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BLACK BEAR MOVEMENTS AND HOME RANGE STUDY

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Project Progress Report
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JOB PROGRESS REPORT (RESEARCH)

State: Alaska

Cooperator: Ronald D. Modafferi

Project No.: W-17-10 Project Title: Big Game Investigations

Job No.: 17.2R Job Title: Black Bear Movements and Home Range Study

Period Covered: July 1, 1977 to June 30, 1978

SUMMARY

In July and August 1976 and 1977, 24 different black bears were captured with Aldrich spring-activated foot snares set along six streams in the Port Wells, Blackstone Bay and Cochrane Bay area of western Prince William Sound.

Fourteen of the bears captured in 1976 were tagged with roto tags and colored vinyl flagging. All 14 bears captured in 1977 were tagged and collared with radio transmitters. Some of these bears were fitted with an expandable type radio collar. One bear was captured twice in 1976 and five of the bears captured in 1977 had been previously captured in 1976.

Attempts to capture bears at baited snares set in July 1977 proved ineffective.

Thirty-two radio tracking flights were conducted from a light fixed-wing airplane (PA-18).

In view of data gathered, questions are raised regarding the significance of spawning salmon in the ecology of black bears in western Prince William Sound.

General movements of radio-collared bears are discussed in relation to various ecological factors. Specific movements of individual bears are related to movement patterns of similar and different sex and age classes of bears. Immature males appeared to move more frequently and over greater distances than other sex and age classes of radio-collared bears.

Home range sizes calculated for males were 5 to 10 times greater than those ranges calculated for females.

General location and slope exposure of den locations varied greatly. A minimum of eight bears older than cubs denned in 73 km^2 of intensively studied habitat.

CONTENTS

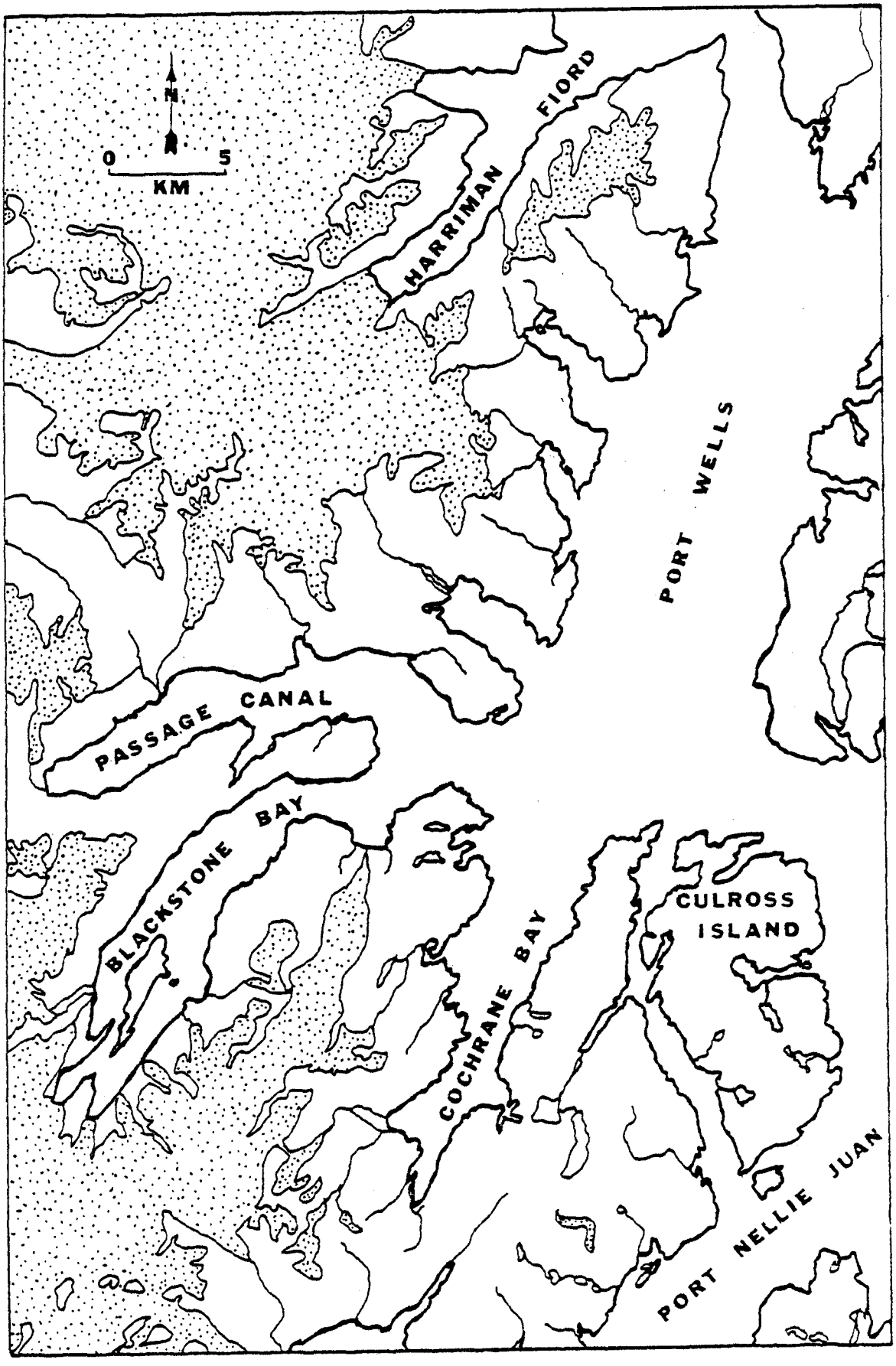
BACKGROUND

Widely distributed and apparently abundant, black bears (*Ursus americanus*) provide a full spectrum of recreational opportunities for people throughout most of Alaska. Statewide hunter harvest data and personal communications indicate that the black bear is rapidly becoming an important "primary" game species, in addition to being a "secondary" species taken incidental to the harvest of other game animals. A recent increase in hunter harvest can be attributed, in part, to a greater number of hunters, a decrease in the availability of other big game species, promotional efforts of guides or air taxi operators, and perhaps the realization by many hunters that black bears provide aesthetically pleasing hunts, a respectable trophy and very flavorful meat.

Although recreational use of black bears has greatly increased in recent years, present knowledge about the biology and population ecology of this species in Alaska is still somewhat limited. Noteworthy published material on black bears in Alaska includes studies by: Rausch (1961) on dentition and growth, Erickson (1965) on general life history, Hatler (1967 and 1972) on food habits, McIlroy (1970 and 1972) on ecology and hunter harvest and Frame (1974) on predation of salmon. A black bear hide and skull sealing program, initiated in many Game Management Units in July 1973, provides data on characteristics of the sport harvest and the bears harvested.

There has also been a general increase in hunting pressure on populations of black bears throughout the state. Those populations in Prince William Sound, in particular, have experienced a tremendous increase in hunting pressure and harvest and presently require close scrutiny. For this reason, and because of the dearth of information on black bears in Alaska, the Department of Fish and Game initiated a research project designed to gather information on bear harvests and population status in western Prince William Sound in 1974 (Fig.1). It was expected that this research would additionally provide information on bear biology applicable to many other coastal Alaskan black bear populations. This first phase of this study necessitated selection of an appropriate study area and development of techniques for use

Fig. 1. Location and extent of glaciers (stippled areas) in western Prince William Sound.



in Alaska. Phase 1 has been completed and reported upon (Modafferi 1978); the purpose of this report is to present results obtained by application of these techniques through June 30, 1978.

