5 Feb.	610	Terror Bay	Near dug den on 11/4/82 near Baumann Ck. 12 km NE of final den site

Table 12. (Cont.) Den site characteristics for brown bears in the Terror Lake Hydro study area in the 1981-82 winter.

Bear no.	(age)	Entrance date	Elevation (meters)	Location by drainage	Comments
028	(3.5)	15 Nov.-17 Jan.	396	Kizhuyak Bay-west side	
033	(3.5)	11 Nov.-17 Jan.	305	Sharatin Bay	
045	(5.5)	15 Nov.-14 Jan.	427	Kizhuyak Bay-west side	
059	(3.5)	4 Nov.-30 Dec.	1006	Terror Bay-Den Mtn.	

in late fall reduced the frequency of radio-tracking flights and all the bears were not located during each flight.

Females denned earlier than did males. Nineteen of 26 females (79%) had denned by 15 November. Only 1 of 10 males (10%) with known locations was denned by that date. All females with known locations had denned by 8 December. At least 3 males were still active on that date.

Den Site Characteristics

Dens of radio-collared bears were located at higher elevations than had previously been reported for Kodiak Island. The mean elevation of 34 dens was 620 meters (range = 152 - 1006 m). The mean elevation of 10 dens of males was 566 m (range = 305 - 1006 m). The mean elevation of 24 dens of females was 642 m (range = 152-1037 m). Lentfer et al. (1972) reported a similar range in elevations of 30-1006 m for 80 dens located on southwestern Kodiak Island, but only 39% of the dens were located at or above 610 m. Eighteen of 34 dens (53%) located in the Terror Lake study area were above 610 m. Spencer and Hensel (1980) stated that bears den at upper and intermediate elevations of 240-750 m in the Terror Lake study area. Seventeen of 34 dens (50%) located in 1982 fell within that elevational range, two dens (6%) were below 240 m, and 15 dens (44%) were above 750 m.

Alpine habitats were preferred for denning in the study area. Spencer and Hensel (1980) suggested that alpine areas above 635 m provide marginal denning habitat because of unstable snow conditions and shallow soils which lack sufficient depth, cohesiveness and vegetative cover to support den excavations. Approximately half the dens located in 1982 were in alpine areas but vegetative cover was not described in detail. Numerous old den excavations which were observed throughout the study area above 600 m further suggest that the use of alpine habitat for dens is not unusual as was suggested by Spencer and Hensel.

A possible explanation for the apparent discrepancy between results of this study and previous denning studies is that locating dens by radio-tracking is a more precise technique than aerial reconnaissance surveys.

It is sometimes difficult to distinguish dens from daybeds from the air. Locating dens by fixed-wing aircraft was relatively unsuccessful in 1982. It was suspected that a heavy snowfall in April covered the entrances of dens from which bears had already emerged making the dens nearly impossible to locate. The dens of bears near wind-blown peaks could be covered by drifting snow almost immediately after abandonment. Spencer and Hensel (1980) confined their search area to elevations below 750 m during helicopter surveys in 1980 and some active dens above that elevation might have been missed.

Distribution of Dens

Sixteen radio-collared bears denned in the Kizhuyak Bay drainage and one denned in the Sharatin Bay drainage. Seventeen bears denned in the Terror Bay and Viekoda Bay drainages. Locations of the dens are shown in Figure 3.

Den sites of 3 bears were not located. Female #020 was last located on 15 November in the Terror Bay area, but it was not located again until after emergence in 1982. Male #023 was active on 9 December west of Kizhuyak Bay and was not relocated until April 1983. Male #003 was located at a suspected den site west of Kizhuyak Bay on 30 December. It was seen walking through deep snow on 5 February, 1983, about 2 km north of its previous location. It was suspected that this bear was active all winter.

A major denning area was located in a group of rugged mountain peaks 4 km northwest of Terror Lake. These peaks, which reach 1122 m in elevation, drain into Terror River to the south and into Baumann Creek to the north. The name "Den Mountain" was assigned to the area for easy future reference. Eight radio-collared bears (#'s 037, 038, 046, 048, 051, 055, 059, 064) denned within an area of approximately 4 km^2 on this mountain. The mean elevation of the 8 dens was 926 m (range $\cong$ 854-1006 m). Numerous suspected old den excavations had been noted on this mountain above 750 meters during previous aerial surveys. Although the southern slope of the peaks was identified as denning habitat by Spencer and Hensel (1980), elevations above 457

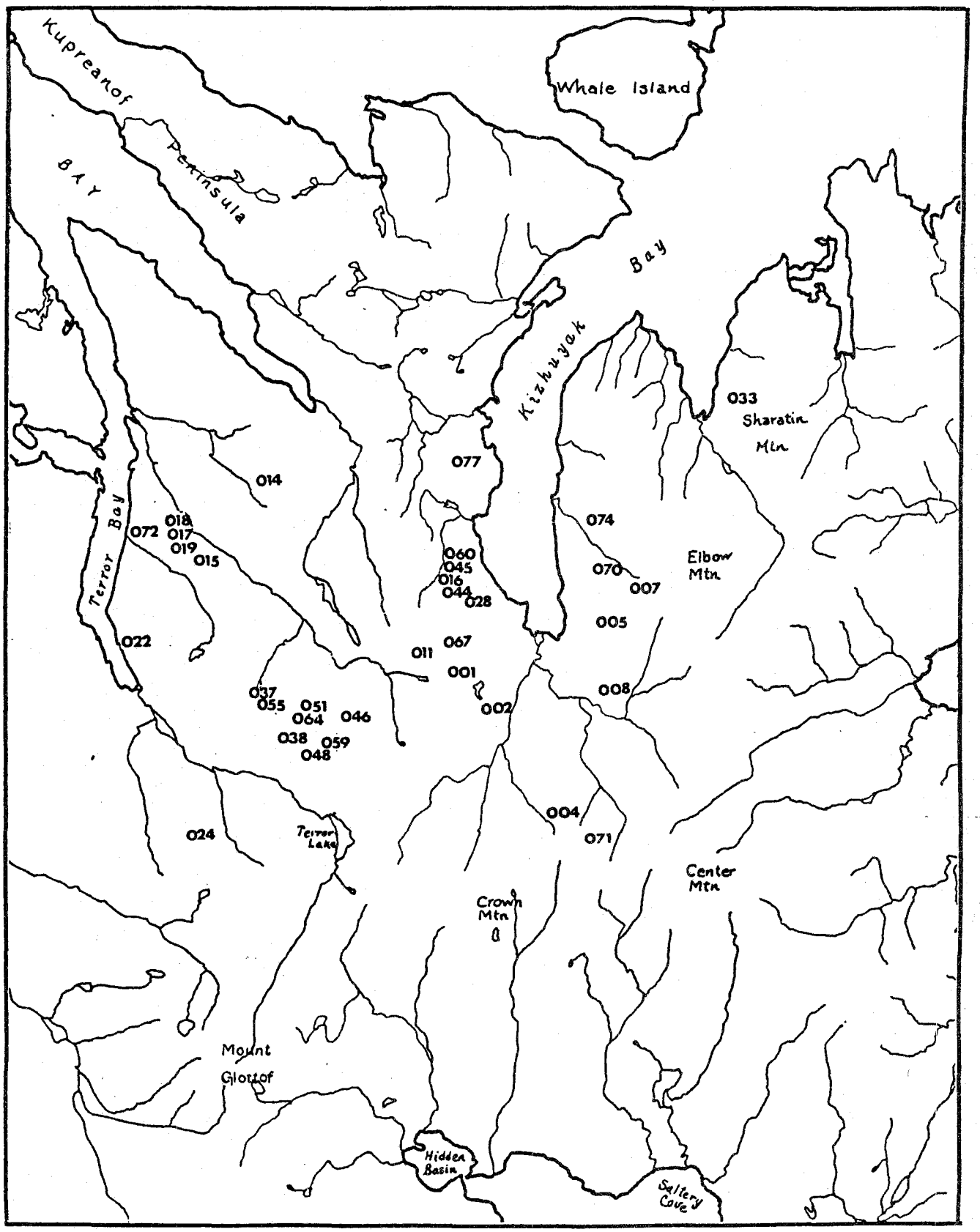

Figure 3. Location of dens of radio-collared bears in 1982-83 winter (1 cm = 2.55 km).

meters were not considered by them to be important for denning. This mountain was one of the most important denning areas in the study area in 1982.

Bears #'s 015, 017, 018, 019, 020, all females, were confirmed or suspected to have denned in lower Baumann Creek. Baumann Creek was another important denning area previously identified by Spencer and Hensel (1980), who reported the use of natural rock dens in this drainage. Re-locating bears in this drainage during the denning period was difficult in 1982 and it was suspected that radio signals may have been blocked if bears were in rock dens.

Nine radio-collared bears (#'s 001, 002, 011, 016, 028, 044, 045, 060, 067) denned in the mountain range west of the head of Kizhuyak Bay, confirming previous observations that the area is the major denning area in the Kizhuyak Bay drainage (Spencer and Hensel, 1980). Seven radio-collared bears (#'s 004, 005, 007, 008, 070, 071, 074) denned in drainages into the east side of Kizhuyak Bay. Three bears (#'s 005, 007, 070) denned within an area of about 1.5 km^2 on a peak northeast of the head of Kizhuyak Bay.

Dens in the Kizhuyak Bay area were generally located above the 150-450 m level reported by Spencer and Hensel (1980) to be preferred denning habitat. Dens of 17 bears in the Kizhuyak drainage had a mean elevation of 603 m (range = 213-1306 m). Dens of 10 of the 17 bears (59%) were located above 450 m.

Fidelity to Denning Areas

Comparing capture locations of bears radio-collared in April-May, 1982 with the den locations in winter 1982-83 suggests that some bears returned to the same general areas to den. It was assumed that bears captured in April had only recently emerged from nearby dens. The mean distance between the tagging location and the den location for 11 females captured in April-May was 1.8 km (range = 0.1-5.8 km). The mean distance between tagging and den locations for 8 males captured in April-May was 3.2 km (range 0.1-7.7 km). Comparisons of den locations in subsequent years will provide more precise information on den site fidelity.

Proximity of Denning to Construction Activities

Only one radio-collared bear denned closer than 1 km to active construction activities in 1982. Male #002, a 15.5 year old, denned west of Rolling Rock Creek about 0.6 km from the construction access road. Several project features were in operation or under construction within 1.5 km of this den site during the November-December period when #002 denned. A diesel generator plant was in operation at the powertunnel entrance. Construction of the powertunnel and of a road to the Rolling Rock Creek diversion was also in progress.

The next closest den to construction activities in the Kizhuyak drainage was that of a 3.5 year old female, #001. This den was located at 915 m elevation 2.5 km west of the Rolling Rock Creek diversion.

The den nearest to Terror Lake, that of a 3.5 year old male (#059), was about 4 km northwest of the dam site. The Terror Lake impoundment area was searched for dens during several aerial surveys and no dens were found. A sow with one yearling cub was observed by construction workers near the Terror Lake dam site in November 1982 and it was suspected that the bear denned nearby.

Impacts of Construction

Progress of Construction, 1982

Construction of the Terror Lake hydroelectric project began in March 1982 with the establishment of a temporary camp and a jetty at Kizhuyak Bay to support access road construction. By mid-July that camp had been expanded to accommodate about 90 people and the access road had been pushed to Terror Lake. In August the jetty camp was closed and approximately 200 personnel began occupying the newly constructed powerhouse camp. The jetty camp area was thereafter used as a staging area for equipment and for the fuel farm. Construction of the powertunnel was begun by early September and earthmoving at the Terror Lake dam site had begun by that time.

Construction of a second camp at the southwest end of Terror Lake was completed and occupied by October. At that time peak occupancy was reached with 170 people at the Terror Lake camp and 110 at the powerhouse camp, a total of 280 personnel.

During November continuous blasting and drilling operations were conducted on the Rolling Rock Creek dam access road and the Falls Creek tunnel in the Kizhuyak River drainage. By mid-December the placement of fill began at the Terror Lake dam site. The outlet powertunnel and the Falls Creek tunnel were well underway and 270 people were working on the project.

Observations of Unmarked Bears in Project Area

Between 5 September and 20 November, 1982, 37 brown bear sightings in the project area were reported by construction workers. Twenty-two sightings (59%) were made between 0700 and 1200 hr. Fifteen sightings (41%) were made between 1201 and 1800 hr. A total of 52 individual bears was seen. Several of the sightings were suspected to have been duplicates. Twenty-six of the 37 sightings (70%) were of single bears and 11 sightings (30%) were of females with cubs. Only one of the bears reported by construction workers was a radio-collared animal.

The reported sightings represent only part of the bears actually observed by workers in the project area. These observations indicate that bears were active in the project area during daylight hours. Most of the bears observed were seen near the approximately 6.5 km long section of the access road between Kizhuyak Bay and the lower tunnel portal. Most of these bears were observed while moving between feeding areas on the Kizhuyak River flats and heavy brush on ajacent hillsides.

One encounter between a brown bear and construction workers was reported. An unmarked female with 3 cubs of the year reportedly exhibited aggressive behavior toward a bus carrying construction workers on 9 September in an alpine meadow east of Terror Lake. The female made several short charges at the bus which had stopped to allow workers to observe the bears.

Several bears were observed in the Kizhuyak River drainages incidental to radio-tracking flights and other field activities. A total of 37 observations included 24 unmarked single bears, 6 sub-adult ear-tagged males and 7 unmarked family groups. At least 4 family groups were considered to be unique. Those family groups included: 1 female with 2 cubs of the year; 1 females with 1 yearling; 1 female with 2 yearlings and 1 female with 3 yearlings.

The unmarked family groups first appeared when salmon became available on the lower Kizhuyak River in August. None of the unmarked family groups was seen near the river after September 30.

Impacts on Denning

No major displacement of bears from traditional denning areas was found in 1982. Spencer and Hensel (1980) predicted that during the construction phase of the project, some bears would den in less desireable sites or they would move into adjacent drainages to den. Nine radio-collared bears denned in the peaks west of Kizhuyak Bay and Kizhuyak River, an area considered to be particularly vulnerable to disturbance. Some unmarked bears probably denned in that area also without being detected. At least one bear denned within close proximity to construction activities near Rolling Rock Creek, an area exposed to heavy vehicular traffic and frequent blasting, drilling and helicopter activity during the denning period. Several bears denned close to their April-May capture locations which further suggests that major displacement did not occur as a result of construction disturbance.

Spencer and Hensel (1980) suspected that denning activities along the slopes north and west of Terror Lake, which they considered to be important denning habitat, would be diminished, although they located no nearby dens during their 1980 field studies. Dens of radio-collared bears in the Terror River drainage were located at higher elevations in 1982 than had been designated as suitable habitat by Spencer and Hensel, but it is unknown if den site selection was related to disturbance from construction. It could be that

the immediate area of the dam site is not preferred denning habitat. Some unmarked bears may have denned in this area without being detected.

The findings that bears denned at much higher elevations than was previously thought could be interpreted to indicate that marginal denning habitat was being used in 1982. An explanation considered more likely is that radio-tracking techniques provided much more accurate data on denning areas than did aerial surveys used in the past. The habitat requirements for denning may be broader than was previously believed. More suitable denning habitat may be available in the study area than was depicted in previous studies. Without knowing the precise locations which individual radio-collared bears used for denning previous to the beginning of construction, the possibility that some bears did respond to construction activities by choosing alternate denning areas cannot be completely discounted. Den locations chosen by individual bears in subsequent years should help to clarify the relationship between den site selection and construction disturbance.

Impacts on Interdrainage Travel Routes

No major alterations in interdrainage travel routes were found in 1982, although some avoidance of construction activities undoubtedly occurred. Spencer and Hensel (1980) were concerned that bear movements between the western slopes of Kizhuyak River and the Kupreanof Peninsula area would be substantially reduced. Sequential locations for several radio-collared bears indicated that movements along that route were not seriously affected in 1982. The location of the construction camp and nearby construction activities probably caused bears to avoid the west side of the Kizhuyak River as a travel route to Hidden Basin. Removal of tree cover in several areas along the river and the construction camp considerably reduced security for travelling bears. Four radio-collared bears did travel between Saltery Creek and the Kizhuyak River, probably using passes in the eastern drainages of Kizhuyak River. Several observations of bears on the mountain northwest of Terror Lake indicated that some bears were still using the pass between Terror River and Baumann Creek which Spencer and Hensel (1980) suggested might be affected by construction activity.

Impacts on Movements and Feeding Activities

Substantial use of the lower Kizhuyak River valley by several radio-collared bears in 1982 indicated that construction activities may have been less disruptive of bears' activities than had been predicted by Spencer and Hensel (1980). The home ranges of 16 radio-collared bears, 10 males and 6 females, intersected major construction activities in the Kizhuyak River drainage in 1982. At least 13 of those bears denned in drainages into Kizhuyak Bay. Several radio-collared bears continued to frequent the immediate area of active construction in the Kizhuyak River valley throughout 1982. These included males, single females and at least one female with yearling cubs. Unmarked bears were also observed frequently in the Kizhuyak River valley during radio-tracking flights and by construction workers. Males and single females were most commonly located close to the construction area, but at least 1 radio-collared female with cubs and up to 4 unmarked females with cubs frequented the lower Kizhuyak River during August and September when salmon were available. The wide range of sex, age and reproductive classes represented among these bears suggests that no single class of bears was more susceptible to disturbance from construction.

A nocturnal pattern of feeding on salmon was apparently adopted by some bears in the Kizhuyak River, a possible response to disturbance from construction activities. Other bears, however, were frequently observed feeding on salmon during the day along the small sloughs in the Kizhuyak River delta.

Some changes from traditional access routes used by bears moving to feed along the lower Kizhuyak River probably occurred as predicted by Spencer and Hensel (1980). Several bears continued to use the slopes west of Kizhuyak River and these bears routinely crossed the construction access road to reach feeding areas in the lower Kizhuyak River. Some bears apparently became somewhat habituated to the construction activities. Other bears may have altered their movements substantially because of disturbance from construction without being detected.

Bears occupying the eastern drainages into Kizhuyak River and the Elbow Creek area were subjected to relatively little construction disturbance in 1982. The eastern side of the Kizhuyak River flats was favored cover for bears using the Kizhuyak River flats. The Elbow Creek pass was the main flight route for helicopters travelling from Kodiak, but surveying of the transmission line was the only other significant activity underway in the eastern part of the study area. Several radio-collared bears were frequently located during August and September in the brushy low hills east of Kizhuyak River within a short distance of salmon spawning areas. Construction of the transmission line scheduled for 1983 will cause much more disturbance and this area may receive less use by bears.

Impacts of construction on bears in the Terror Lake area were difficult to detect in 1982. None of the radio-collared bears regularly frequented the Terror Lake basin in 1982. A radio-collared male was located travelling through the valley above Terror Lake on one occasion. Spencer and Hensel (1980) identified approximately 10 bears using the immediate vicinity of the lake in 1980. Some unmarked bears were observed feeding on the slopes above Terror Lake in early summer, 1982. Helicopter traffic and surveying crews were the main sources of disturbance prior to early July and it is suspected that these activities had relatively little impact on early seasonal movements of bears. The intense construction activity present by late fall would intuitively appear to have been sufficient to cause bears to avoid the area. Comparable construction activities in the Kizhuyak drainage did not cause complete avoidance by bears. The low frequency of use by radio-collared bears in the immediate area of Terror Lake may indicate that the area is only moderately important habitat compared to adjacent areas.

Heavy siltation caused by excavation at Terror Lake was suspected to have reduced the fishing success of bears feeding on salmon in Terror River. Bears may have ceased fishing activities earlier than usual because of the heavy silt load.

Impacts of Garbage Disposal and Food Handling

A project license stipulation was that food storage and garbage disposal were to be conducted so that potential nuisance brown bears were not attracted. That stipulation was violated by the use of an open, unfenced burning pit near Kizhuyak River for several months. The burning pit attracted little use by bears. Garbage was sometimes allowed to accumulate temporarily in unsecured areas in the construction camp and food was occasionally left untended during transport and storage. No serious bear-human conflicts were reported as a result of improper garbage or food handling in 1982. Movements of brown bears were not noticeably influenced by food storage or garbage disposal practices in 1982.

Impacts of Other Activities

Sport fishing for salmon in the lower Kizhuyak River was a popular recreational activity for construction workers during late July through October. Several people encountered bears while fishing, but no serious confrontations were reported. Most of the sport fishing was done in late afternoon, when brown bears were actively feeding. It is suspected that bears avoided sport fishermen to some extent but sport fishing was probably not a major source of disturbance.

Brown bear hunting occurred in April, May, October, and November in the Kizhuyak Bay area, but it probably had only a minor impact on bear movements. Deer hunting, which occurred during August-December was suspected to have attracted some bears, which fed on deer carcasses. Other bears may have moved away from coastal hunting areas to avoid hunters.

Commercial fishing activity, conducted throughout the year, was the major potential source of non-construction disturbance to bears. The herring fishery in April and May was potentially most disruptive because of the widespread use of small aircraft for spotting herring. It was not unusual for several aircraft and boats to be working simultaneously in Terror Bay and upper Kizhuyak Bay. The presence of boats and aircraft probably influenced the use of intertidal areas and near-coastal movements of bears, at least during periods of peak fishing activity.

RECOMMENDATIONS FOR 1983

1. A minimum of 10 additional bears should be captured and fitted with radio-collars in 1983 to maintain a minimum sample of 35 radio-collared bears. The capturing operation should be done in June after the spring hunting season.

2. Weekly flights from April through November should be made to monitor movements of radio-collared bears during their active periods. Two flights per month should be made during the December-March period to monitor late entrance and early emergence of bears from dens.

3. Den sites should be located precisely by radio-tracking and with aerial photographs. Onsite examinations of selected dens of radio-collared bears should be done to describe the physical characteristics of dens and the habitat of den sites. The higher than expected use of alpine habitat for denning requires more detailed investigation into denning preferences which might be related to disturbance from construction.

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APPENDIX 1. DISTRIBUTION MAPS FOR BROWN BEARS

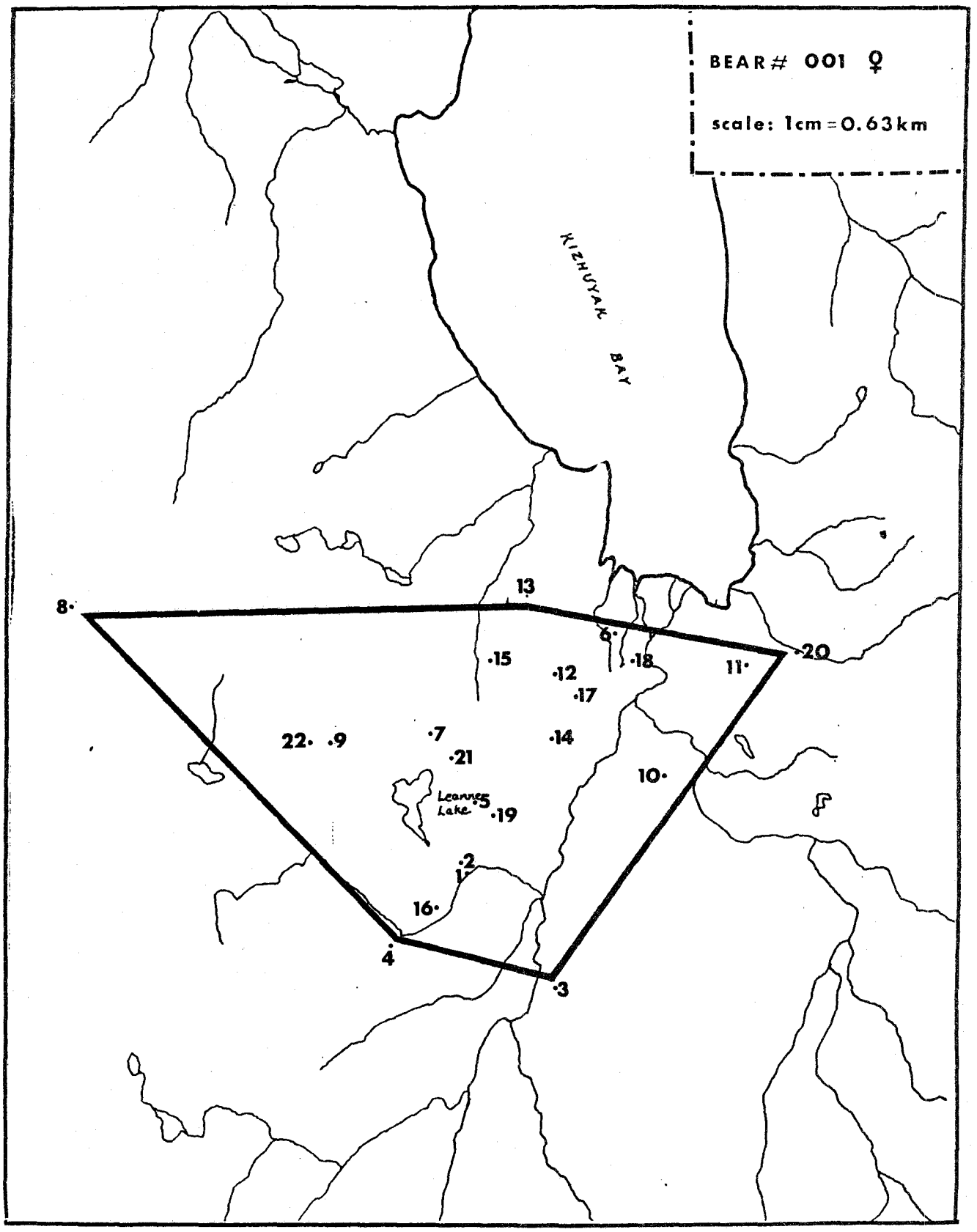


Figure 4. Point locations and home range for brown bear 001 in 1982.

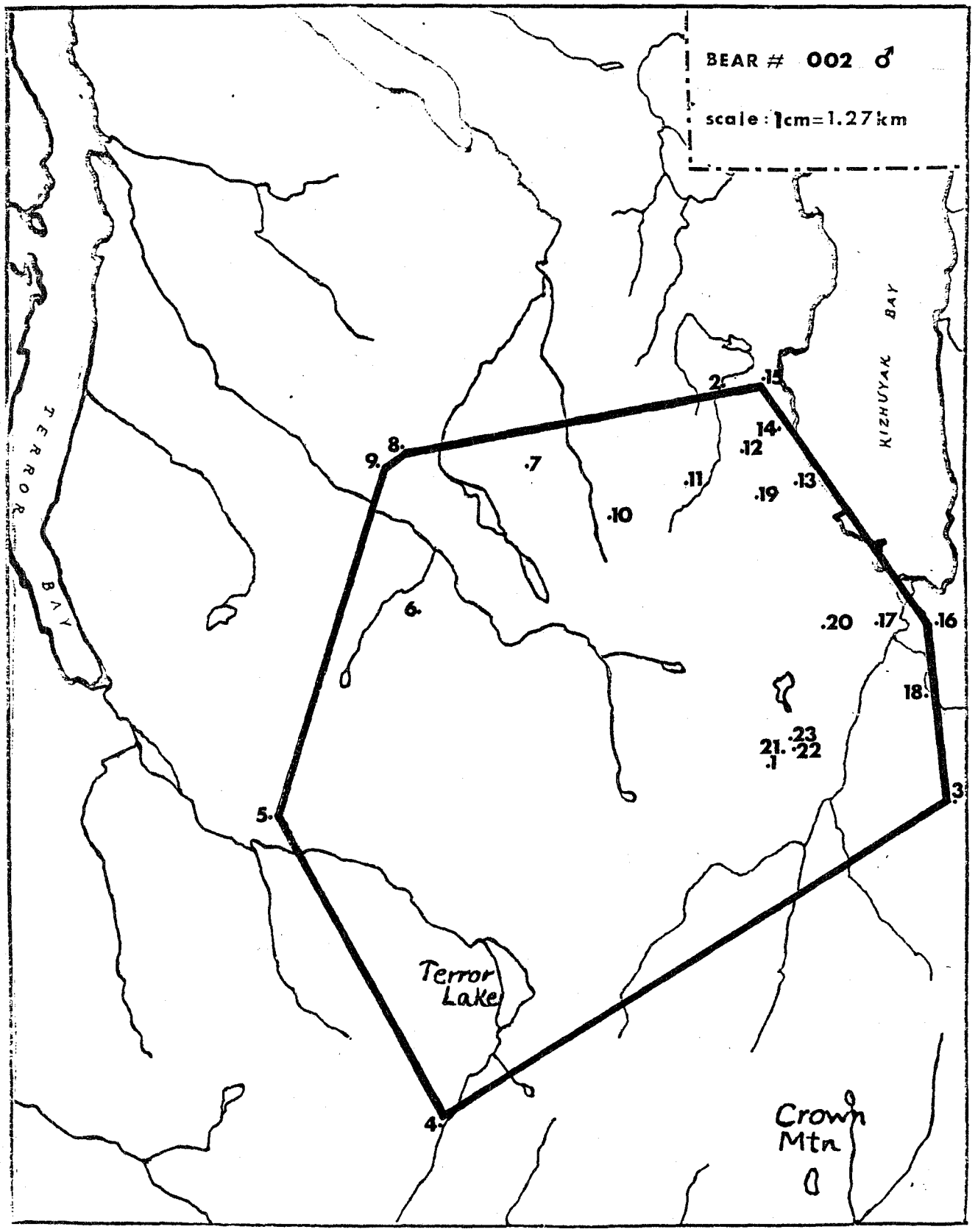


Figure 5. Point locations and home range for brown bear 002 in 1982.

