Habitat Preferences And Distribution Of Polar Bears In The Western Canadian Arctic

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1.0 SUMMARY

This report analyzes and discusses polar bear distribution and habitat data that were collected from October 1970 through May 1979 during population ecology studies in the Western Canadian Arctic. Most of the data were collected between mid March and the end of May of each year. However, some data collected during the summer and fall are also used.

Seven sea ice habitat types are included in the evaluation but only three are important to polar bears in the study area: Type 1, stable fast ice with deep snow drifts along the pressure ridges; Type 3, the floe edge, and, Type 4, areas of moving ice with 7/8 or more ice cover. Types 3 and 4 are distributed in a band of varying width which runs parallel to the mainland coast, across the western entrance to Amundsen Gulf and up the west coast of Banks Island.

Adult males show a strong preference for Types 3 and 4 over Type 1. Subadult males had a lesser though still significant preference for Types 3 and 4. Adult females with cubs of the year showed a marked preference for Type 1, probably because there were fewer bears, especially adult males, there. Subadult females also preferred Type 1, but lone females and females with older cubs showed no preference.

The study area was divided into eight subareas which were compared for their relative importance to polar bears. Overall, the most important feeding area from winter to early summer is adjacent to the Cape Bathurst polynya which generally lies between Baillie Islands, Cape Parry and the southwest coast of Banks Island and consists mainly of Types 3 and 4. The most important Type 1 was distributed along the west coast of Banks Island and the northern half of Amundsen Gulf.

Polar bears show a strong fidelity to spring feeding areas. Within the study area, the population has two components which tend to be associated with the west coast of Banks Island and the mainland coast respectively. The polar bears of the mainland coast, but not Banks Island, constitute part of a population shared with Alaska.

It appears, for the next few years at least, that moat proposed drilling and production activities will be taking place along the mainland coast north of the Mackenzie Delta and Tuktoyaktuk Peninsula. Thus, it seems likely that any detrimental effects (eg. oil spills, noise, attraction to camps, increased hunting, etc.) will be felt by polar bears along the mainland coast which are, to some degree, an internationally shared population. Polar bears on the west coast of Banks Island have a strong affinity for that area and are likely to be less affected by offshore drilling and production along the mainland coast. If shipping occurs through the Cape Bathurst polynya and northern Amundsen Gulf, ship disturbance and oil spills may detrimentally impact that portion of the polar bear population which is associated with the western and southern' coasts of Banks Island.

2.0 INTRODUCTION

In the fall of 1970, the Canadian Wildlife Service initiated a study of the population ecology of the polar bear (*Ursus maritimus*) in the Western Canadian Arctic, mainly to provide management data with particular reference to quotas. In 1974, the study was expanded to consider the possible effect on polar bears of offshore exploration for hydrocarbons in the Beaufort Sea.

Originally it was anticipated that the project would last for five years. However, between 1974 and 1975, the number and productivity of polar bears declined by about a third and a half respectively, apparently in response to an even greater drop in the numbers and productivity of their prey species, ringed seals (*Phoca hispida*) and bearded seals (*Erignathus barbatus*) (Stirling et al., 1975; 1976; 1977). Never before in the Arctic have we been able to quantitatively document such sudden and large-scale changes in polar bear and seal populations due to natural causes. This was a unique opportunity to monitor the time required for polar bear and seal populations to recover from such a large decline. Consequently, despite funding difficulties, some monitoring of the polar bear population was carried out between 1976 and 1979 (Stirling, 1978; DeMaster et al., 1980).

During the mark and recapture studies, data were collected on the sea ice habitat types searched and on the locations of polar bears and their tracks. Although these notes were fairly general, over several years some patterns in the distribution and habitat preferences of polar bears became apparent (Stirling et al., 1975). The objective of this report is to analyze and discuss the data available on the distribution and habitat preferences of polar bears in the Western Canadian Arctic.

3.0 MATERIALS AND METHODS

3.1 The study area

The study area was broadly defined as the Beaufort Sea east of 141°W and south of 75°N, and Amundsen Gulf (Fig. 1). There were two reasons for considering such a large area. First, our initial mark and recapture studies indicated the possibility that polar bears in the Western Arctic population might move throughout the study area during the year. Second, the whole area offshore from the Tuktoyaktuk Peninsula and north along the west coast of Banks Island had been leased for oil exploration. Consequently, it was important that baseline studies on polar bears in the Western Arctic be applicable to the whole area.

3.2 Tagging "and recapture of individual bears

Although many of the data collected for the population ecology study are not applicable to this report, some background is relevant. The most important task for the population ecology aspects was to mark and recapture the maximum number of polar bears. For several reasons, the greatest amount of field work in the Western Arctic was conducted from late March to late May. Longer days and reasonably stable weather prevail over most of the Arctic then, making it possible to complete much field work in a short time. The snow conditions are best for tracking at that time of year so more polar bears can be captured then than when they can only be located visually, as in the summer. Also, in the spring polar bears are thinner and easier to drug safely than in the summer when they become fat and overheat more easily in the warmer weather. Most importantly, all age and sex classes of bears can be captured at that time.