OBJECTIVES

To delineate populations; to determine home ranges and movement patterns; to determine population densities, sex and age composition, vulnerability to hunting and mortality by sex and age class; and to gather basic life history information on black bears in Prince William Sound.

PROCEDURES

Streams in western Prince William Sound, that in the past have contained substantial numbers of spawning pink (*Onchorhynchus gorbuscha*) and/or dog (*O. keta*) salmon, were visited frequently throughout July to determine when bears were in these areas feeding on salmon and when to commence trapping activities. An outboard motor powered skiff was used for transportation to and between different trapping areas.

In 1976, Aldrich spring activated foot snares were set as trail sets in freshly used bear trails found along preselected streams that contained spawning salmon (Fig. 2).

Capture and handling techniques developed in 1976 proved to be effective and efficient (Modafferi 1978), and similar procedures were followed in 1977 on a smaller, more "discrete" study area, on the Tebenkof Peninsula (Fig. 3). There an attempt was made to capture and radio-collar as many bears as possible. In addition to trapping at streamside locations in July 1977, some snares were set at other locations where bait was put out to attract the bears. Bears were immobilized with Sernylan, measured for standard body parameters, weighed with a spring scale, tattooed on the upper lip, and tagged on the ears with numbered roto tags and colored flagging. A premolar tooth was extracted and a sample of blood was taken from each bear.

Fourteen bears captured on the Tebenkof Peninsula in 1977, were fitted with radio-transmitting collars and radio-relocated from a skiff during the summer and from a light fixed-wing aircraft (PA-18) through the fall and spring.

RESULTS

Capturing, Radio-Collaring and Radio-Tracking

In July and August 1976, foot snares were set at five different streamside locations (Harrison Lagoon, Pirate Cove, Tebenkof west,

Fig 2. Locations where black bears were captured, marked and/or radio-collared released, and killed by hunters in western Prince William Sound, 1976-1977. HL = Harrison Lagoon, PC = Pirate Cove, TW = Tebenkof west, TE = Tebenkof east, PK = Parks Creek and PL = Paulson Creek. The star and circled star indicate locations where bears were captured at HL in 1976 (B103) and PK in 1977, respectively, and killed by hunters in the spring of 1978.

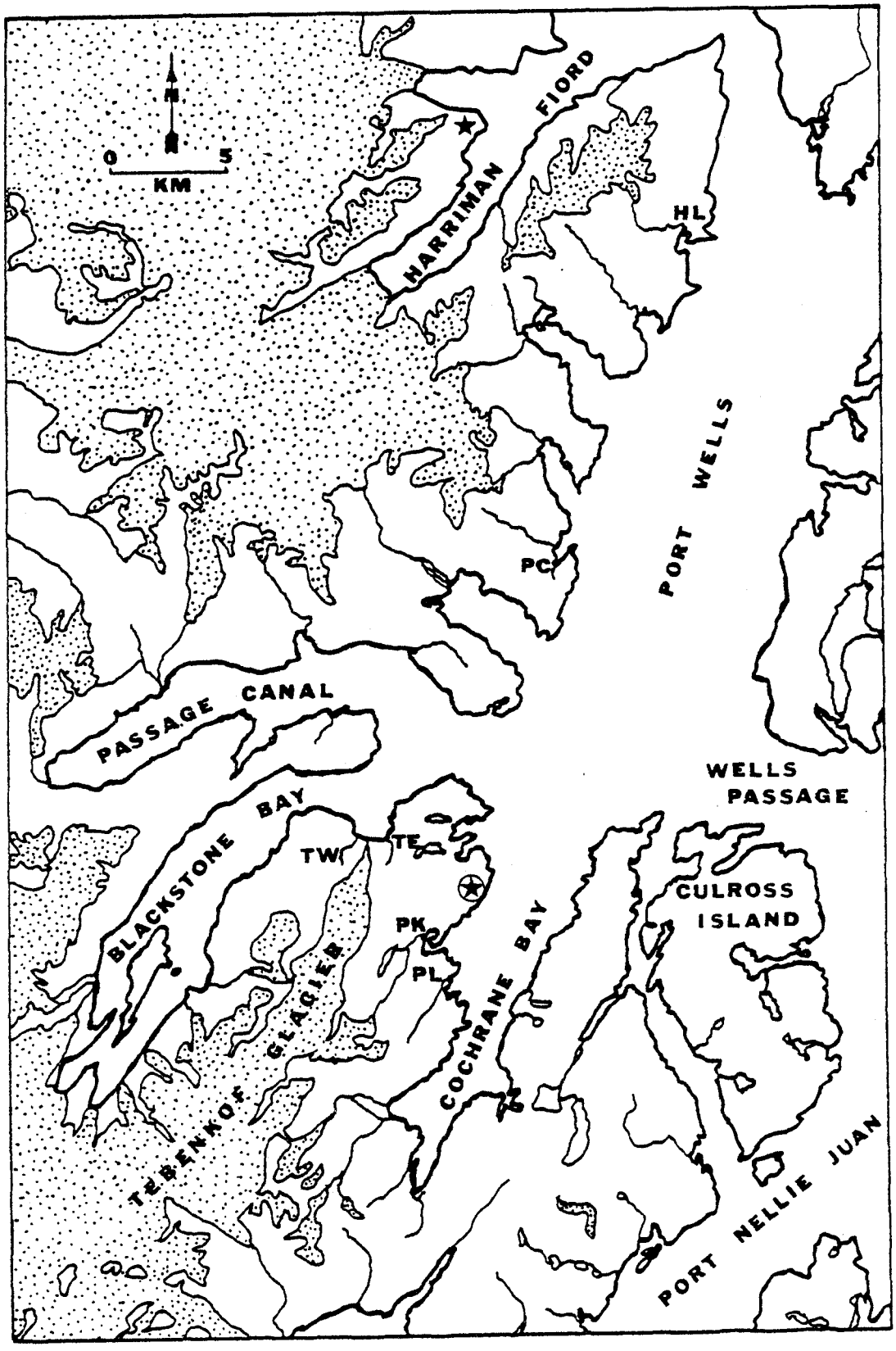
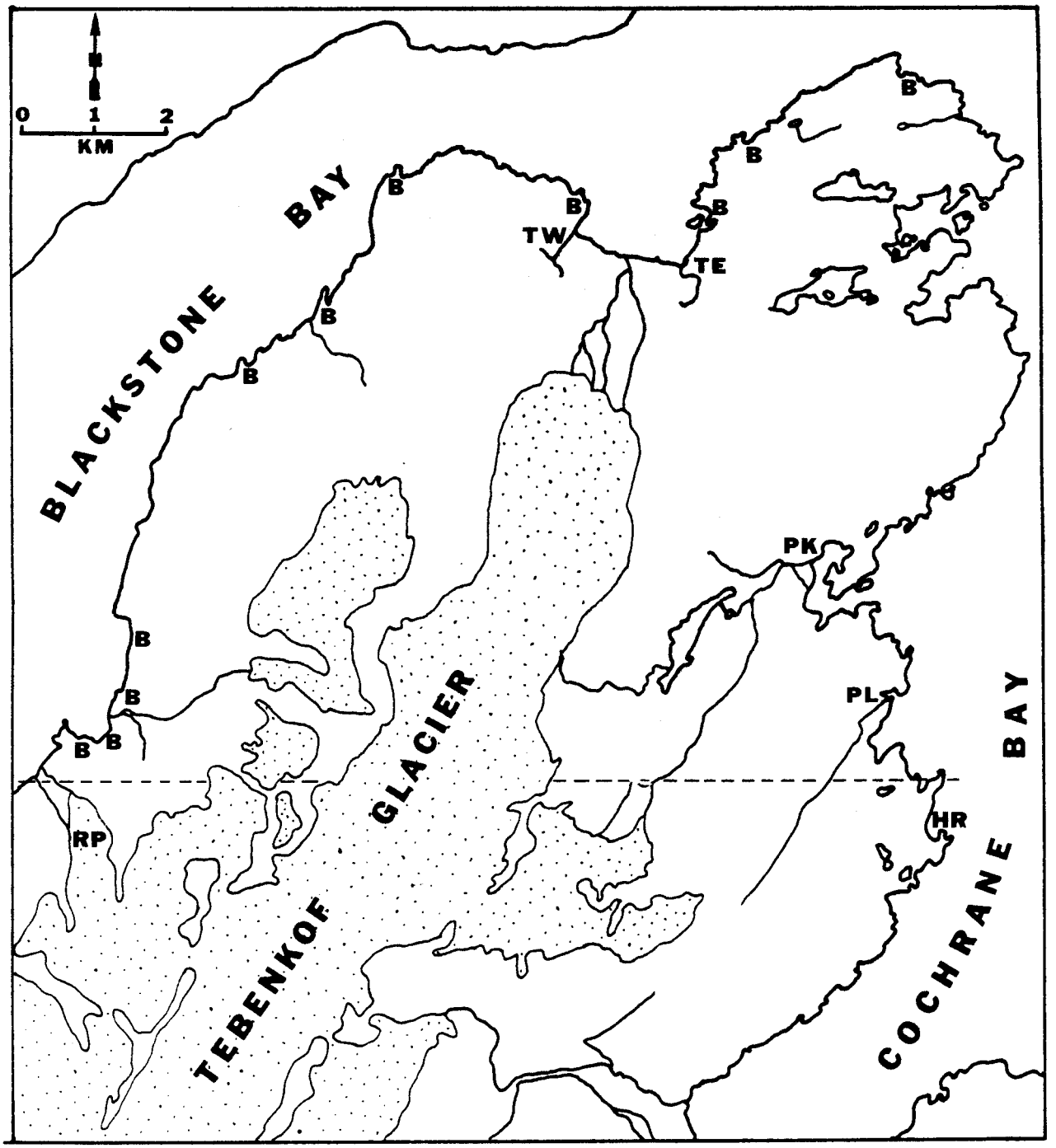