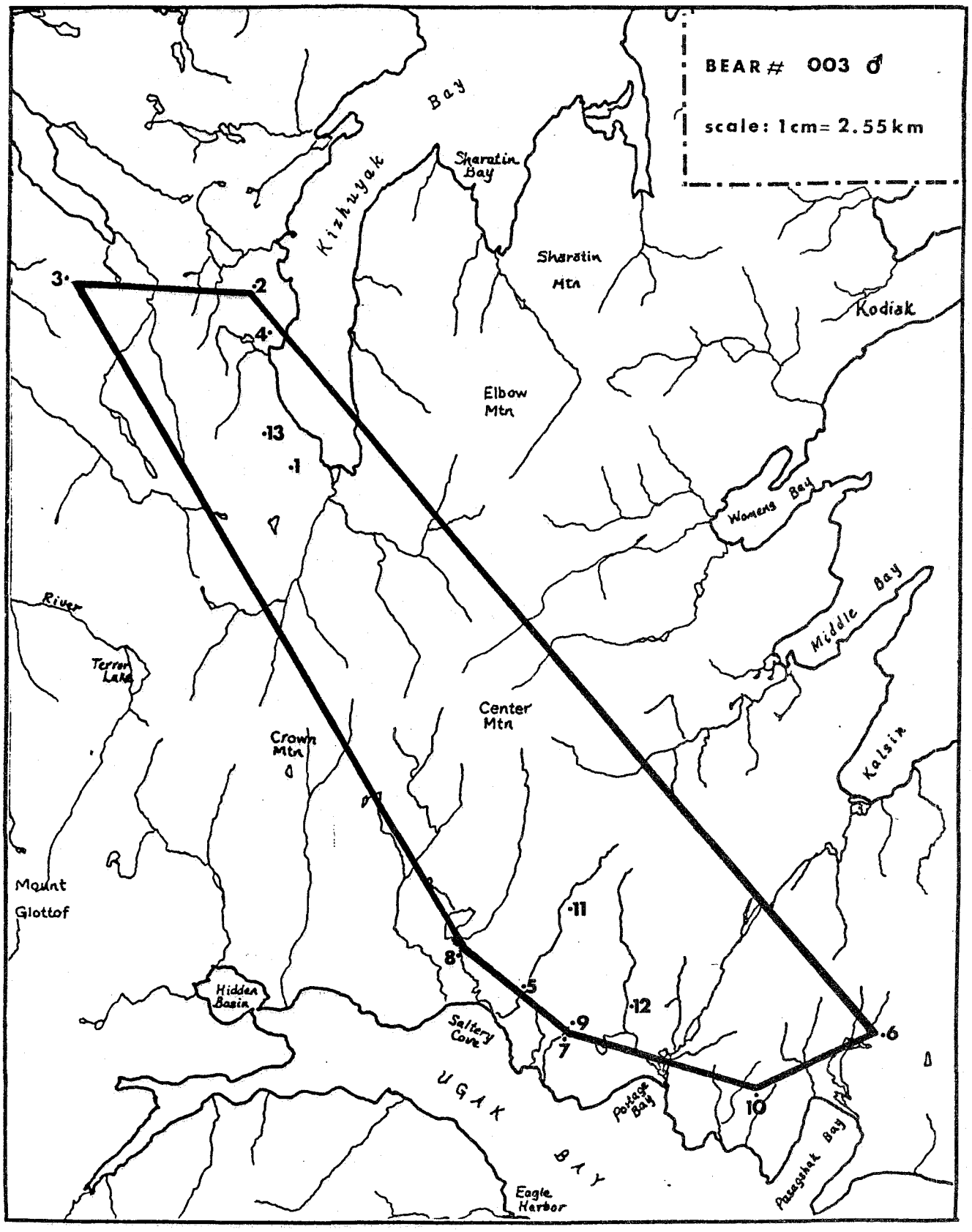


Figure 6. Point locations and home range for brown bear 003 in 1982.

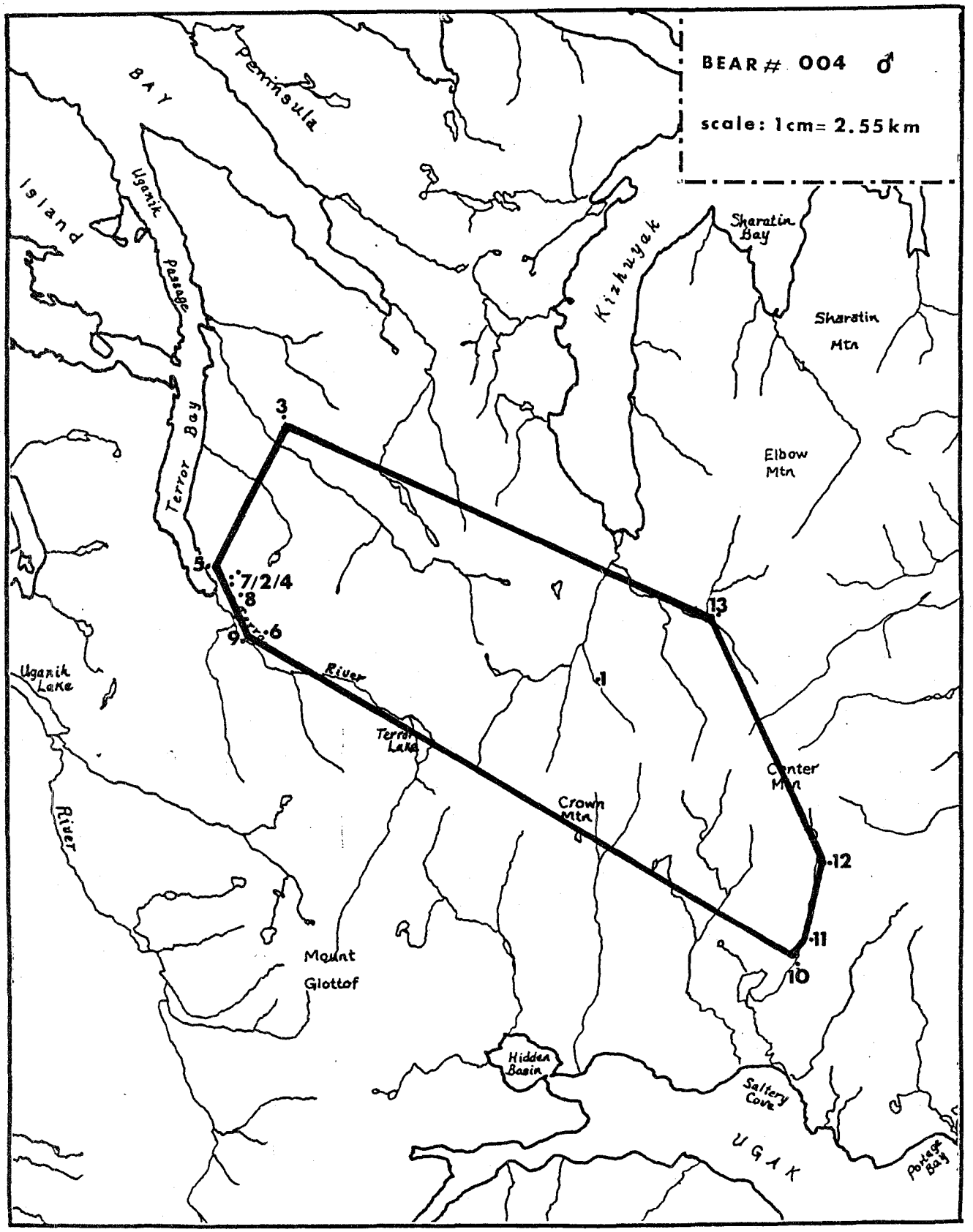


Figure 7. Point locations and home range for brown bear 004 in 1982.

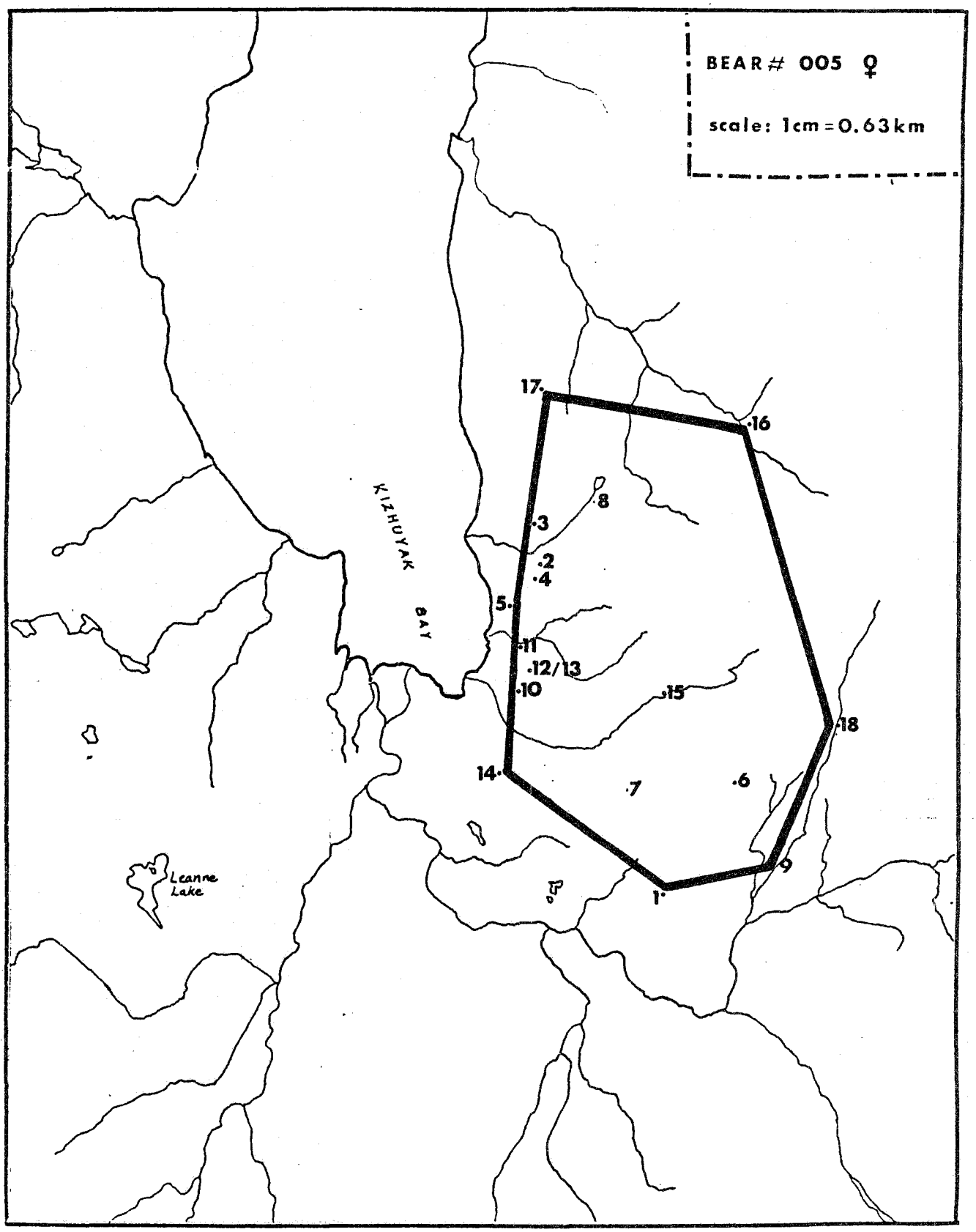


Figure 8. Point locations and home range for brown bear 005 in 1982.

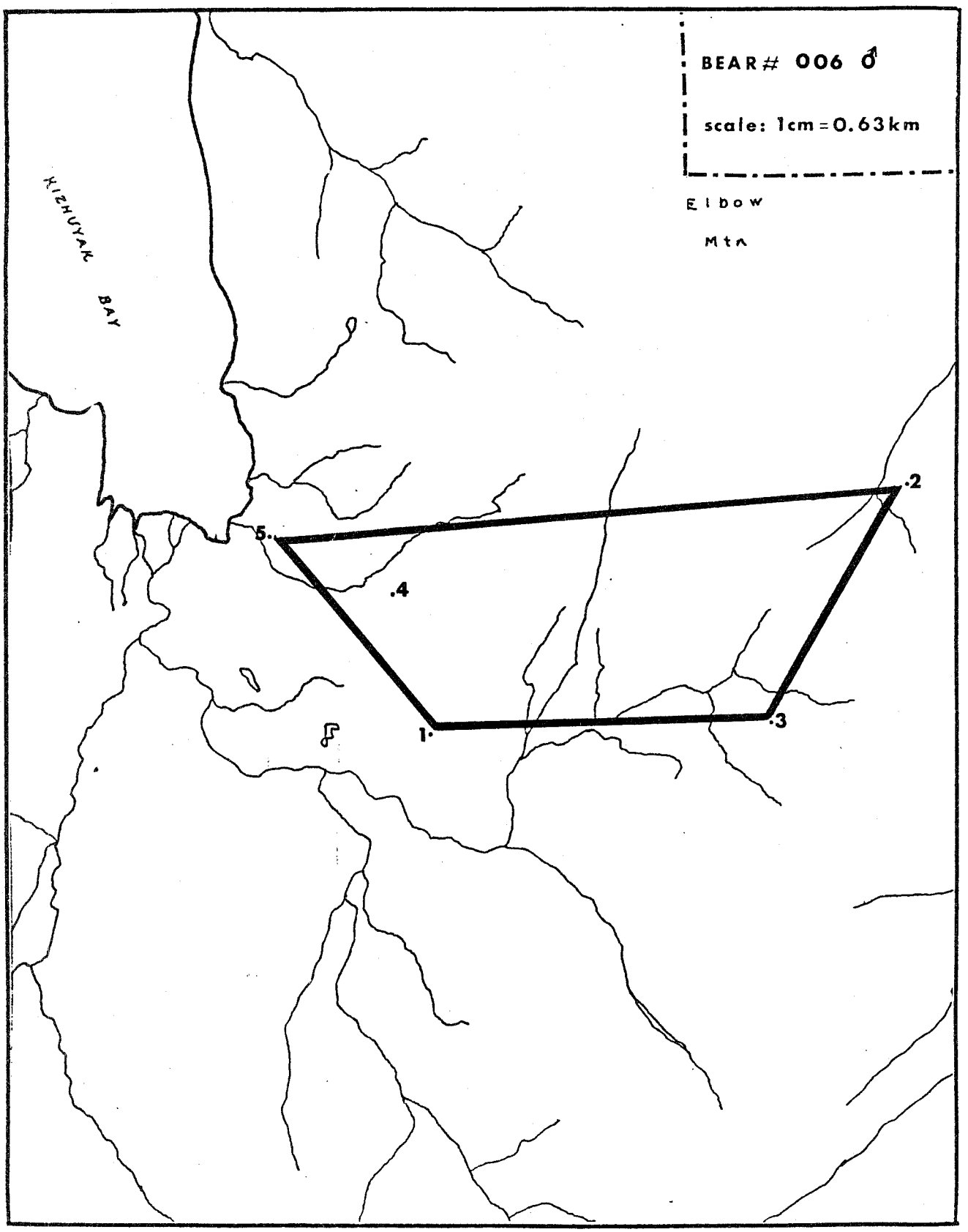


Figure 9. Point locations and home range for brown bear 006 in 1982.

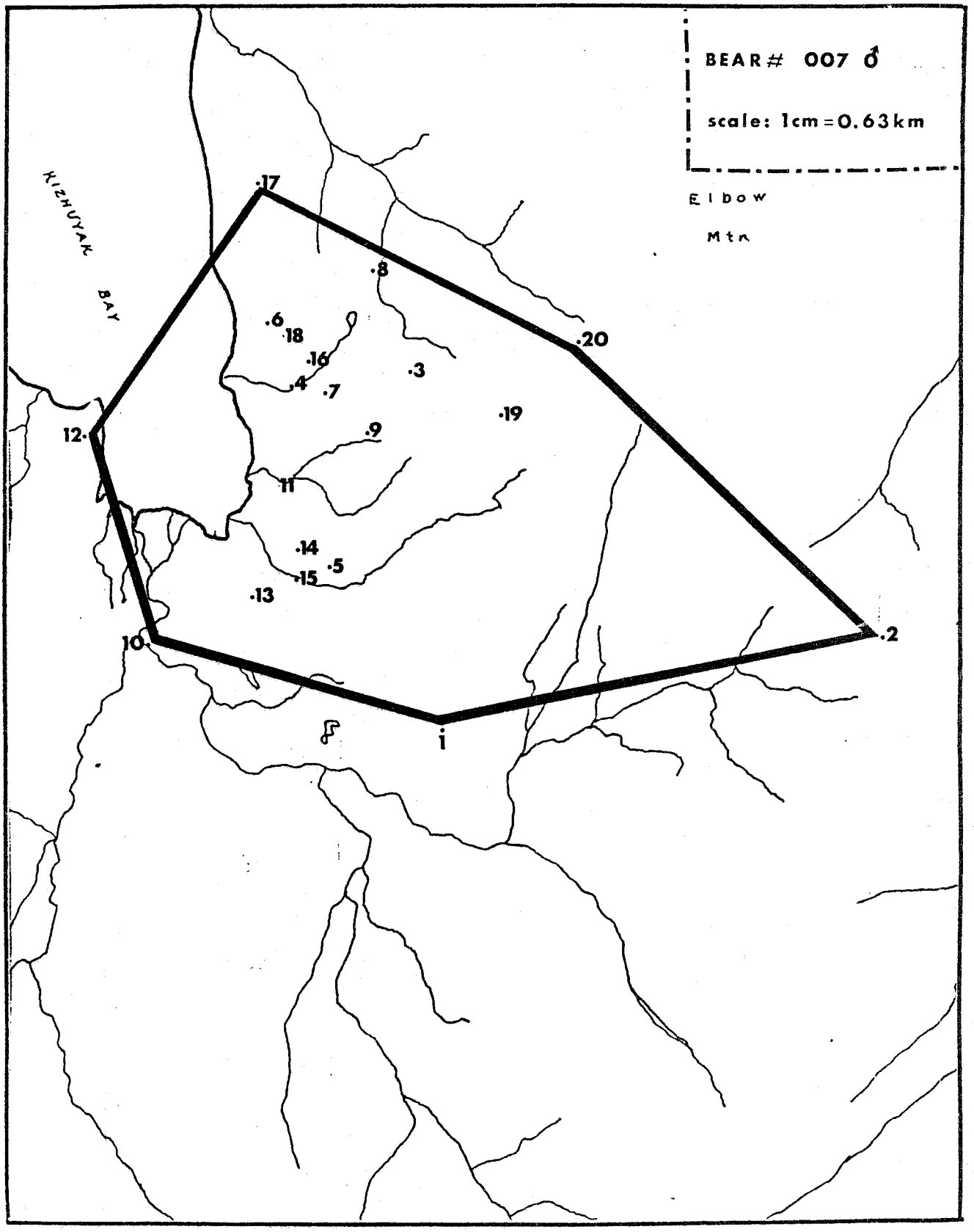


Figure 10. Point locations and home range for brown bear 007 in 1982.

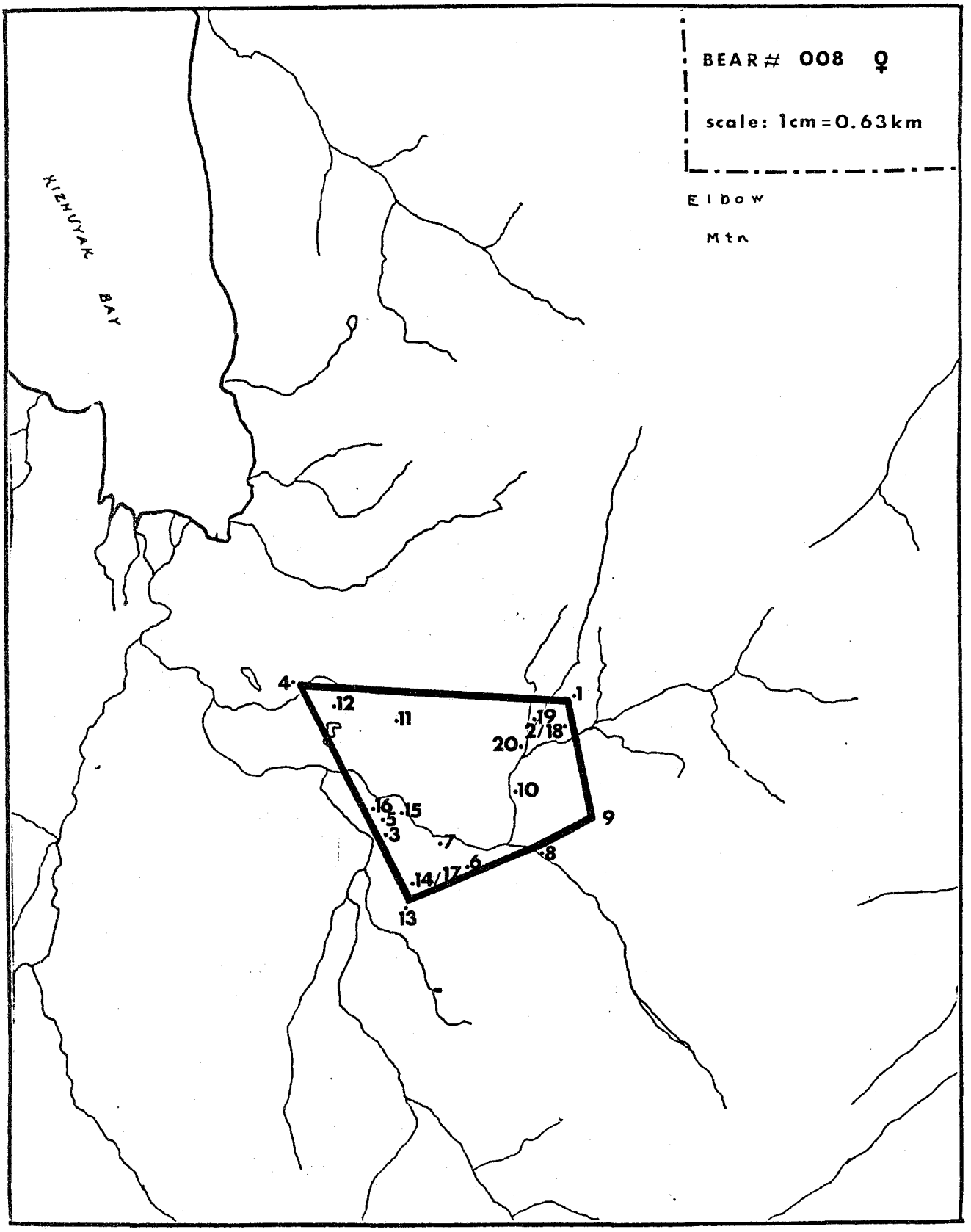


Figure 11. Point locations and home range for brown bear 008 in 1982.

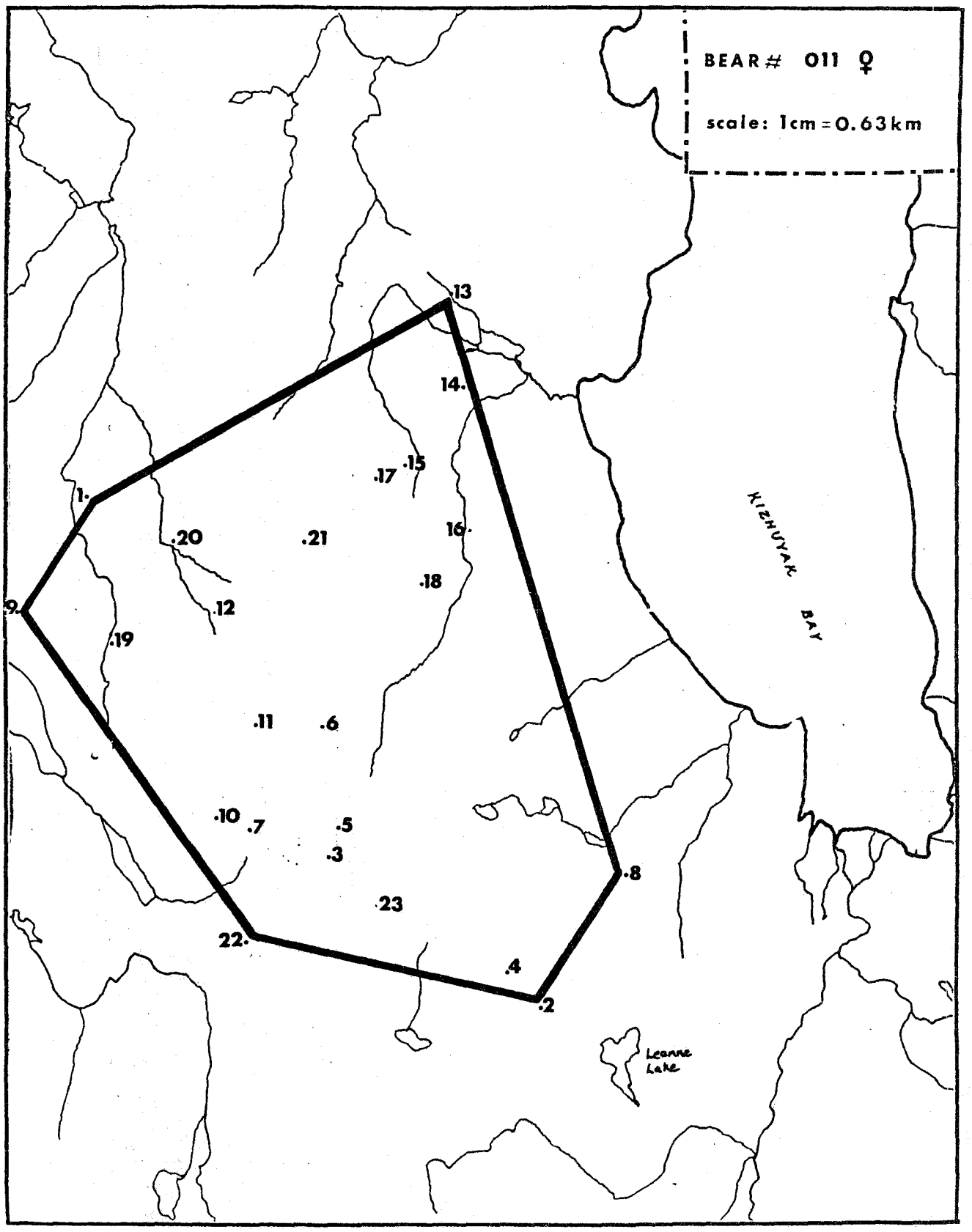


Figure 12. Point locations and home range for brown bear 011 in 1982.

