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BROWN BEAR HABITAT PREFERENCES AND BROWN BEAR LOGGING AND MINING RELATIONSHIPS IN SOUTHEAST ALASKA

By

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and
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Volume II

Progress Report
Federal Aid in Wildlife Restoration
Project W-22-2, Job 4.17R

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PROGRESS REPORT (RESEARCH)

State: Alaska

Cooperator: Jack W. Lentfer, Juneau, Alaska; and Matthew D. Kirchhoff, ADF&G

Project No.: W-22-2 Project Title: Big Game Investigations

Job No.: 4.17R Job Title: Brown Bear Habitat Preferences and Brown Bear Logging and Mining Relationships in Southeast Alaska

Period Covered: 1 July 1982 through 30 June 1983

SUMMARY

Seventeen brown bears (Ursus arctos) were captured in the Hawk Inlet study site during this report period. Home range sizes averaged 115 and 42 km^2 for males and females, respectively. Fifteen bears were tracked to their dens which averaged 799 m in elevation. Most denning occurred in early November. Bears were not uniformally distributed during summer. Although most bears occupied coastal salmon streams during August, 5 (28%) bears remained in interior sites.

Key words: Admiralty Island, brown bear, habitat, Southeast Alaska, Ursus arctos.

CONTENTS

BACKGROUND

Historically, the brown/grizzly bear (Ursus arctos) was widely distributed in North America from central Mexico to northern Canada and Alaska, and from the Mississippi to the Pacific Coast (Hall and Kelson 1959). Today, populations of this species are restricted to northwestern Canada, Alaska, and a few scattered wilderness enclaves in Montana, Idaho, and Wyoming. Alaska has the last major population of brown/grizzly bears in the United States. An understanding of their ecology, including basic life history, population status, movement and home range patterns, and habitat relationships, is essential for knowledgeable management.

Brown bears are indigenous to Southeast Alaska where they occur throughout the mainland and on islands north of Frederick Sound. Management concerns include hunting, habitat alteration resulting from clear-cut logging and/or mining activities, and effects of disturbance from increased human activities associated with development and recreation.

General background and literature review for this study were outlined previously (Schoen 1982). This study proposes to determine seasonal habitat preferences by brown bears in Southeast Alaska, and evaluate the effects of mining and logging activities on bear populations. The general approach at the Admiralty Island study site is to monitor bear movements, activity patterns, and habitat use in the Hawk Inlet area before intensive mine development in the Greens Creek drainage, during its development, and for 2 years of actual mine operations.

In Tenakee Inlet on east Chichagof Island, bear habitat preference will also be determined. This study area includes an unlogged watershed surrounded by watersheds which have had extensive recent clear-cutting. In this area, we will evaluate bear use of logged vs. unlogged areas.

OBJECTIVES

To determine weekly and seasonal movement patterns and habitat utilization by brown bears in Southeastern Alaska, particularly in respect to activities associated with mining and/or logging, and to locate and describe denning sites and determine reproductive rates and relate these to habitat and harvest levels.

STUDY AREA

The study area is located in the Alexander Archipelago of Southeast Alaska. Specific sites have been selected on northern Admiralty Island and on eastern Chichagof Island in the northern portion of the archipelago.

The Hawk Inlet study site, on Admiralty Island, was described previously (Schoen 1982). The location of anadromous salmon streams and dates and peak escapements by species are presented in Appendix A (Table 1 and Fig. 1).

The Tenakee site, located on southeast Chichagof Island, is approximately 1,000 km^2 (Fig. 1). The topography of this area is varied with elevations ranging from sea level to 1,180 m. There are approximately 170 km of marine shoreline and several large tidal estuaries. The area is forested with western hemlock (Tsuga heterophylla), Sitka spruce (Picea sitchensis), and Alaska cedar (Chamaecyparis nootkatensis). Muskegs are scattered throughout the forest with isolated areas of subalpine and alpine above 600 m. Most of the watershed in the Tenakee site, with the exception of the Kadashan River drainage, has been extensively clear-cut. Clear-cuts range from 2 to over 20 years old. The Kadashan River watershed has received very minor cutting and represents a large, nearly pristine watershed in the center of the study site.

MATERIALS AND METHODS

Bears were captured in the alpine by darting from a helicopter. Sernylan (phencyclidine hydrocloride) was the immobilizing drug used in combination with a tranquilizer (acepromazine). Additional bears were captured along beaches and salmon streams by snaring with Aldrich foot snares and then immobilizing. Following capture, bears were fitted with radio collars. Additional methods were reported by Schoen (1982).

Movements, home range patterns, and habitat use were determined by relocating instrumented bears through aerial radio telemetry. A further description of this methodology is provided in Schoen (1982).

RESULTS AND DISCUSSION

Twenty-three brown bears have been captured in the Hawk Inlet study site since the study began in August 1981. During this reporting period, 17 bears were captured or recaptured; 16 of these were instrumented with radio collars (Table 1). Nine bears were captured in the alpine from a helicopter, and 7 were captured in snares along streams or on the beach. No capture-related mortality occurred during 1982. Brown bear trapping effort in Hawk Inlet during summer 1982 is summarized in Appendix B. Both helicopter and snaring techniques were effective methods of capturing brown bears.

Home ranges were determined for radio-collared bears during 1982 by connecting the outer points of location to form convex polygons (Appendix C). The mean home range size of 6 males was 115 ± 75 km^2 ($\bar{x}$ ± SD), and the mean of 12 females was 24 ± 16 km^2.

Most bears began denning by 1 November. The mean den elevation of 15 radio-collared bears was 799 ± 228 m (Table 2). Most denning occurred in high-elevation alpine habitat. Three bears, however, denned in lower elevation (<500 m) forested habitat.

During the 1982 field season, 5 of 18 (28%) bears remained in interior regions of the study site instead of moving down to coastal salmon streams. A paper on differential distribution of Admiralty Island brown bears was presented at the Sixth International Conference on Bear Research and Management. This paper is included as Appendix D.

ACKNOWLEDGMENTS

We would like to acknowledge John Matthews, Matt Kirchhoff, Jack Lentfer, Rod Flynn, Paul Conry, Don McKnight, Steve Peterson, Joann Barnett, and Dara Miller for their assistance during various phases of this research.

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Fig. 1. Tenakee Inlet study site located on southeast Chichagof Island, Alaska (study site enclosed by dashed line).

Table 1. Brown bears captured in Hawk Inlet study area, Admiralty Island, Alaska, fall 1981 through summer 1982.

Animal No.	General location	Sex	Capture Age (yr)[a]	Capture Weight (kg)[a]	Capture Date	Capture technique/ habitat	Ear tag Color	Ear tag #	Ear tag Ear	Current status
51	Lower Greens Creek	M	1	60	8-28-81	Snare/ riparian	Orange Orange	51 52	Right Left	Ear radio lost 9-81
60	Upper Greens Creek	F[b,c]	Adult	160+	9-21-81	Helicopter/ alpine	Orange	60	Right	Radio functional
59	Upper Greens Creek	M[b]	1	80	9-21-81	Helicopter/ alpine	Yellow	59	Left	Radio functional
58	Eagle Peak	M[c]	4	180	9-21-81	Helicopter/ alpine	Yellow	58	Left	Disappeared 8-82
36	Robt. Barron Peak	F[d]	Adult	230	9-26-81	Helicopter/ alpine	Yellow	36	Right	Radio lost 5-82
50	Upper Greens Creek	M	2	120	9-26-81	Helicopter/ alpine	White	50	Right	Radio lost 10-81
14	Upper Greens Creek	F[c]	3	120	9-26-81	Helicopter/ alpine	Red	14	Right	Radio functional
43	Upper King Salmon	F	Adult	290	9-27-81	Helicopter/ alpine	Orange/ green	43	Left	Radio lost 5-82
6	Upper King Salmon	F	Adult	150	9-27-81	Helicopter/ alpine	Blue/ orange	6	Right	Radio functional
B-14	Upper King Salmon	F	2	100	9-26-81	Helicopter/ alpine	--	--	--	Capture mortality
10	Upper Greens Creek	M	Adult	310	7-2-82	Helicopter/ alpine	Red	10	Right	Radio functional

Table 1. Continued.

Animal No.	General location	Sex	Capture Age (yr)[a]	Capture Weight (kg)[a]	Capture Date	Capture technique/ habitat	Ear tag Color	Ear tag #	Ear tag Ear	Current status
99	Upper Greens Creek	F[d]	Adult	200	7-8-82	Helicopter/ alpine	Blue	99	Left	Radio functional
63	Upper Greens Creek	F[d]	Adult	160	Recapt. 7-8-82	Helicopter/ alpine	Orange	63	Left	Radio functional
20	Greens Creek	M	3	100	7-30-82	Snare/ riparian	Red	20	Right	Radio functional
56	Greens Creek	F[d]	Adult	170	7-30-82	Snare/ riparian	White	56	Left	w2/2[e], radio functional
48	Greens Creek	M	Adult	310	8-3-82	Snare/ riparian	Yellow	48	Left	Radio functional
38	Upper Greens Creek	F	Adult	280	7-2-82	Helicopter/ alpine	Yellow	38	Right	Radio functional
39	Mansfield Pen.	F	Adult	270	8-7-82	Snare/ riparian	Yellow	39	Right	Radio functional
37	Mansfield Pen.	F	Adult	270	8-3-82	Snare/ riparian	Yellow	37	Left	Radio functional
95	Mansfield Pen.	F[d]	Adult	170	7-8-82	Helicopter/ alpine	Blue	95	Left	Radio functional
72	Eagle Peak	M	Adult	200	7-8-82	Helicopter/ alpine	Orange	72	Right	Radio functional
62	Admiralty Cove	F	Adult	150	6-16-82	Snare/beach	Orange	62	Left	Disappeared 8-82

Table 1. Continued.

Animal No.	General location	Sex	Capture Age (yr)[a]	Capture Weight (kg)[a]	Capture Date	Capture technique/ habitat	Ear tag Color	Ear tag #	Ear tag Ear	Current status
34	Mansfield Pen.	F[f]	2	70	7-8-82	Helicopter/ alpine	Yellow	34	Left	w/sow 1/2[g] ear radio stopped
67	Greens Creek	F	2	60	8-2-82	Snare/ riparian	Orange	67	Left	--

[a] Estimated at capture.

[b] Mother and offspring.

[c] Recaptured summer 1982.

[d] Accompanied by 2 cubs.