Fig 3. Location of intensively studied area on Tebenkof Peninsula (north of dashed line) in northwestern Prince William Sound. (B= location of baited sites and TW, TE, PK and PL = location of salmon spawning stream sites where trapping took place in 1977. RG = Ripon Glacier and HR = Horse. Darkened areas denote glaciers.)



Tebenkof east and Paulson Creek; Fig. 2) and 15 different bears were captured, marked and released (Table 1). One of these bears (B101) was recaptured that year and fitted with a radio collar.

No bears were captured in 130 trap nights at baited snares set from July 18-29, 1977.

In August of 1977, snares were set at four different streamside locations (Tebenkof west, Tebenkof east, Parks Creek and Paulson Creek; Fig. 3) and 14 different bears were captured, marked, collared with radio transmitters and released (Tables 2 and 3). Of the 14 different bears captured in 1977, two were cubs of the year and five had been captured the previous year.

Data on frequency of radio transmitters on individual bears, locations for bears captured in 1976 and 1977 and locations for bears recaptured in 1977 are presented in Tables 3, 4 and 5, respectively.

One bear captured and marked in 1976 and one bear captured and radio-collared in 1977 were subsequently shot by hunters in spring 1978. Locations of the capture sites and the kill sites are depicted in Fig. 2. Radio relocations for four male bears, two adult females with cubs of the year, four adult females with yearling young, and one subadult female are presented in Figs. 4, 5, 6 and 7, respectively. The location and spatial distribution of dens used by the radio-collared bears, as determined by radio relocation, are illustrated in Fig. 8.

Though radio-tracking flights were attempted three times each week inclement weather greatly interfered with this schedule (Appendix A).

DISCUSSION

Limitations of Data

Because of dense ground cover and the general nature of the terrain in the study area, most radio locations were simply that; i.e., sources of radio transmissions were determined but the radio-collared bears were seldom observed. Under these circumstances, bears that "appeared" to be very sedentary may have previously removed their radio collar and actually been many miles removed from the transmitted signal. Only after reconnaissance on the ground, could these two possibilities be distinguished. At the time of writing this report, several individual bears fell into this category.

Few data on movements of individual bears were available at the time of this writing and there are obviously exceptions to the following generalizations. Nonetheless, because of the present lack of information on black bear movements in coastal Alaska, it seems appropriate to set forth several general interpretations and hypotheses resulting from these studies.

Table 1. Date of capture, location of capture, sex, maternal status, age and weight of black bears ear tagged in western Prince William Sound, 1976.

Date of capture	Location[a]	No. ear tags	Sex	Maternal status[b]	Age[c]	Weight (lbs)
7/29/76	TW(TW)[d]	B101/B102	F	P	3	175
8/19/76	TW	B101/B102	F	P	3	200
7/31/76	HL	B103/B104	M	-	2	115
8/2/76	TW(TW)	B105/B106	F	P	8	160
8/3/76	PL(PK)	B107/B108	M	-	1	90
8/9/76	TW	B109/B110	M	-	6	185
8/9/76	TW	B111/B112	M	-	1	90
8/10/76	HL	B113/B114	F	NC	4	120
8/10/76	TE	B115/B116	F	S	2	80
8/19/76	TW	B117/B118	F	NC	10	150
8/19/76	TE(PK)	B119/B120	M	-	1	100
8/22/76	PC	B121/B122	M	-	2	125
8/22/76	TE	B123/B124	F	S	1	85
8/24/76	TE(PK)	B125/B126	F	C	4	140
8/28/76	TW	B127/B128	F	S	1	90
8/28/76	TW	B129/B130	F	NC	6	155

[a] TW = Tebenkof west, HL = Harrison lagoon, PL = Paulson creek, TE = Tebenkof east and PC = Pirate cove.

[b] P = pregnant, NC = not known to have cubs, C = known to have cubs and S = subadult.

[c] Age determined by counting cemental annuli in stained thin sections of premolar teeth. An age of 1; means that the individual was 1 year and 7 months old.

[d] Location of capture in subsequent year; 1977.

Table 2. Date of capture, location of capture, sex, maternal status, age and weight of black bears ear tagged and radio-collared in western Prince William Sound, 1977.