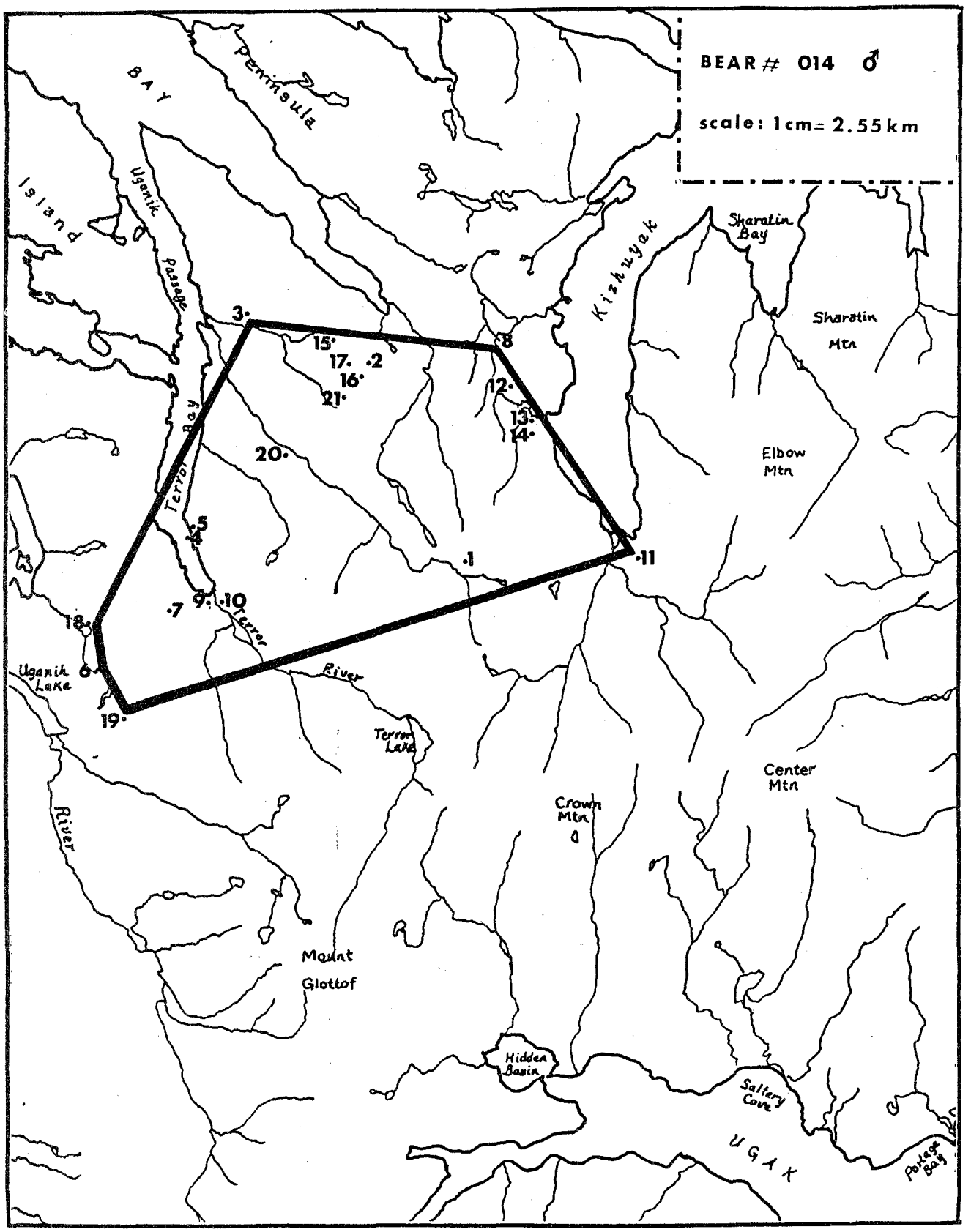


Figure 13. Point locations and home range for brown bear 014 in 1982.

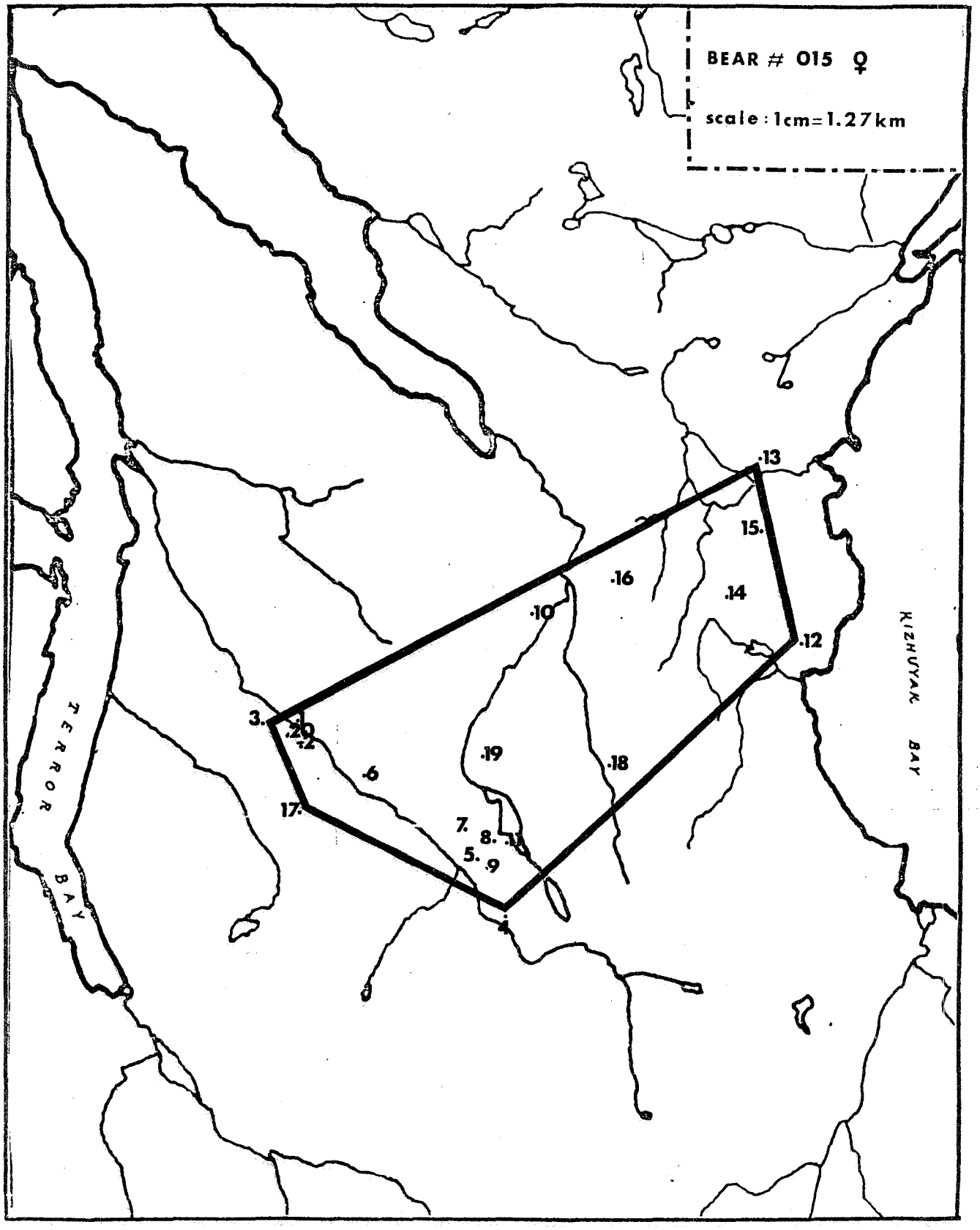
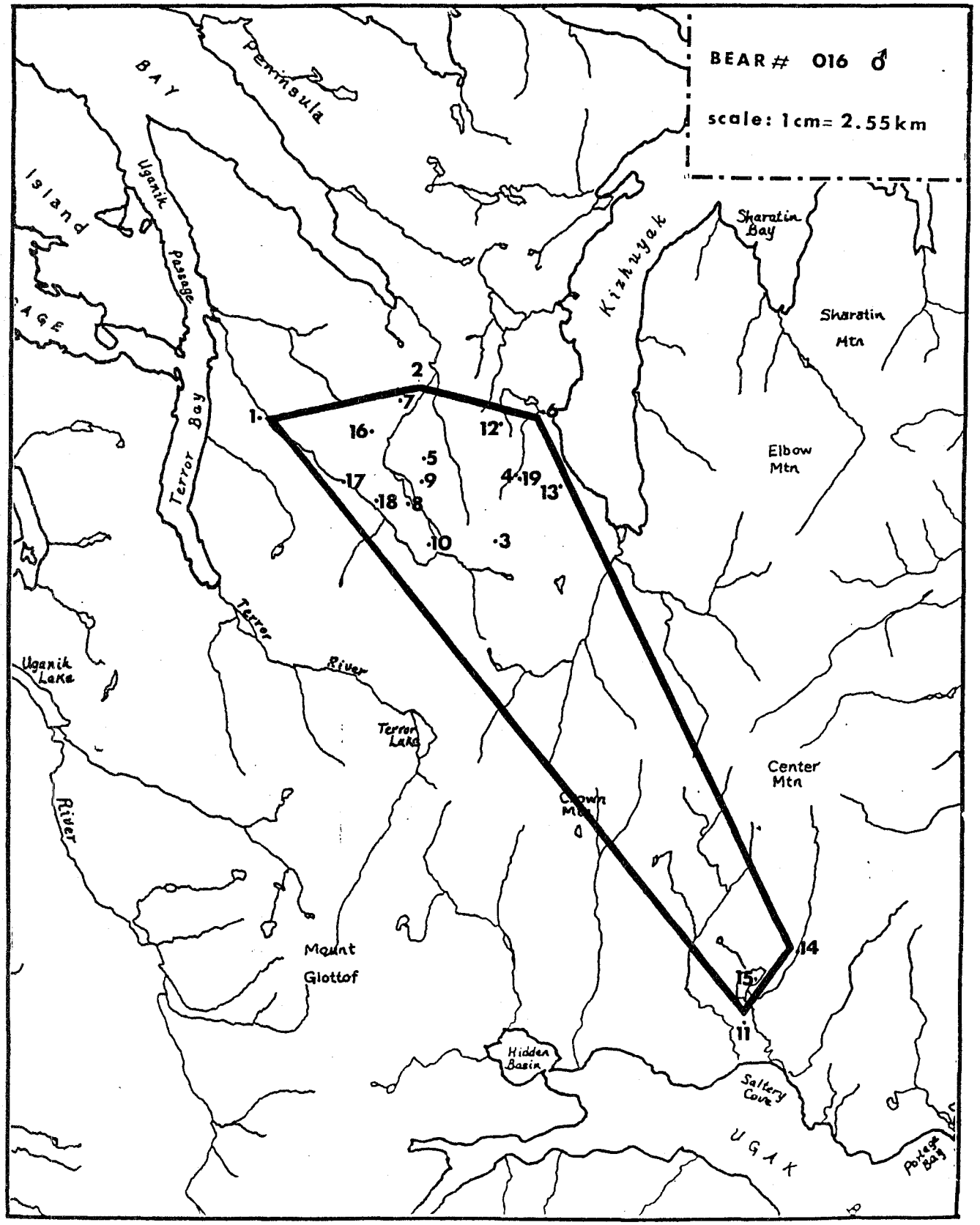


Figure 14. Point locations and home range for brown bear 015 in 1982.



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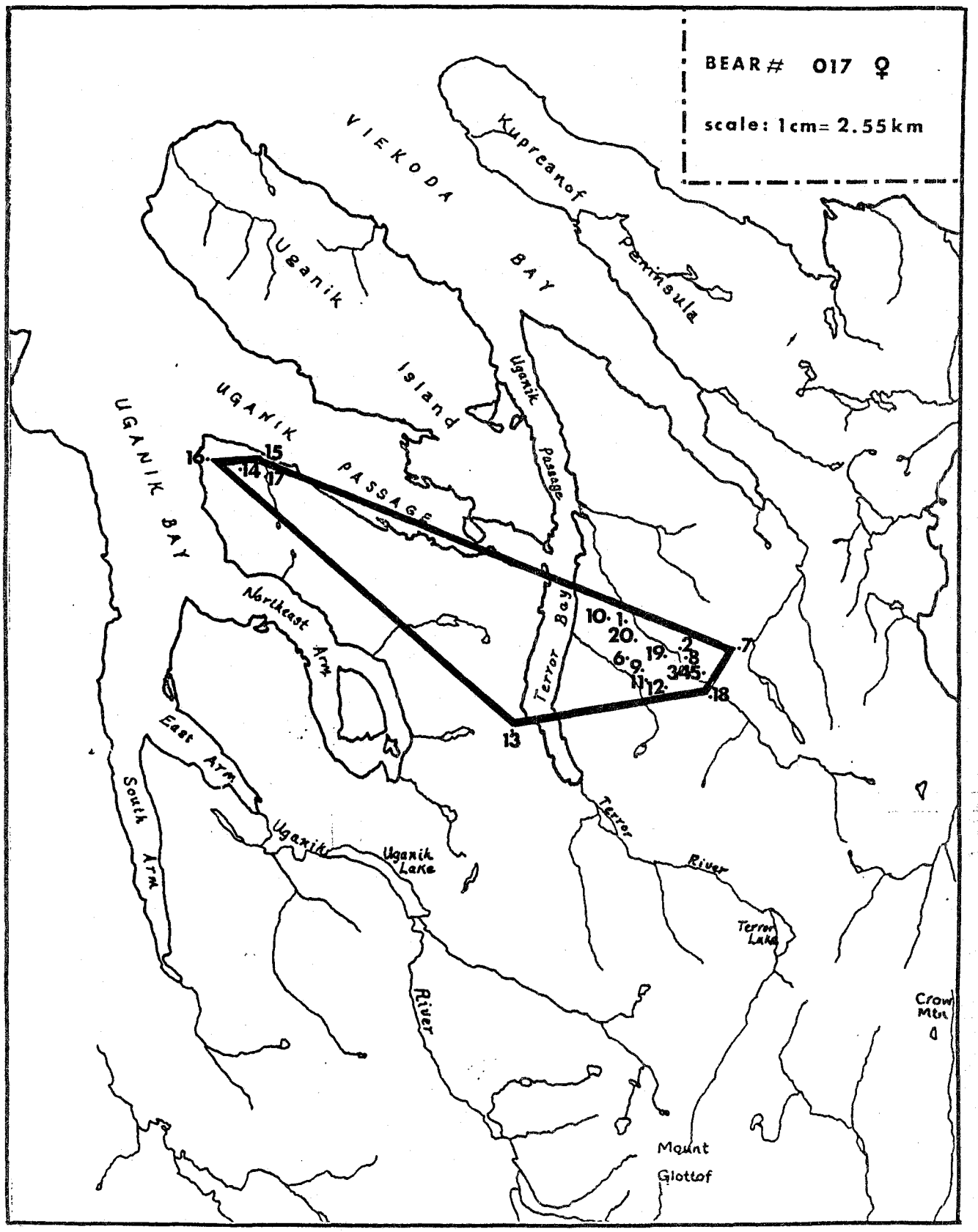

Figure 16. Point locations and home range for brown bear 017 in 1982.

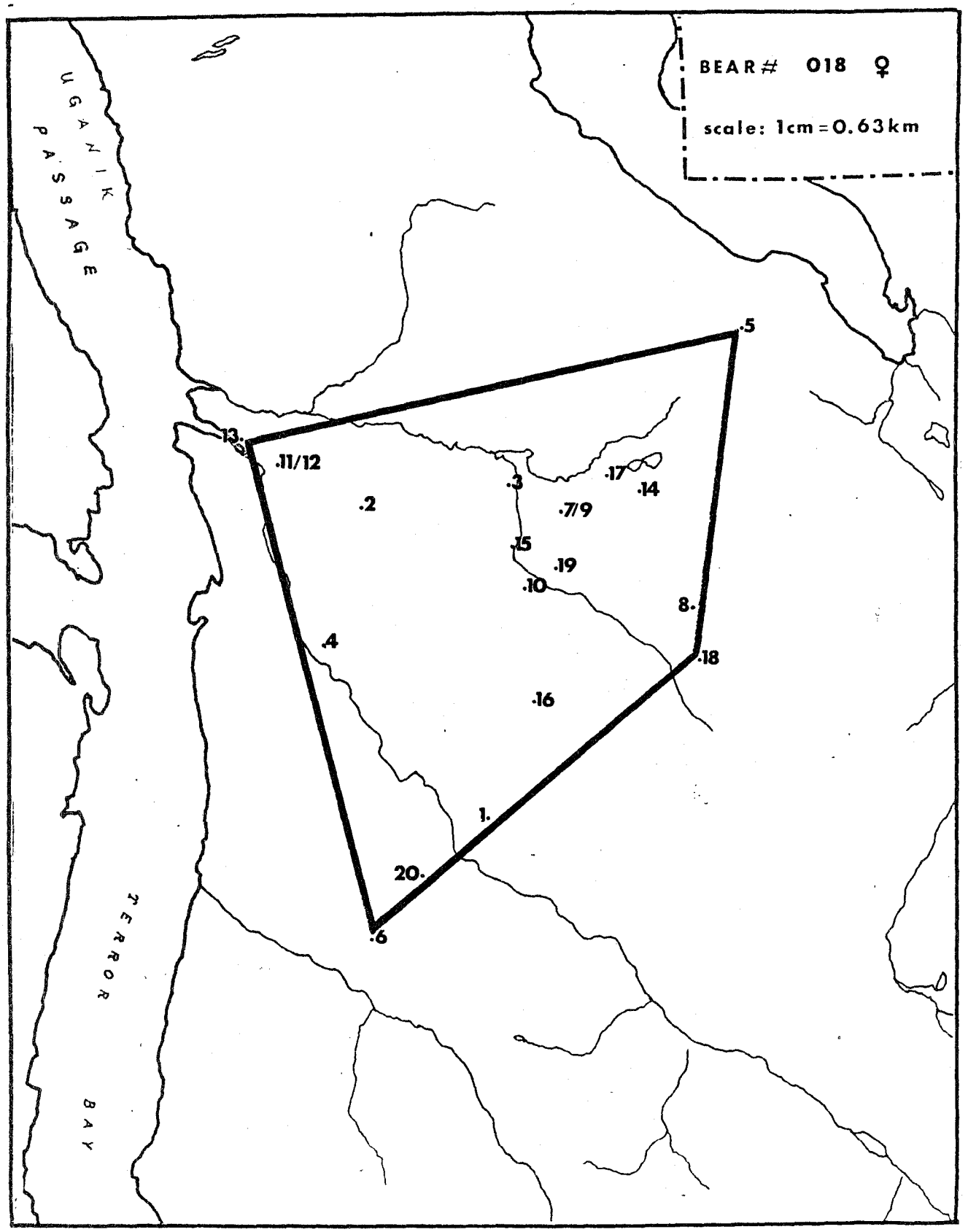

Figure 17. Point locations and home range for brown bear 018 in 1982.

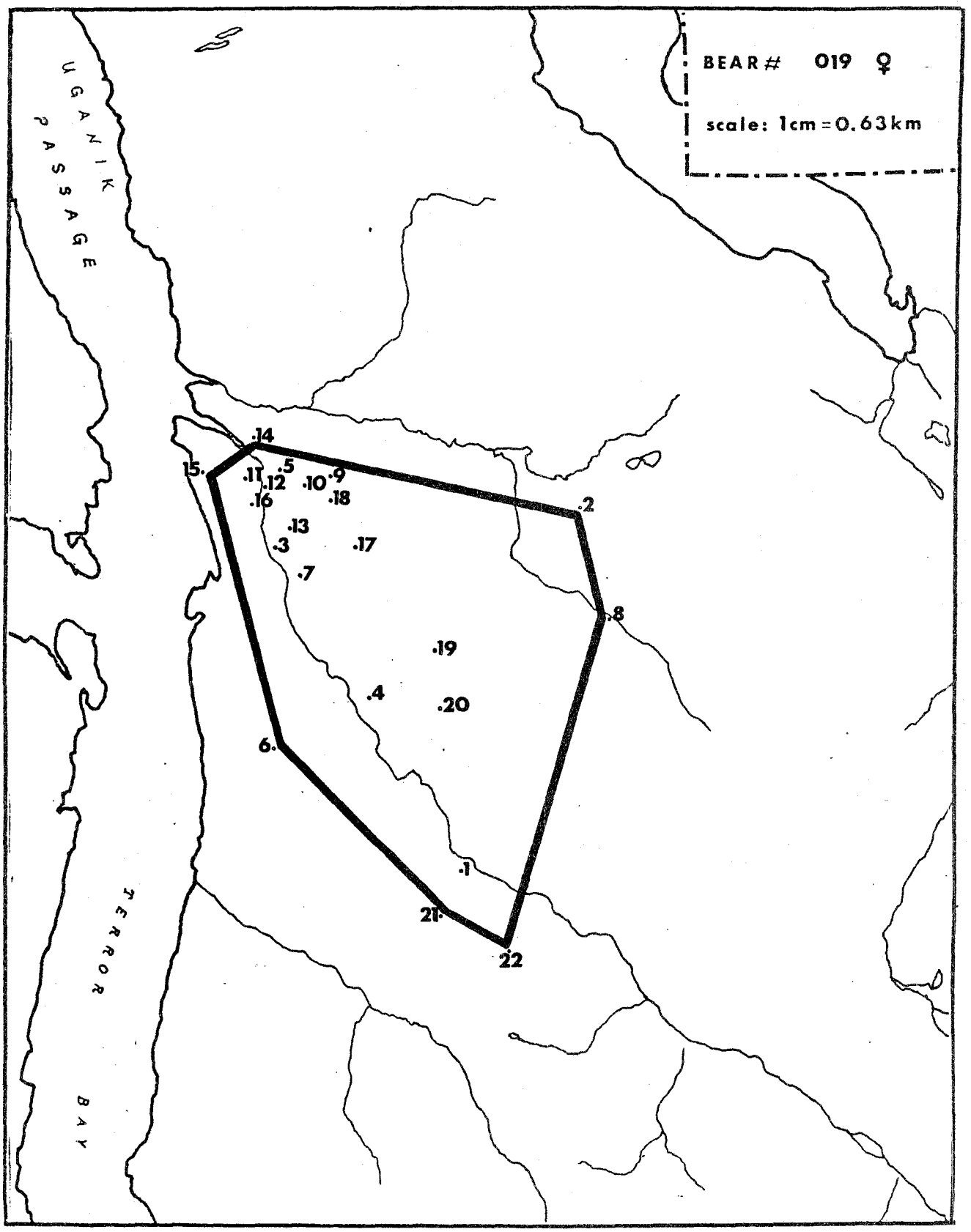

Figure 18. Point locations and home range for brown bear 019 in 1982.

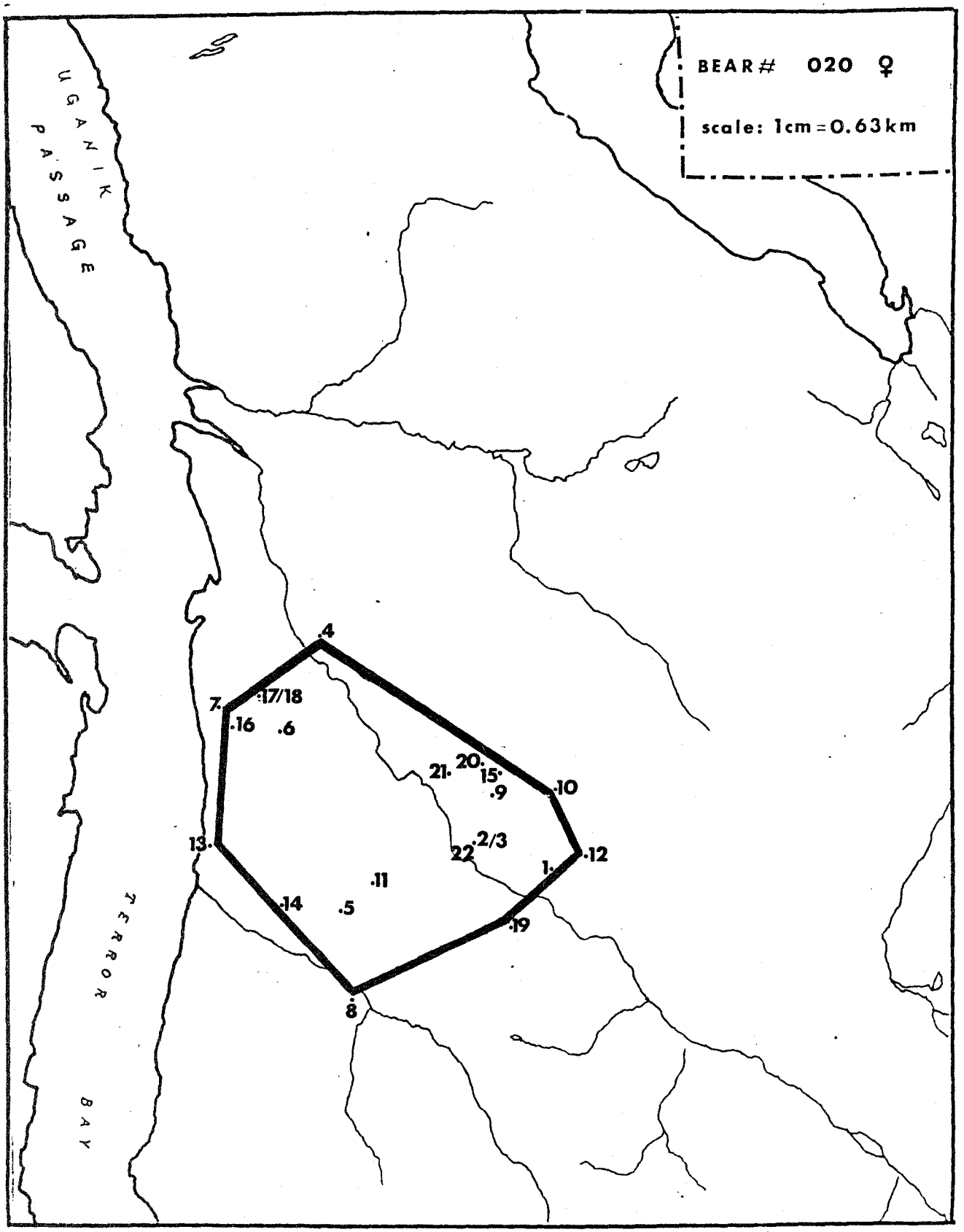

Figure 19. Point locations and home range for brown bear 020 in 1982.

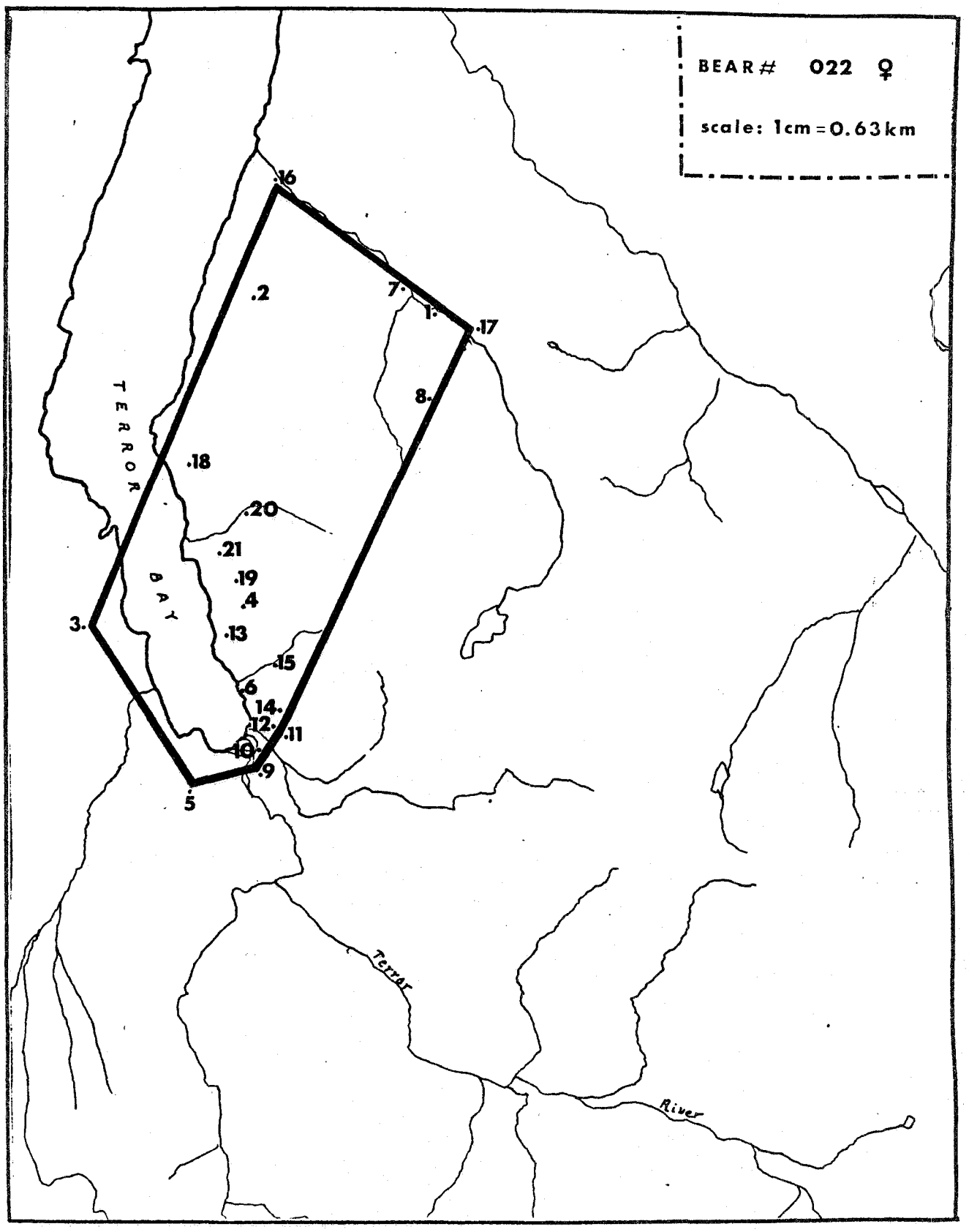

Figure 20. Point locations and home range for brown bear 022 in 1982.