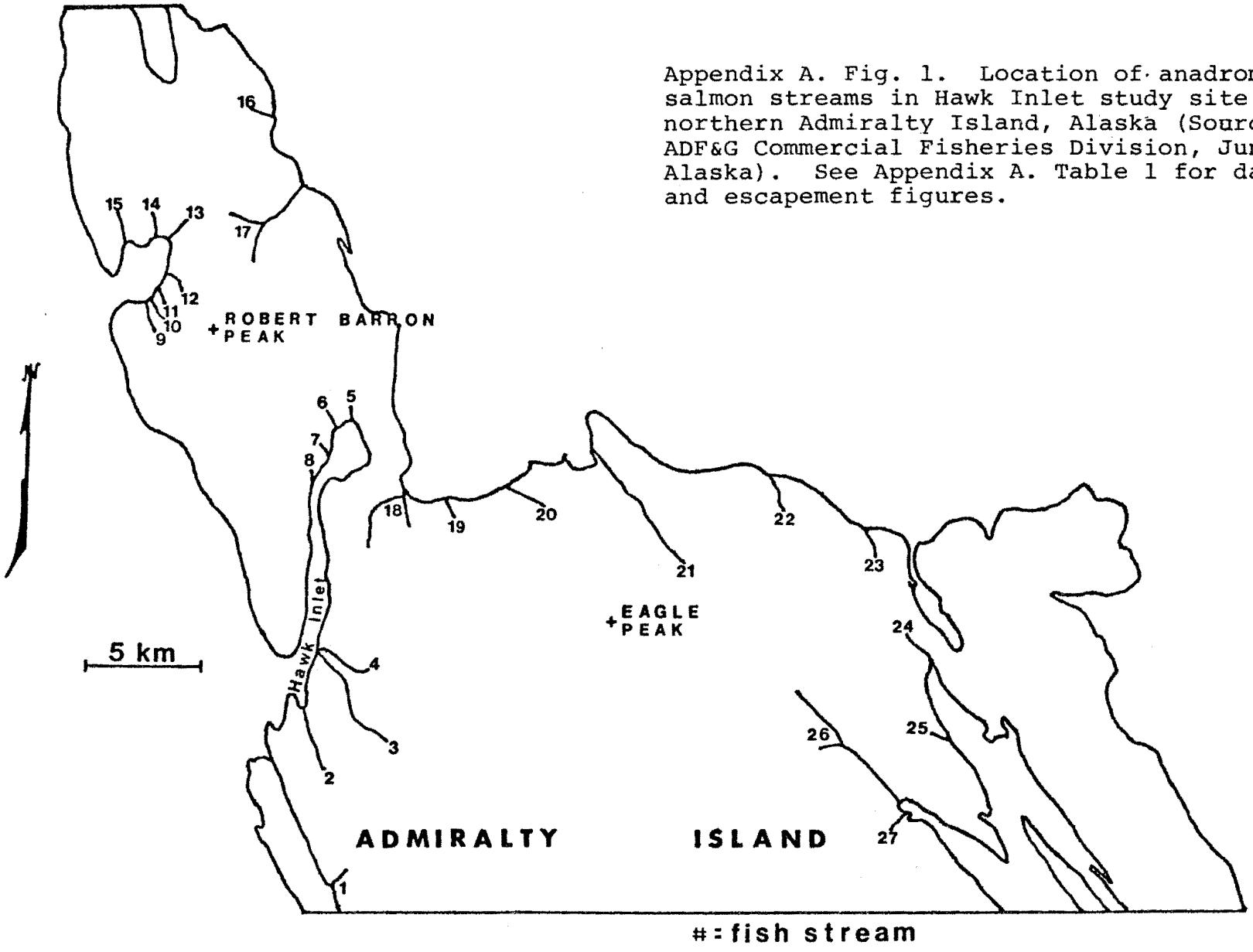
[e] w2/2 = with 2, 2-year-olds.

[f] With mother and sibling.

[g] w/sow 1/2 = with sow and 1, 2-year-old.

Table 2. Denning dates and den site description of radio-collared brown bears in Hawk Inlet, Admiralty Island, Alaska, winters 1981-82 and 1982-83.

Bear No.	Date first located in den	General location	Elevation (m)	Habitat	Comments
60	11-2-81	Upper King Salmon River	915	Subalpine/rock	Denned w/#59
59	11-2-81	Upper King Salmon River	915	Subalpine/rock	Denned w/#60
58	10-21-81	West of Eagle Peak	915	Rocky	--
36	10-2-81	NW Robt. Barron Peak	640	Subalpine/rock	--
14	11-2-81	Upper King Salmon River	1,160	Rocky outcrop	Last location, den site uncertain
43	11-2-81	Upper King Salmon River	1,010	Alpine/rock	--
6	10-2-81	Upper Greens Creek	610	Avalanche slide	Last location, den site uncertain
60	11-1-82	Upper King Salmon River	1,098	Rock	--
59	11-1-82	Upper King Salmon River	945	Rock	--
6	11-1-82	Upper King Salmon River	1,128	Rock	--
14	11-8-82	Upper Wheeler Creek	854	Rock	--
10	11-1-82	Upper Wheeler Creek	915	Rock	--
99	11-4-82	Upper King Salmon River	823	Rock	--
63	11-1-82	Young Bay	915	Rock	--
20	11-1-82	Upper King Salmon River	823	Rock	--
56	11-8-82	Greens Creek	823	Rock	--
48	11-8-82	Upper Wheeler Creek	366	Rock	--
38	11-1-82	Greens Creek	915	Forest	--
39	11-4-82	Robt. Barron Peak	823	Rock	--
37	11-4-82	Robt. Barron Peak	479	Alpine/rock	--
95	11-22-82	Hawk Inlet	396	Forest	--
72	11-8-82	Upper King Salmon River	671	Rock	--



Appendix A. Fig. 1. Location of anadromous salmon streams in Hawk Inlet study site on northern Admiralty Island, Alaska (Source: ADF&G Commercial Fisheries Division, Juneau, Alaska). See Appendix A. Table 1 for dates and escapement figures.

Appendix A. Table 1. Approximate date and average count of peak escapements for pinks, chums, chinook, and coho salmon, 1971 to 1982 on northern Admiralty Island, Alaska. (Source: ADF&G Commercial Fisheries Division, Juneau, Alaska).

Stream No.[a]	Pinks		Chums		Chinook		Coho	
	Approximate date of peak escapement	Average peak escapement	Approximate date of peak escapement	Average peak escapement	Approximate date of peak escapement	Average peak escapement	Approximate date of peak escapement	Average peak escapement
1	No data	No data	No data	No data				
2	8/12	900	8/15	150				
3	8/15	10,010	7/29	2,236				
4	8/14	945	8/14	27				
5	8/9	70	8/8	115				
6	8/11	50	No data	No data				
7	8/11	6	8/6	73				
8	No data	No data	No data	No data				
9	8/27	861	8/12	326				
10	8/19	361	7/28	120				
11	No data	No data	No data	No data				
12	No data	No data	No data	No data				
13	8/4	1,000	8/4	500				
14	No data	No data	No data	No data				
15	No data	No data	No data	No data				
16	No data	No data	No data	No data				
17	8/20	5,125	8/12	95				
18	8/23	1,833	7/22	1,000				
19	8/16	1,500	7/22	1,000				
20	8/16	1,200	No data	No data				
21	8/11	6,200	7/30	2,774			8/19-11/14	30
22	No data	No data	No data	No data				
23	No data	No data	No data	No data				
24	No data	No data	7/28	838				
25	No data	No data	No data	No data				
26	8/9	5,395	7/27	3,401	7/28	88		
27	7/11	275	No data	No data				

[a] See Appendix A. Fig. 1 for location of stream numbers.

Appendix B. Summary of brown bear trapping effort at Hawk Inlet, Admiralty Island, Alaska, summer 1982.

Date	Location	Stream No.	Snares set	Snares sprung	Estimated bears in area	Bears sighted	Bears captured	Trend of pinks and chums[a]
6-15-82	Young Bay		13	--	7			0
6-16-82	Young Bay		13	2	7		♀#62	0
6-17-82	Young Bay		12	2	6			0
6-18-82	Young Bay		12	4	4			0
6-19-82	Young Bay		Pulled					0
6-20-82	Young Bay		Pulled					0
6-21-82	Young Bay		13	1	2			0
6-22-82	Young Bay		13	1	1			0
6-23-82	Young Bay		Pulled					0
6-28-82	Pile Driver	2	5	--	2			0
6-29-82	Pile Driver	2	5	1	1			0
6-30-82	Pile Driver	2	5	1	1			0
7-1-82	Pile Driver	2	5	0	0			0
7-2-82	Pile Driver	2	5	0	0			0
7-3-82	Pile Driver	2	Pulled					
7-26-82	West Head	7	2	--	1			
	Hawk Inlet Pile Driver	2	4	--	2			0
	Zinc Creek	4	3		5			0

Appendix B. Continued.

Date	Location	Stream No.	Snares set	Snares sprung	Estimated bears in area	Bears sighted	Bears captured	Trend of pinks and chums[a]
7-27-82	West Head Hawk Inlet	7	2	1	1			0
	Pile Driver	2	4	2	2			0
	Zinc Creek	4	8	1	5	1		0
	Greens Creek	3	2	0	2			0
7-28-82	West Head Hawk Inlet	7	2	0	0			0
	Pile Driver	2	4	1	2			0
	Zinc Creek	4	8	2	5	1		0
	Greens Creek	3	2	0	2	1		0
7-29-82	West Head Hawk Inlet	7	2	0	0			0
	Pile Driver	2	4	1	0			0
	Zinc Creek	4	8	2	4	3		0
	Greens Creek	3	2	0	1			0
7-30-82	West Head Hawk Inlet	7	2	0	0			6
	Pile Driver	2	4	0	1			0
	Zinc Creek	4	8	3	5		♂#20, ♀#56 w2/2[b]	0
	Greens Creek	3	2	0	1			0
7-31-82	West Head Hawk Inlet	7	2	1	1			
	Pile Driver	2	4	2	1			0
	Zinc Creek	4	6	2	4	1		0
	Greens Creek	3	2	1	1			100

Appendix B. Continued.

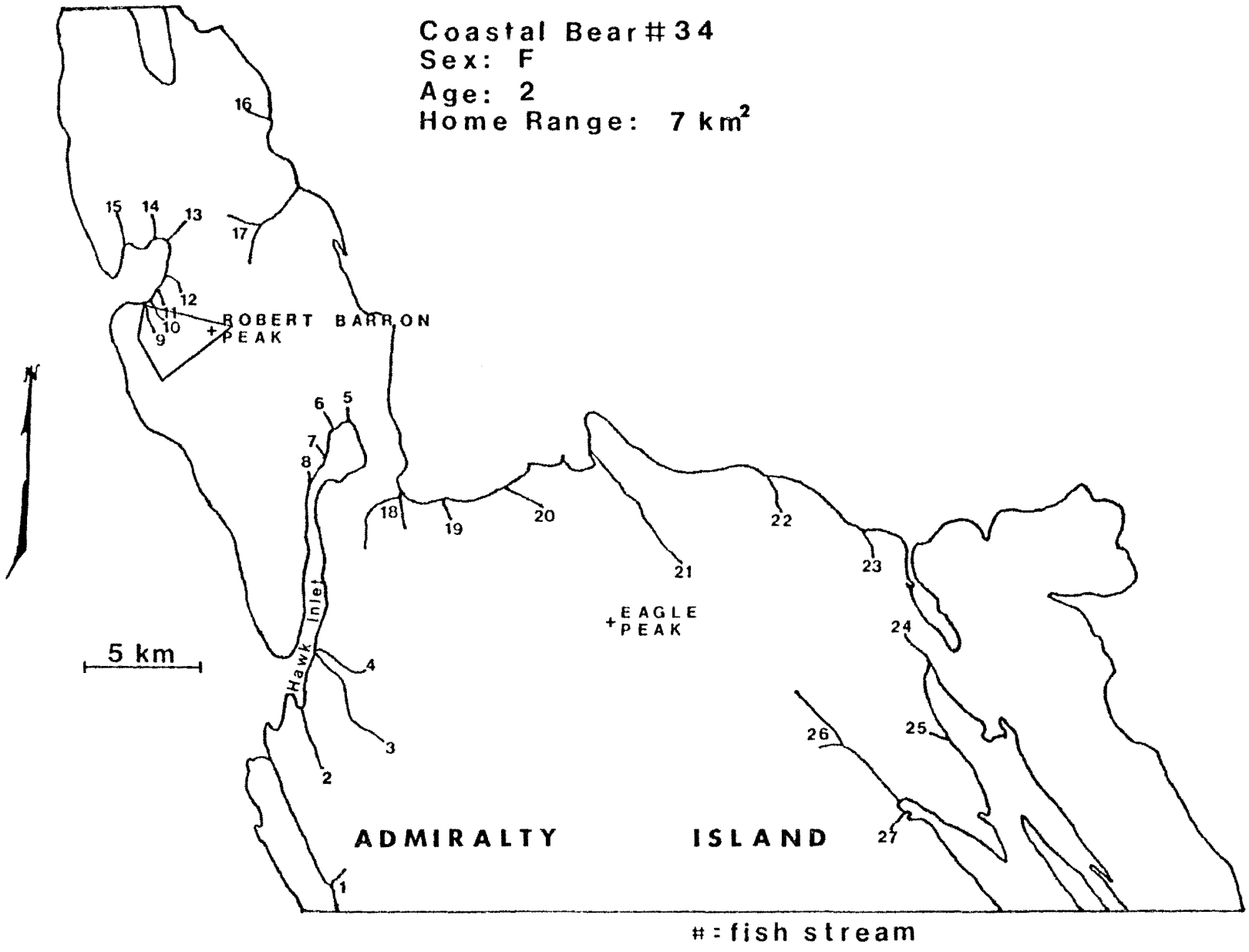
Date	Location	Stream No.	Snares set	Snares sprung	Estimated bears in area	Bears sighted	Bears captured	Trend of pinks and chums[a]
8-1-82	West Head Hawk Inlet	7	2	0	0			8
	Pile Driver	2	4	1	1			0
	Zinc Creek	4	7	2				0
	Greens Creek	3	Pulled	0	2	♀w3/2[c], sow shot		200
	Head, Hawk Inlet	5	4	2	5	1 & #58[d]		150
8-2-82	West Head Hawk Inlet	7	2	1	1			5
	Pile Driver	2	4	2	1			0
	Zinc Creek	4	8	3	4		♀#67	0
	Head, Hawk Inlet	5	4	2	5	1		100
8-3-82	West Head Hawk Inlet	7	2	0	0			4
	Pile Driver	2	4	0	0			0
	Zinc Creek	4	7	3	3		♂#48	0
	Head, Hawk Inlet	5	4	2	4		♀#37	125
8-4-82	West Head Hawk Inlet	7	2	0	0			0
	Pile Driver	2	4	0	0			0
	Zinc Creek	4	6	0	3			0
	Head, Hawk Inlet	5	4	1	3			50
8-5-82	West Head Hawk Inlet	7	2	0	0			0
	Pile Driver	2	Pulled	1	1			10
	Zinc Creek	4	7	0	3			25
	Head, Hawk Inlet	5	6	1	1	#58		20