Date of capture	Location[a]	No. ear tags	Sex	Maternal status[b]	Age[c]	Weight (lbs)
7/25/77	TW(TW)[d]	B105/B132	F	C	9	150
8/7/77	TW(TW)	B101/B102	F	C	4	-
8/13/77	TW	B135/B136	F	S	CUB/B105[e]	26
8/14/77	PK(TE)	B119/B139	M	-	2	115
8/14/77	PK(PL)	B107/B108	M	-	2	135
8/16/77	PK(TE)	B125/B126	F	CPY	5	148
8/16/77	PK	B141/B142	F	C	11	136
8/16/77	PK	B143/B144	F	NC	12	180
8/17/77	PK	B137/B138	F	P	11	170
8/19/77	PK	B147/B148	F	S	1	72
8/20/77	PK	B149/B150	M	-	2	141
8/24/77	PL	B151/B152	F	S	1	94
8/27/77	PK	B153/B154	M	-	2	127
8/28/77	TW	B155/B156	M	-	CUB/B101	40

[a] TE = Tebenkof east, TW = Tebenkof west, PK = Parks creek and PL = Paulson creek.

[b] C = cubs, CPY = known to have cubs the previous year, NC = not known to have cubs, P = pregnant and S = subadult.

[c] Age determined by counting cemental annuli in stained thin sections of premolar teeth. An age of 1; means that the individual was 1 year and 7 months old.

[d] Location of capture the previous year (1976).

[e] No. of sow

Table 3. Frequency and type of radio-collar put on black bears captured in western Prince William Sound, 1976-1977.

No. ear tags	Date radio-collared	Collar type[a]	Radio frequency (MHZ)	Receiver channel.frequency
B101/B102	8/28/77	AVM BOLT-ON	150.880	4.1
B106/B132	7/25/77	AVM EXPANDABLE	150.993	8.38
B135/B136	8/13/77	AVM EXPANDABLE	151.018	9.38
B119/B139	8/14/77	AVM EXPANDABLE	151.004	9.13
B107/B108	8/14/77	AVM BOLT-ON	150.811	1.23
B125/B126	8/16/77	AVM EXPANDABLE	150.966	7.25
B141/B142	8/16/77	AVM EXPANDABLE	151.039	10.27
B143/B144	8/16/77	AVM BOLT-ON	150.869	3.38
B137/B138	8/17/77	AVM BOLT-ON	150.800	1.08
B147/B148	8/19/77	AVM EXPANDABLE	150.930	6.15
B149/B150	8/20/77	AVM EXPANDABLE	151.080	12.16
B151/B152	8/24/77	AVM EXPANDABLE	151.028	10.10
B153/B154	8/27/77	AVM EXPANDABLE	150.941	6.30
B155/B156	8/28/77	AVM EXPANDABLE	150.979	8.10

[a] Radio collars fabricated by AVM Instruments Company Champaign, Ill., 61820.

Table 4. Locations for black bears captured on the Tebenkof Peninsula in western Prince William Sound, 1976 and 1977.

Location	1976 No. males	1976 No. females	1976 Total	1977 No. males	1977 No. females	1977 Total
Tebenkof west	2	5	7	1[a]	2	3
Tebenkof east	1	3	4	0	1[a]	1
Paulson creek	1	0	1	0	1	1
Parks creek	Not trapped		-	4	5	9
Total	4	8	12	5	9	14

a One of the individuals was a cub of the year.

Table 5. Data on individual black bears captured in 1976 and recaptured in 1977 in western Prince William Sound.

No. ear tags	Sex	Age[a]	Location of capture 1976	Location of capture 1977
B101/B102	F	3	TW	TW[b]
B106/B132	F	8	TE	TW[b]
B107/B108	M	1	PL	PK
B119/B139	M	1	TE	PK
B125/B126	F	4	TE[b]	PK

a Age determined by counting cemental annuli in premolar teeth in 1976; where 1 equals an age of 1 year plus about 7 months.

b Bear accompanied with a cub or cubs of the year.

Fig. 4. Radio relocations for four different male black bears (A = B119, B = B149, C = B153 and Y - B107) radio-collared in western Prince William Sound, 1977.

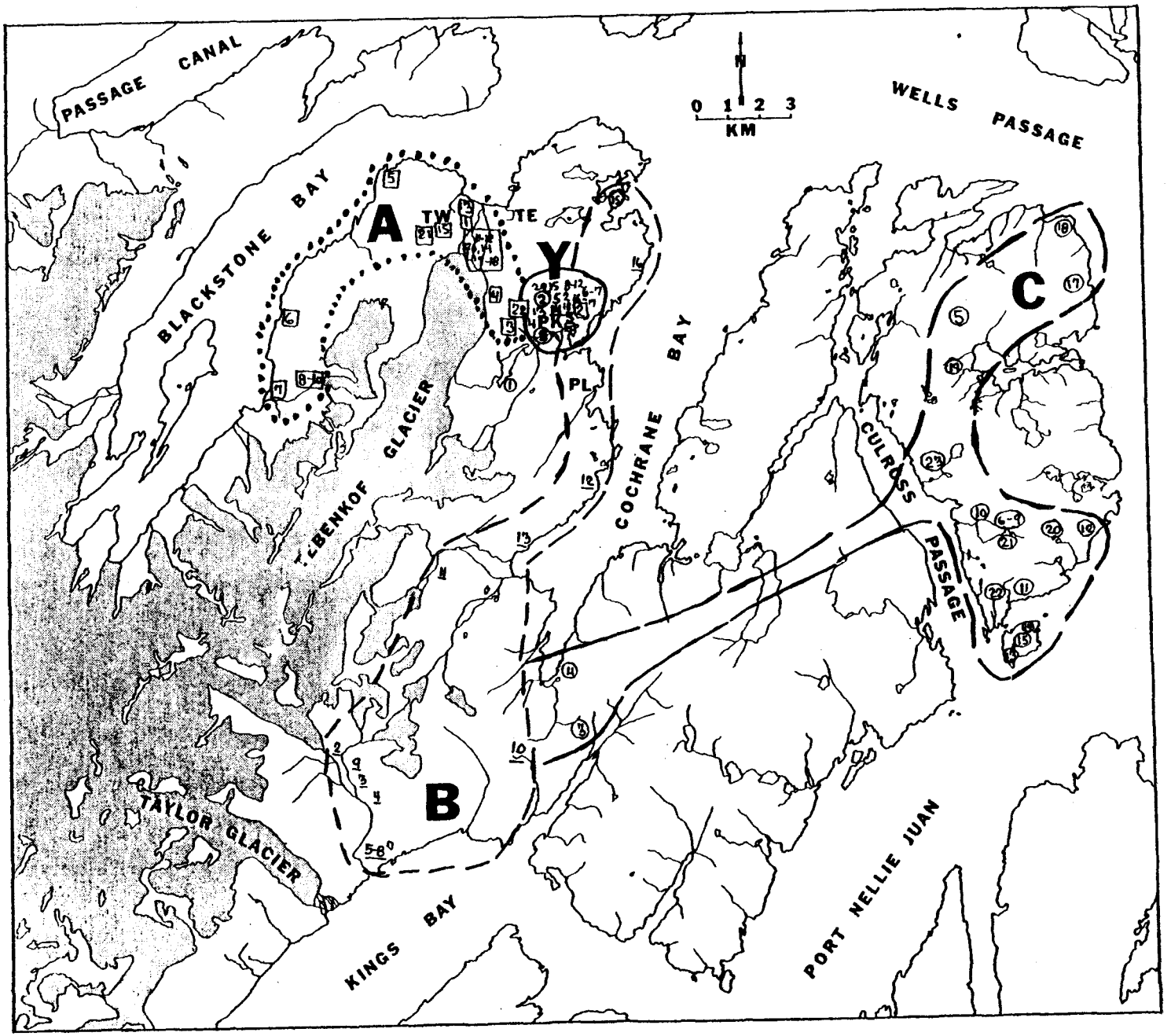


Fig. 5. Radio relocations for two different adult female black bears (D = B125 and E = B137) radio-collared in western Prince William Sound, 1977. Bear D was accompanied by two cubs in the summer 1976 and bear E was accompanied by a single cub in summer 1978.