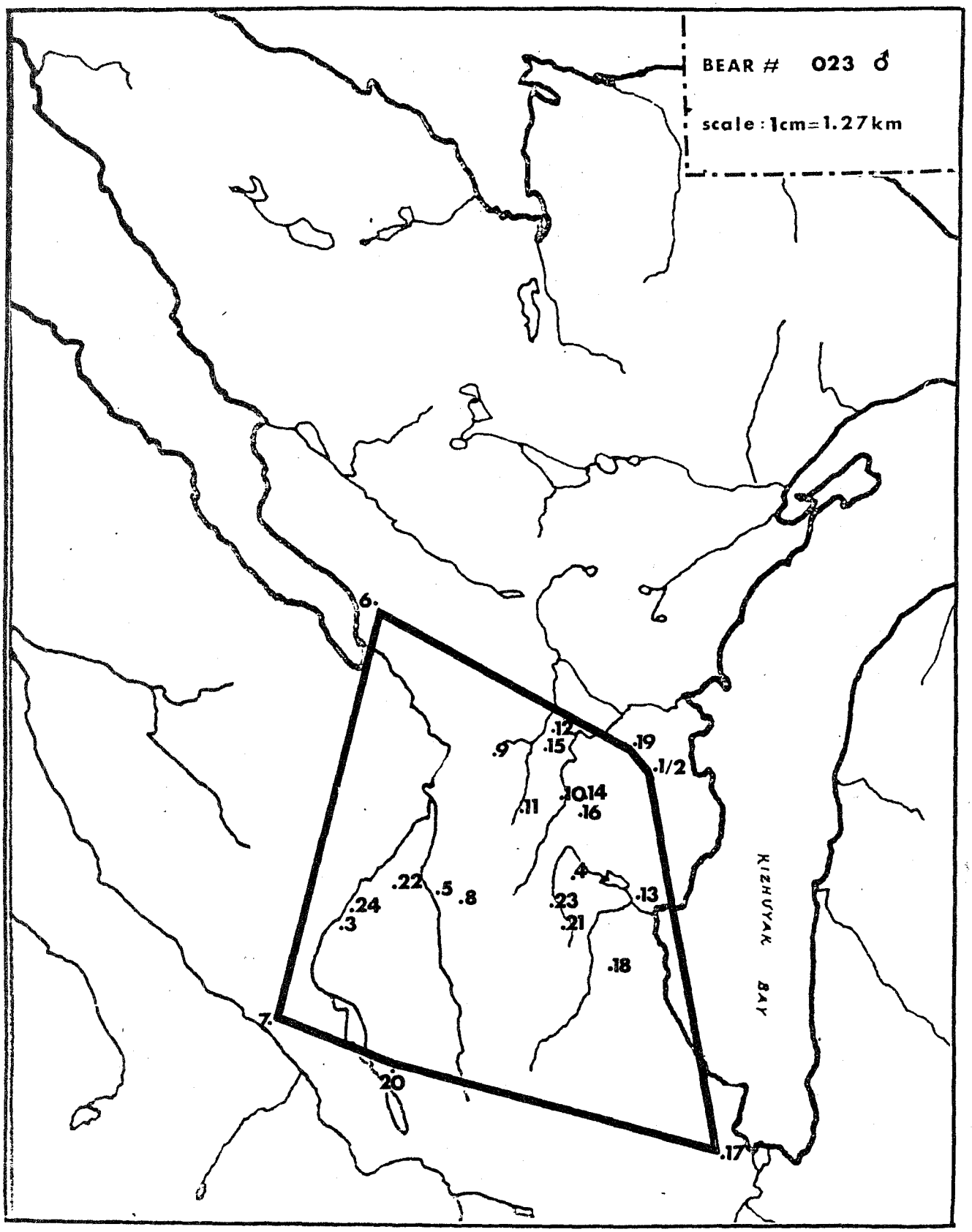

Figure 21. Point locations and home range for brown bear 023 in 1982.

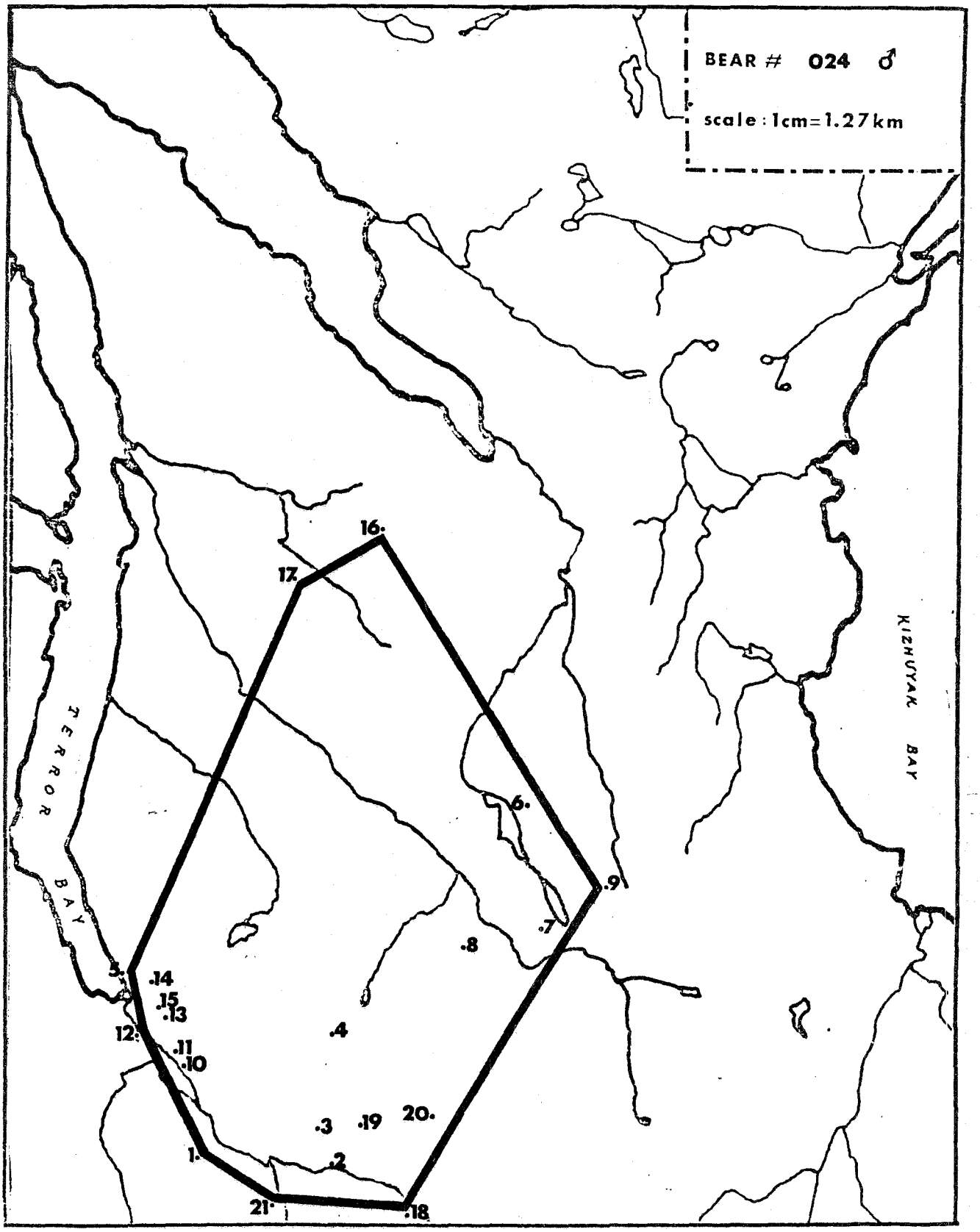

Figure 22. Point locations and home range for brown bear 024 in 1982.

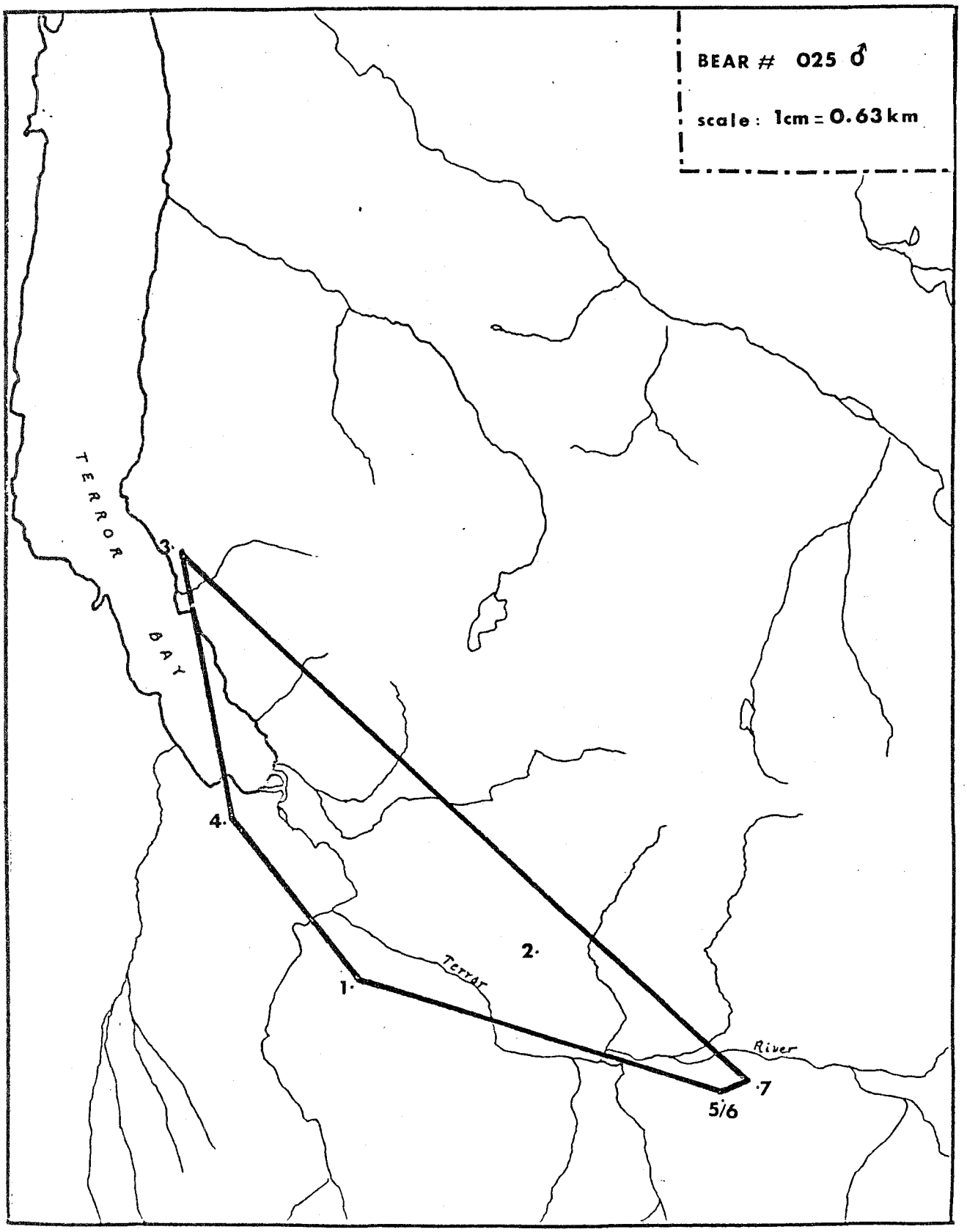

Figure 23. Point locations and home range for brown bear 025 in 1982.

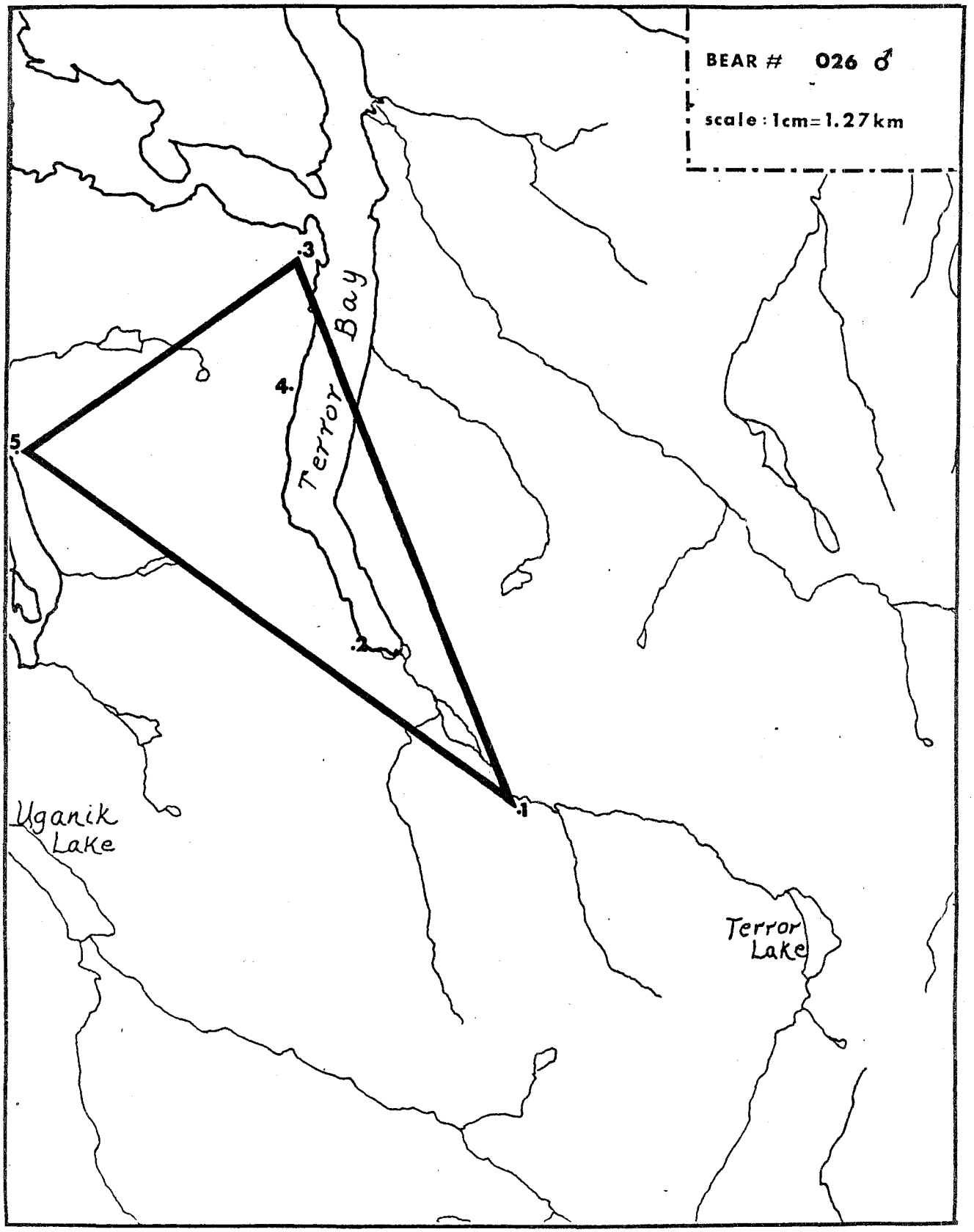

Figure 24. Point locations and home range for brown bear 026 in 1982.

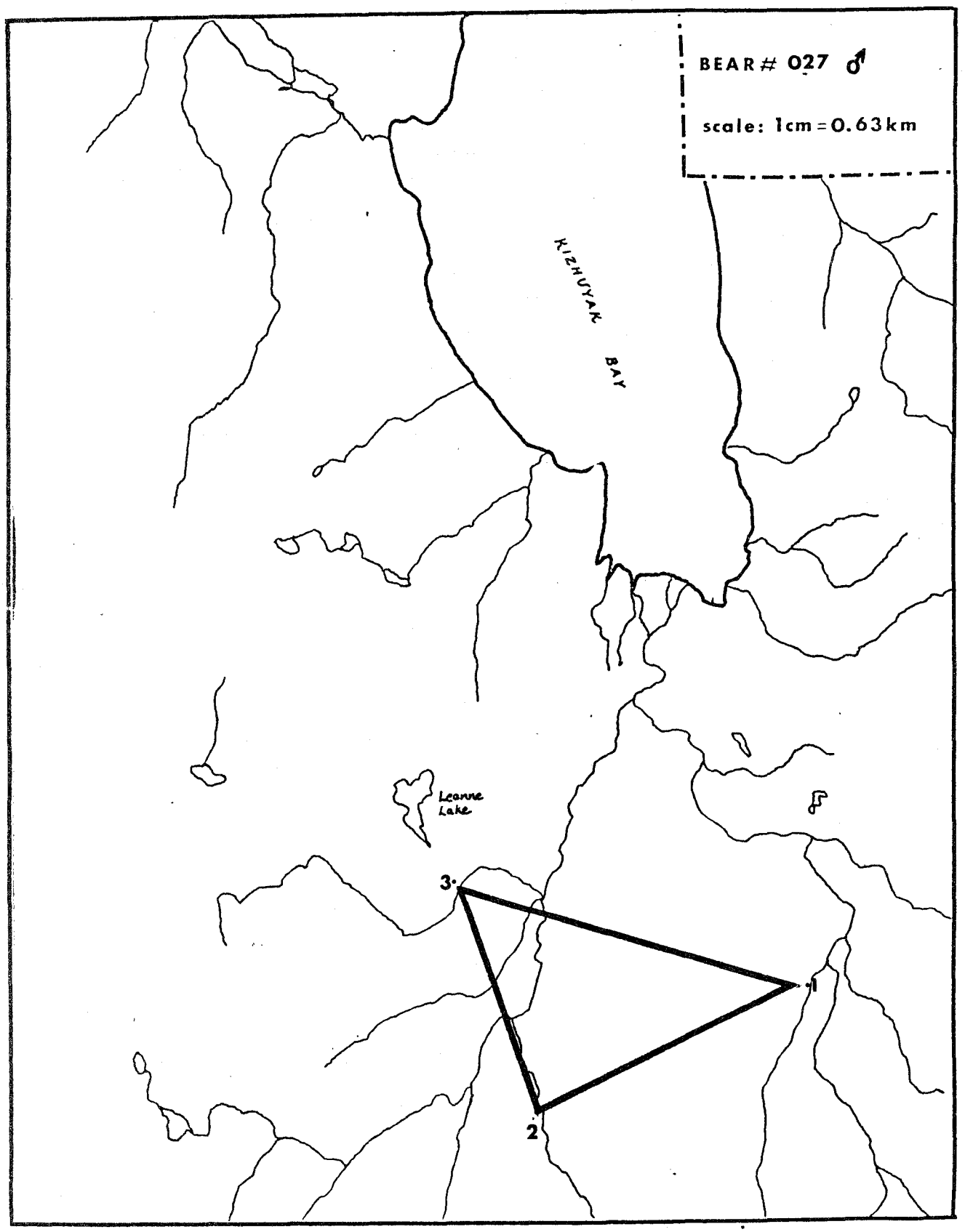

Figure 25. Point locations and home range for brown bear 027 in 1982.

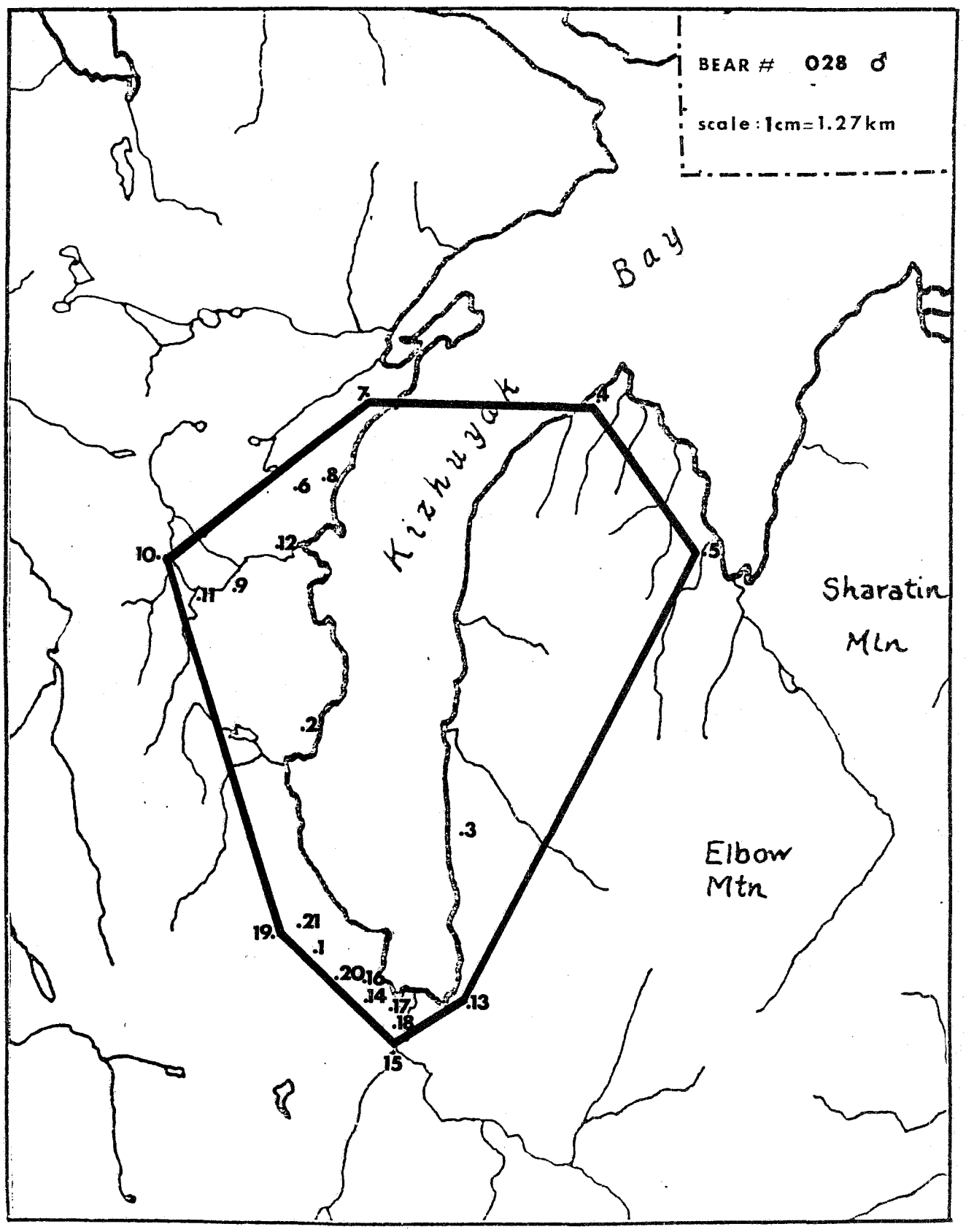

Figure 26. Point locations and home range for brown bear 028 in 1982.

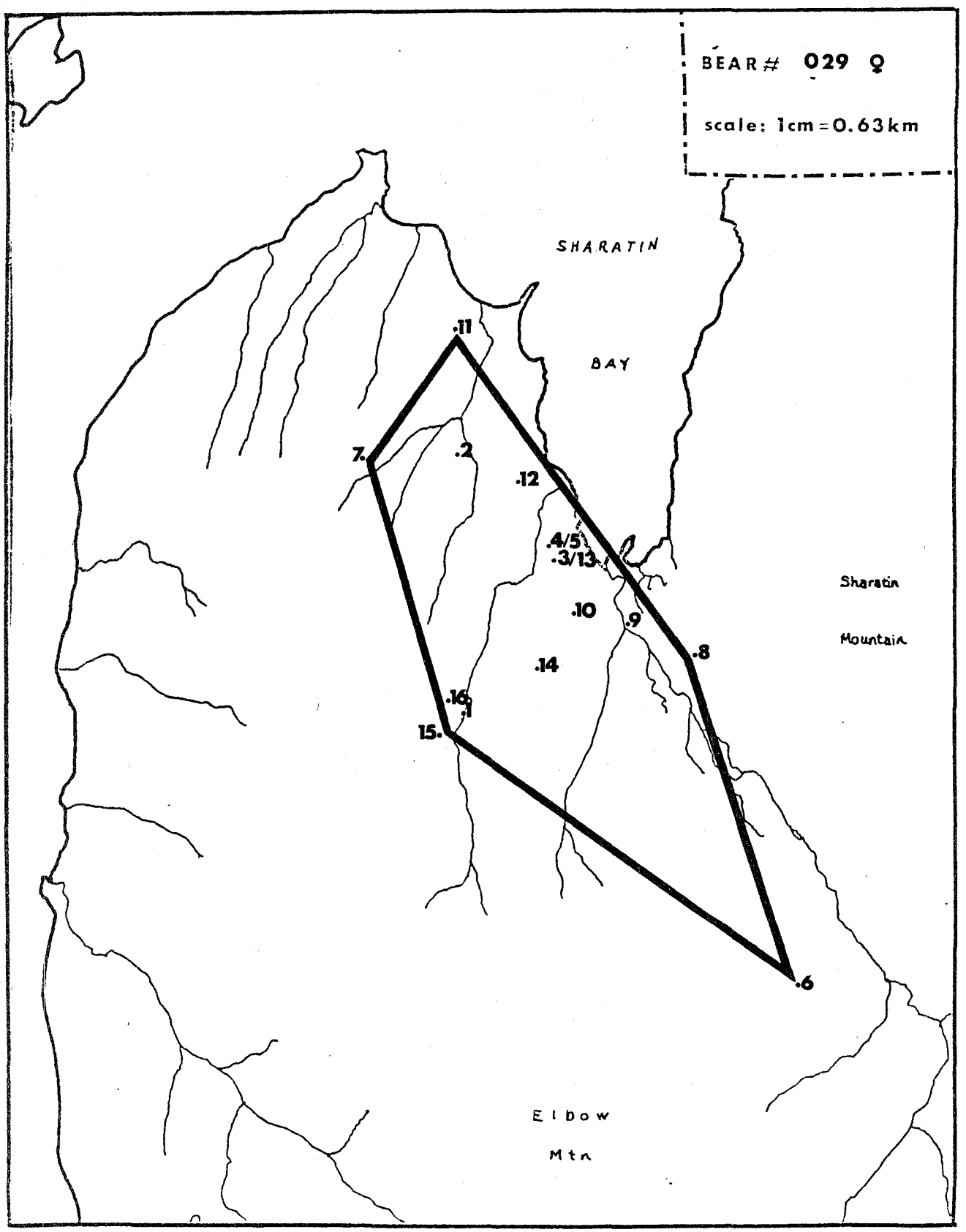

Figure 27. Point locations and home range for brown bear 029 in 1982.