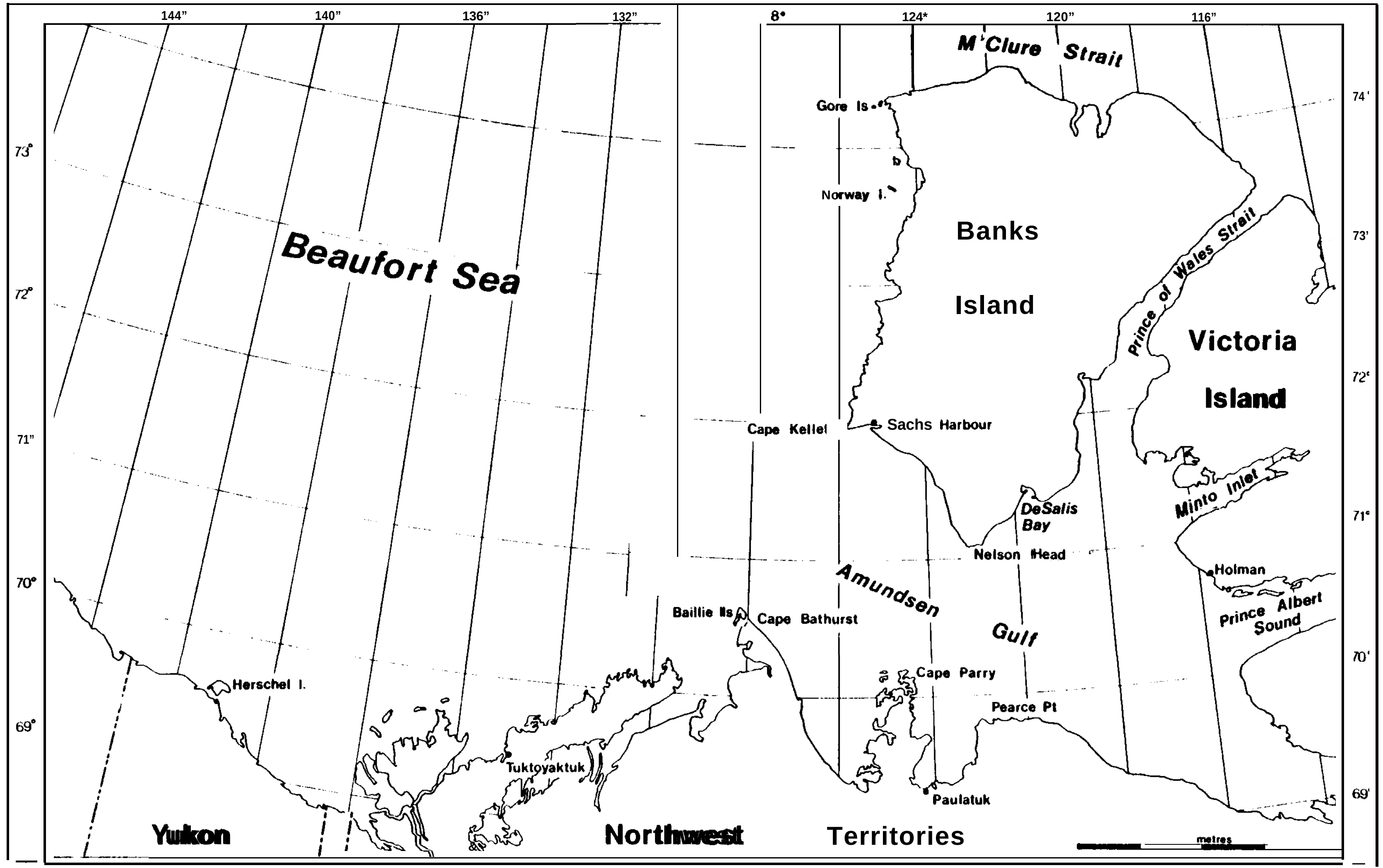

Figure 1. Map of the study area.

Females with cubs of the year are out of their dens, and so data on productivity and maternity denning can be collected. Also, polar bears mate in the spring, and data on reproduction can be obtained as well.

Some data were collect ed in the same fashion during the summer and fall, but less extensively. AS applicable, these data will be utilized in the report.

It became apparent that polar bears were not evenly distributed over all types of sea ice habitat throughout the Western Arctic. Because of the importance of capturing a large sample of bears for estimating the size of the population, effort was concentrated in areas where more could be captured. Even so, considerable search effort was still made in areas such as north of the Yukon coast and eastern Amundsen Gulf where we caught fewer bears. During the monitoring phase from 1976 through 1979, we had smaller budgets and concentrated our efforts between Tuktoyaktuk, Cape Parry, Nelson Head and the west coast of Banks Island where bears tend to be more abundant.

3.3 Recording of tracks and bears

For all bears captured or sighted, as much as possible of the following information was recorded: age and sex of the bear, location and date (Stirling et al., 1975). Subadults were defined as being from 2 1/2 to 4 years of age. If a bear was captured, all data were recorded. For bears seen but not captured, the age class and sex could be recorded only for large adult males and females accompanied by cubs of any age. The ages of cubs with females could be estimated from the air but not their sex. The age class or sex of most lone bears could not be determined from the air so they were recorded as unclassified.

All tracks sighted were recorded regardless of age. Although we tried to avoid counting the same tracks twice, this undoubtedly occurred. At first, we separated the tracks into what appeared to be fresh or old but, because that was mostly a function of recent weather we pooled them in the analysis.

3.4 Classification of sea ice habitat types

The following general categories were used to describe sea ice habitat types in relation to the distribution of polar bears.

Type 1: stable flat areas interspersed with pressure ridges that have not moved for a long time (Fig. 2); ridges drifted with snow and suitable for seal lairs; snw of variable depth on the flat ice between the pressure ridges; usually in mouths of bays and landfast ice out from coastlines (for more descriptive detail on seal lair habitat see Smith and Stirling, 1975).

Type 2: as above but without extensive drifts suitable for seal lairs (Fig. 3); ice between ridges is usually bare; appears particularly rough because of lack of snow cover and drifts.

Type 3: the floe edge where leads are wide (>1 km), usually with small open or refrozen leads parallel to floe edge or emanating from pressure ridges not usually heavily drifted (Fig. 4); includes areas of less than 7/8 ice cover where large floes are intermixed with leads and patches of open water.

Type 4: areas of 7/8 ice cover or more in "active zones", such as around Baillie Islands (Fig. 5); wind and currents cause much movement of ice, followed by refreezing creating intermittent lanes or patches of refrozen young ice; bare or only slightly drifted.

Figure 2. Type 1 sea ice habitat (note the long deep snow drifts around the pressure ridges).