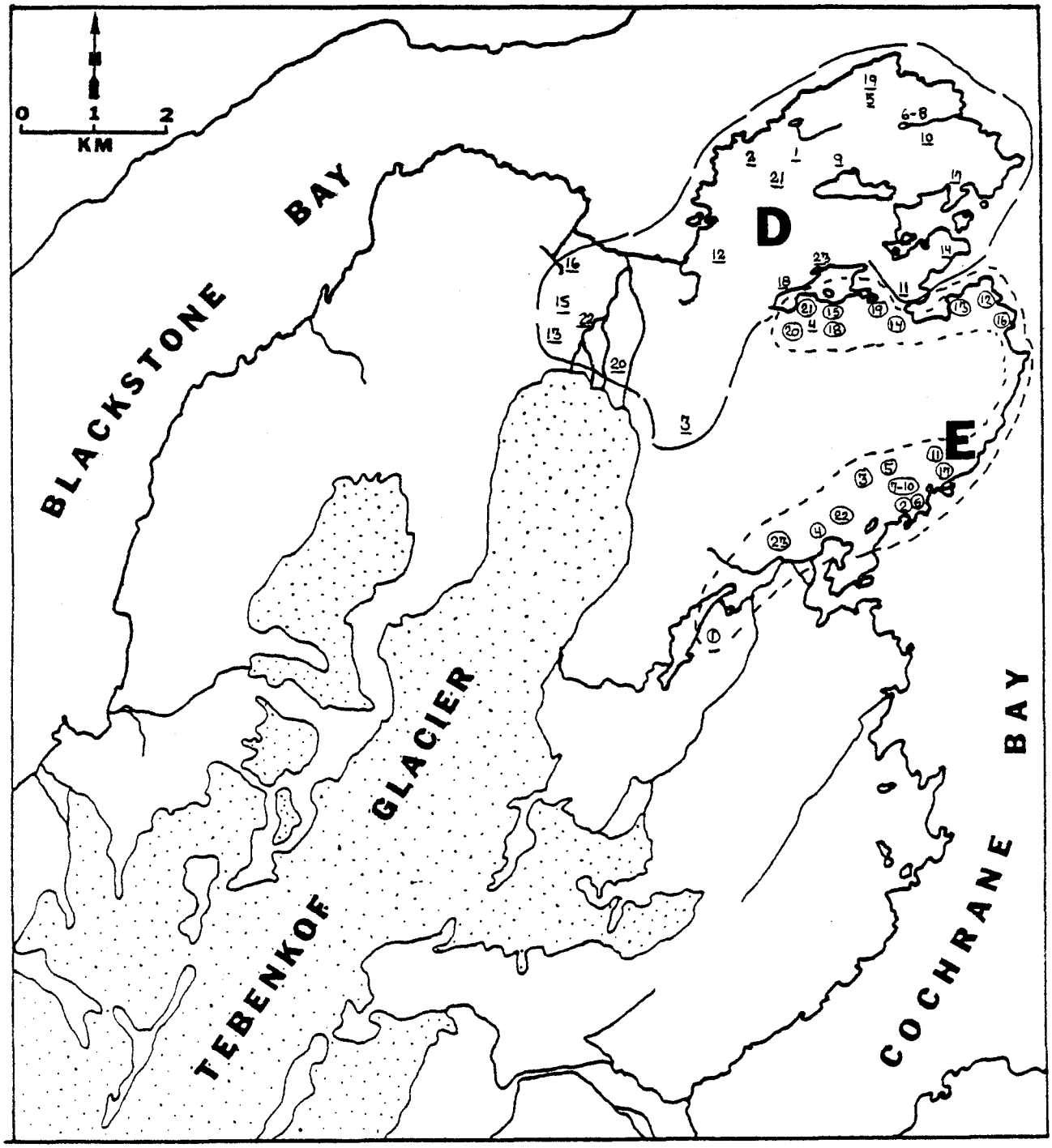


Fig. 6. Radio relocations for four different adult female black bears (F = B101, G = B107, H = B141 and I = B143) radio-collared in western Prince William Sound, 1976 or 1977. Each bear was assumed to have yearling cubs in the spring of 1978.