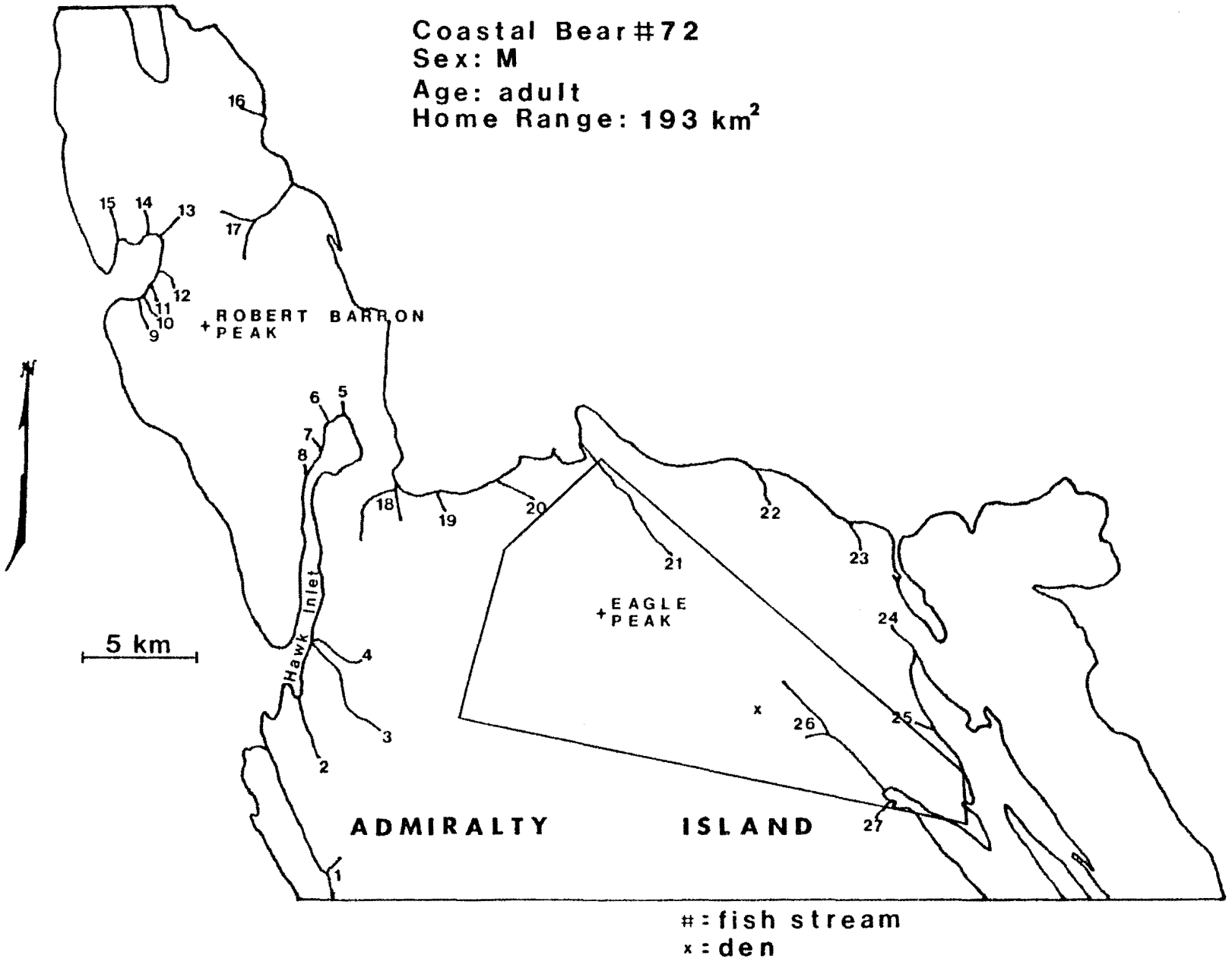
Appendix B. Continued.

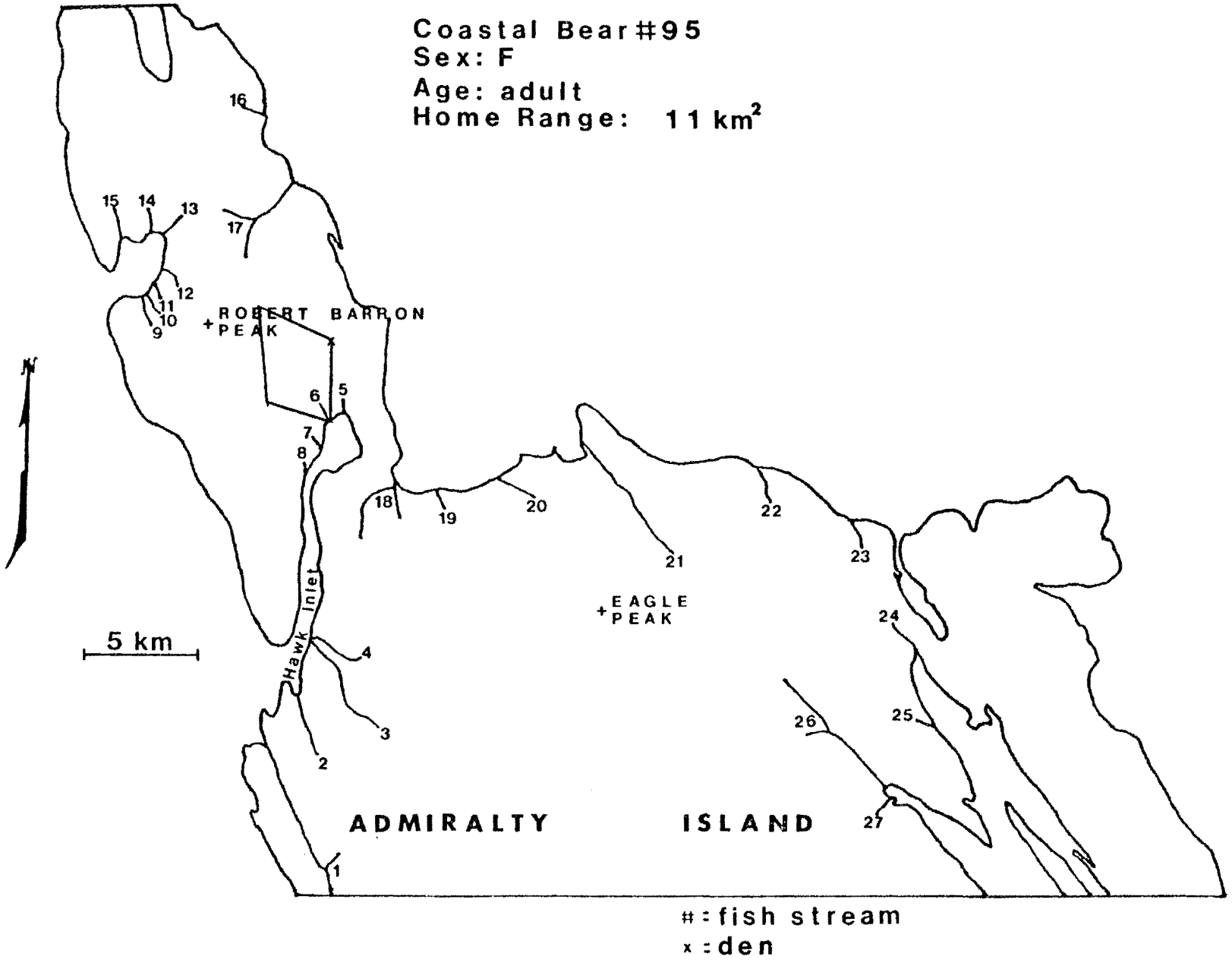
Date	Location	Stream No.	Snares set	Snares sprung	Estimated bears in area	Bears sighted	Bears captured	Trend of pinks and chums[a]
8-6-82	West Head Hawk Inlet	7	2	0	1			2
	Zinc Creek	4	7	1	2			70
	Head, Hawk Inlet	5	8	2	2			25
8-7-82	West Head Hawk Inlet	7	2	1	2	♂#58	♀#39	10
	Zinc Creek	4	7	2	2			100
	Head, Hawk Inlet	5	8	3	2			150
8-8-82	West Head Hawk Inlet	7	Pulled	0	1			4
	Zinc Creek	4	Pulled	1	1			125
	Head, Hawk Inlet	5	8	2	2		Recapt. ♂ #58	150
8-9-82	Head, Hawk Inlet	5	Pulled	2	2			75
Totals			313	66			7	