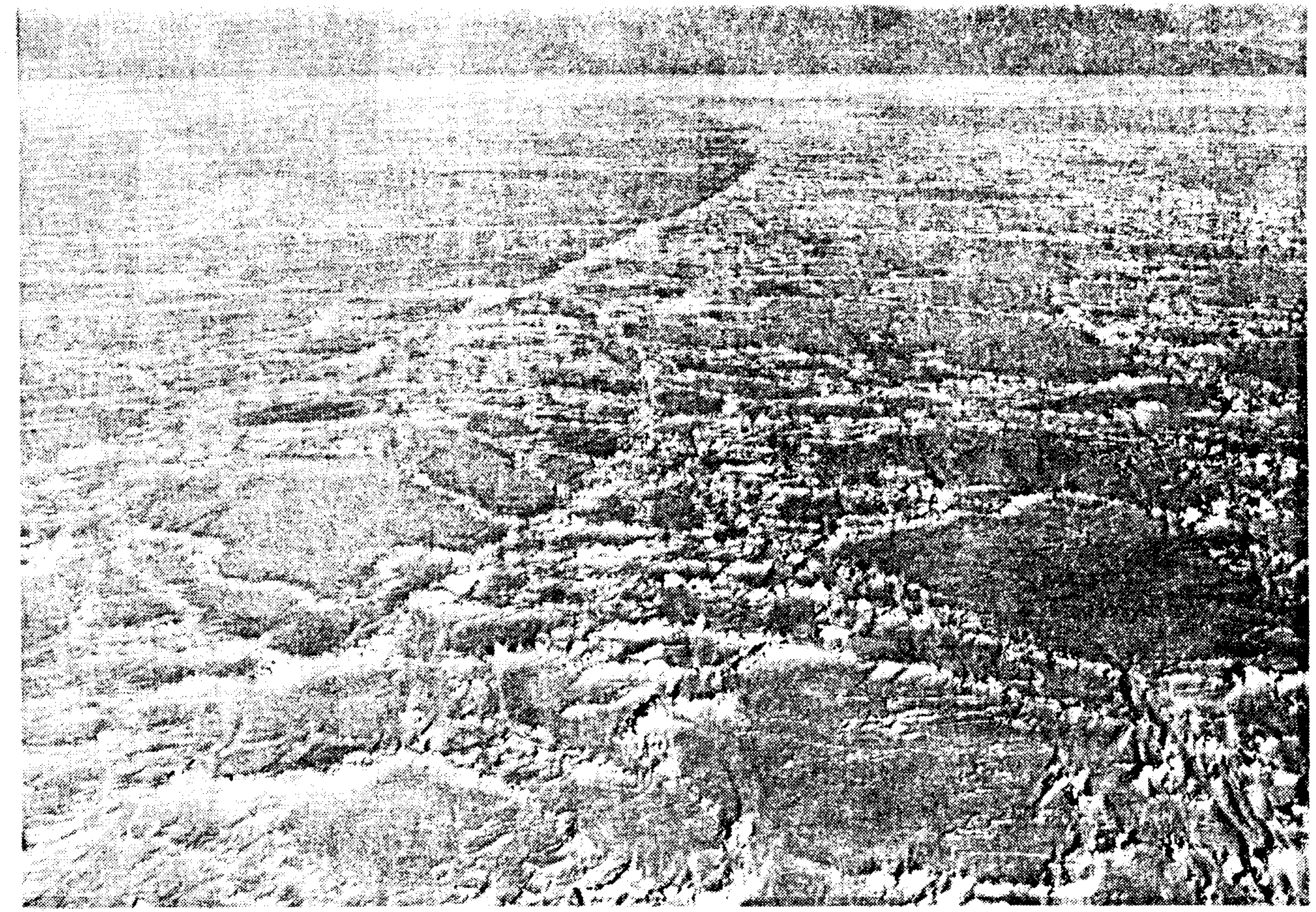

Figure 3. Type 2 sea ice habitat (note the bare ice and small snow drifts around the pressure ridges).