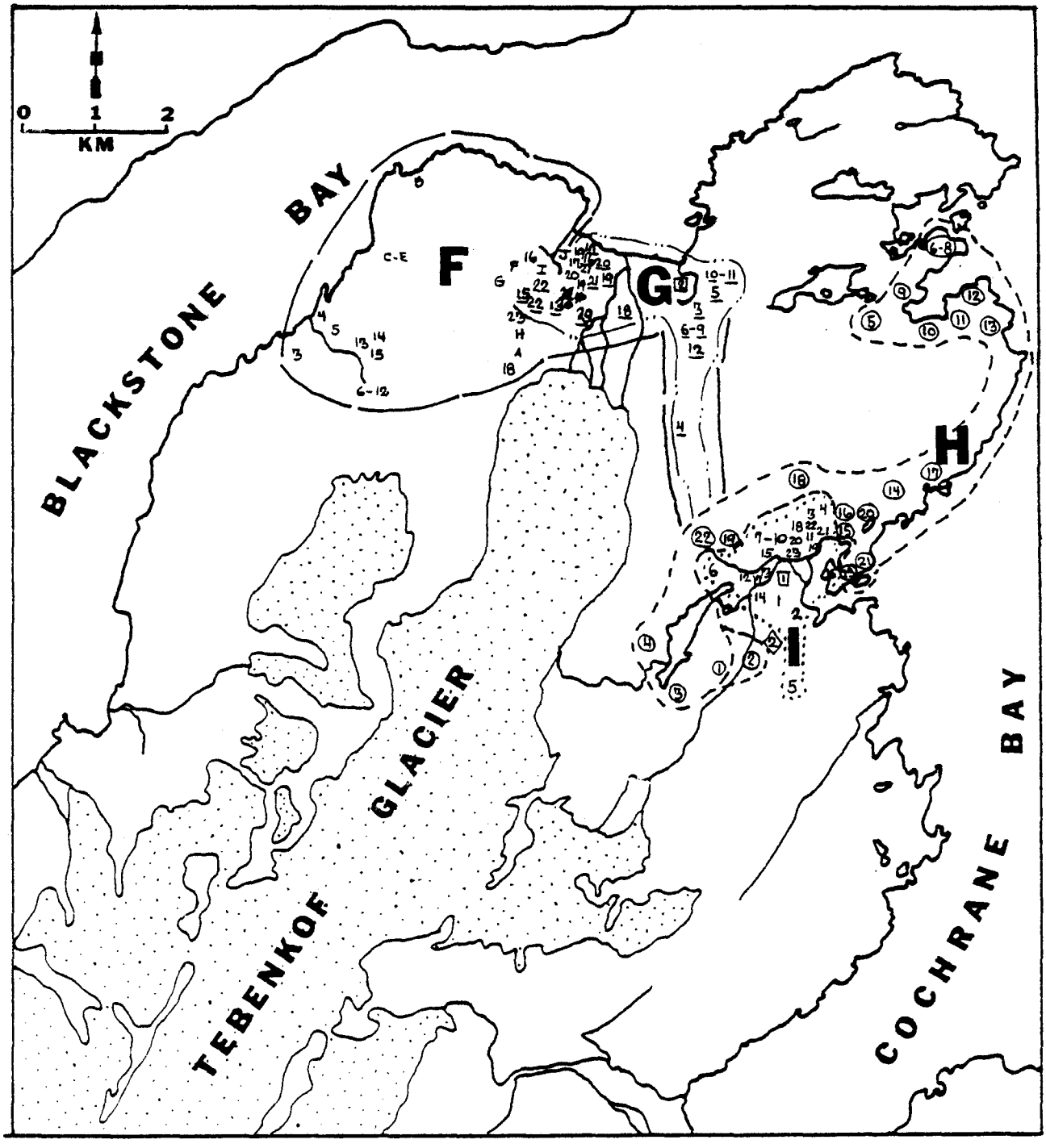


Fig. 7. Radio relocations for a subadult female black bear (J = B147) radio-collared in western Prince William Sound, 1977.

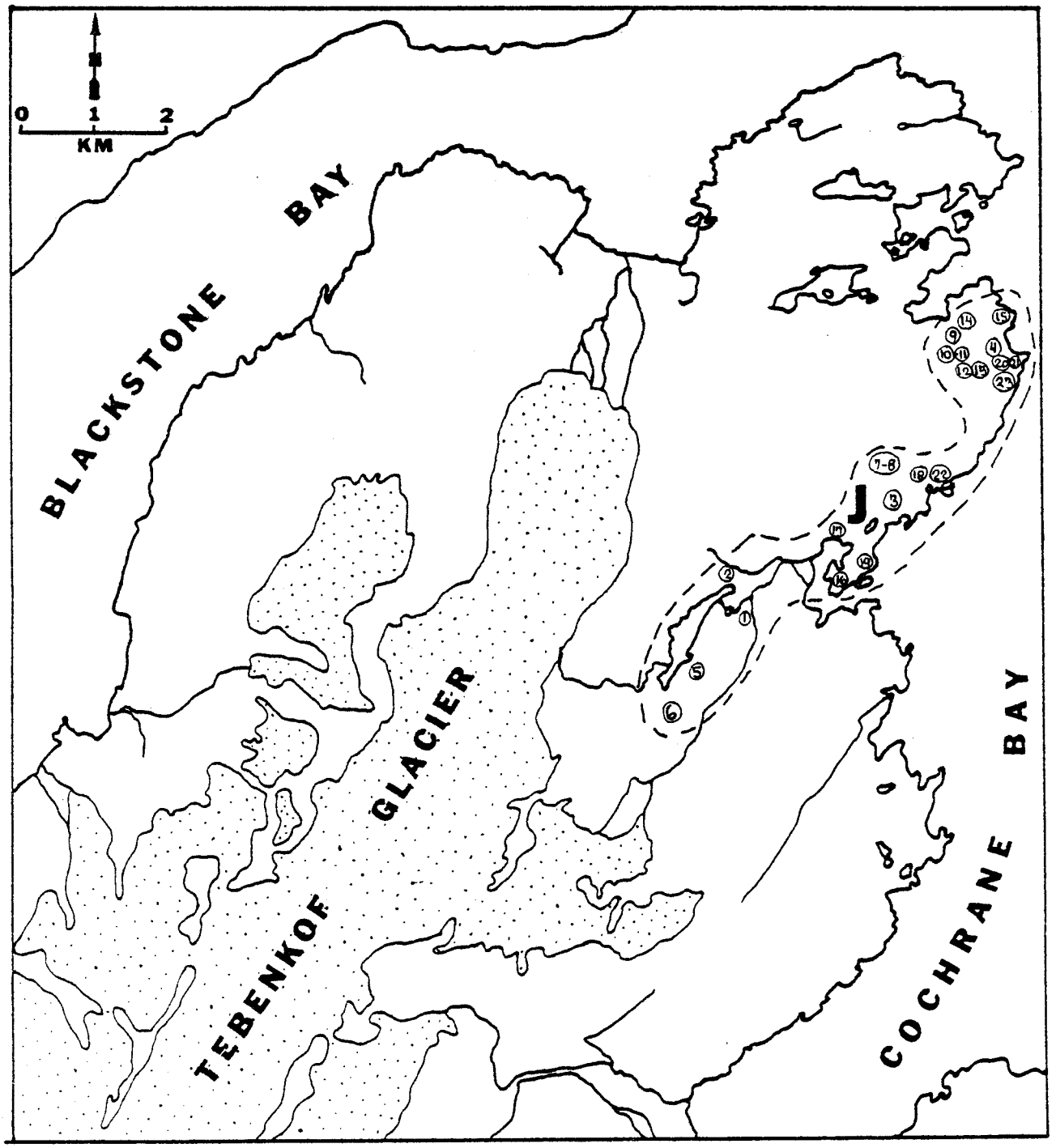
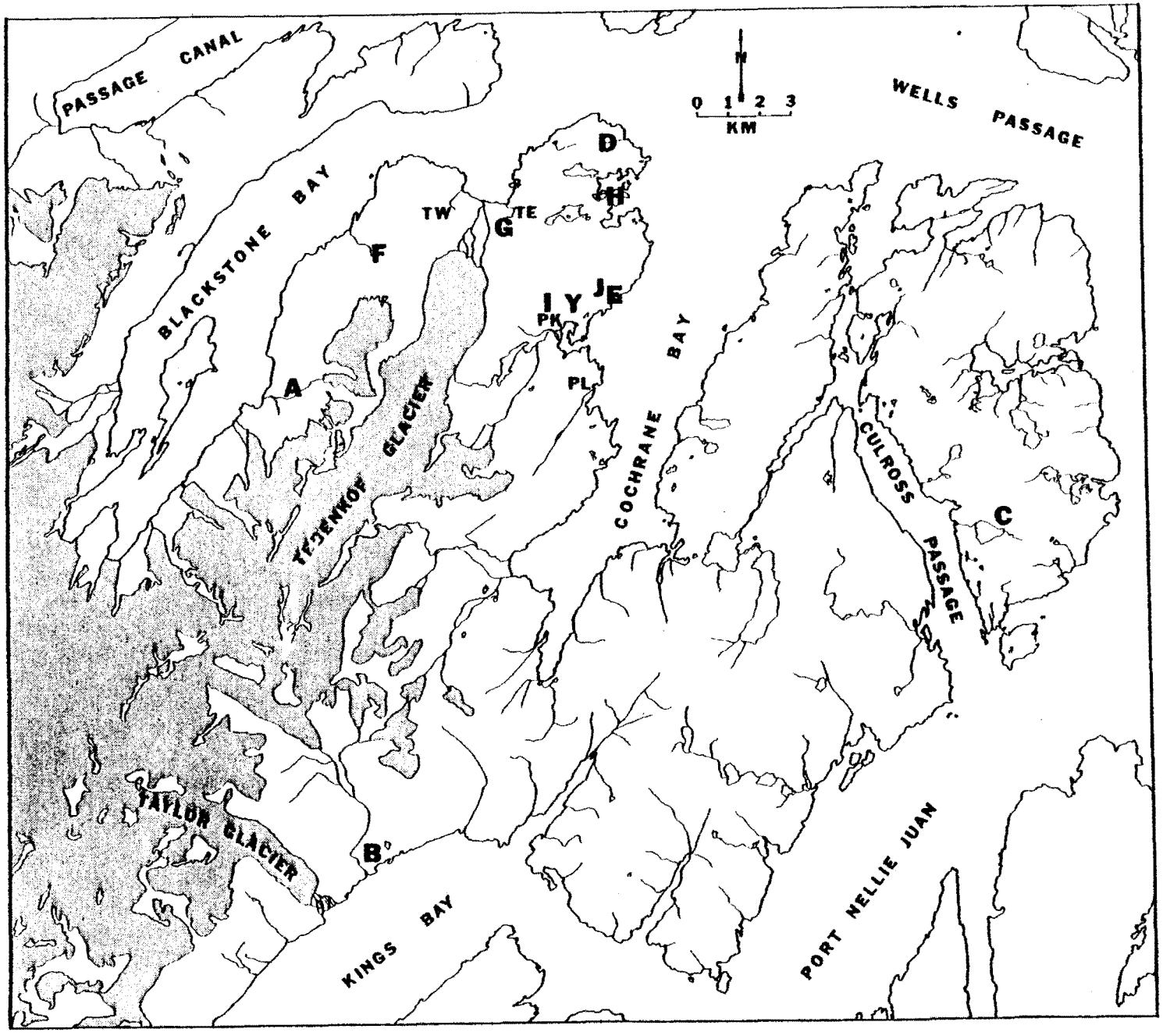