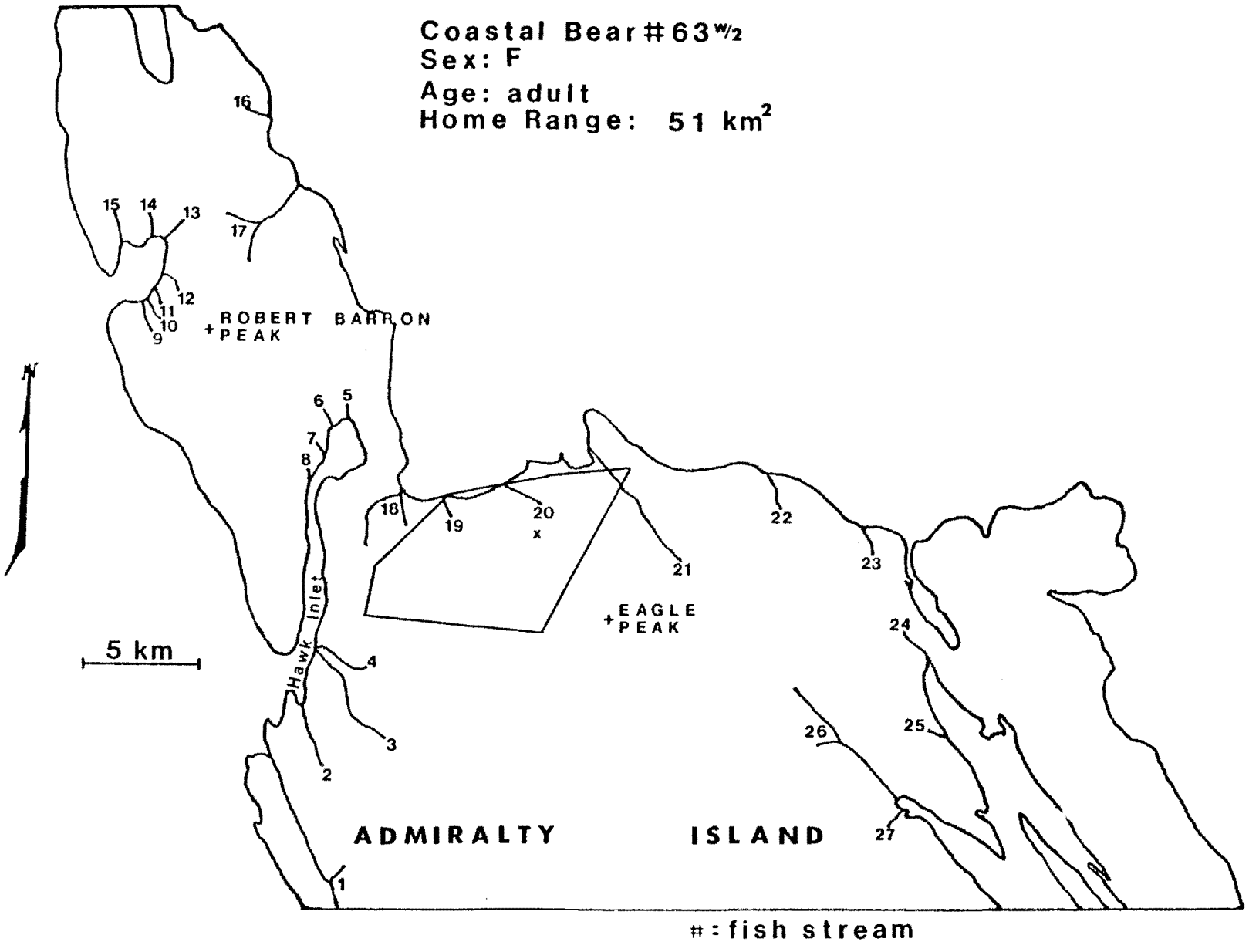
[a] Number of fish counted visually in stream on that day.
[b] w2/2 = with 2, 2-year-olds.
[c] w3/2 = with 3, 2-year-olds.
[d] One unidentified bear with #58.

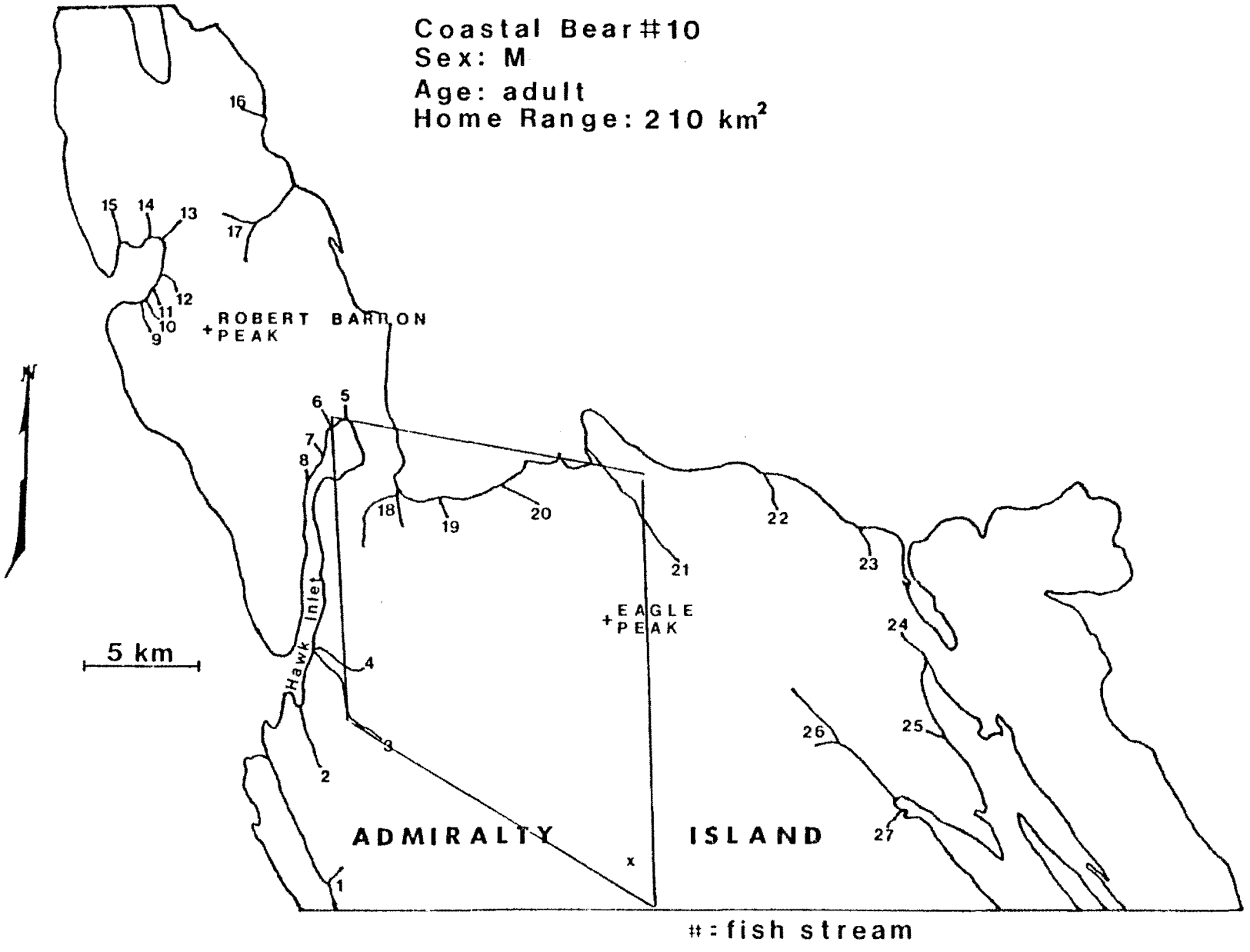
Appendix C. Home range polygons for 12 radio-collared brown bears from northern Admiralty Island, Alaska, summer 1982. Refer to Appendix A (Table 1 and Fig. 1) for salmon escapement counts and stream numbers. Coastal Bear #63 w/2 = #63 was with 2 cubs.

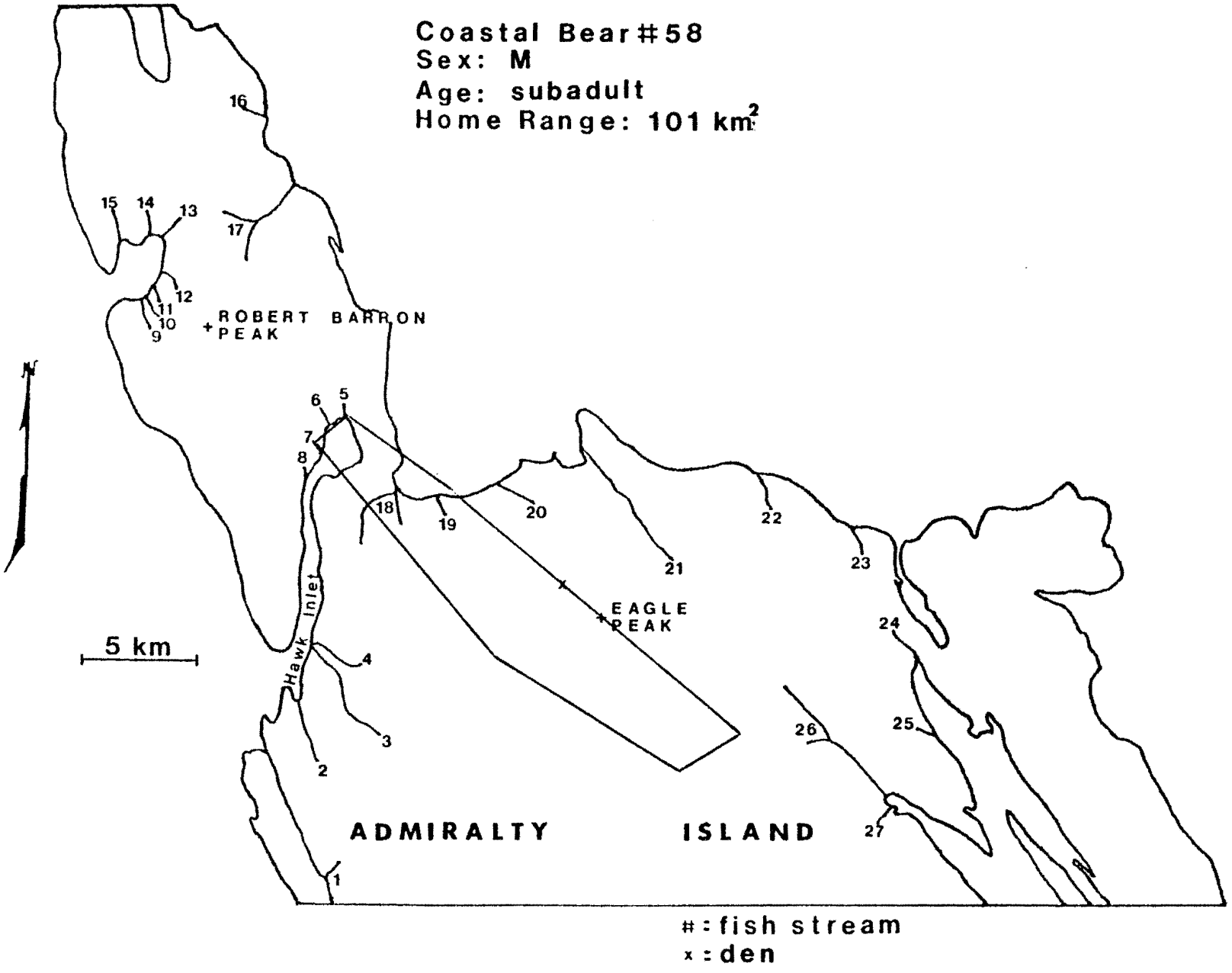

Coastal Bear # 34
Sex: F
Age: 2
Home Range: 7 km²
ROBERT BARRON PEAK
EAGLE PEAK
Hawk Inlet
5 km
ADMIRALTY ISLAND
= fish stream