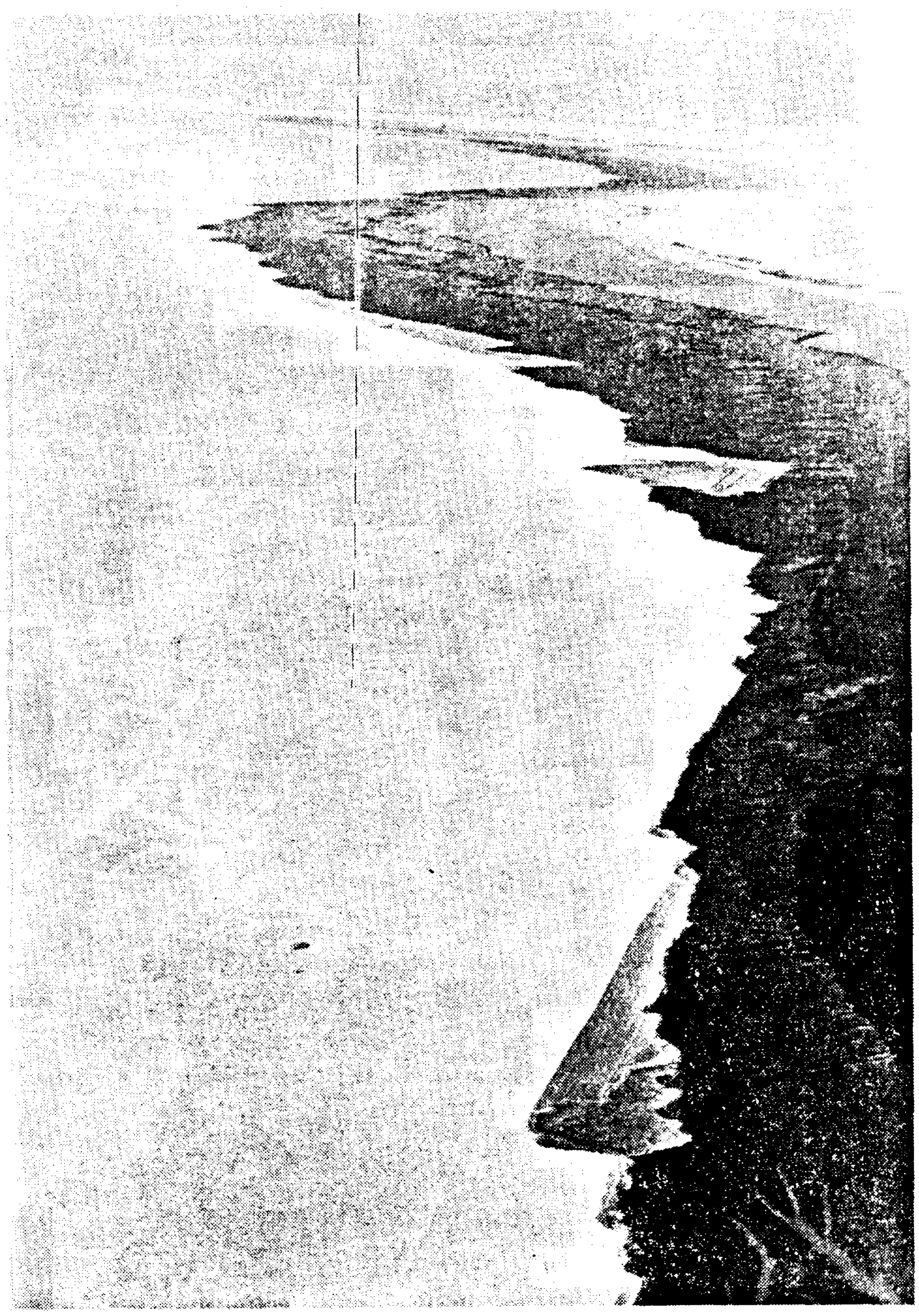

Figure 4. Type 3 sea ice habitat (note presence of floe edge, young ice and refrozen leads).

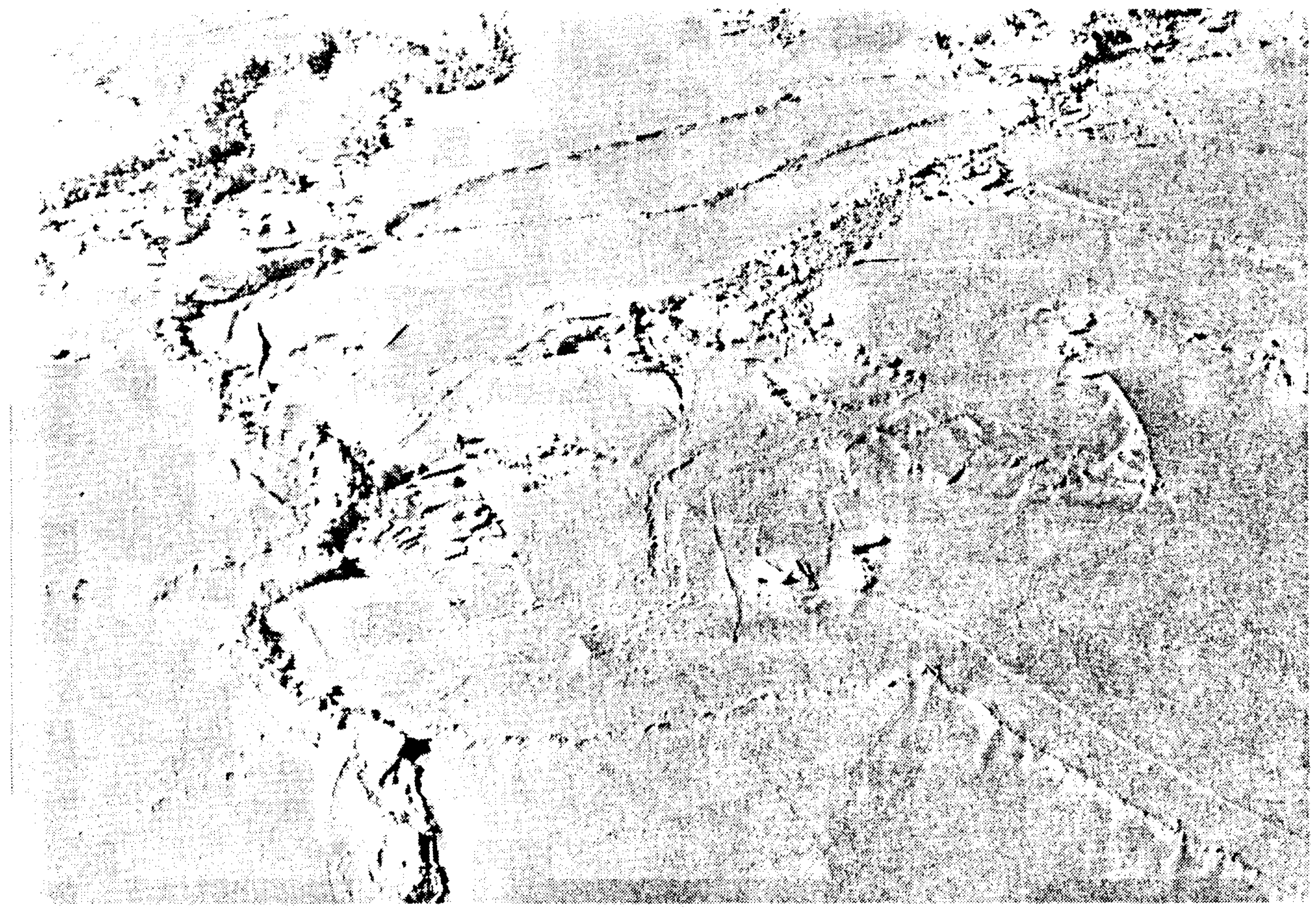

Figure 5. Type 4 sea ice habitat (note the abundance of polar bear tracks).