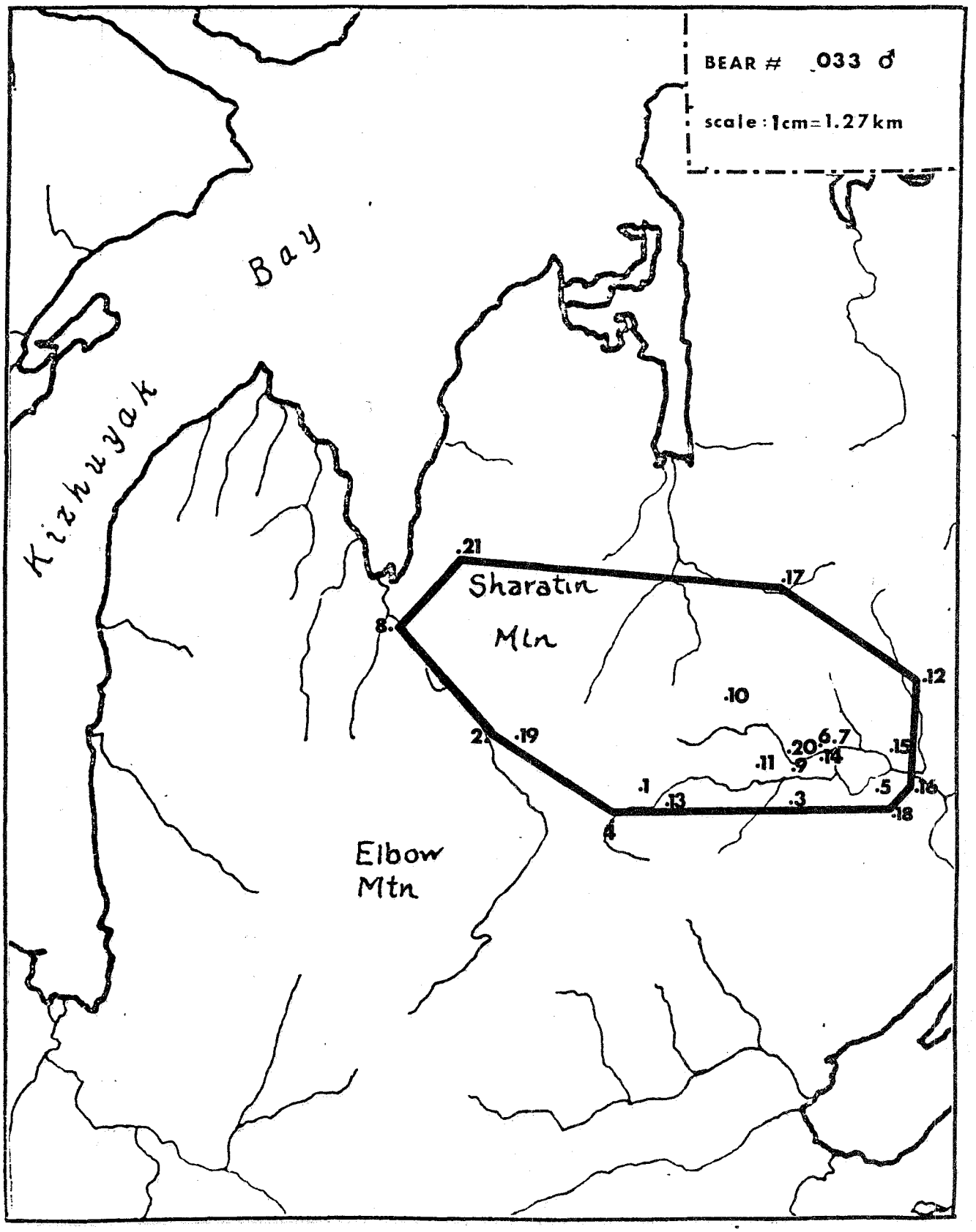

Figure 28. Point locations and home range for brown bear 033 in 1982.

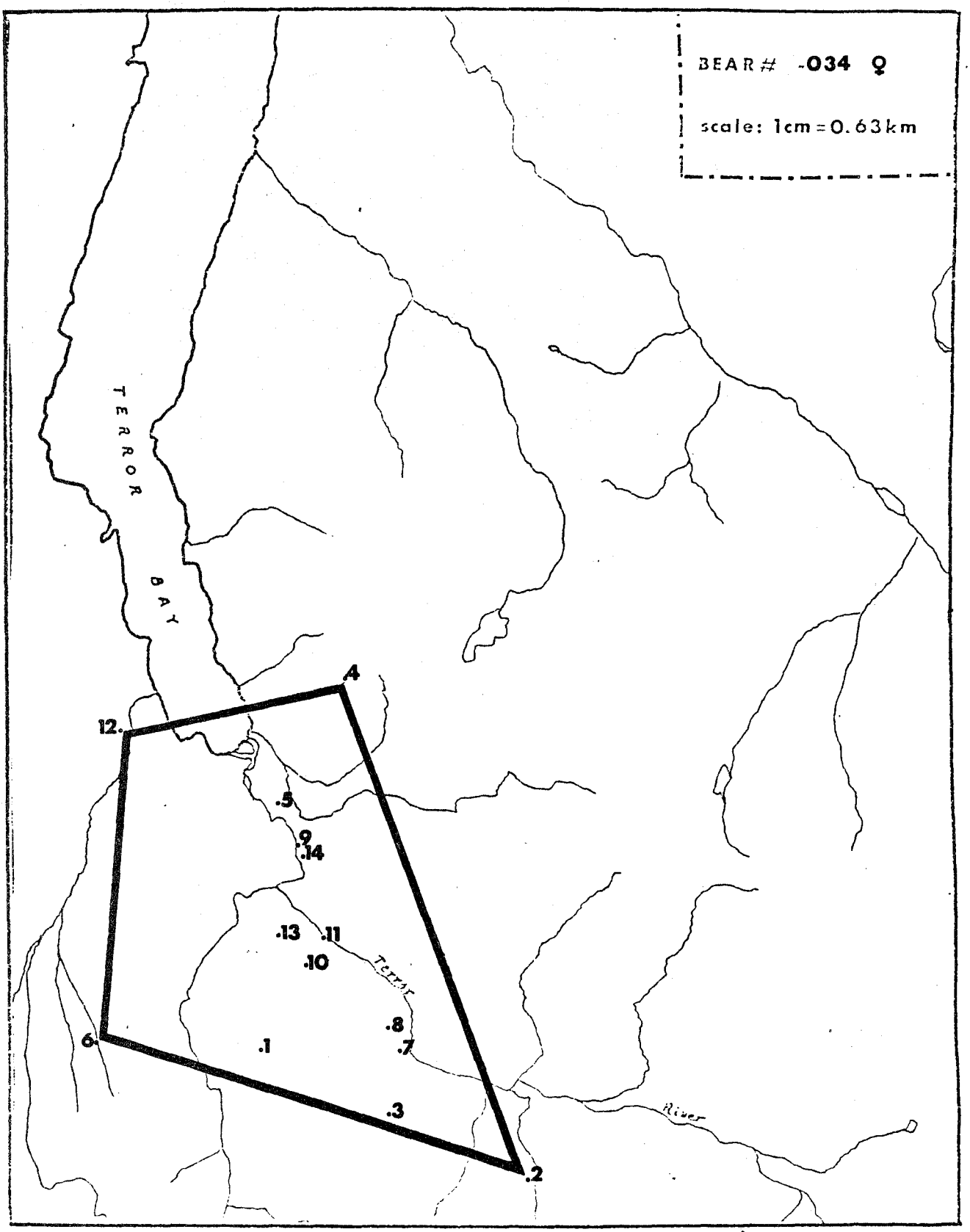

Figure 29. Point locations and home range for brown bear 034 in 1982.

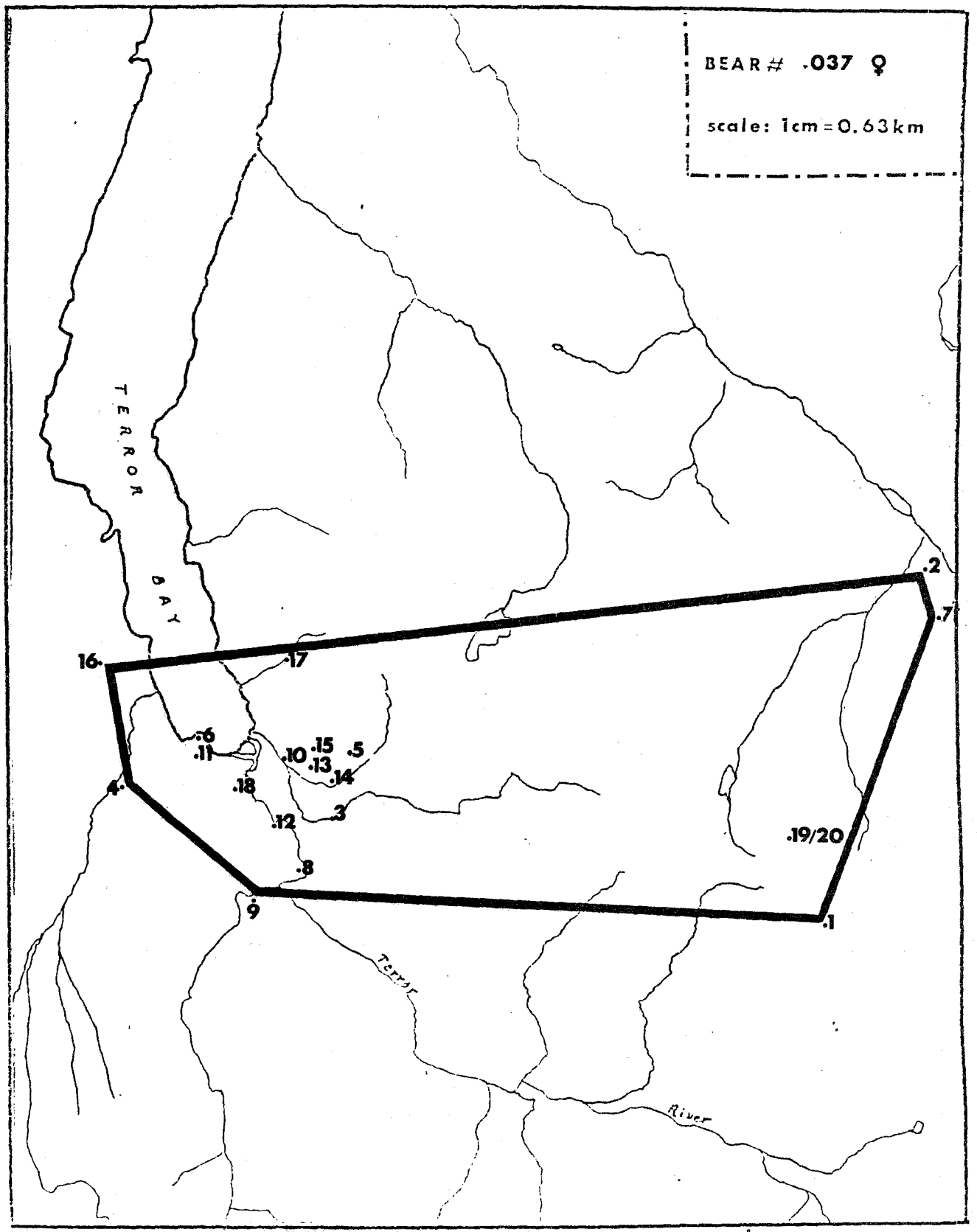

Figure 30. Point locations and home range for brown bear 037 in 1982.

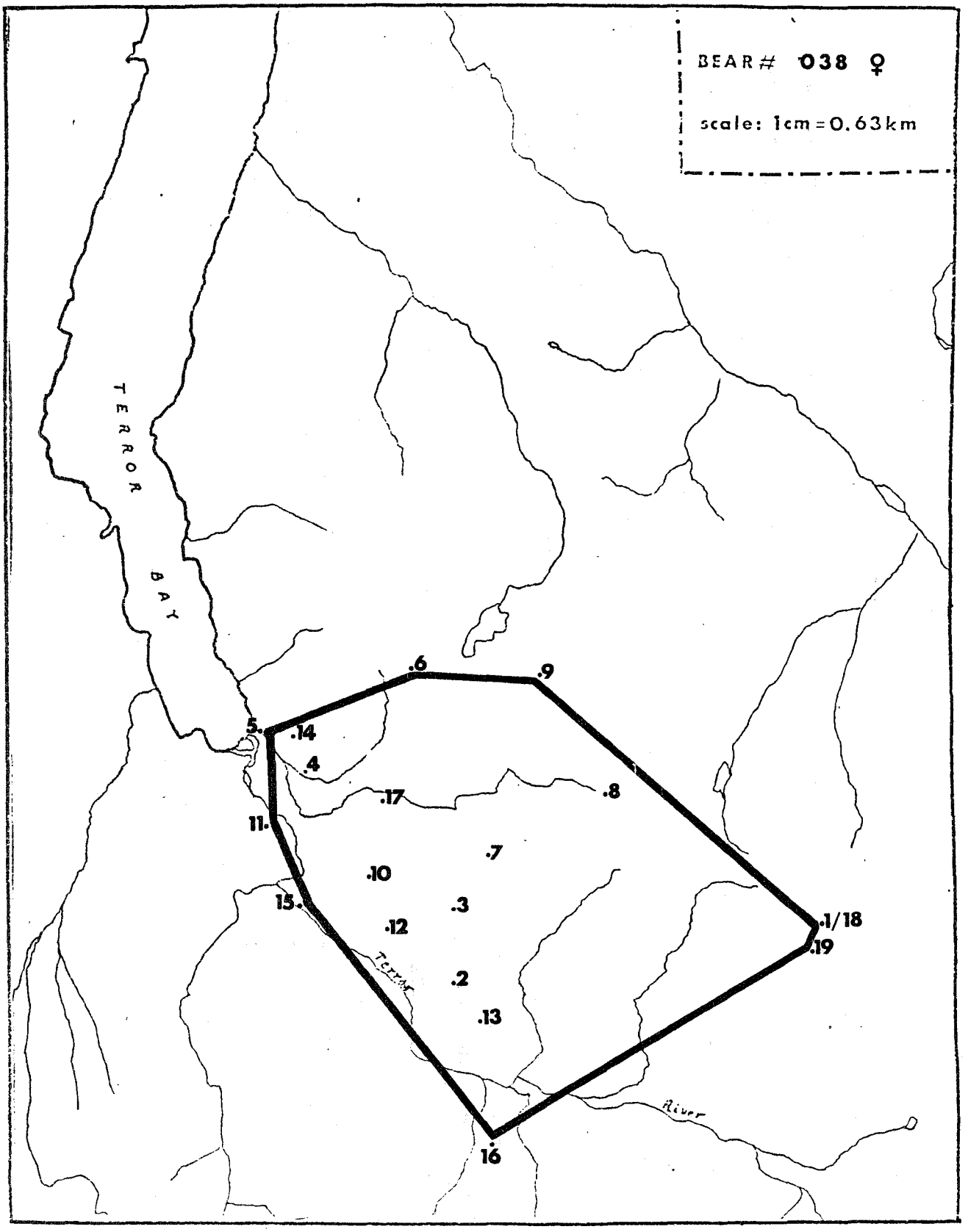

Figure 31. Point locations and home range for brown bear 038 in 1982.

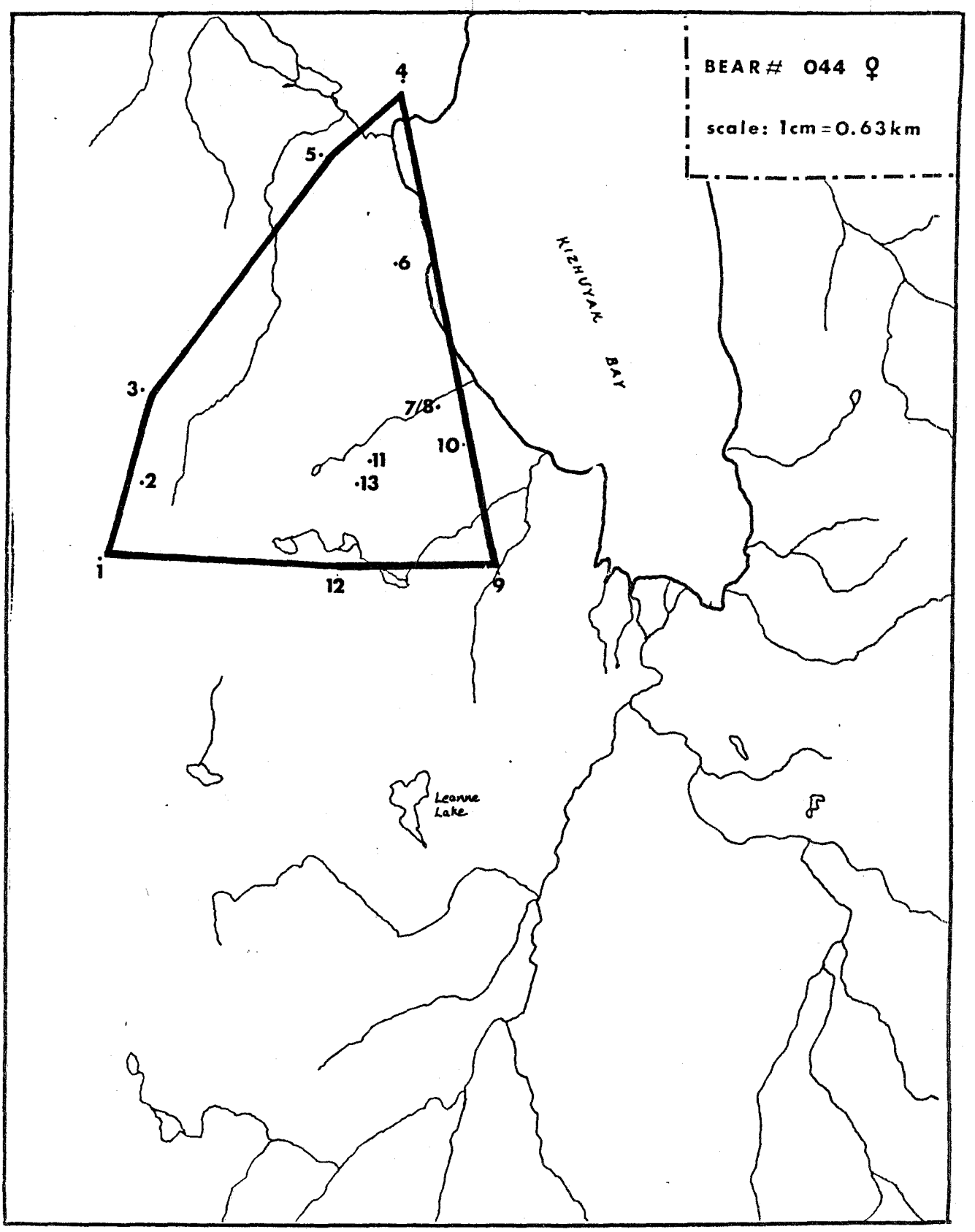

Figure 32. Point locations and home range for brown bear 044 in 1982.

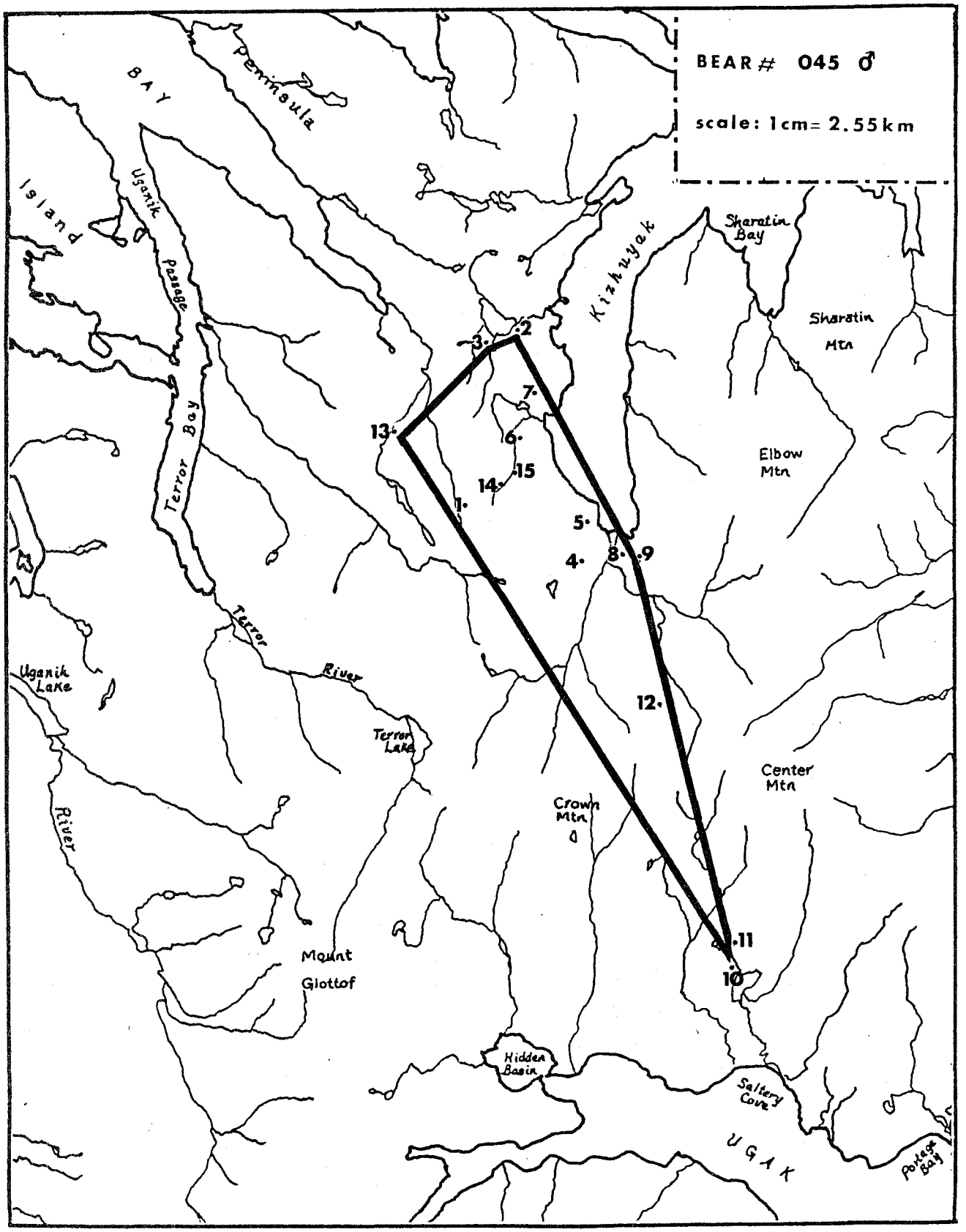

Figure 33. Point locations and home range for brown bear 045 in 1982.

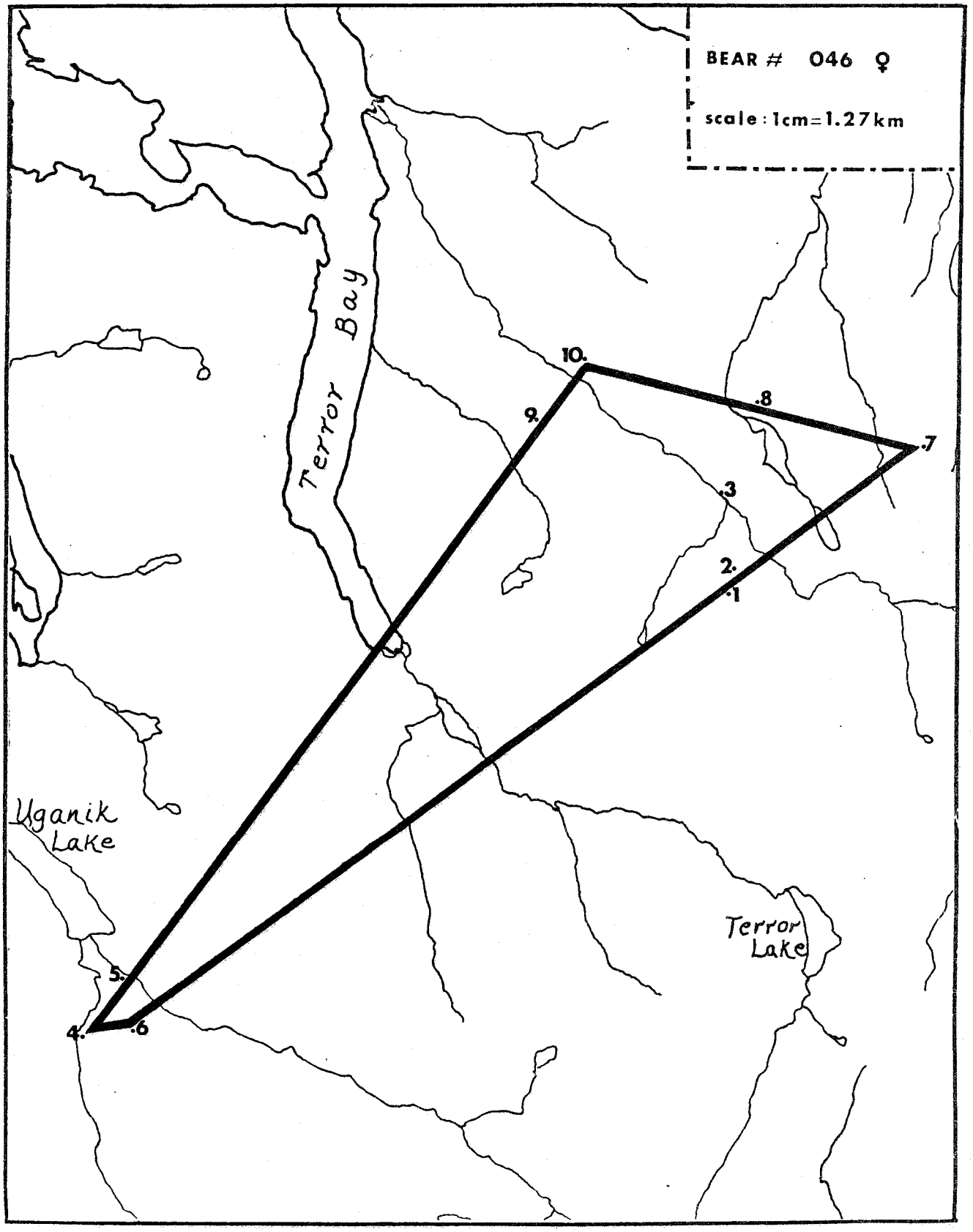

Figure 34. Point locations and home range for brown bear 046 in 1982.