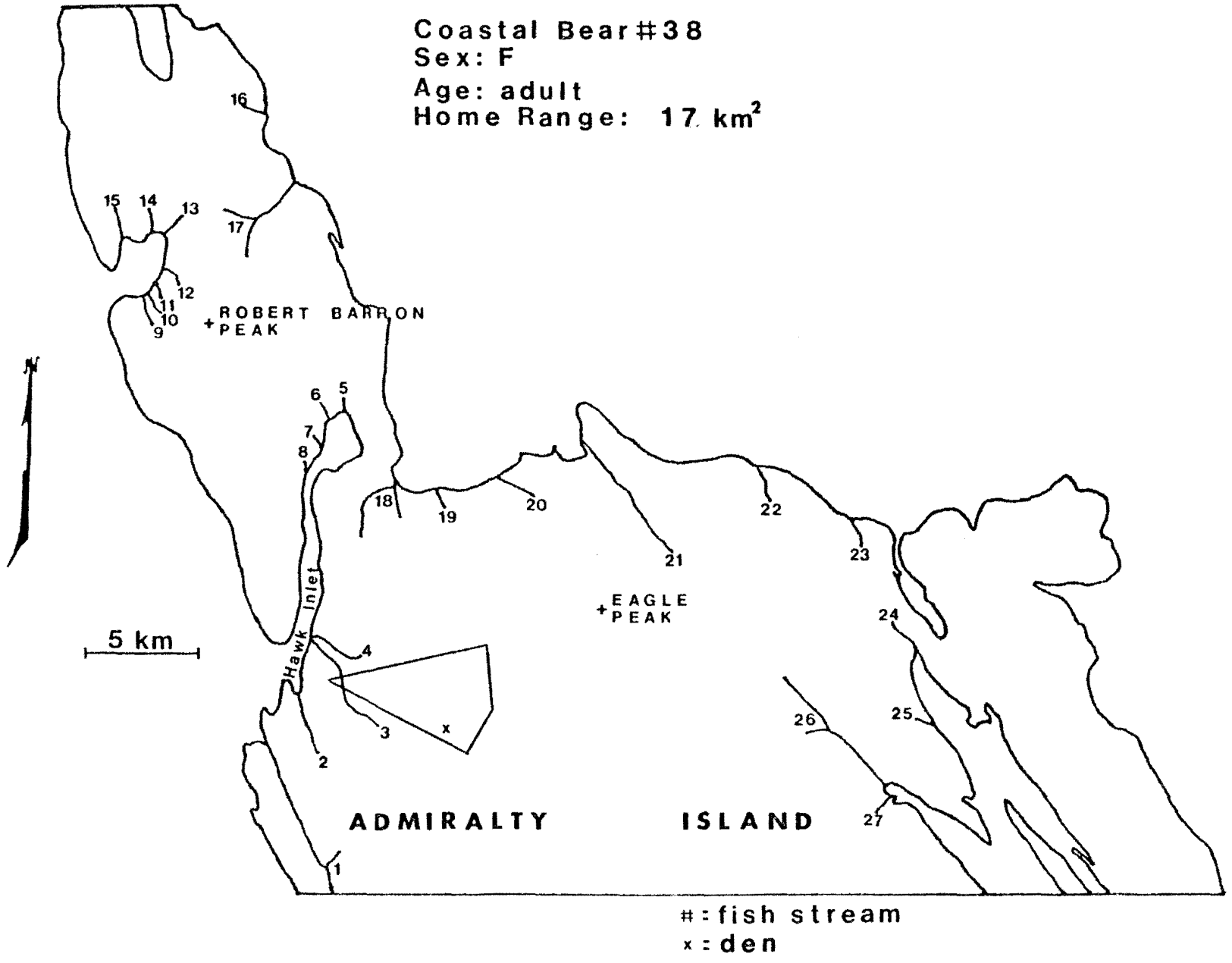

Coastal Bear #72
Sex: M
Age: adult
Home Range: 193 km²
ROBERT BARRON PEAK
EAGLE PEAK
Hawk Inlet
5 km
ADMIRALTY ISLAND
#: fish stream
x: den

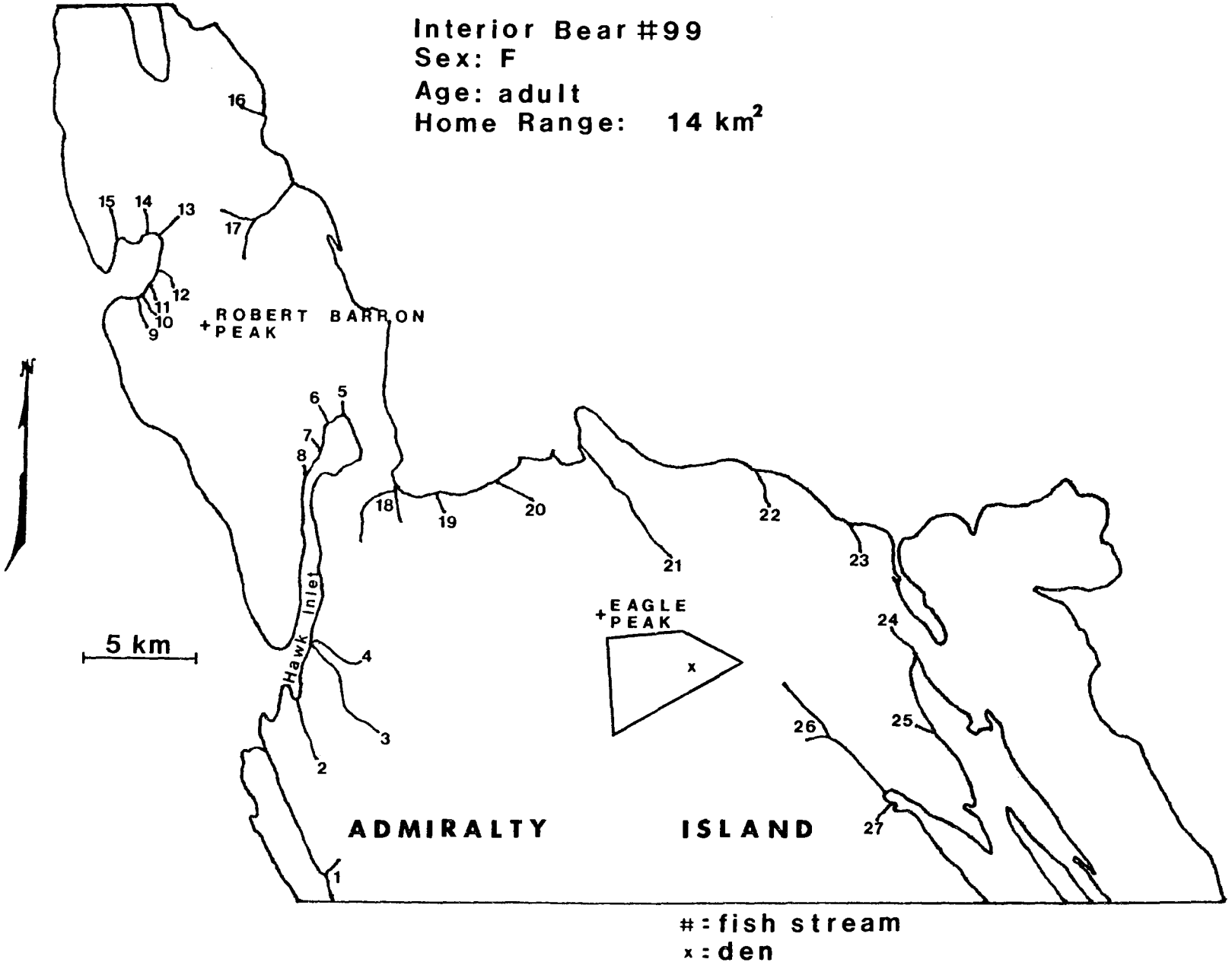

Coastal Bear #95
Sex: F
Age: adult
Home Range: 11 km²
ROBERT BARRON PEAK
EAGLE PEAK
Hawk Inlet
5 km
ADMIRALTY ISLAND
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
: fish stream
x : den

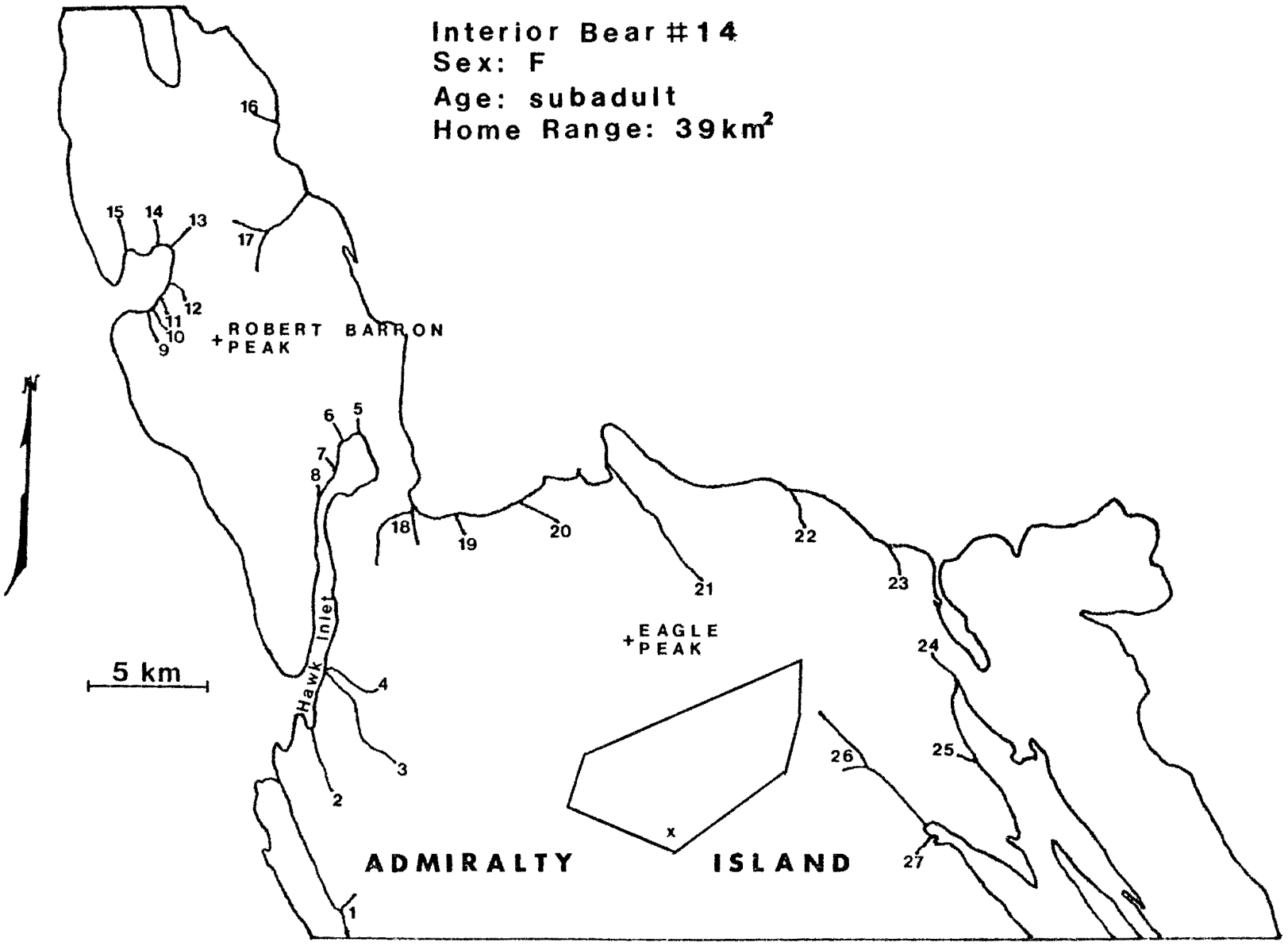

Coastal Bear #63 W/2
Sex: F
Age: adult
Home Range: 51 km²
ROBERT BARRON PEAK
EAGLE PEAK
Hawk Inlet
5 km
N
ADMIRALTY ISLAND
#: fish stream