Type 5: areas of continuous heavy pressure ice that have not moved for a long time (Fig. 6); relatively uncommon except in small areas such as Cape Kellett or in years such as 1974.

Type 6: rough ice along coastline (Fig. 7); develops in ridges parallel to the coast because of the tide; characteristic in areas with steep banked coastlines such as parts of southern Banks Island; less common along the mainland coast.

Type 7: deep bays and areas of smooth land-fast ice such as Prince Albert Sound; held in place by small offshore islands; variable snow cover and fewer ridges than Type 1: not common in Western Arctic.

The occurrence and extent of the different habitat types in late winter and spring varies considerably from year to year. Figure 8 illustrates their approximate distribution in what might be a fairly typical year in the eastern Beaufort Sea and Amundsen Gulf (based on Lindsay, 1975; 1977; smith and Rigby, 1981). The most important feature is the system of shore leads that runs parallel to the mainland coast from Alaska, across the western entrance to Amundsen Gulf and north along the west coast of Banks Island. These leads are kept at least partially open throughout the winter and spring by a combination of winds and currents. The leads may vary in width from a few metres to tens of kilometres. The location of the lead between Herschel and Baillie islands is remarkably constant between years and roughly follows the 20 m contour (Cooper, 1974). The location of the shore lead along the west coast of Banks Island, though quite constant, is more variable than along the mainland

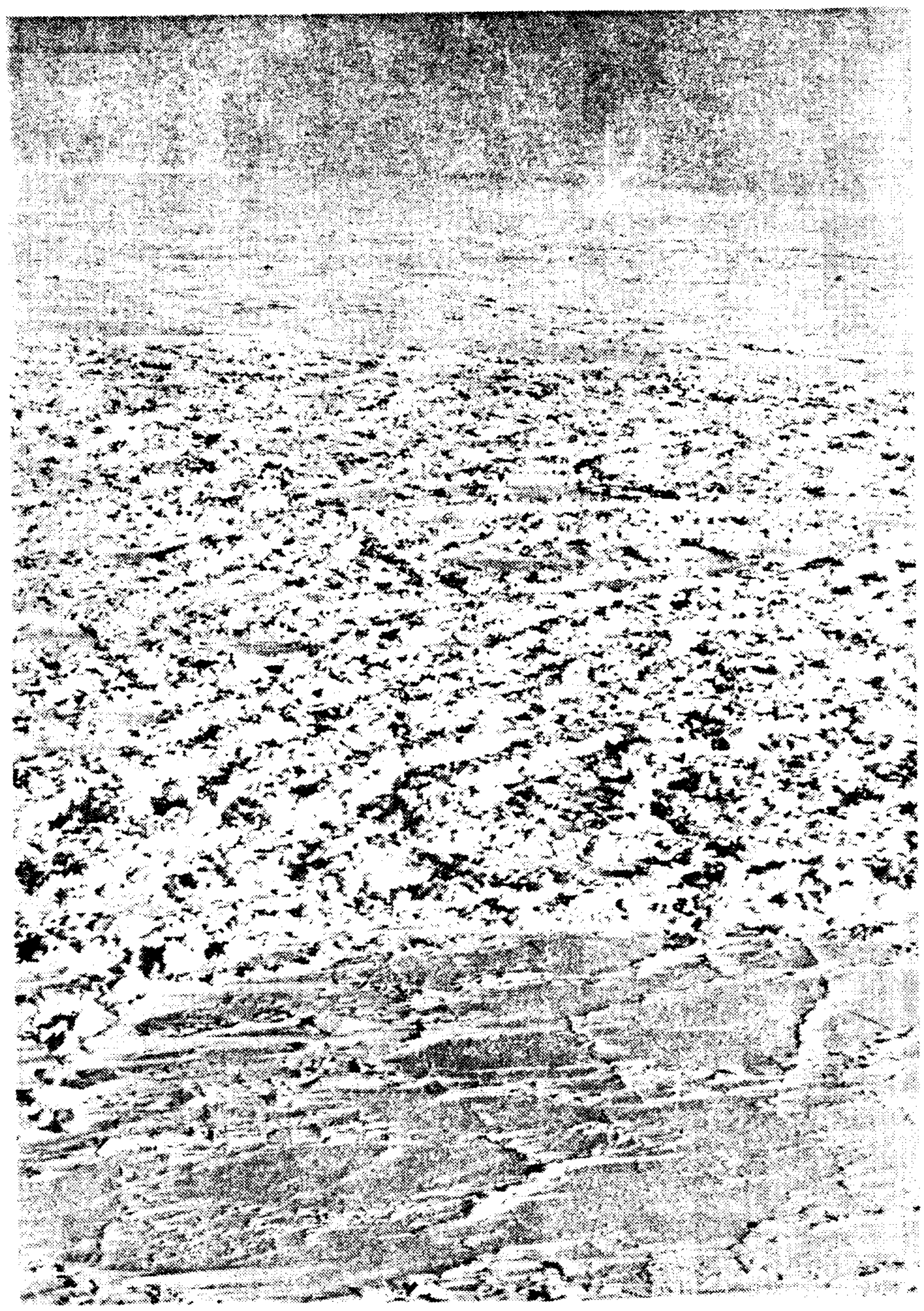

Figure 6. Type 5 sea ice habitat.

Figure 7. Type 6 sea ice habitat.