Fig. 8. Locations where radio-collared bears were during the winter denning period (A = B119, B = B149, C = 153, D = B125, E = B137, F = B101, G = B107, H = B141, I = B143 and J = B147).



The Relevance of Spawning Salmon in the Ecology of Black Bears in Western Prince William Sound

Since the gathering of black bears at salmon spawning areas in the summer appears common and general to bears in this area, it is likely that a thorough understanding of this phenomenon may be of value in appraising the status of individual populations of bears. These temporal and spatial clusters of bears represent the most dense and visually observable annual aggregations of bears known to occur and an understanding of them could yield maximum direct census values and minimum population estimates for specific areas.

In July and August 1976 and 1977, at least 14 different bears (captured or observed) moved to four streams to feed on spawning salmon. Perhaps one can explain the relative absence of bear sign in these areas in 1975 (Modafferi 1978) by the apparent lack of fish available in August of that year. However, if fish were of vital importance in the diet of bears, one would expect to see a considerable amount of bear sign near the streams as bears "searched and waited for" the spawning salmon to arrive. This proved not to be the case; bears arrived at streams several weeks after the salmon in both 1976 and 1977. An alternate possibility is that salmon may not be as important to a bear's diet as was previously believed.

In 1976, 12 bears were captured in the Tebenkof glacier area (TE and TW), yet in 1977 only two sows and their cubs were captured there. In 1977, the year when few bears were captured at the Tebenkof area, nine bears were captured at Parks Creek; five of these bears had been captured at the Tebenkof area the previous summer (1976). Unfortunately, Parks Creek was not trapped in 1976. In 1977, many blueberries (*Vaccinium* sp.) and salmonberries (*Rubus spectabilis*) were available along the salmon spawning areas of Parks Creek and may have attracted bears and accounted for the difference between the number of bears captured at the Tebenkof area and Parks Creek in 1977. If salmon were a vitally important dietary constituent to bears in August, it is difficult to explain why in both 1976 and 1977 Paulson Creek, the stream which appears to have the largest and most consistent run of salmon, had only produced one captured bear. In each year, it was also noted that Paulson Creek, which was visited essentially every day, contained overwhelmingly less bear sign than any of the other aareas monitored.

Available data indicate: 1) that in some years very few bears may visit streams containing spawning salmon (all areas in 1975 and 1978), 2) that bears do not necessarily gather at the same streams each year (Tebenkof 1976 vs. 1977 and Tebenkof vs. Parks Creek in 1977), 3) that in a given year many bears do seem to congregate at one particular area more than at others (Tebenkof 1976 and Parks Creek 1977) and 4) that a stream with a seasonally good, annually consistent and readily available run of salmon may fail to attract many bears in any year (Paulson Creek 1976 and 1977).

General Movements of Bears and Their Relationship to Various Ecological Factors

Shortly after bears were captured and radio-collared in August 1977, they dispersed from the salmon spawning streams. Field observations and data on success rates of snaring (Modafferi 1978) indicate that more bears were present at the streams during the second and third weeks of August than during the first or last weeks, though substantial numbers of fish were available from late July on into early September.

Although most bears had stopped feeding on salmon before the end of August, they remained at mid to lower elevations for several more weeks, where salmonberries continued to be a major dietary constituent and blueberries supplanted salmon as the other staple. Some time in September, bears moved from lower elevations to alpine areas where blueberries probably became the dominant dietary item, as is usually the case in most interior areas of Alaska. The observation of five single bears on October 2, 1977 in alpine areas (at about 500 to 800 m elevation) supports this contention.

Bears probably continued to feed on blueberries during most of September and on into October. During this period, the bears, especially immature males, appeared to be quite mobile. By the last week of October most bears had ceased traveling and by that time had probably selected a den site. Radio-tracking data strongly indicated that all bears were in hibernacula at the time of the November 2 tracking flight.

Extensive movements which occurred prior to denning may, in part, be attributed to one or several of the following: searches for a den site, movements to a preselected den site, movements to new feeding areas, emigration from a natal area (immature) and/or territorial reconnaissance (adults, particularly males).

Most bears remained in their dens or at least were very sedentary until mid April. Radio-tracking data indicated that bears departed from their denning areas between April 19 and May 3.

By May 3, the snow line had receded altitudinally to about 500 ft on the south and east facing slopes but was still down to the tideline on north and west facing slopes. Very early warm spring weather initiated the melting of snow, and vegetation on the southeast facing slide areas was growing ("greening up") by May 15. This was early in contrast to vegetation in the beach fringe areas which did not appear green until May 23. At this same date, snow was still at the tideline on north slopes but had receded to 300 to 500 m on some south slope slide areas where alders (*Alnus* sp.) were obviously already "leafing out."

Success of black bear hunters in western Prince William Sound is usually best from mid May through mid June and this is when bears utilize the beach fringe areas in spring where they are extremely vulnerable.

However, in spring 1977 many hunters reported seeing no bears and very little bear sign in the beach fringe areas. Radio-tracking flights

corroborated the hunters' observations, as bears were almost never radio-located in shoreline areas but were mostly found on south facing slide slopes between 100 and 300 m elevation.

It appeared that bears remained in these mid elevation slide areas through June. Breeding activities probably started in the last week of June, continued through the last week of July and may even have extended into early August.

Bears (particularly immature males) moved frequently and over great distances after leaving their denning area. It appeared that males emerged from dens prior to females and that locale of, but not extent of, their movements was greatly affected by the snow pack and its disappearance. Bears probably prefer open, south-east facing slopes if they are snow free and herbaceous vegetation and grasses are available and growing. However, if snow persists on these slopes through mid June bears will utilize beach fringe areas for foraging. In spring 1976, when slopes as well as beach fringe areas were free of snow, more bears were observed, by myself and J. Reynolds, on the slopes surrounding Long Bay (near Glacier Is.) than on the beach fringe areas.