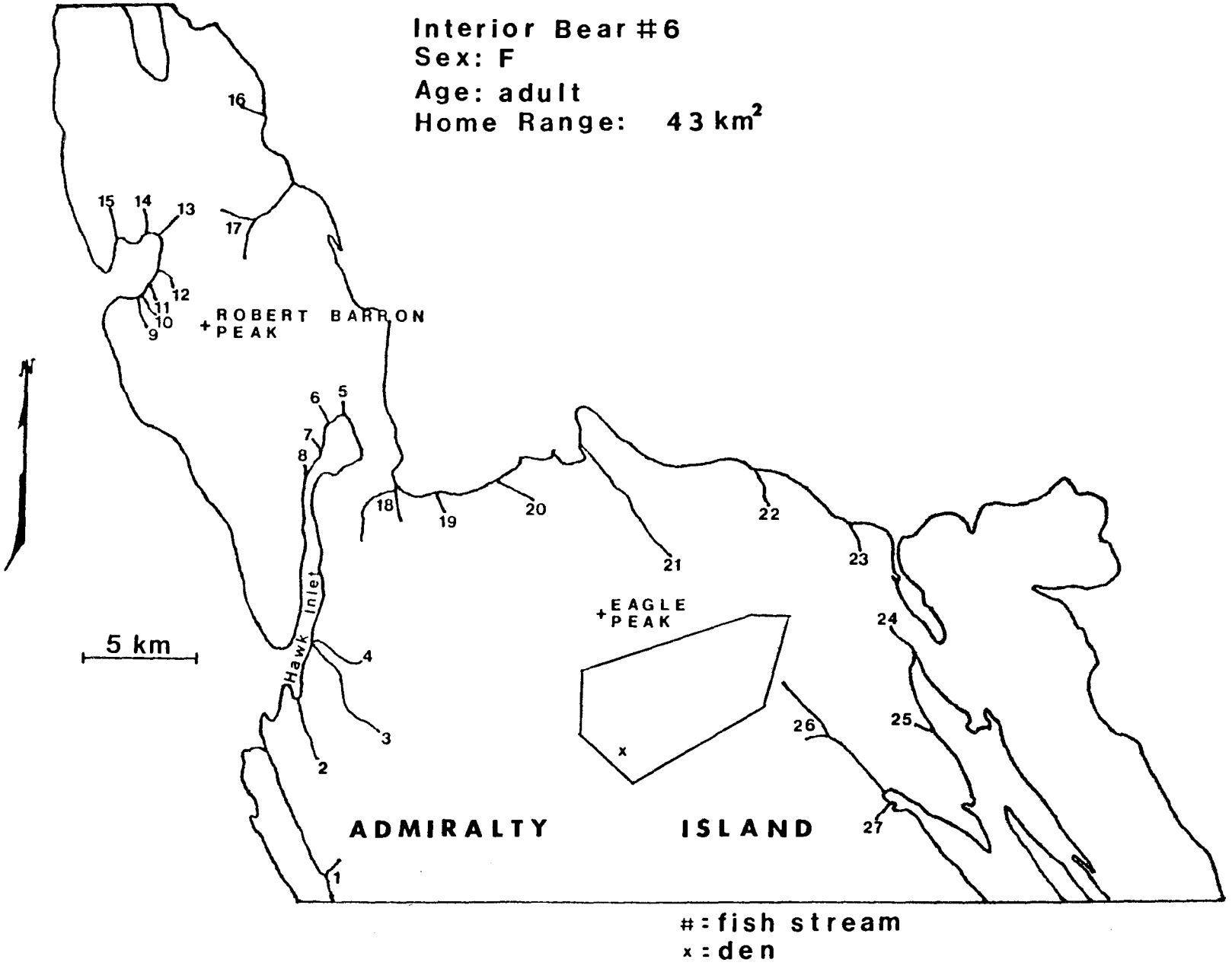

Coastal Bear #10
Sex: M
Age: adult
Home Range: 210 km²
ROBERT BARRON PEAK
EAGLE PEAK
Hawk Inlet
ADMIRALTY ISLAND
5 km
N
#: fish stream

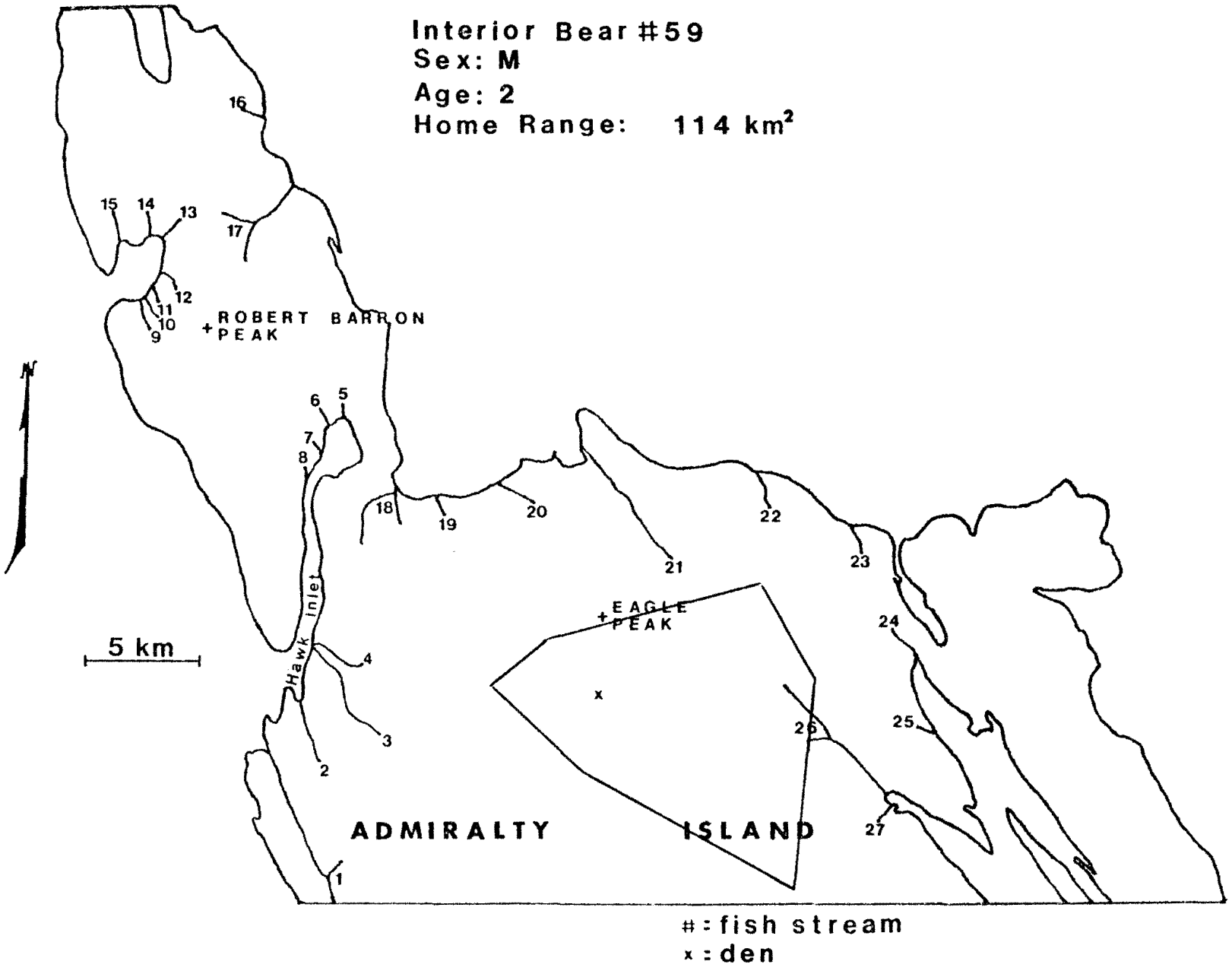

Coastal Bear #58
Sex: M
Age: subadult
Home Range: 101 km²
ROBERT BARRON PEAK
EAGLE PEAK
Hawk Inlet
5 km
ADMIRALTY ISLAND
#: fish stream
x: den

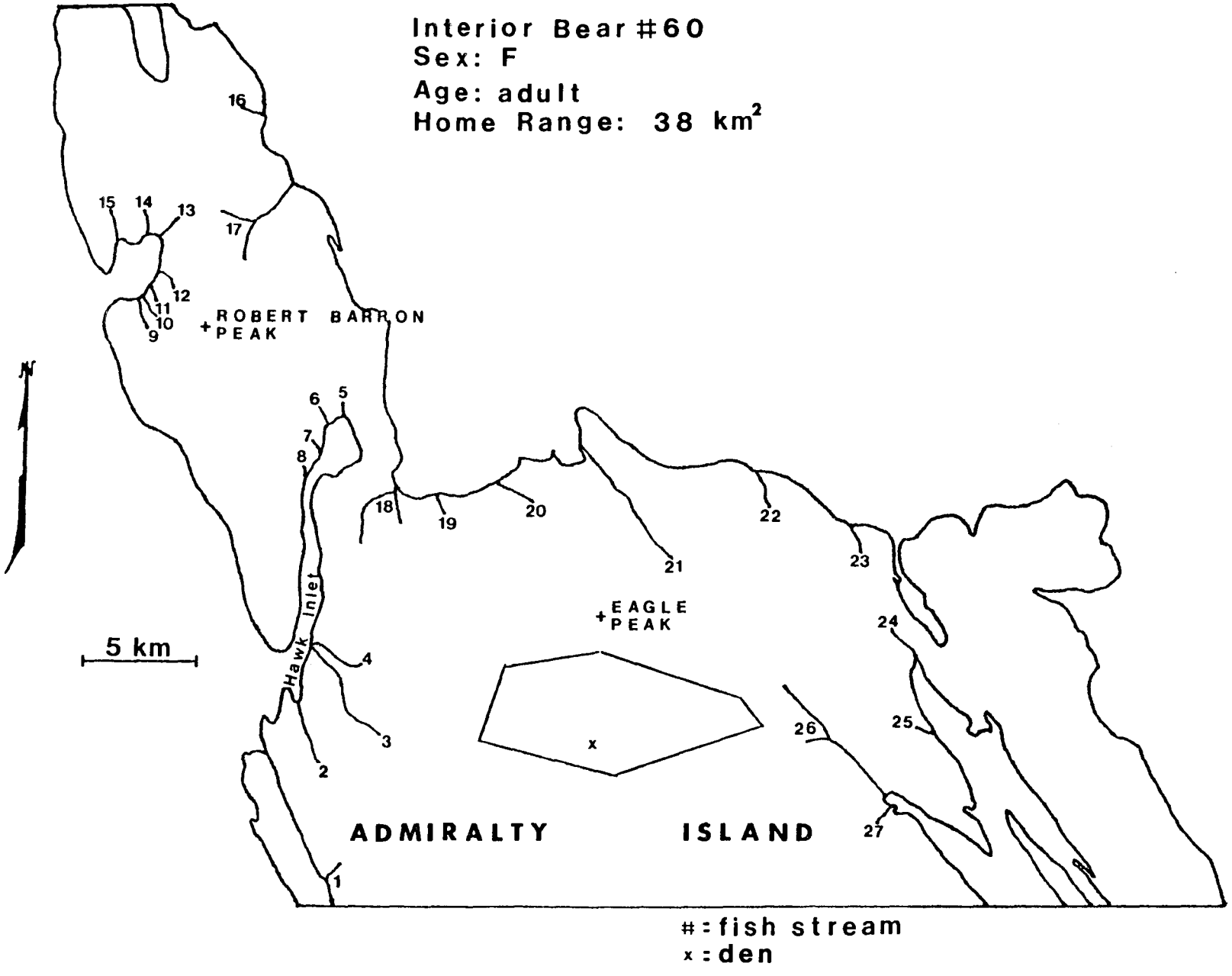

Coastal Bear#38
Sex: F
Age: adult
Home Range: 17 km²
ROBERT BARRON PEAK
EAGLE PEAK
Hawk Inlet
5 km
ADMIRALTY ISLAND
#: fish stream
x: den


Interior Bear #99
Sex: F
Age: adult
Home Range: 14 km²
ROBERT BARRON PEAK
EAGLE PEAK
Hawk Inlet
5 km
ADMIRALTY ISLAND
: fish stream
x : den


Interior Bear #14
Sex: F
Age: subadult
Home Range: 39km²
ROBERT BARRON PEAK
EAGLE PEAK
Hawk Inlet
ADMIRALTY ISLAND
5 km
N
#: fish stream
x: den


Interior Bear #6
Sex: F
Age: adult
Home Range: 43 km²
ROBERT BARRON PEAK
EAGLE PEAK
Hawk Inlet
5 km
N
ADMIRALTY ISLAND
#: fish stream
x: den


Interior Bear #59
Sex: M
Age: 2
Home Range: 114 km²
ROBERT BARRON PEAK
EAGLE PEAK
Hawk Inlet
5 km
ADMIRALTY ISLAND
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
: fish stream
x : den


Interior Bear #60
Sex: F
Age: adult
Home Range: 38 km²
ROBERT BARRON PEAK
EAGLE PEAK
Hawk Inlet
5 km
ADMIRALTY ISLAND
#: fish stream
x: den

APPENDIX D.