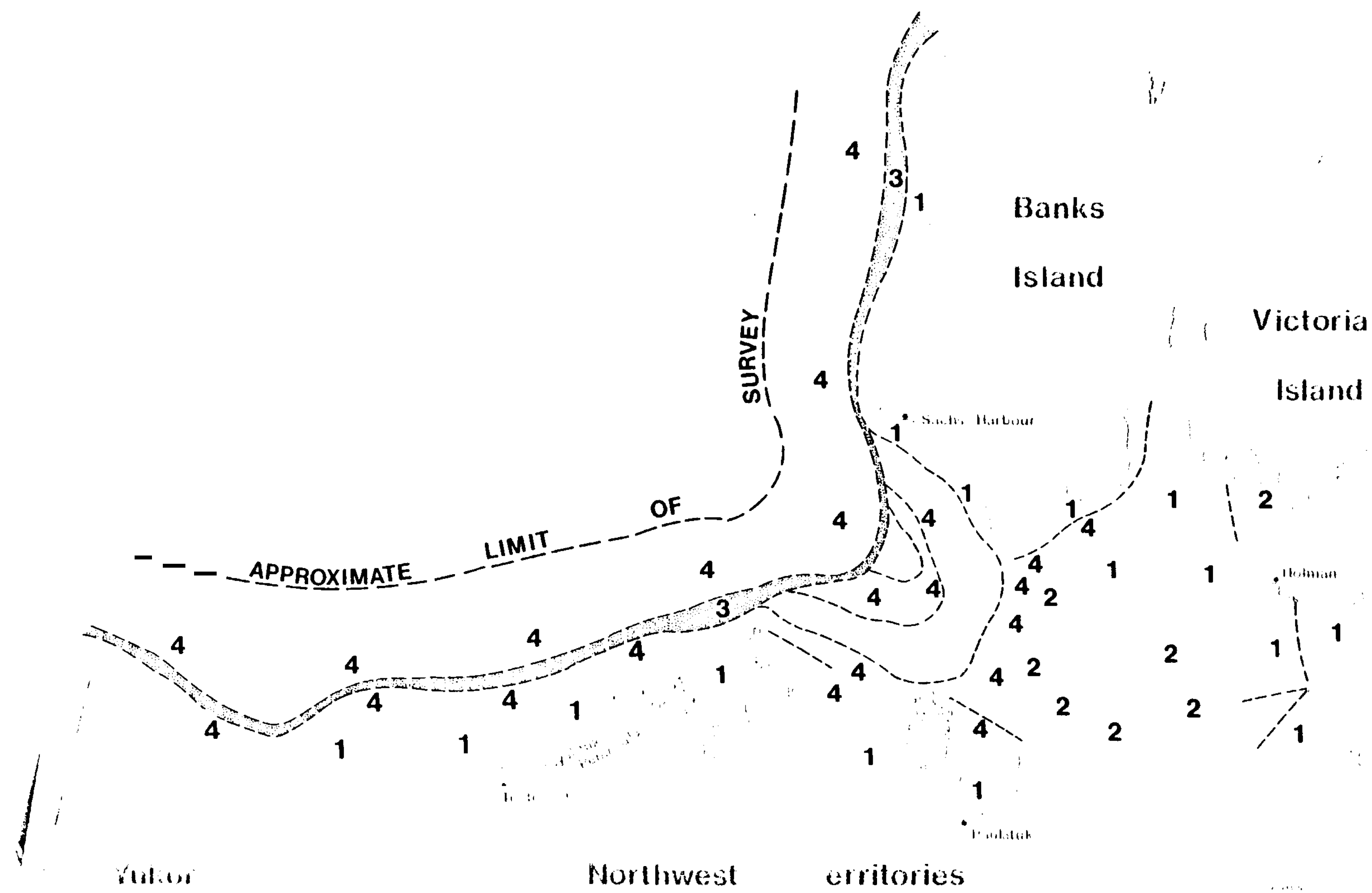

Figure 8. General distribution of sea ice habitat types.

coast. As suggested by the locations of some of the leads on Figure 8 between Banks Island and Cape Parry, in some years the floe edge may lie much further east and there may be large areas of open water in Amundsen Gulf throughout the winter and spring (Lindsay, 197S and 1977; Smith and Rigby, 1981). By late spring in most years and in late winter in some, a large body of open water known as the Cape Bathurst polynya appears NE of Baillie Islands. 'The Type 4 "active ice" is distributed along both sides of the shore lead system. However, the extent of this habitat type may vary considerably between Banks Island and the mainland, depending on the location of the main lead system and on how large the Cape Bathurst polynya ls. In general, Types 3 and 4 are more common in that area than anywhere else in the Western Arctic.

In the area 150 km or more offshore, the sea is covered by an essentially continuous combination of annual and multi-year ice. However, this area was too distant for us to be able to survey extensively and it is not considered in this report. The distribution of Type 1 was fairly constant between years (Fig. 8) but its extent varied considerably between years, apparently as a result of environmental factors. Type 2 tended to predominate in the southern half of Amundsen Gulf, possibly because it was too far to receive wind-blown snow carried from Banks or Victoria islands. Type 2 also occurred to varying degrees within the Type 1 shown on Figure 8.

3.5 Recorded movements of tagged bears

Locations where bears were originally captured, recaptured, or killed by Inuit hunters, were analyzed to provide information on seasonal fidelity to spring feeding areas, movements of bears between seasons within the study area, and movements between the western Canadian Arctic and Alaska. From these data we can estimate how far from the site of an environmental disruption the polar bear population might be affected.

3.6 Geographic areas compared

The Western Arctic was divided into eight subareas which were compared for their relative importance to polar bears (Fig. 9).

Subareas 1 and 2 were divided at the Yukon-NWT border. In general, the water offshore from the Yukon coast gets deeper more quickly, and is more influenced by fresh water from the Mackenzie River. More of the present and proposed offshore hydrocarbon exploration will take place in Subarea 2 than anywhere else. Separation of this area from others may enable later comparisons of baseline data to determine whether or not offshore activities have detrimental effects upon polar bears. Subareas 3, 4 and 7 include the Cape Bathurst polynya and associated areas of leads, open water and Type 4. To some degree, the subdivisions were arbitrarily determined by the areas which are surveyed when based from Baillie Islands, Cape Parry or Sachs Harbour. However, these divisions facilitate comparison of the northern versus the southern parts of the study area as well as Baillie Islands versus Cape Parry.

In most years, Amundsen Gulf is completely frozen from late winter to late spring and early summer. In general, ringed seal productivity tends to be higher in Subarea 6 than in Subarea 5, apparently because of the greater amounts of suitable pupping habitat (Smith and Stirling, 1975).