Prior to mid June bears probably feed mostly on grasses (*Calamagrostis* sp.), horsetail (*Equisetum* sp.), sedges (*Carex* sp.), cabbage (*Lysichitum* sp.) and ferns (*Polypodiaceae*). Although these items may persist in the diet, field observations indicate that by mid June and on into July, bears are at mid elevations where *Fauria crista-galli* and salmonberries probably become dietary staples. This contention is further supported by the fact that from July 18-29, 1976, a total of 130 trap nights at baited sets along near tidelines was ineffective in capturing or attracting a single bear (Modafferi 1978). Apparently bears were "content" at higher elevations and were not actively utilizing or seeking food sources available in the beach fringe areas.

Fauria and *Rubus* probably do not decline in importance as a food source even with the arrival and availability of spawning salmon in late July, as it was not until the first week of August that most bears appeared to gather at streams containing spawning salmon. Though salmon were available through August and into early September most bears appeared to have left the streams by late August and started to feed on blueberries. If this is true, bears probably leave salmon streams as soon as berries become ripe (palatable quality) and if they are available (adequate quantity). The small amount of data presently available indicate that only if berries are not available, do the bears actively seek out and feed on spawning salmon. This hypothesis can be justified with the following unsupported logic.

Bears generally emerge from their dens in spring with enough fat to maintain themselves for several weeks, should they be confronted with inclement spring weather and unavailability of food. During this time period, the bears must locate an adequate food source to prepare for the breeding season. After the breeding season, bears must again replenish energy and acquire a quantity of fat to carry them through the denning period. The high soluble carbohydrate content of blueberries makes them

an ideal pre-hibernation food source for bears. What bears really don't need at this time of the year is a diet relatively high in protein. Additional evidence indicating that bears require and seek out a food source capable of being converted into high energy depot fat, is the fact that they prefer to eat the eggs, head cartilage and brain of salmon (good sources of fats) and seldom bother to eat the body flesh of fish (high in protein, low in fats). This suggests that bears may only move to salmon spawning streams when the quality (ripeness) or quantity of berries are below a given level.

Noteworthy Movements of Individual Bears

Three, 2.5 year old males (A, B and C; Fig. 4) moved more frequently and over greater distances than other sex/age classes of radio-collared bears. These immature bears traversed approximately 14, 18 and 30 straight line km between the capture site (Parks Creek) and where they denned for the winter. Curiously, each bear went in a different direction, denning in completely different locations with respect to their capture site; A denned to the west, B to the south and C to the east. After emerging from their dens, bears A and B moved back towards the capture site, but bear C essentially circled around all of Culross Island. To get on Culross Island bear C had to swim across at least 0.5 km of open water.

On May 11, bear B was observed at an elevation of about 300 m traveling overland through an area of extensive snow cover. This bear was eventually shot by a hunter on June 5, about 2.5 km north of the capture site.

Based on data presently available, the home ranges of these individual males are essentially as indicated in Fig. 4, except for the communal use and sharing of the Parks Creek area during August while feeding on salmon and travel lanes to and from this "common" area. Male A's home range includes the area from the east side of the Tebenkof Glacier forelands to Ripon Glacier on the eastern shore of Blackstone Bay, 26 km^2. The range of bear B includes all land on the east side of the Tebenkof Peninsula and to the east of bear A's range and all land south to Cotterell River in the Kings Bay watershed, 91 km^2. Bear C appeared to utilize all of Culross and Applegate Islands, after leaving Parks Creek where it was captured. The Parks Creek area and the apparent travel routes to Culross Island were not considered in calculating this bear's 73 km^2 range.

Ranges of female bears appeared more definitive and smaller than those of males. The greatest distance traversed by a female bear from the capture site was only about 9 km. The ranges for radio-collared female bears varied in size from 5 to 12 km^2 and were approximately 12, 9, 12, 5, 12 and 8 km^2 for bears D, E, F, G, H, and J, respectively. As for males, travel routes to and from Parks Creek were not considered in calculating ranges of bears D, F and G.

Some female bears were captured at salmon streams located within their calculated ranges, while other females appeared to move out from calculated ranges to feed on salmon. Females D, F and G appeared to

have ranges about 3 km away from the salmon streams where they were captured or visited in 1977 and yet there were salmon available at other streams within the boundaries of their calculated ranges. Ranges calculated for females E, H and J were very similar to each other and included Parks Creek, the salmon stream at which they were captured. Female J, a yearling, may be an offspring of either bear E or H, as female progeny frequently utilize part of their mother's range (Rogers 1977). The rather apparent sedentary behavior of female I, may indicate that the radio collar is no longer on the bear.

At least nine bears denned on the northern one-third of the Tebenkof Peninsula (Fig. 8), a minimum denning density of eight non-cub bears for 73 km^2 of intensively studied habitat or one denning adult bear per 8 km^2.

General topography and slope exposure of den locations varied greatly. It appears that dens on the southern exposure of Parks Creek watershed (E, I, J and Y) and on the southern exposure in Kings Bay (B) would be more desirable than other den sites because of the early snow melt and subsequently early growth of vegetation in these areas. There is no doubt that, at emergence, a considerable amount of snow was present and around dens of bears A and F, but there was essentially no snow near dens of bears B, E, I, J and Y. Additionally, vegetation "greened up" much earlier near the latter den sites.

One bear (B103) captured as a two-year-old at Harrison Lagoon in 1976, was killed about 10 km to the northwest, by a hunter in spring 1978. Though the distance traversed was not great, the bear had crossed at least 2 km of rugged glacier or a similar distance of ice berg laden water to arrive at the kill site.

RECOMMENDATIONS

Movements of individual bears must be monitored for at least three years before they can be assessed and meaningfully evaluated.

It is vitally important to capture and radio-collar cubs of the year because knowledge of their movement patterns and mortality rates is critical in appraising population dynamics. The value of this information necessitates development of practical, functional and dependable "expandable" type radio collars.

The same area should be intensively studied for the duration of this project and bear activity at adjacent salmon streams should continue to be monitored.

Attempts should be made to capture and radio-collar adult male bears. Perhaps this can be accomplished by setting baited snares in the spring when adult males are most vulnerable to hunters. However, this must be accomplished with a minimum of interaction with hunters and their activities.

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APPENDIX A.

Dates and codes for designated radio relocations of black bears in western Prince William Sound, Alaska, 1976-78.

Code	Date of relocation	Code	Date of relocation
A	9/30/76	8	4/19/78
B	3/31/77	9	5/3/78
C	5/10/77	10	5/11/78
D	5/23/77	11	5/15/78
E	6/1/77	12	5/19/78
F	6/8/77	13	5/22/78
G	6/9/77	14	5/25/78
H	6/28/77	15	5/27/78
1	9/1/77	16	6/5/78
2	9/26/77	17	6/7/78
3	9/30/77	18	6/10/78
4	10/2/77	19	6/12/78
5	10/25/77	20	6/20/78
6	11/2/77	21	6/21/78
7	11/8/77	22	6/28/78
		23	6/29/78
		24	7/11/78