04 February 1983

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RH: Admiralty Island Brown Bear Distribution Schoen, Lentfer, Beier

Differential Distribution of Brown Bears on Admiralty Island, Southeast Alaska: A Preliminary Assessment

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Abstract: Twenty brown bears radio-tracked on Admiralty Island in southeast Alaska for 2 to 13 months were not uniformly distributed during summer in lower elevation tidal and riparian habitats. These findings differ from the assumption of uniform summer brown bear distribution. Our data suggest that a segment of the population remains in upper elevation interior regions and that anadromous salmon streams were not utilized by the interior bear population during the year.

Key Words: Brown bear, Ursus arctos, Admiralty Island, southeast Alaska, home range, habitat use, seasonal distribution.

Brown bears (Ursus arctos) are indigenous to southeast Alaska where they occur on the islands north of Frederick Sound and the mainland. Management concerns include magnitude and composition of harvest, habitat alteration from timber and mineral extraction, and increasing human disturbance associated with recreation and development. Past research has been directed at basic life history including litter size, spring and summer distribution, and movements (Klein 1958, Perensovich 1966, Wood 1976). Although hunting mortality of southeast Alaska brown bears has been intensively monitored (Johnson 1980), relatively few data on seasonal habitat requirements are available.

Southeast Alaska brown bears are generally believed to make several altitudinal movements between spring and fall denning: 1) they leave their high country dens in spring to feed on emergent vegetation along beaches and tidal flats; 2) they move upward in early summer to feed on new vegetation; 3) they return to lower elevations to feed on spawning salmon (Oncorhynchus spp.) in midsummer; and 4) they return to alpine areas to feed on

vegetation prior to denning. During fall 1981, the Alaska Department of Fish and Game initiated research in northern southeast Alaska to determine seasonal distribution, habitat preference, and home range and den site characteristics of brown bears. This paper describes our first year's results obtained by radio telemetry.

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STUDY AREA

The study area is the northern portion of the Alexander Archipelago in southeast Alaska at approximately 57-58° north latitude and 134-136° west longitude. Vegetation is dominated by 2 major habitat types--temperate rain forest and alpine tundra. Interspersed throughout the forest are poorly drained, open muskeg areas. Forests of this region are typically western hemlock-Sitka spruce (Tsuga heterpophylla-Picea sitchensis). The climate is maritime with cool, moist weather predominating. Snow accumulates at sea level during the winter, and higher elevations (>800 m) are snow covered for 7-9 months. Annual precipitation averages about 140 cm, and January and July temperatures average -6 and 13°C, respectively (NOAA weather records).

Our primary study site is located around Hawk Inlet on northern Admiralty Island (2,734 km^2), which is the third largest island in the archipelago. The study area, about 400 km^2, encompasses approximately 60 km of marine shoreline, several large tidal flats, numerous small lakes, about 15 anadromous fish streams, and elevations to 1,400 m. Old-growth hemlock-spruce forest dominates two-thirds of the area, and upper elevation brush, alpine-subalpine, and rock make up about 30% of the area.

METHODS

Most bears were captured in alpine habitat at about 750 m elevation by immobilizing with a projectile syringe from a helicopter. A fixed-wing aircraft used in conjunction with the helicopter helped locate bears for immobilizing and keep them in sight in heavy cover until immobilization was complete. Drugs used were etorphine (0.04 mg/kg) and phencyclidine hydrochloride (3.4 mg/kg). Other bears were captured along beaches and anadromous fish streams with Aldrich foot snares and then immobilized. Captured bears were instrumented with Telonics radio collars or ear radios and ear-marked with tags and colored flagging. A premolar tooth was extracted for age determination; sex, standard body measurements, and estimated weight were recorded.

Movements, home ranges, and habitat use were determined by relocating instrumented bears approximately once per week during daylight hours from a fixed-wing Helio Courier aircraft. Location accuracy was generally within 40 m. At each location, elevation, slope, aspect, and habitat type were recorded. Locations were plotted on USGS topographic maps (1:63,360 scale), and home ranges determined by connecting the outer points of location (Mohr 1947). Home range sizes were calculated using a polar planimeter. Mean elevations and home range sizes are reported plus or minus 1 standard deviation. Significant differences between means were determined by the Mann-Whitney U test.

RESULTS AND DISCUSSION

Seven brown bears (2 males, 5 females) were instrumented in the Hawk Inlet alpine area during late September 1981 (Table 1). These bears denned in alpine/subalpine in early November. The mean den elevation of 5 bears was 793 ± 112 m. Four bears shed their radio collars during the winter. Two of these were recollared on 2 July 1982. Bears emerged from their dens between 12 May and 1 June. The winter of 1981-82 was one of heavy snow accumulation and emergence may have been later than most years.

During the period from den emergence through June, all instrumented bear relocations ($\bar{N}$ = 17, excluding 1 bear captured on the beach on 6-16-82) occurred in alpine, rock, subalpine, and brush slope habitats in that order. The mean elevation of telemetry relocations was 820 ± 190 m. To our knowledge, from den emergence through June, only 1 of 6 marked bears moved down to sea level grass flats (Table 2). We recognize, however, that some of the marked bears that lost radios could have moved to coastal areas without our knowledge. During this same period, we observed unmarked bears and bear sign at sea level where bears were feeding on new growth of grasses, sedges, and herbaceous vegetation. This coastal distribution associated with grass/sedge meadows in late spring is considered typical of southeast Alaska brown bears following their emergence from dens (Johnson 1980).

Currently, the brown bear hunting season ends on Admiralty Island on 20 May. Most brown bear hunting in this area is conducted in the spring from boats and is concentrated at lower elevations at the head of bays and along tidal flats (Johnson 1980). Our data indicate that a portion of the bear population was either denned or in alpine habitat throughout early May and thus essentially unavailable for the spring hunting season in 1982. It is too early in this study to say whether this is a common occurrence or was unique to this particular spring. We are also unable at this time to evaluate whether or not particular sex/age components of the population or what proportion of the population may remain at higher elevation interior sites during the spring season. These questions will be answered in subsequent years.

During the first week of July 1982, 7 new bears (2 males, 5 females) were instrumented in alpine habitat (Table 1). This brought the number of instrumented bears which occurred in alpine or interior areas to 12. On 20 July, 9 of these bears were still in high elevation alpine/subalpine habitat. By 26 July, 5 were still at higher elevation interior sites, where they remained throughout the summer and fall (Table 2, Fig. 1). The other bears moved down to or near coastal salmon streams (Fig. 2). We will refer to bears which remained in alpine/interior areas as interior bears and those which utilized low elevation fish streams as coastal bears. The shift from high elevation interior sites to low elevation coastal areas corresponded to the movement of salmon into streams to spawn. By the first week of August, an additional 6 bears (2 males, 4 females) had been captured along salmon streams or beaches (Table 1). Once established near low elevation salmon streams, all of the radio-collared coastal bears remained there until about mid-September.

Interior and coastal bears differed markedly in their use of habitat from July through mid-September (Table 3). Interior bears used subalpine, alpine, and brush habitats primarily, and coastal bears used mostly old-growth and riparian forest. Throughout the summer 5 (28%) of our instrumented bears ($\underline{N}$ = 18) remained in higher elevation, interior regions of the study area. These interior bears consisted of 3 adult females (without cubs), 1 subadult female, and 1 subadult male. On Kodiak Island in the Gulf of Alaska, Atwell et al. (1980) also reported extensive use of alpine habitat by brown bears from the last week of June through early August with a peak in mid-July. Heaviest bear use on Kodiak Island was associated with Carex meadows. By mid-August, the Kodiak bears left the alpine presumably for salmon streams. R. Smith (Alaska Department of Fish and Game, pers. comm.) also reported substantial use of alpine by radio-instrumented bears on Kodiak during summer 1982. All of these bears utilized fish streams later in the summer.

During August when all the instrumented coastal bears were on or near salmon streams, the interior bears had moved to steep avalanche slopes (brush habitat) dominated by alder (Alnus spp.), salmonberry (Rubus spectabilis), and devils club (Oplopanax horridum). During this period, the interior bears were rarely observed visually on radio telemetry flights. In contrast, they were frequently observed during June and early July when they utilized open alpine/subalpine habitats. The difficulty of observing bears in these upper elevation avalanche slopes may have contributed to the widespread belief that most bears are using anadromous fish streams during late July and August. However, Klein (1958) reported that in years of good berry crops and poor fish runs, fewer bears or their sign were observed along fish streams with greater numbers of bears using higher elevations and interior regions. Although we have not yet begun diet studies, we suspect our interior bears were foraging extensively on berries at this time.

By mid-September, many coastal bears began to move away from fish streams, while the interior bears continued using avalanche slopes (Table 2). Fall habitat use of these 2 groups from 17 September to denning is presented in Table 3. Interior bears utilized primarily brush habitat, followed by rock and subalpine habitat. Coastal bears utilized old-growth forest, brush, rock, riparian, and subalpine habitat in that order.

Most bears had denned by the first week of November. The mean den elevation of 15 instrumented bears during November 1982 was 799 ± 228 m. Most bears (81%) denned in alpine/rock habitat. Three coastal bears denned in old-growth forest habitat at about 450 m. The 5 interior bears denned at a mean elevation of 970 ± 139 m which was significantly ($P < .05$) higher than coastal bear dens.

Home ranges were calculated for 18 bears during 1982. Males averaged 115 ± 75 km^2 and were significantly ($P < .05$) greater than females which averaged 24 ± 16 km^2. Mean home ranges of interior and coastal bears were the following: 4 coastal males, 116 ± 83 km^2; 1 interior male, 114 km^2; 8 coastal females, 19 ± 15 km^2; and 4 interior females, 33 ± 13 km^2. Females utilizing the concentrated forage resource, spawning salmon, had smaller ($P = .13$) home ranges than females exploiting the more widely distributed resource of vegetation and berries. Most coastal females remained on a particular stream system once established there. In contrast, most coastal males moved to several or more streams during the fishing season and their home ranges were much larger.