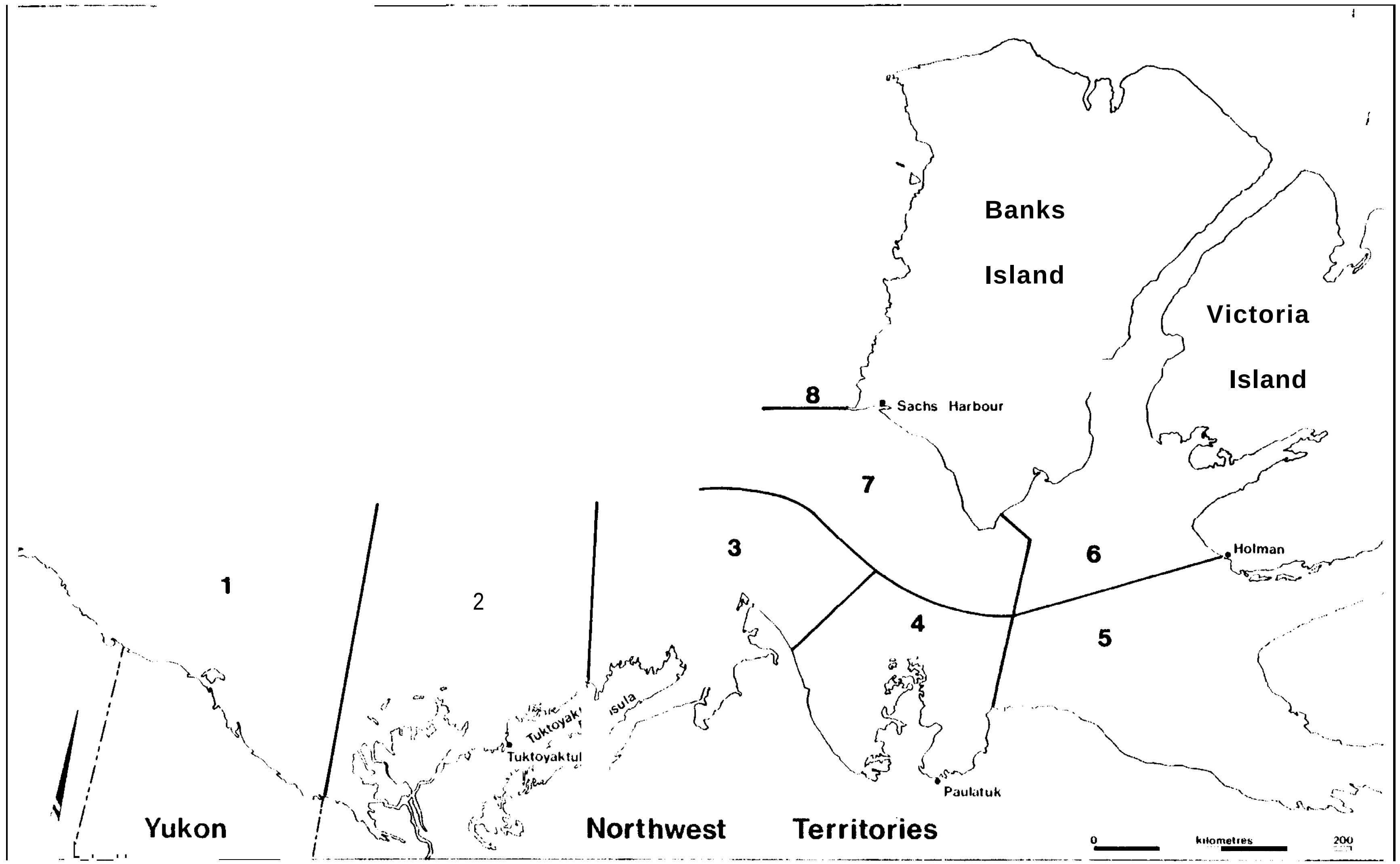

Figure 9. Delineation of subareas.

4.0 RESULTS AND DISCUSSION

4.1 Number of kilometres of habitats surveyed

Table 1 summarizes the number of kilometres of each habitat type surveyed during the spring mark and recapture studies from 1971 through 1979. Periods during which the weather or light conditions were too poor for collecting track data were not included. Because of the emphasis upon obtaining the maximum sample size of captured animals, the habitat types were not surveyed in proportion to the extent of their occurrence. Even so, the number of kilometres travelled in each (Table 1) is probably an approximate reflection of their relative proportions. The exception is Type 2 which was more extensive in some years than the data would suggest but which was not extensively searched because polar bears were less abundant there.

Table 1. Number of kilometres of each habitat type surveyed for polar bears and tracks from mid March to the end of May, 1971-79.

	Type								
Subarea	1	2	3	4	5	6	7	u	T
1	1351	52	288	5147	90	198	-	-	7126
2	3912	145	1373	5701	337	24	788	-	12280
3	877		1739	3337	209	15	100	145	6422
4	1211	601	219	3234	27	-	87	-	5379
5	3326	1090	40	390	5	-	283	-	5134
6	5451	2267	65	582	24	78	197	-	8664
7	2392	312	3992	5635	44	339	-	-	12714
8	5173	45	5948	4275	801	445	71	6	16764
T	23693	4512	13664	28301	1537	1099	1526	151	74483

4.2 Sightings of polar bears and tracks by habitat type

Tables 2 and 3 summarize the sightings of polar bears in each age and sex category, and the number of bears and tracks seen per 100 km of habitat surveyed, in the different habitat types between mid March and the end of May from 1971 through 1979.