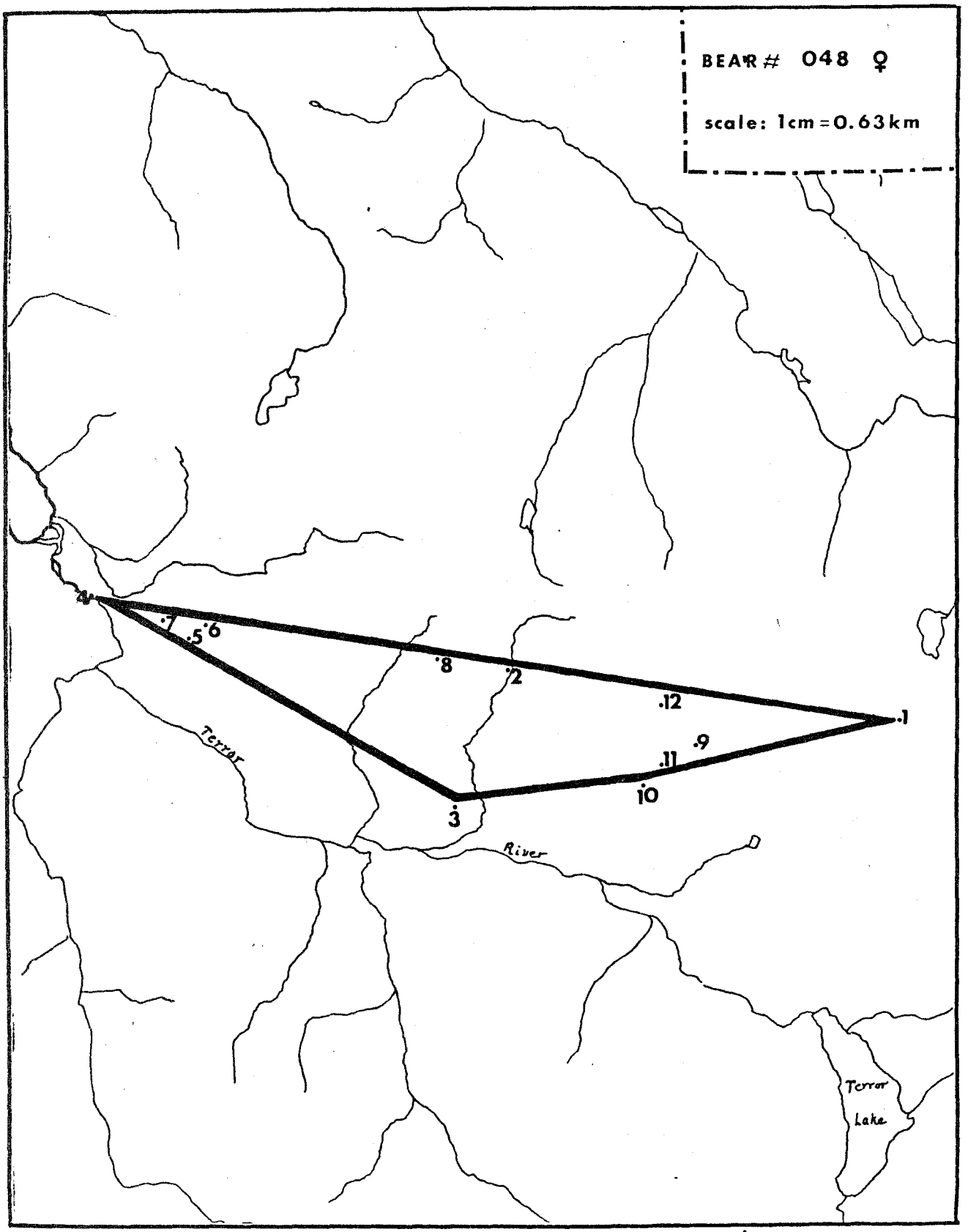

Figure 35. Point locations and home range for brown bear 048 in 1982.

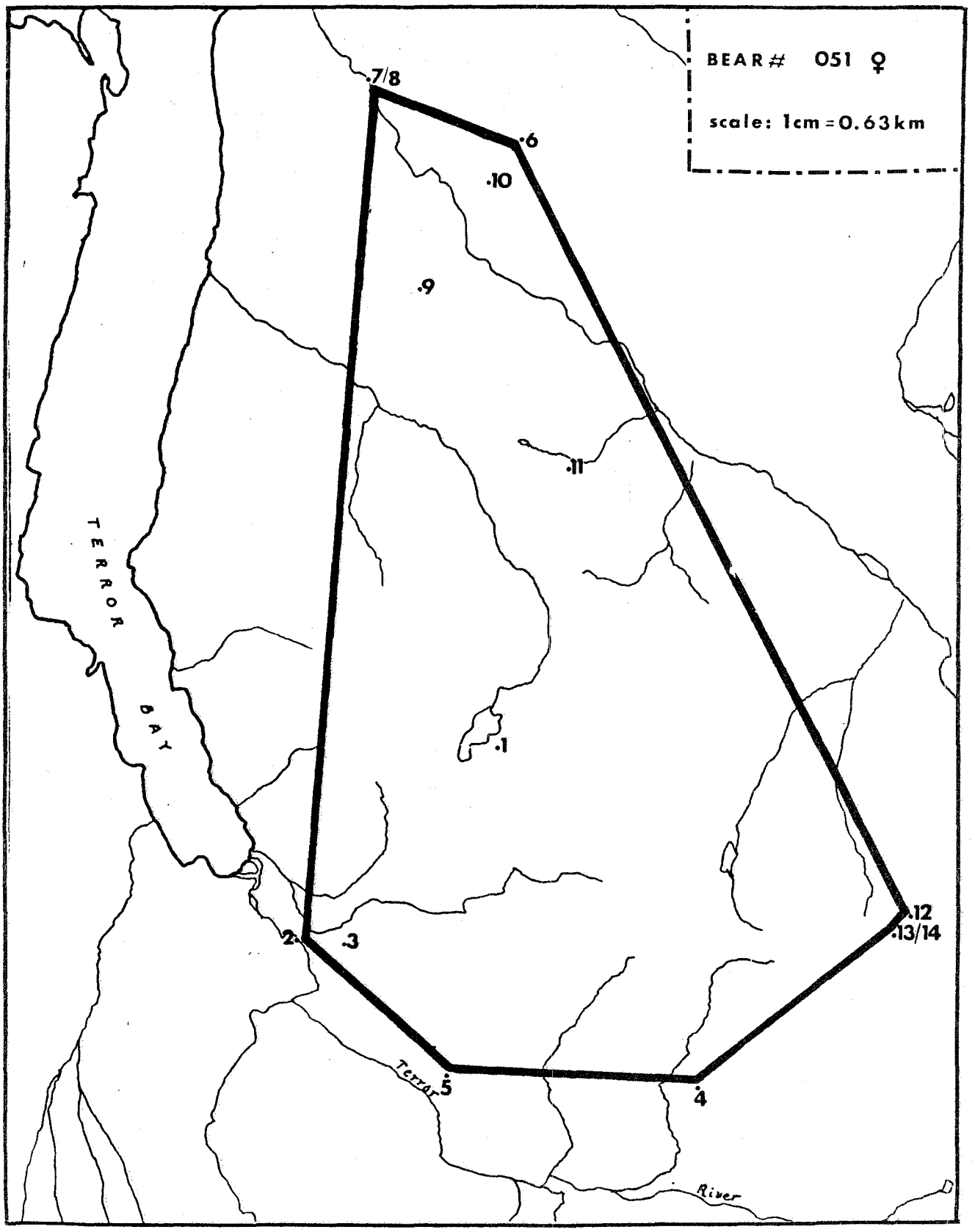

Figure 36. Point locations and home range for brown bear 051 in 1982.

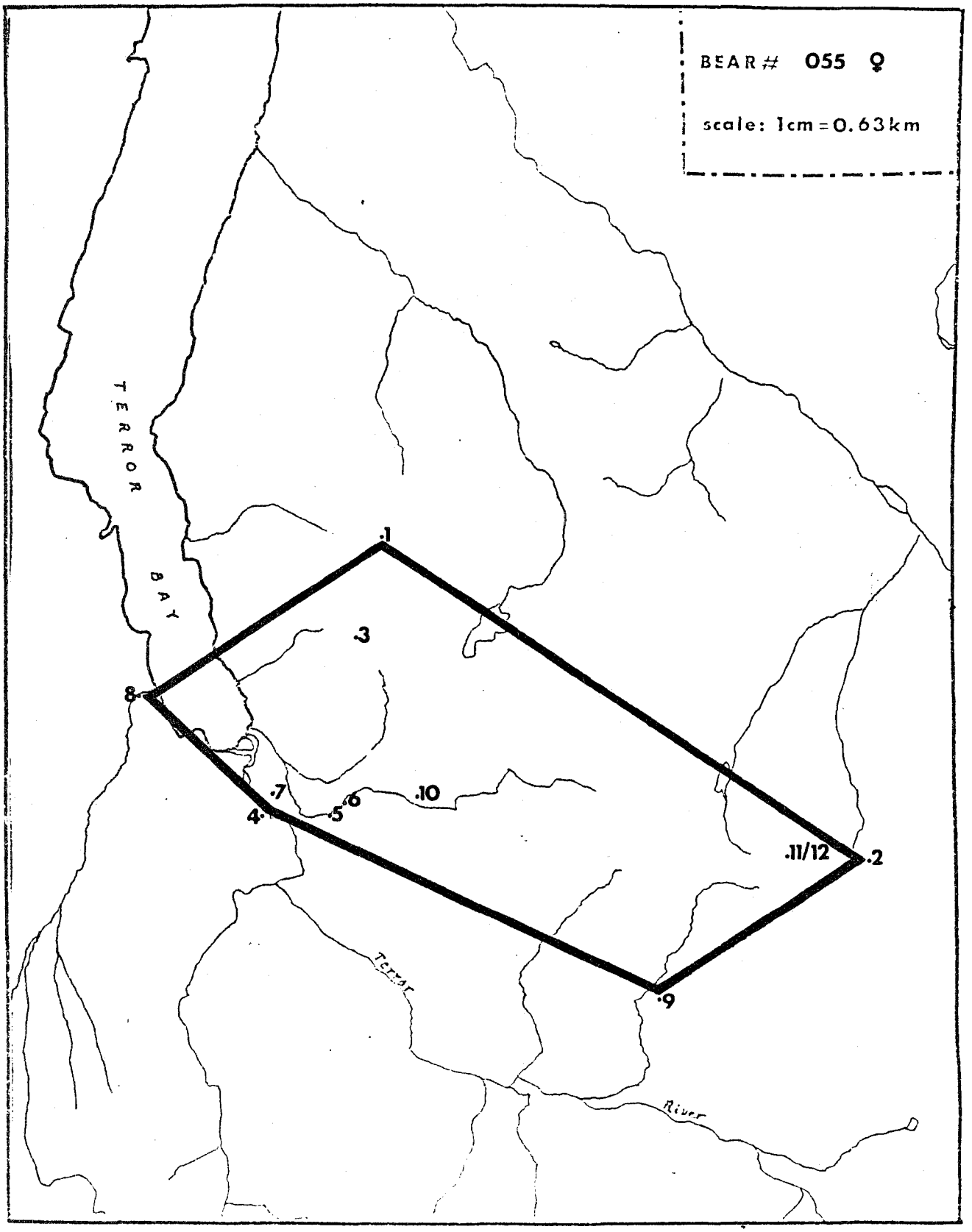

Figure 37. Point locations and home range for brown bear 055 in 1982.

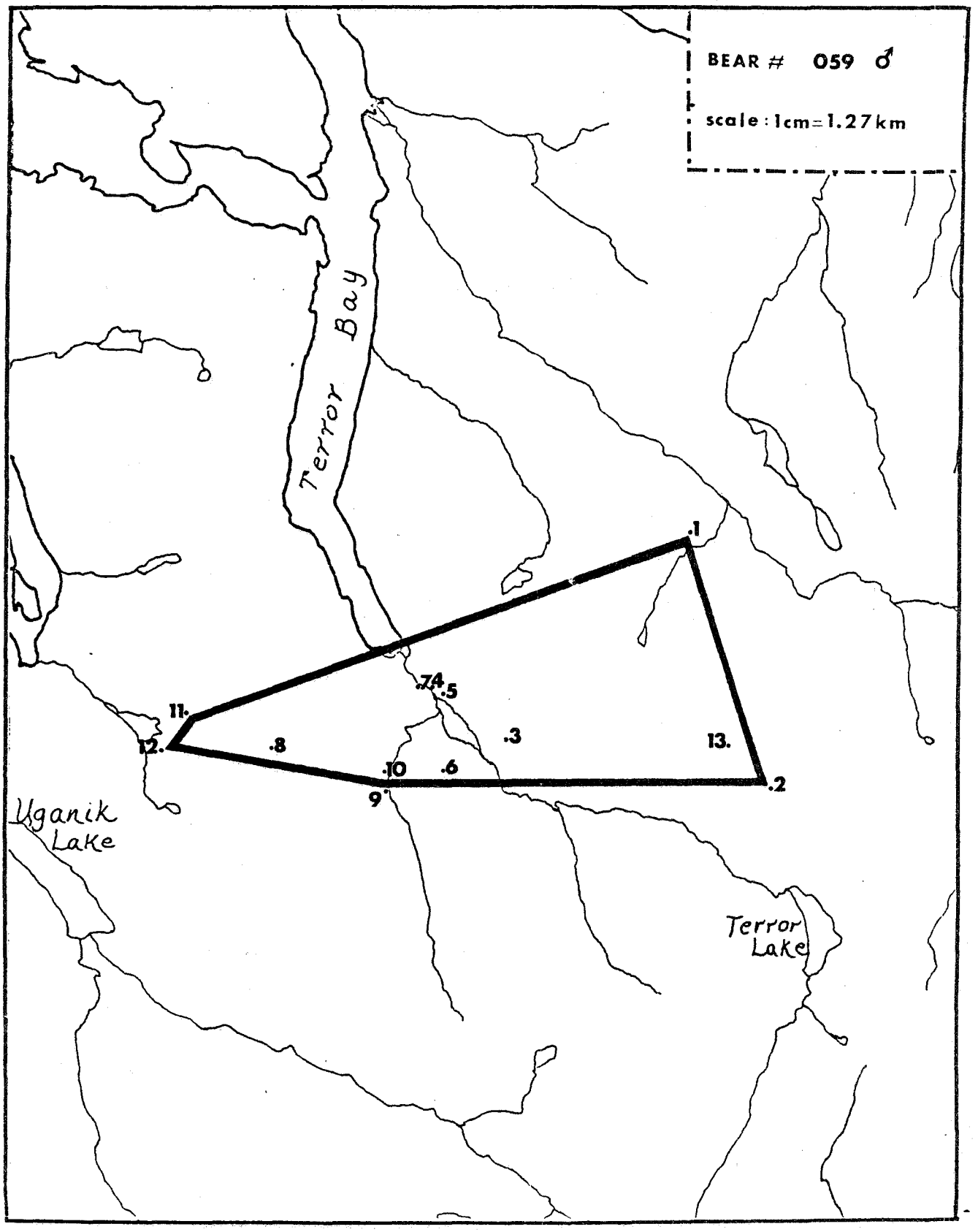

Figure 38. Point locations and home range for brown bear 059 in 1982.

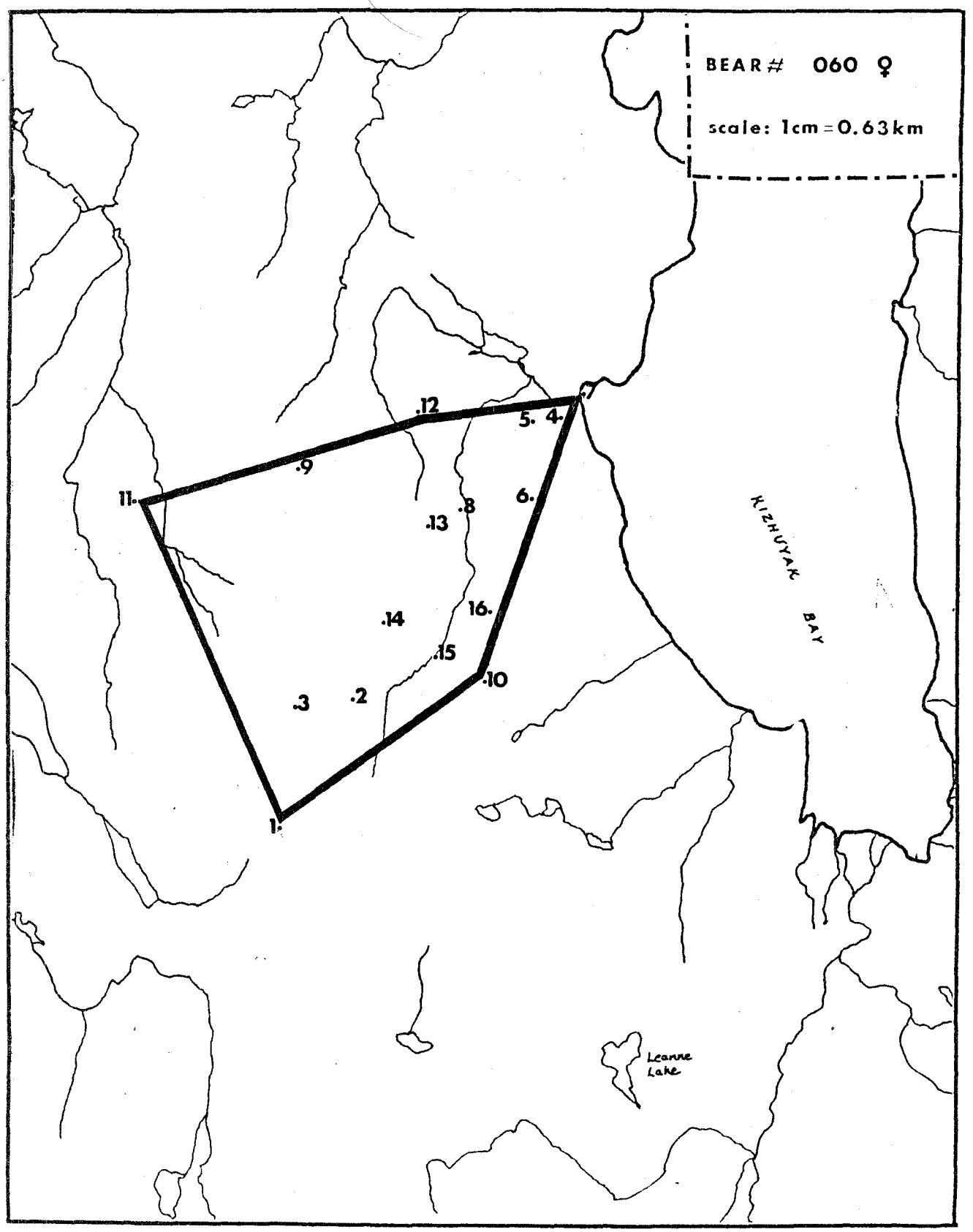

Figure 39. Point locations and home range for brown bear 060 in 1982.

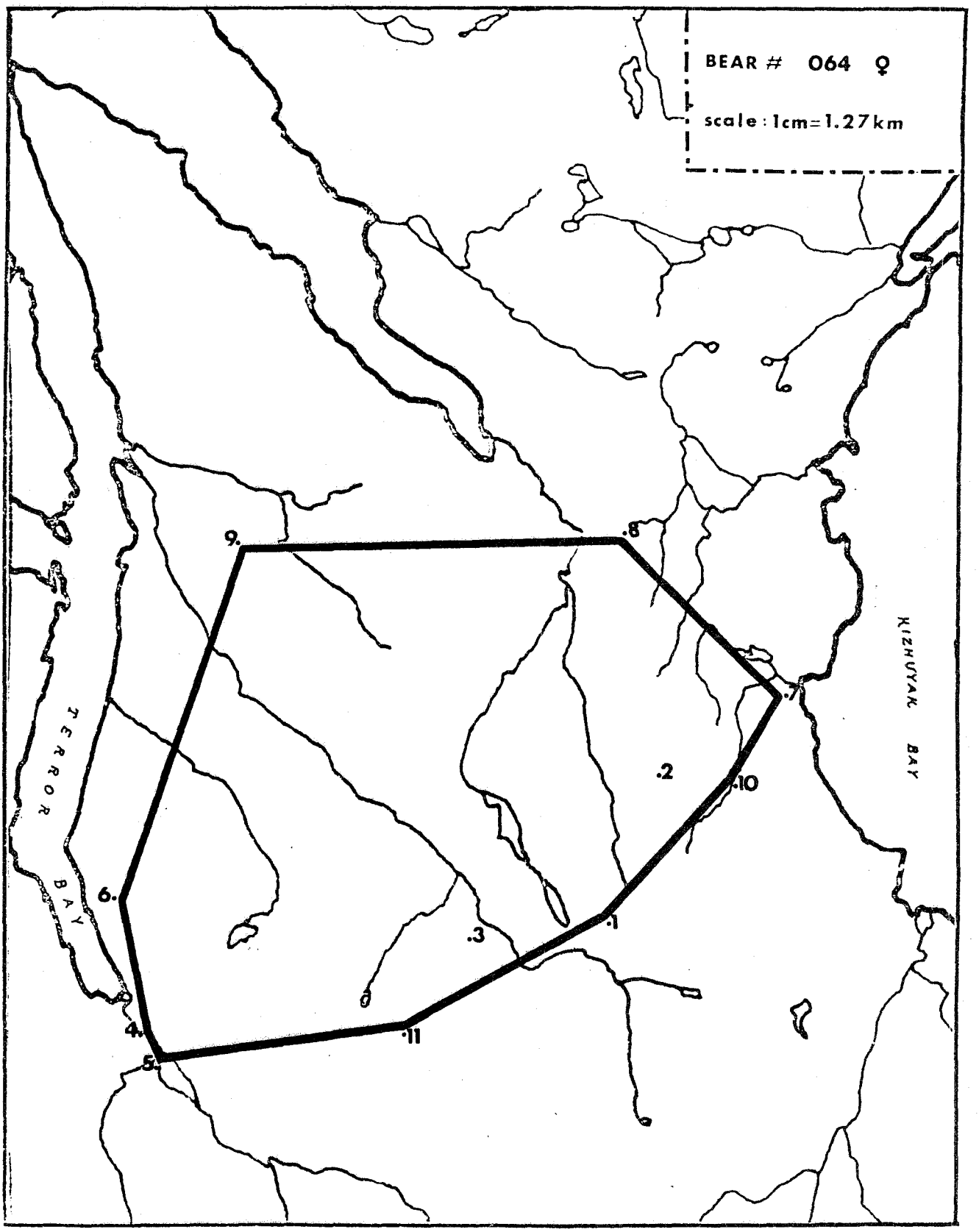

Figure 40. Point locations and home range for brown bear 064 in 1982.

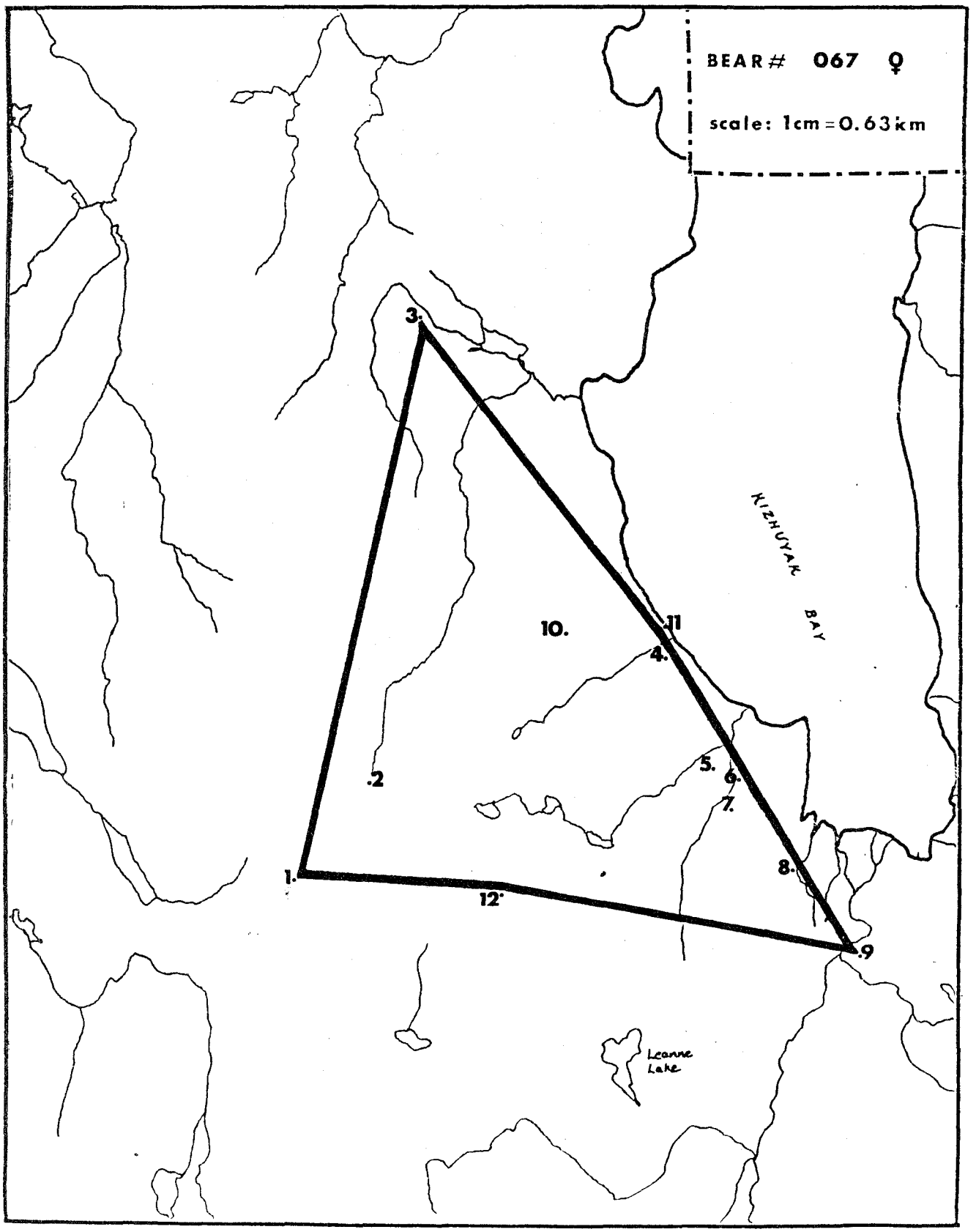

Figure 41. Point locations and home range for brown bear 067 in 1982.

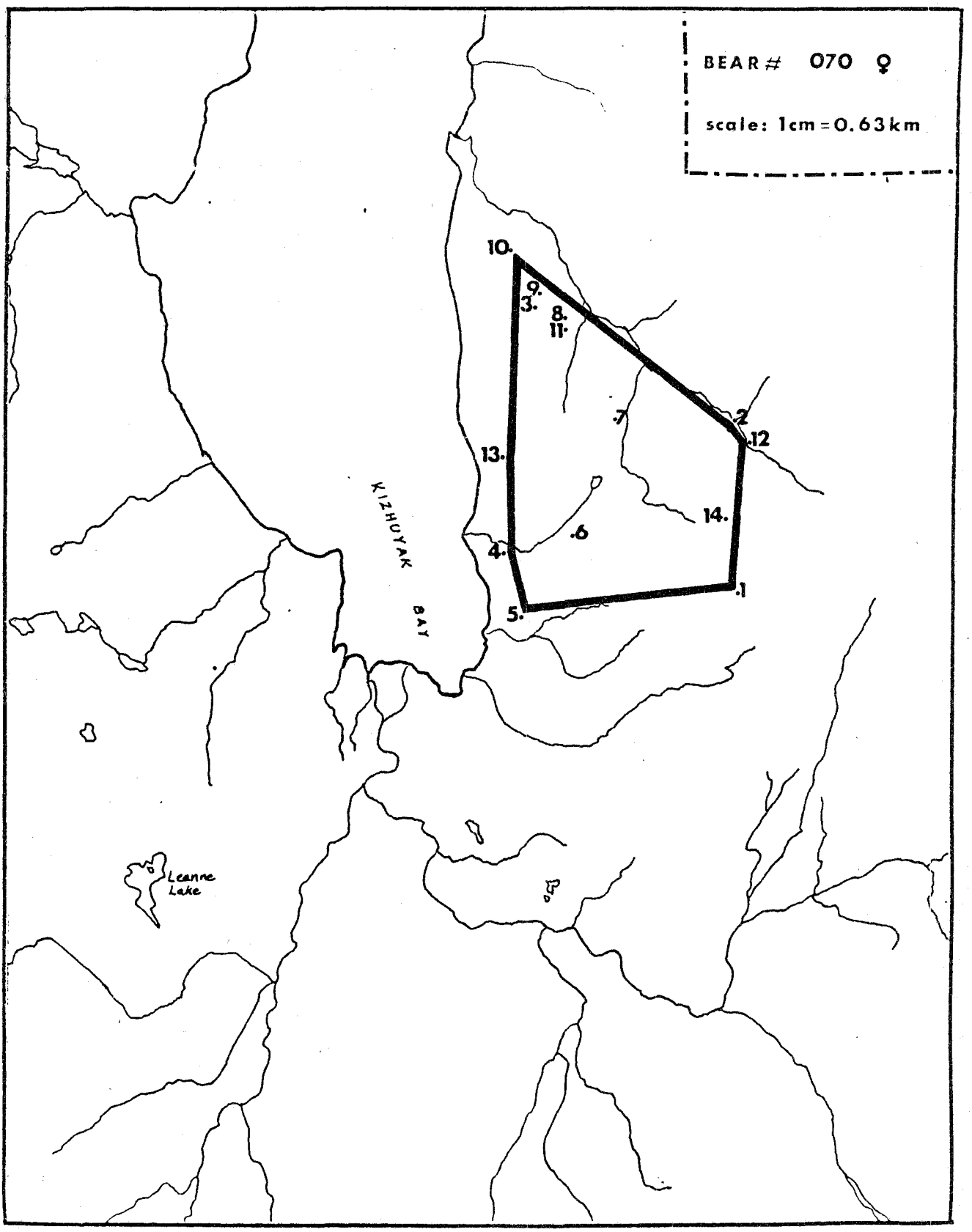

Figure 42. Point locations and home range for brown bear 070 in 1982.