Data presented here, although preliminary, suggest that brown bears on Admiralty Island are not uniformly distributed on anadromous fish streams during late summer as originally hypothesized, nor does it appear that all seek out coastal grass flats following emergence from their dens. Whether this represents differences in distribution by different sex and age classes or individual differences in learned behavior remains to be determined. We must also learn if individual bears are consistent from year to year in their distribution and preference for specific habitats. Regardless, these data indicate that bears are widely distributed and use a variety of habitats throughout their active period. This is beneficial to the population in areas where the abundance of important forage resources (e.g., berries, anadromous fish) is not uniformally distributed and fluctuates annually.

As resource development and human activities increase in this area, it will become necessary to intensify our management of the brown bear, especially relative to monitoring population densities. Reliable census techniques have not been developed. In doing so, it will be important to consider the problems associated with differential distribution of this species.

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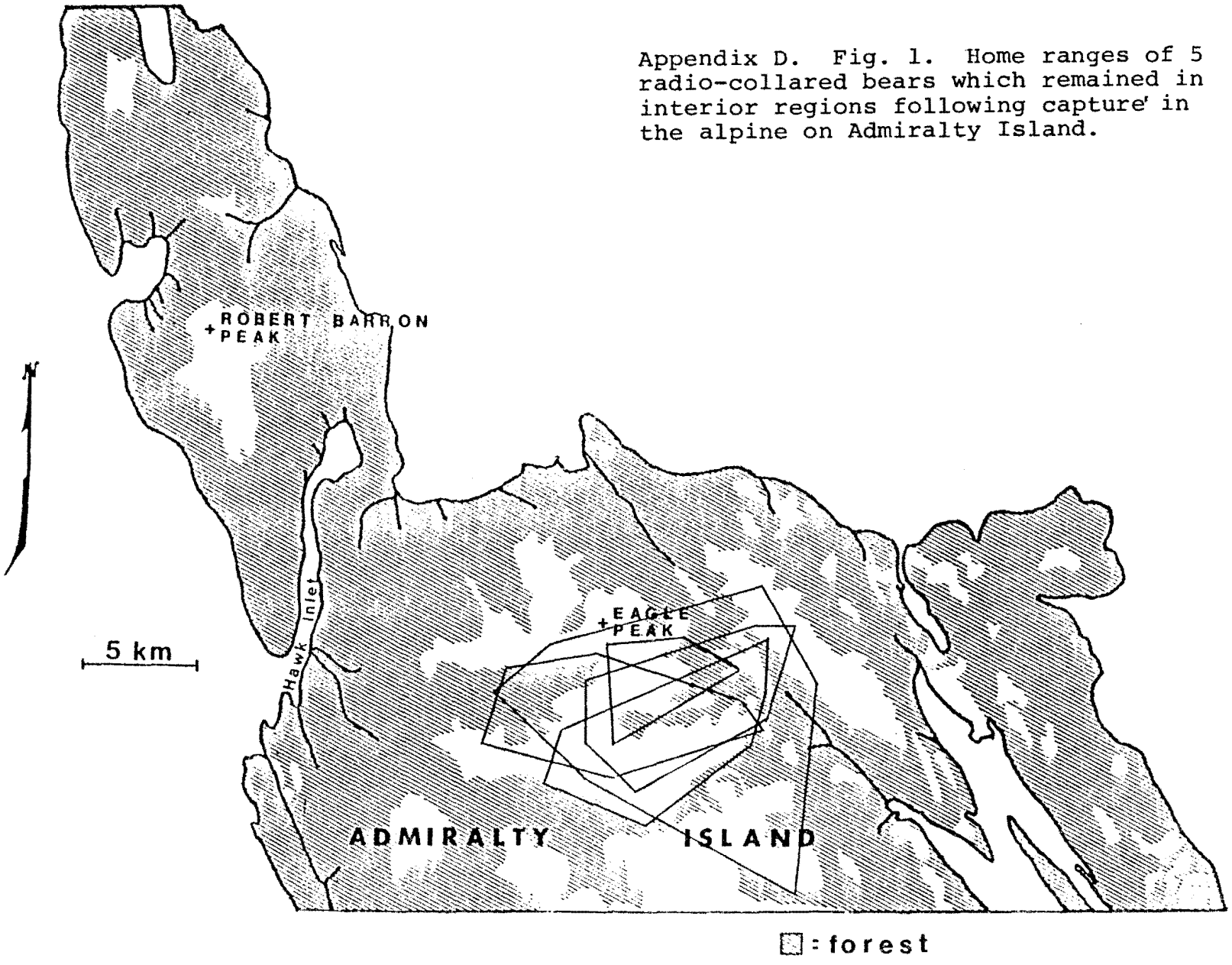
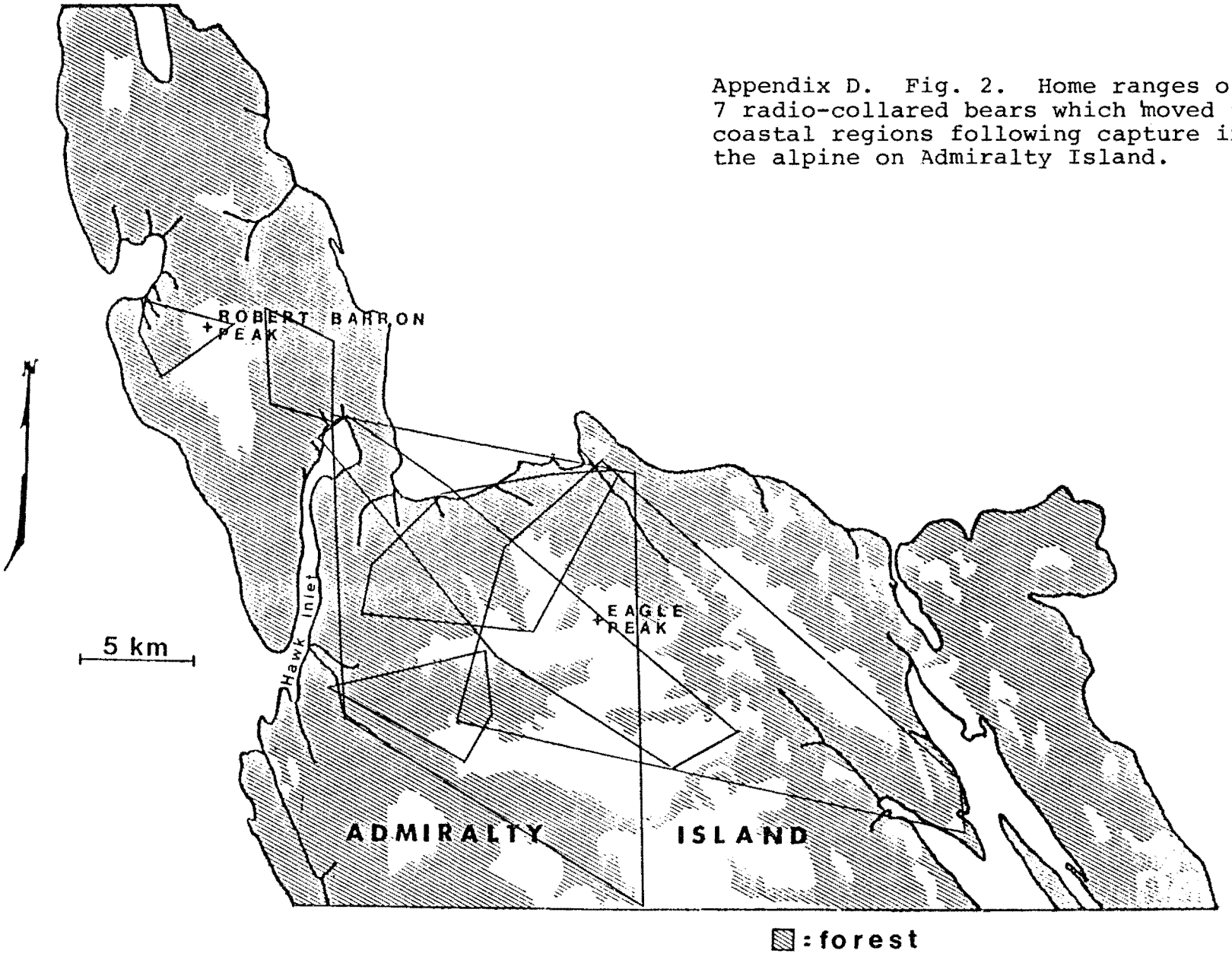


Appendix D. Fig. 1. Home ranges of 5 radio-collared bears which remained in interior regions following capture in the alpine on Admiralty Island.



Appendix D. Fig. 2. Home ranges of 7 radio-collared bears which moved to coastal regions following capture in the alpine on Admiralty Island.

Appendix D. Table 1. Summary and status of brown bears radio collared on Admiralty Island, 1981-82.

Sex	Age (yr)	Capture Location	Distribution	1982 Home Range (km^2)	1982-83 Den Elevation (m)	Den Habitat	Period Tracked
M	2	alpine	interior	114	945	rock	9/2/81 - 12/31/82
F	adult	alpine	interior	38	1,098	rock	(9/21/81 - 6/1/82)[1] (7/2/82 - 12/31/82)[2]
F	adult	alpine	interior	43	1,128	rock	9/27/81 - 12/31/82
F w/2-yr-olds	adult	alpine	interior	14	823	rock	7/8/82 - 12/31/82
F	subadult	alpine	interior	39	854	rock	(9/26/81 - 11/81)[1] (7/2/82 - 12/31/82)[2]
M	adult	alpine	coastal	210	915	rock	7/2/82 - 12/31/82
M	adult	alpine	coastal	193	671	rock	7/2/82 - 12/31/82
M	subadult	alpine	coastal	101	-----	----	9/21/81 - 8/82
F	adult	alpine	coastal	---	-----	----	9/26/81 - 6/17/82[1]
F	adult	alpine	coastal	17	915	rock	7/2/82 - 12/31/82
F w/yrlgs.	adult	alpine	coastal	11	396	forest	7/8/82 - 12/31/82
F w/yrlgs.	adult	alpine	coastal	51	915	rock	7/8/82 - 12/31/82
F w/ad-F	2	alpine	coastal	7	-----	----	7/8/82 - 10/82
F	adult	alpine	-------	---	-----	----	9/27/81 - 6/1/82[1]
M	adult	stream	coastal	56	366	forest	8/3/82 - 12/31/82
M	subadult	stream	coastal	52	823	rock	7/30/80 - 12/31/82
F	adult	beach	coastal	6	-----	----	6/16/82 - 8/82
F w/2-yr-olds	adult	stream	coastal	9	823	rock	7/30/82 - 8/31/82
F	adult	stream	coastal	17	479	forest	8/3/82 - 12/31/82
F	adult	stream	coastal	33	823	rock	8/7/82 - 12/31/82

[1] radio collar lost.

[2] recaptured - new radio collar.

Appendix D. Table 2. Seasonal distribution of radio-collared brown bears on Admiralty Island, May-November 1982.

Season	Number of Radio-Collared Bears			
	Remained in Interior	Moved from Interior to Coastal	Remained in Coastal	Moved from Coastal to Interior
Den emergence-6-30	3 + (2)[1]	0 + (1)[1]	1[2]	0
7/1 - 9/16	5	7	6	0
9-17 - denning	5	0	0	10

[1] Marked bears which lost their radio collars over winter.

[2] Radio-collared bear captured on beach, 6-16-82.

Appendix D. Table 3. Habitat use by instrumented brown bears on Admiralty Island during summer (7-1 to 9-16) and fall (9-17 to 11-8) 1982.

	% Utilization			
	Interior Bears		Coastal Bears	
Habitat Type	Summer (n=42)	Fall (n=24)	Summer (n=42)	Fall (n=24)
Old-growth forest	10		61	43
Riparian forest			22	7
Subalpine	36	4	5	5
Alpine	21		7	
Brush	28	71		30
Rock	5	25	1	13
Muskeg			2	
Beach			2	
Tidal flats				2