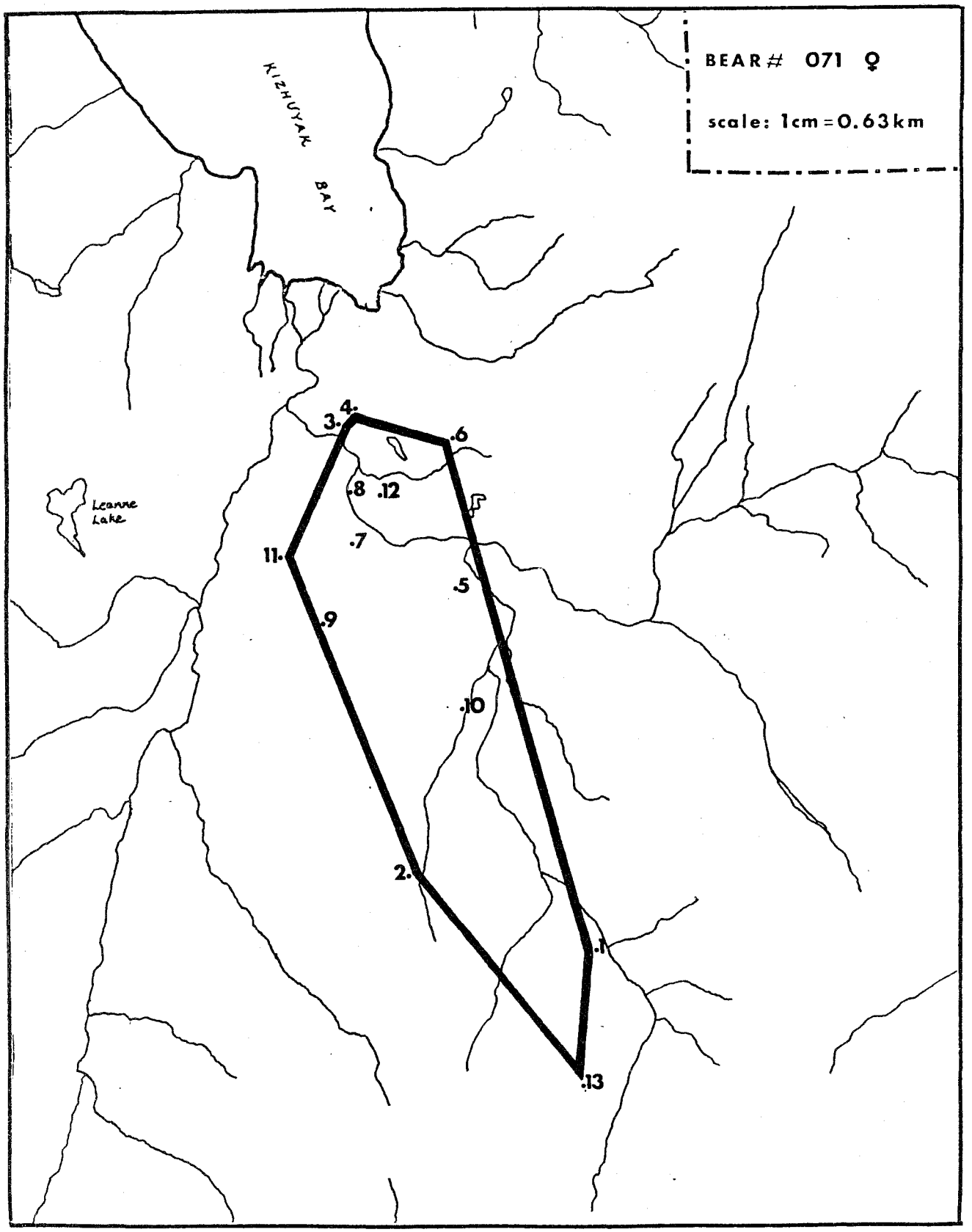

Figure 43. Point locations and home range for brown bear 071 in 1982.

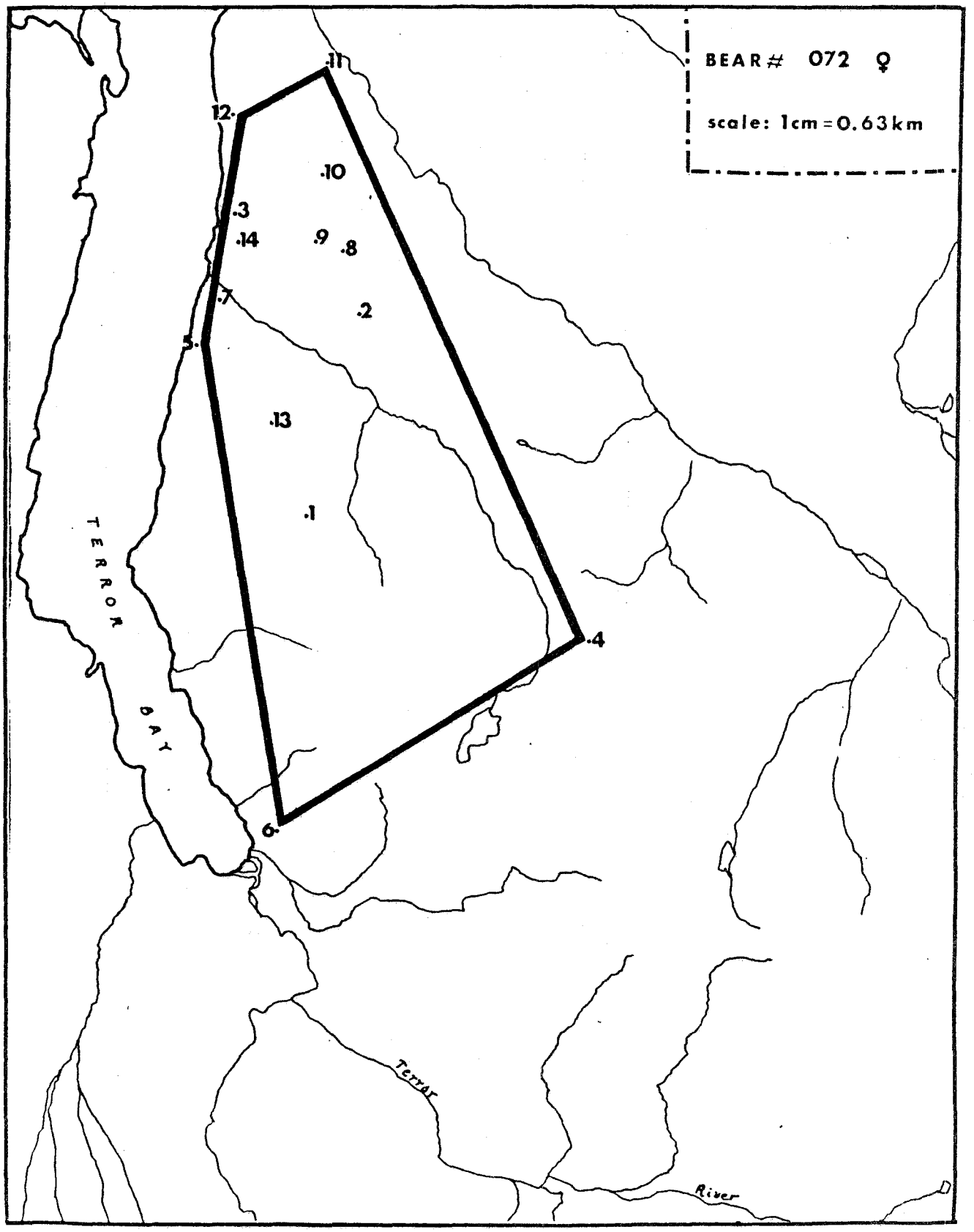

Figure 44. Point locations and home range for brown bear 072 in 1982.

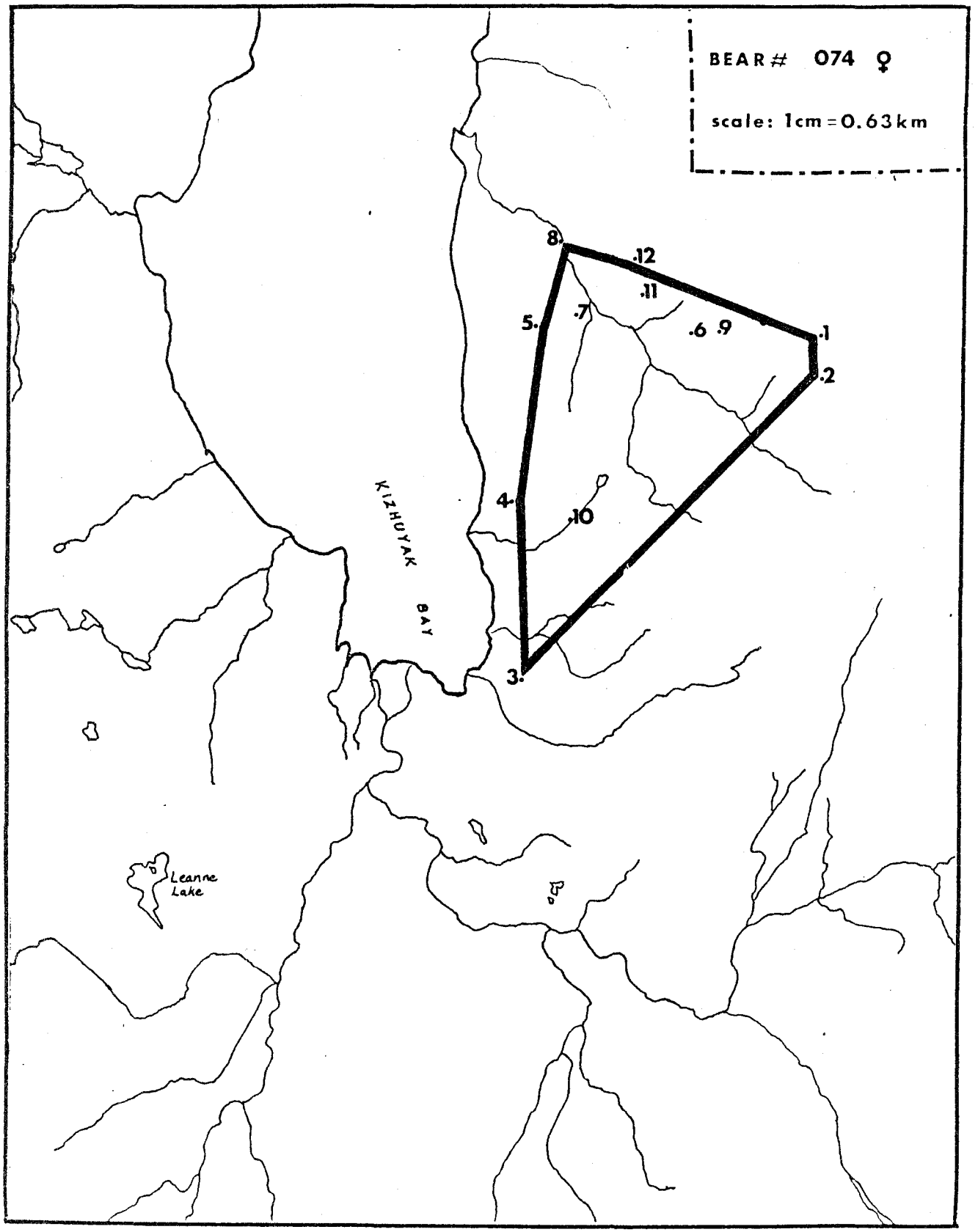

Figure 45. Point locations and home range for brown bear 074 in 1982.

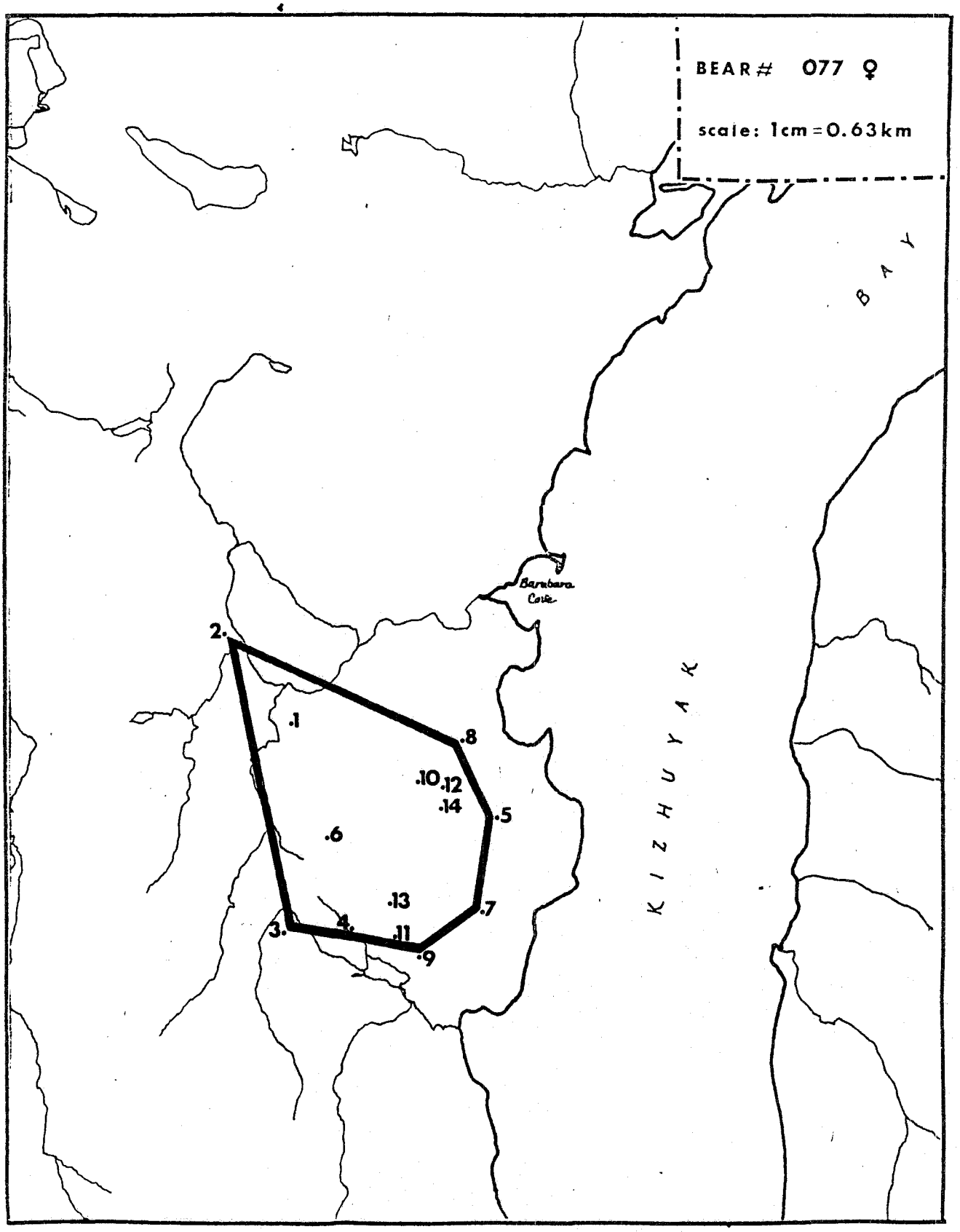

Figure 46. Point locations and home range for brown bear 077 in 1982.

TERROR LAKE HYDROELECTRIC PROJECT

REPORT ON MOUNTAIN GOAT STUDIES, 1982

Roger B. Smith and Larry Van Daele

ALASKA DEPARTMENT OF FISH AND GAME

Submitted to the

Alaska Power Authority

SUMMARY OF FINDINGS

The results of 3 aerial surveys and other observations of mountain goats in the Terror Lake Hydroelectric project area indicated that construction activities had no detectable effects on goat movements and distribution in 1982. Major winter ranges were located in the Wild Creek and Hidden Basin Creek drainages into Ugak Bay. Few goats occupied the Terror River and Kizhuyak River drainages during the winter. Goats began moving from Ugak Bay to the Kizhuyak Bay drainage in late spring and some goats occupied kidding areas west of Kizhuyak River by mid-June. At least 3 females gave birth to kids in the Falls Creek drainage within less than 1 km of active road construction activities. Up to 8 goats occupied the Falls Creek area intermittently from March through December during peak construction activities. Ranges used for kidding in 1982 were little changed from those previously recorded. No major shifts occurred in summer distribution of goats in the Terror River, Ugak Bay or Kizhuyak River drainages in 1982. An increasing overall trend in the Kodiak Island goat population was indicated by results of the August survey. Only 3 goats were killed by hunters in the Terror Lake vicinity in 1982. Construction activity was not a factor in hunting success or hunter distribution.

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INTRODUCTION

Studies to monitor the impacts on wildlife of construction and operation of the Terror Lake Hydroelectric project were required by the Federal Energy Regulatory Commission (FERC) as a condition for project licensing. The requirement for wildlife studies was intended to partially mitigate habitat loss from the project's construction. The Alaska Department of Fish and Game contracted with the Alaska Power Authority (APA) to conduct the study on mountain goats. The study began in 1982 and it is scheduled to continue through the project's construction phase (1982-1984) and 2 years into the operational stage (1985-1986). This paper is a progress report for 1982.

Background

Several wildlife management agencies have expressed concerns about the effects on mountain goats of harassment, habitat destruction and overharvest resulting from road construction associated with resource extraction activities (Johnson, 1977). Previous studies on the impacts of natural resource development on mountain goats have focused on logging (Chadwick, 1973; Schoen, and Kirchoff, 1982; Smith, 1982) and mining (Pendergast and Bindernagel, 1977). Pre-project studies suggested that disturbance during construction of the Terror Lake project might displace mountain goats from traditional ranges in the Kizhuyak River and Terror Lake drainages of Kodiak Island (Spencer and Hensel, 1980). Traditional ranges of the goat population were well-documented from aerial surveys conducted nearly every year since the goats were introduced to Kodiak Island in 1952. Additional surveys were done in 1980 to delineate kidding ranges and winter distribution of goats in the project area (Spencer and Hensel, 1980). Because goat distribution and movements were relatively well-known, continued aerial surveys were considered adequate sources of information for evaluating the impacts of the construction project.

Study Objectives

This study was to document the impacts of construction and operation of the Terror Lake Hydro electric project on mountain goats. The study

objectives were:

1. Determine changes in mountain goat use of feeding and kidding ranges.

2. Determine changes in mountain goat movement patterns.

Acknowledgements

Several Alaska Department of Fish and Game employees assisted in the field work and in completing this report. Karl Schneider secured approval for the project and contributed his editorial and supervisory skills. Ben Ballenger assisted with the aerial surveys. L. Metz prepared the figures and S. Malutin typed several drafts of this report.

Hank Hosking of the U.S. Fish and Wildlife Service collected observations by construction personnel and provided useful summaries of progress of construction.

Helicopter pilots, T. Miller and W. Edgars, and fixed-wing pilots, J. Miller and R. Wright, flew the aerial surveys.

METHODS

Three aerial surveys were conducted in 1982 to determine the seasonal distribution and movements of mountain goats in the Terror River, Kizhuyak River and northwestern Ugak Bay drainages. Additional observations of goats made incidental to other field activities and observations made by construction personnel were also recorded.

A winter distribution survey was done on 26, 27 February, 1982, using a Bell 206-B helicopter with a pilot and 2 observers. Known and suspected goat wintering areas were searched by making repeated passes at elevations above 150 m. Suspected goat habitat along the Kodiak transmission line corridor was also searched. Each goat observation was plotted on a 1:63,000

scale topographic map. Group size and the number of kids and adults were recorded. The elevation, exposure and snow conditions were recorded for each observation.

The above described technique was used to locate parturition areas in the project area on 15, 16 June, 1982.

A third survey to determine summer distribution was done on 12, 18 and 19 August by fixed-wing aircraft with a pilot and one observer. This survey included additional areas in the Uganik and Ugak drainages which were not covered during the previous 2 surveys.

Distribution of goats in 1982 was compared with pre-construction distribution based on several years of aerial surveys and hunter kill data. Because pre-construction seasonal goat distribution in the study area was well documented it was assumed that major shifts in the ranges occupied by goats could be attributed to the effects of disturbance from construction activites.

THE STUDY AREA

Description and location of study area

The study area is located in the northeastern part of Kodiak Island and includes drainages into Kizhuyak Bay, Terror Bay, Uganik River and northwestern Ugak Bay (Fig. 1). A range of rugged granitic peaks extends in a northeast-southwest direction and divides the island. The area has a maritime climate with frequent rain, overcast skies and high winds. The climate and geology of Kodiak Island are described in Karlstrom (1969).

Vegetation of the study area is primarily a mosaic of grass, brush and forbs from sea level to about 450 m. Alder (Alnus crispa sinuata), salmonberry (Rubus spectabilis), bluestem (Calamagrostis canadensis) and fireweed (Epilobium angustifolium) are the dominant plant species. Cottonwood (Populus balsamifera) and Kenai birch (Betula papyrifera kenaica) are found along valley

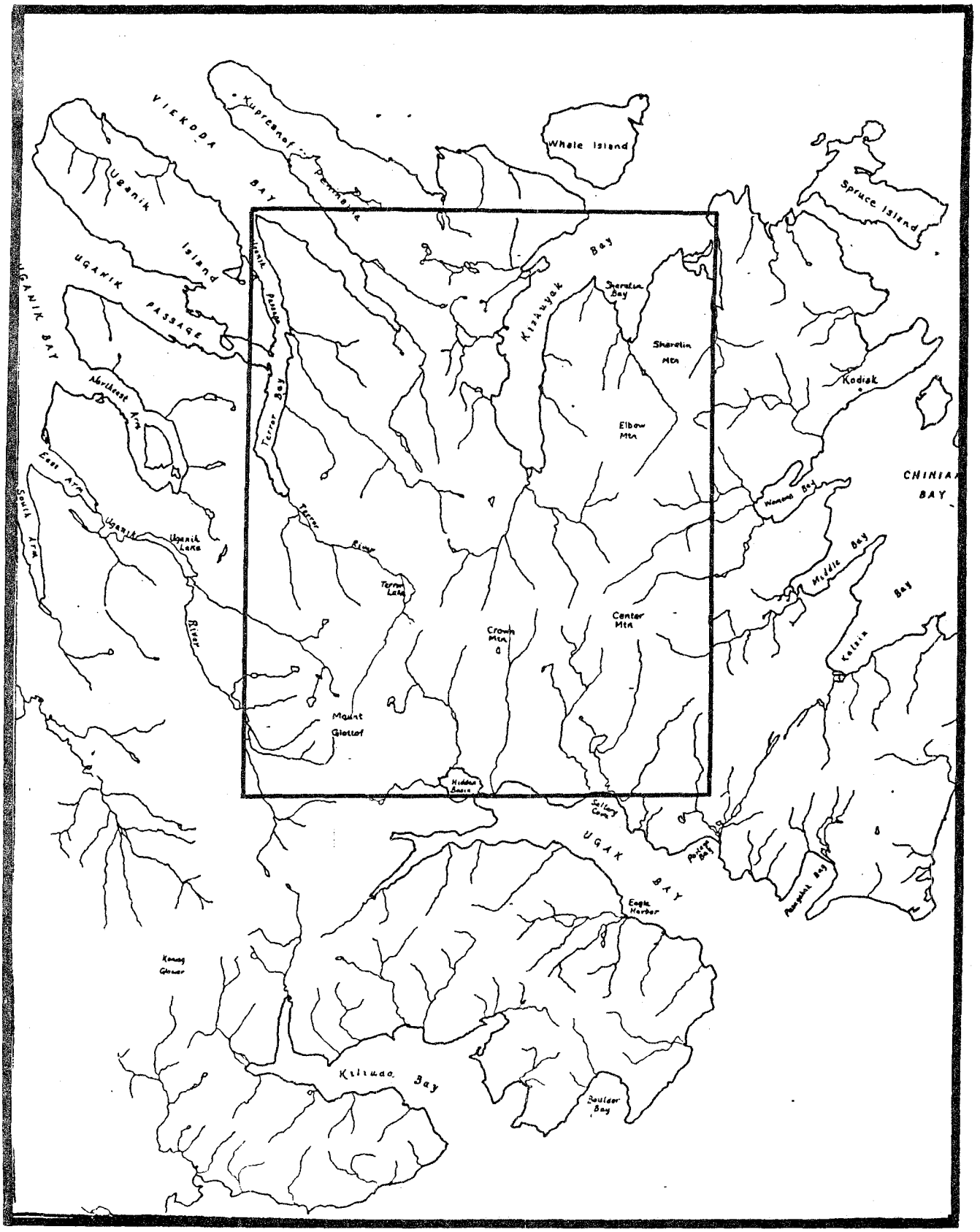

Figure 1. Location of the Terror Lake study area (1 cm = 4.22 km).

bottoms and lower slopes. Alpine tundra vegetation begins at about 450 m. Major plant species in this zone include sedges (Carex spp.), crowberry (Empetrum nigrum), low cranberry (Vaccium vitis idaea) and willow (Salix spp.). A detailed description of vegetation in the project area is found in Hickock and Wilson (1979).

The central mountain range provides habitat for an introduced population of mountain goats estimated by the Alaska Department of Fish and Game at over 300 animals. Habitat relationships of goats on Kodiak Island were reported on by Hjeljord (1971). Spencer and Hensel (1980) described the Terror Lake study area and discussed relationships between habitat and goat distribution.

Description of Terror Lake Hydroelectric Project

The Terror Lake Hydroelectric project is designed to provide a 20 MW conventional hydroelectric power source for the City of Kodiak. Terror Lake, a natural lake 40 kilometers southwest of Kodiak, will be raised with a rockfill dam to occupy a 7.5 km long basin. A tunnel will be constructed underground to transport water from Terror Lake to the powerhouse in Kizhuyak River. Additional diversion dams are to be built in the Kizhuyak River drainages to augment the water supply.

Project construction began in March 1982 and is expected to be complete by 1984. Several major project features were under construction in 1982. A construction access road from Kizhuyak Bay to Terror Lake was completed in July 1982. Two construction camps, one at Terror Lake and one near the powerhouse site on Kizhuyak River, housed up to 270 personnel by December. Construction of the powertunnel, the diversions, and the main dam at Terror Lake were well underway.

RESULTS AND DISCUSSION

Winter Distribution

A total of 79 goats, 60 adults and 19 kids, was observed during a 4.9 hr survey on 27, 28 February, 1982. Twenty-one observations of goats in

groups ranging from 1 to 12 animals were recorded. The goats were located at a mean elevation of 446 m with a range of 305-640 m. Results of the winter survey are contained in Tables 1 and 2. Locations of the goat observations are shown in Figure 2.

Results of the 1982 survey were similar to the results of the 1980 winter survey reported by Spencer and Hensel (1980). Ninety-two goats were observed during the 1980 survey, compared to 79 goats in 1982. Twenty-seven sightings were made in 1980 compared to 21 sightings in 1982. Only one goat was seen in the Kizhuyak drainage during both surveys. No goats were found in the Terror Lake drainage during either year. Goats were found at a mean elevation of 446 m in 1982 compared to 268 m in 1980. Snow accumulations were much less in 1982 which apparently allowed goats to range to higher elevations.

Spencer and Hensel (1980) reported that 1-3 goats were observed west of the powerhouse site on Kizhuyak River during the 1980 winter. A single goat was seen during the 1982 winter survey about 2.5 km southwest of the powerhouse site. Helicopter pilots reported seeing up to 8 goats in the Falls Creek drainage within 1 km of the powerhouse site by March, 1982.

The 1982 survey confirmed that the Wild Creek and Hidden Basin Creek drainages of northwestern Ugak Bay contain the major winter range on Kodiak Island. Seventy-eight of 79 goats observed were in the Ugak Bay drainages. It is suspected that a few goats were missed in the Kizhuyak and Terror drainages. Spencer and Hensel (1980) noted that a group of 13 goats was observed west of lower Terror River in late winter 1980.

Distribution during kidding

Twenty-four observations of post-parturient females or of adult-kid groups were made in a 6.4 hour survey on 15, 16 June, 1982. A total of 177 goats, including 35 kids and 142 adults, was counted. Results of the survey are shown in Tables 3 and 4. Locations of the goat observations are illustrated in Figure 3.

Table 1. Summarized results of winter mountain goat distribution survey in Terror Lake study area 27, 28 February, 1982.

Drainage	No. adults	No. kids	Total no.	Mean elevation (meters)	Range in elevation (meters)
Kizhuyak Bay	1	0	1	305	305
Ugak Bay	59	19	78	453	335-640
	60	19	79	446	305-640

Table 2. Results of an aerial mountain goat distribution survey in the Terror Lake study area, 27, 28 February, 1982.

Observation no.	No. adults	No. kids	Total no.	Aspect	Elevation (m)	Drainage
1	1	0	1	S	305	Kizhuyak Bay
2	1	0	1	SE	520	Hidden Basin
3	5	1	6	SE	580	Hidden Basin
4	1	0	1	SW	500	Hidden Basin
5	4	1	5	SW	580	Hidden Basin
6	1	2	3	SW	640	Hidden Basin
7	5	3	8	SW	610	Hidden Basin
8	3	0	3	SW	365	Hidden Basin
9	5	2	7	SW	365	Hidden Basin
10	4	2	6	SW	395	Hidden Basin
11	1	0	1	SW	500	Hidden Basin
12	1	0	1	SE	580	Wild Creek
13	2	0	2	SE	425	Wild Creek
14	3	1	4	SE	425	Wild Creek
15	1	0	1	E	500	Wild Creek
16	2	0	2	E	395	Wild Creek
17	8	4	12	SW	380	Wild Creek
18	1	0	1	S	335	Wild Creek
19	4	1	5	SE	335	Wild Creek
20	2	0	2	SE	335	Wild Creek
21	5	2	7	SE	425	Wild Creek
Totals	60	19	79			

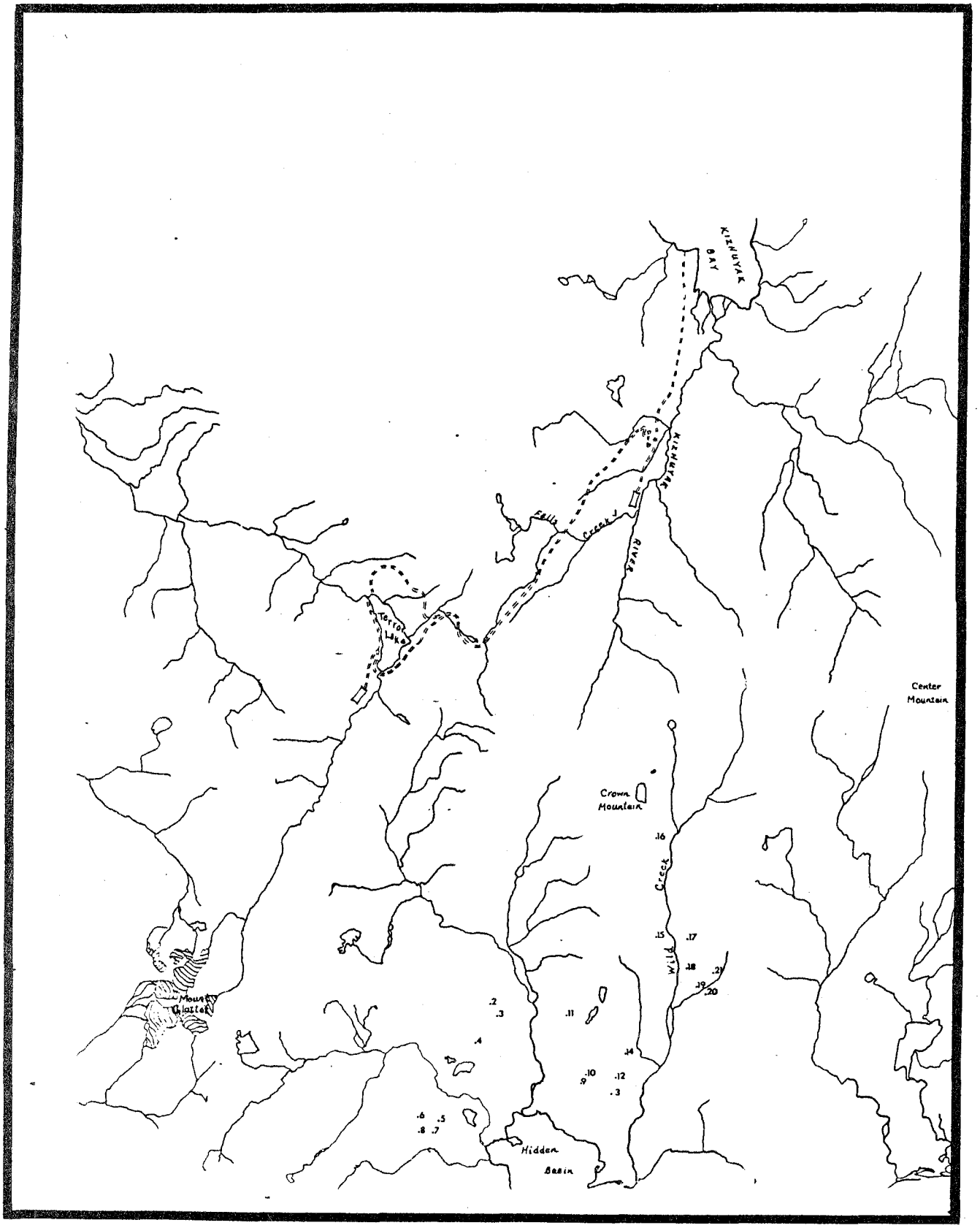

Figure 2. Locations of mountain goat observations from a winter distribution survey in Terror Lake study area, 27, 28 February, 1982 (1 cm = 1.5 km).

Eight females with kids were located in the Kizhuyak drainage. Seven females each had 1 kid and one female had 2 kids. Three females, each with 1 kid, were located in the Falls Creek drainage approximately 1 km southwest of the powerhouse site. These goats occupied elevations ranging from 518 to 549 m. Five females, 4 with single kids and 1 with twins, were found along the slope west of Kizhuyak River south of Falls Creek. These goats were located at elevations ranging from 822-1097 m. Southerly or southeasterly exposures were favored by goats located in the Kizhuyak drainage.

The 3 post-parturient females seen in Falls Creek apparently gave birth when nearby road construction activity was at a peak. By the 21 May the access road had been built to within about 0.5 km northeast of Falls Creek and by 15 June it had been extended another 2 km to cross the northern tributary of Falls Creek. Helicopter pilots reported seeing as many as 8 goats in Falls Creek by early March, 1982, and it was suspected that some goats remained there to give birth. Disturbances from blasting, drilling and earthmoving equipment occurred daily during late May and early June when kidding occurred. Frequent low level flights by helicopters transporting personnel and equipment to the access road also occurred during this period. A 150 m high ridge about 500 m east of the road, which separated the road from Falls Creek, probably provided some security to goats.

Goats continued to occupy the Falls Creek drainage into late July. Three adults and 3 kids were seen on 12 July and a female with one kid was seen on 20 July. Goats seen on those dates were near the ridge less than 500 m south of the access road and they could easily be seen from the road.

Three observations of adult-kid groups were made in the Terror River drainage during the June survey. A total of 21 goats, including 5 kids, was observed. The adult-kid groups were located at least 3 km west of Terror Lake in the headwaters of the easternmost drainage into the south side of Terror River. Spencer and Hensel (1980) previously reported the occurrence of females with newborn kids in that drainage. Construction activity at Terror Lake prior to mid-June was mainly limited to surveying and aerial inspections. Helicopter traffic was frequent at the lake beginning in March.

It appears unlikely that distribution of goats near Terror Lake during kidding was influenced by the level of construction activity present in 1982.

Thirteen observations of post-parturient females or adult-kid groups were made in the Hidden Basin Creek and Wild Creek drainages into Ugak Bay. A total of 110 goats, 89 adults and 21 kids, was counted in the Ugak Bay drainages.

The 1982 survey indicated that the primary ranges used for kidding are in the Ugak Bay drainages. Twenty-one of the 30 kids (70%) observed in the Kizhuyak and Ugak drainages combined were located in Hidden Basin Creek and Wild Creek. No kids were found in the eastern tributaries of Kizhuyak River in June, which suggests that kids observed there later in the summer were born in the Ugak Bay drainages. The previously reported findings of Spencer and Hensel (1980), that some kidding occurs on the ridge west of Kizhuyak River and in the tributary to Terror River west of Terror Lake, were confirmed in 1982.

Summer distribution

Results of the August, 1982, survey indicated that the goat population is in an upward trend. A total of 249 goats, 186 adults and 63 kids was counted in a 9.2 hr. aerial survey. Results of this survey are shown in Tables 5 and 6 and locations of goats are illustrated in Figure 4. A total of 202 goats was counted during the previous 1981 survey. The increasing population trend is probably a result of the expansion of goats into previously unoccupied habitat and improved survival during recent winters (Smith, 1982).

Thirty goats, 26 adults and 4 kids, were found southwest of Terror Lake in the southern tributaries of Terror River. That represents an increase over the 15 goats reported in this area by Spencer and Hensel (1980). Twenty-four of the 30 goats were seen on the mountain 2-3 km west of Terror Lake. Six adult goats were seen further southwest of Terror Lake.

Table 3. Summarized results of kidding distribution survey in the Terror Lake study area 15, 16 June, 1983.

Drainage	No. adults	No. kids	Total no.	Mean elevation (meters)	Range in elevation (meters)
Kizhuyak Bay	37	9	46	815	518-1097
Terror River	16	5	21	894	762-1037
Ugak Bay	89	21	110	640	366-854
	142	35	177	730	366-1097

Table 4. Results of an aerial mountain goat kidding distribution survey, in the Terror Lake study area, 15, 16, June, 1982.

Observation no.	No. adults	No. kids	Total no.	Aspect	Elevation (m)	Drainage
1	2	1	3	SE	550	Kizhuyak Bay
2	1	0	1	SE	580	Kizhuyak Bay
3	2	0	2	SE	550	Kizhuyak Bay
4	1	1	2	S	520	Kizhuyak Bay
5	1	1	2	S	550	Kizhuyak Bay
6	2	0	2	SE	580	Kizhuyak Bay
7	5	0	5	E	730	Kizhuyak Bay
8	2	0	2	E	490	Kizhuyak Bay
9	2	0	2	E	760	Kizhuyak Bay
10	1	0	1	E	640	Kizhuyak Bay
11	1	0	1	E	1005	Kizhuyak Bay
12	1	0	1	E	795	Kizhuyak Bay
13	2	0	2	E	855	Kizhuyak Bay
14	1	1	2	E	1035	Kizhuyak Bay
15	1	1	2	E	1035	Kizhuyak Bay
16	5	1	6	E	1100	Kizhuyak Bay
17	1	2	3	E	915	Kizhuyak Bay
18	1	1	2	E	825	Kizhuyak Bay
19	1	0	1	S	760	Kizhuyak Bay
20	1	0	1	E	730	Kizhuyak Bay
21	2	0	2	E	760	Kizhuyak Bay
22	1	0	1	E	885	Kizhuyak Bay
23	2	0	2	S	945	Terror Bay
24	1	1	2	S	885	Terror Bay
25	1	0	1	SE	701	Terror Bay
26	2	0	2	SE	701	Terror Bay
27	1	0	1	E	670	Terror Bay
28	2	2	4	E	1035	Terror Bay
29	7	2	9	E	760	Terror Bay
30	1	0	1	W	915	Ugak Bay
31	4	0	4	S	610	Ugak Bay
32	1	0	1	S	760	Ugak Bay
33	4	0	4	S	730	Ugak Bay
34	1	0	1	SE	795	Ugak Bay
35	2	0	2	E	460	Ugak Bay
36	1	1	2	E	425	Ugak Bay
37	1	0	1	S	396	Ugak Bay
38	1	0	1	E	550	Ugak Bay
39	4	2	6	E	365	Ugak Bay
40	4	2	6	NE	365	Ugak Bay
41	1	0	1	E	760	Ugak Bay
42	3	3	6	E	736	Ugak Bay
43	3	0	3	NE	610	Ugak Bay
44	6	0	6	S	685	Ugak Bay

Table 4. (Cont'd). Results of an aerial mountain goat kidding distribution survey, in the Terror Lake study area, 15, 16, June, 1982.

Observation no.	No. adults	No. kids	Total no.	Aspect	Elevation (m)	Drainage
45	4	2	6	S	855	Ugak Bay
46	2	2	4	S	795	Ugak Bay
47	2	0	2	S	640	Ugak Bay
48	1	0	1	S	915	Ugak Bay
49	1	0	1	E	915	Ugak Bay
50	4	3	7	S	760	Ugak Bay
51	7	0	7	N	730	Ugak Bay
52	3	0	3	E	760	Ugak Bay
53	4	0	4	E	760	Ugak Bay
54	1	0	1	E	425	Ugak Bay
55	1	0	1	E	460	Ugak Bay
56	1	0	1	E	520	Ugak Bay
57	1	1	2	NE	580	Ugak Bay
58	1	0	1	E	460	Ugak Bay
59	1	0	1	SE	460	Ugak Bay
60	2	1	3	W	580	Ugak Bay
61	2	1	3	S	640	Ugak Bay
62	4	1	5	W	760	Ugak Bay
63	1	1	2	S	700	Ugak Bay
64	2	1	3	W	760	Ugak Bay
65	3	0	3	S	580	Ugak Bay
66	2	0	2	W	685	Ugak Bay
67	1	0	1	SW	460	Ugak Bay
68	1	0	1	S	305	Ugak Bay
Totals	142	35	177			

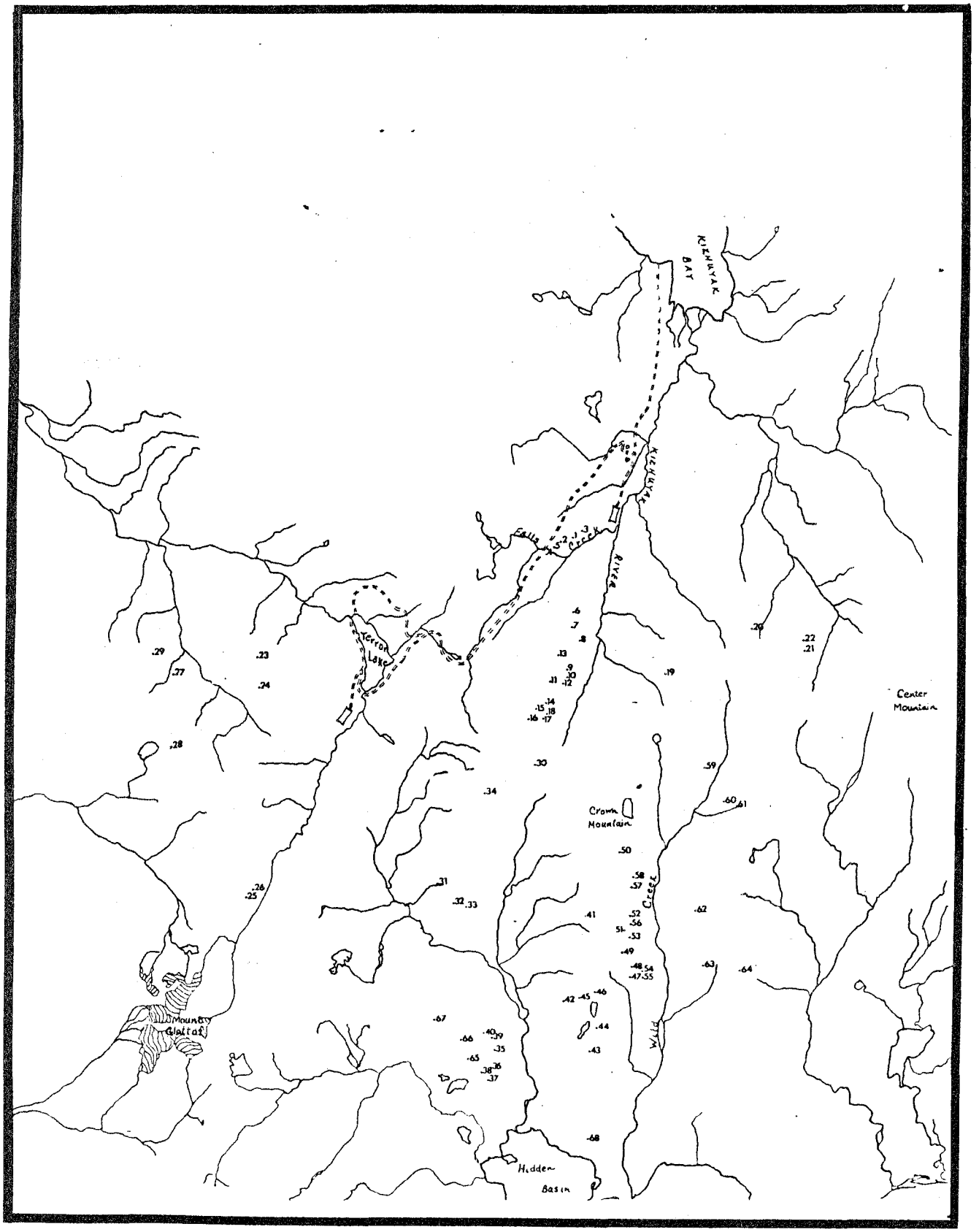

Figure 3. Locations of mountain goat observations from a kidding survey in the Terror Lake study area, 15, 16, June, 1982 (1 cm = 1.5 km).

Table 5. Summarized results of summer mountain goat distribution survey in Terror Lake study area 12, 18, 19 August, 1982.

Drainage	No. adults	No. kids	Total no.	Mean elevation (meters)	Range in elevation (meters)
Kizhuyak Bay	57	18	75	933	762-1128
Terror/Uganik Bays	37	6	43	1082	1006-1220
Ugak	92	39	131	813	571-915
	186	63	249	916	571-1220

Table 6. Results of aerial mountain goat survey in Terror Lake project area, 12, 18, 19 August, 1982.

Observation no.	No. adults	No. kids	Total no.	Aspect	Elevation (m)	Drainage
1	1	0	1	E	945	Kizhuyak Bay
2	4	1	5	E	975	Kizhuyak Bay
3	1	0	1	N	945	Kizhuyak Bay
4	1	0	1	E	915	Kizhuyak Bay
5	20	7	27	S	855	Kizhuyak Bay
6	2	0	2	SE	915	Wild Creek
7	5	3	8	W	915	Wild Creek
8	4	2	6	S	915	Wild Creek
9	1	0	1	SW	855	Hidden Basin
10	3	0	3	N	825	Hidden Basin
11	1	0	1	E	760	Kizhuyak Bay
12	3	2	5	N	945	Kizhuyak Bay
13	26	8	34	NE	1130	Kizhuyak Bay
14	2	0	2	W	760	Hidden Basin
15	1	0	1	SW	700	Hidden Basin
16	2	0	2	S	855	Wild Creek
17	3	2	5	W	915	Hidden Basin
18	1	0	1	S	760	Hidden Basin
19	7	0	7	S	760	Wild Creek
20	17	8	25	E	825	Wild Creek
21	4	4	8	S	915	Wild Creek
22	2	2	4	N	885	Wild Creek
23	7	5	12	NW	855	Hidden Basin
24	1	0	1	E	580	Wild Creek
25	1	0	1	S	580	Wild Creek
26	2	1	3	S	915	Wild Creek
27	4	2	6	E	730	Hidden Basin
28	9	1	10	SW	1065	Terror Bay
29	2	0	2	E	1035	Terror Bay
30	2	0	2	S	1065	Terror Bay
31	1	1	2	N	1065	Terror Bay
32	5	2	7	W	1005	Terror Bay
33	1	0	1	SW	1065	Terror Bay
34	1	0	1	NE	1130	Terror Bay
35	1	0	1	SE	1035	Uganik Bay
36	1	0	1	W	1100	Uganik Bay
37	3	0	3	N	1005	Uganik Bay
38	4	2	6	SE	1160	Uganik Bay
39	2	0	2	S	1130	Uganik Bay
40	3	0	3	E	1220	Uganik Bay
41	2	0	2	W	1065	Uganik Bay
42	7	2	9	SW	730	Hidden Basin
43	4	0	4	SE	640	Hidden Basin
44	1	0	1	E	825	Hidden Basin
45	2	2	4	S	795	Hidden Basin
46	9	6	15	S	1065	Hidden Basin
	186	63	249			

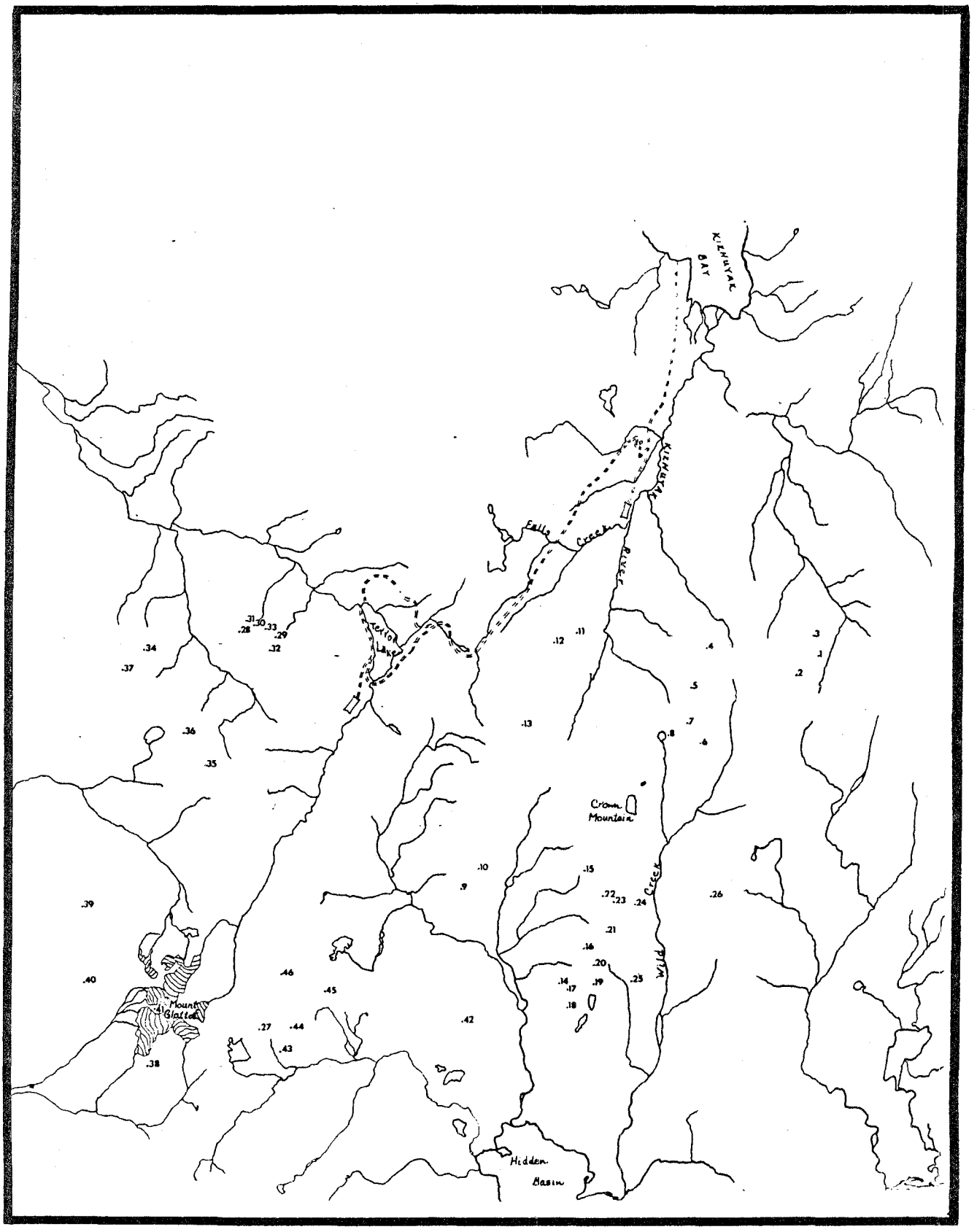

Figure 4. Locations of mountain goat observations from a summer distribution survey, in Terror Lake study area, 12, 18, 19 August, 1982 (1 cm = 1.5 km).

Numerous construction activities were in progress at Terror Lake in August, but they apparently had little impact on summer goat distribution. The construction access road along the west side of the lake had been completed and the construction campsite and other work sites were being cleared. Frequent helicopter traffic was another potential source of disturbance. No major shifts in summer goat distribution were apparent in the Terror Lake area in 1982. Goats were found in approximately the same locations west of Terror Lake as have been noted in previous aerial surveys by the Alaska Department of Fish and Game.

Thirteen goats, 11 adults and 2 kids, were found on the western slopes of Mt. Glotoff and in the upper Uganik River drainage. A small herd of goats has been located in that area during previous summer surveys and it is doubtful that distribution of goats there was related to construction activity at Terror Lake.

No unusual distribution of goats in the Kizhuyak or Ugak drainages was apparent from the August survey results. Previous surveys indicated that goats routinely range along the length of the major escarpment west of Kizhuyak River extending into Hidden Basin. More goats were observed on the Kizhuyak River side in August 1982 than were observed in 1981, the year before construction began. In 1982, 40 goats were seen on the Kizhuyak River side compared to only 6 goats in 1981. In 1981 52 goats were located on the Hidden Basin Creek side and only 4 goats were seen on the Kizhuyak River side of the escarpment. Spencer and Hensel (1980) raised the possibility that goats might shift from traditional range in the Kizhuyak River to occupy primarily the Ugak Bay drainage during construction. There is no indication that distribution of goats along the escarpment was substantially influenced by construction activities in 1982.

Hunting activities

Goat hunting is regulated by a limited permit hunt during a Sept. 1-Oct. 31 season. Only 3 goats were reported killed by hunters in the Terror Lake vicinity in 1982. All three goats were killed on the ridge west of the

upper Kizhuyak valley. A total of six people reported hunting. It is unlikely that this low level of hunting activity influenced goat movements significantly.

The construction access road was used by at least one goat hunter to reach the goats located west of upper Kizhuyak River. Although the access road was closed to public access by stipulations of the project license, opportunistic use of the road is difficult to prevent. Most hunters continued using Terror Lake for access in 1982. Occasional use of the road by hunters is not expected to significantly affect hunting success.

The project contractor attempted to discourage the use of Terror Lake by goat hunters in 1982 by closing the area to floatplanes. The closure was without legal authority and the contractor was so informed by the Alaska Power Authority.

Additional goat observations in 1982

Several additional observations confirmed that goats occupied the western side of Kizhuyak River adjacent to the construction area throughout 1982. An adult goat was seen descending into Falls Creek on 13 November near the diversion site by construction personnel. Four goats, 3 adults and 1 kid, were observed from an aircraft at the outlet of Leanne Lake on 15 November. Possibly the same group of goats was seen on 16 November near the Rolling Rock Creek diversion and again on 9 December near Falls Creek.

Distribution of goats in the Terror Lake basin

No goats were observed in the area to be inundated by the Terror Lake dam in 1982. Two goats were seen during a 15 June aerial survey west of upper Terror River at about 700 m. These goats may have crossed the river earlier, but they were located well above the area of inundation. Neither the 1982 aerial surveys nor previous surveys have indicated that goats make significant seasonal movements between the east and west sides of upper Terror River. The Terror Lake basin is apparently not preferred habitat.

Recommendations for further study

Aerial surveys should be continued to monitor seasonal distribution and movements of mountain goats in the Terror Lake hydroelectric project area. Surveys conducted in 1982 to document winter distribution, kidding activities and late summer distribution should be repeated in 1983. Other incidental observations of goats in the study area should continue to be recorded and analyzed to supplement aerial survey information.

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