From inspection of these tables, it is clear that polar bears were not equally distributed in all habitats. For example, 82% (514/627) of the sightings were made in Types 3 and 4 (42.3 and 39.7% respectively; a difference that was not significant; $X^2 = 1.62$, $df = 1$, $p > 0.05$). The number of sightings in Type 3 may be biassed high because bears tend to be distributed along the floe edge where they are easy to find with little time-consuming tracking. In contrast, polar bears were more difficult to see in Type 4 and most animals were located only after tracking. Also, although similar numbers of tracks of bears were seen per 100 km of habitat surveyed in Types 3 and 4 (Table 2), twice as many bears were sighted per 100 km in Type 3 (Table 3).

Although we have no quantitative data on the proportion of the each habitat type, we estimate that in most years there would be at least two to three times more Type 4 than Type 3. Even with acknowledging the possible bias toward a higher rate of sightings, it appears that the density of polar bears is probably higher in Type 3 than in any other type.

From Table 3, similar densities of bears and tracks were sighted per 100 km of habitat surveyed in Types 1, 5 and 6. However, large numbers of bears were found only in Type 1 (Table 2). This was simply because it was so much more abundant.

Table 2. Sightings of polar bears of different age and sex classes in the different habitat types between mid March and the end of May, 1971-79. (Family groups were considered as one sighting).

	Type						
Age/Sex Class	1	2	3	4	5	6	T
adult male	20	1	115	122	5		263
adult female (alone)	9	-	37	39	2		87
unclassified bears	12	-	36	9	1		58
subadult male	6	-	38	25			69
subadult female	15	-	14	15	1		45
adult female with cubs of the year	28		4	11		2	45
adult female with yearlings	6	1	7	21	1	1	37
adult female with 2-year-olds	2		14	6			22
yearlings alone				1			1
Total	98	2	265	249	10	3	627

Table 3. Number of polar bears and tracks sighted per 100 km of potential habitat surveyed.

	Type						
	1	2	3	4	5	6	7
# km travelled	23,693	4,512	13,664	28,301	1,537	1,099	1,526
# bears seen	157	4	296	314	11	9	0
# tracks seen	1,004	106	1,635	3,509	114	70	16
# bears/100 km	0.66	O*O9	2.17	1.11	0.72	0.82	-
# tracks/100 km	4.24	2.35	11.97	12.40	7.42	6.37	1.05

As noted earlier, there is little Type 6 (coastal) in the Western Arctic compared to, for example, southeastern Baffin Island or the High Arctic. In those areas, a much larger proportion of the polar bears are found in Type 6 (unpubl. data). Similarly, there is a relatively small proportion of good Type 7 (deep bays) in the Western Arctic compared to southeastern Baffin Island where, like Type 6, it is much more important to polar bears.

The most plausible hypothesis to explain the greater number of polar bears in Types 3 and 4 is that seals, their main food, are more abundant there, more accessible, or both. Some knowledge of how seals are distributed and hunted aids understanding of polar bear distribution. As the autumn freeze-up progresses, ringed and bearded seals maintain breathing holes in the last leads to freeze over by abrading the young ice with the heavy claws of their foreflippers. Breeding adult ringed seals tend to concentrate in fast ice areas which remain frozen through most if not all of the winter. In most areas, drifting snow covers the breathing holes, and provides some protection from predators. In stable ice areas where the drifts become deep enough (mainly Type 1) the pregnant female ringed seals scoop out subnivean birth lairs in which to give birth to their single pups (McLaren, 1958; Smith and Stirling, 1975). Bearded seals and subadult ringed seals tend to be more abundant in the moving ice and open water areas where the ice continually breaks up and refreezes through the winter (Types 3 and 4). The snow cover over breathing holes is usually much thinner and occasionally there may be none at all. Studies of the hunting behavior of free-ranging undisturbed polar bears have shown that their most common method of hunting seals is to wait beside an open, or snow covered, breathing hole or at a lead and wait for a seal to surface to breathe (Stirling, 1974a; Stirling and Latour, 1978). This is especially true during cold or windy weather when few seals haul out on the ice. Thus, it appears that seals may be more accessible to bears in Types 3 and 4 than in Type 1 because the breathing holes have less snw over them.

One additional factor may contribute toward the concentration of polar bears along the floe edge. Recent studies (eg. Buckley et al., 1979) indicate that upwelling occurs along the floe edge and provides localized enrichment which may help to produce and attract greater densities of epontic organisms, and hence also attract ringed seals. The same is likely true of smaller leads as well. It seems plausible that seals may be both more abundant and more accessible to polar bears in Types 3 and 4 than in the other habitat types.

4.3 Distribution of different age and sex classes of polar bears in relation to habitat variability

Besides the differences in the number of polar bears in each habitat type, there were differences in the age and sex class distributions (Tables 2 and 4). The sample sizes of bears in habitat types other than 1, 3 and 4 were too small to permit testing for preferences. Also, in pooled data of this sort, it is not possible to examine more precise relationships between polar bears and individual ice types. Nevertheless, some points are apparent.

From Table 4, significantly more adult males were found in Types 3 and 4 than Type 1. Figure 10 shows the distribution of adult males in the study area. It approximately overlaps the distribution of Types 3 and 4 (Fig. 8); few adult males were seen in subareas 5 and 6, where Types 1 and 2 prevail, although 18.5% (13,798/74,983) of the kilometres surveyed were in those subareas (Table 1). Similarly, along the mainland coast and the west coast of Banks Island, relatively few adult males were found close to the coast where Types 1 and 2 prevail in the landfast ice. There was no apparent preference of adult males between Types 3 and 4.

Table 4. Habitat preferences of polar bears by age and sex class (based on Table 2).

Age/Sex Class	Types Compared: 1 v. 3 and 4	Types Compared: 3 v. 4
adult male	-22.31[a]**	
adult female (alone)	+ 2.16	
subadult male	- 3.10*	+ 2.21
subadult female	+11.52**	
adult female with cubs of the year	+82.92**	
adult female with yearlings		- 8.36**
adult female with 2-year-olds	- 2.05	+ 2.83

+preference for the first habitat type compared

[a]all values are X^2 with 1 degree of freedom; values less than 2 were omitted

*$p < 0.05$

**$p < 0.01$

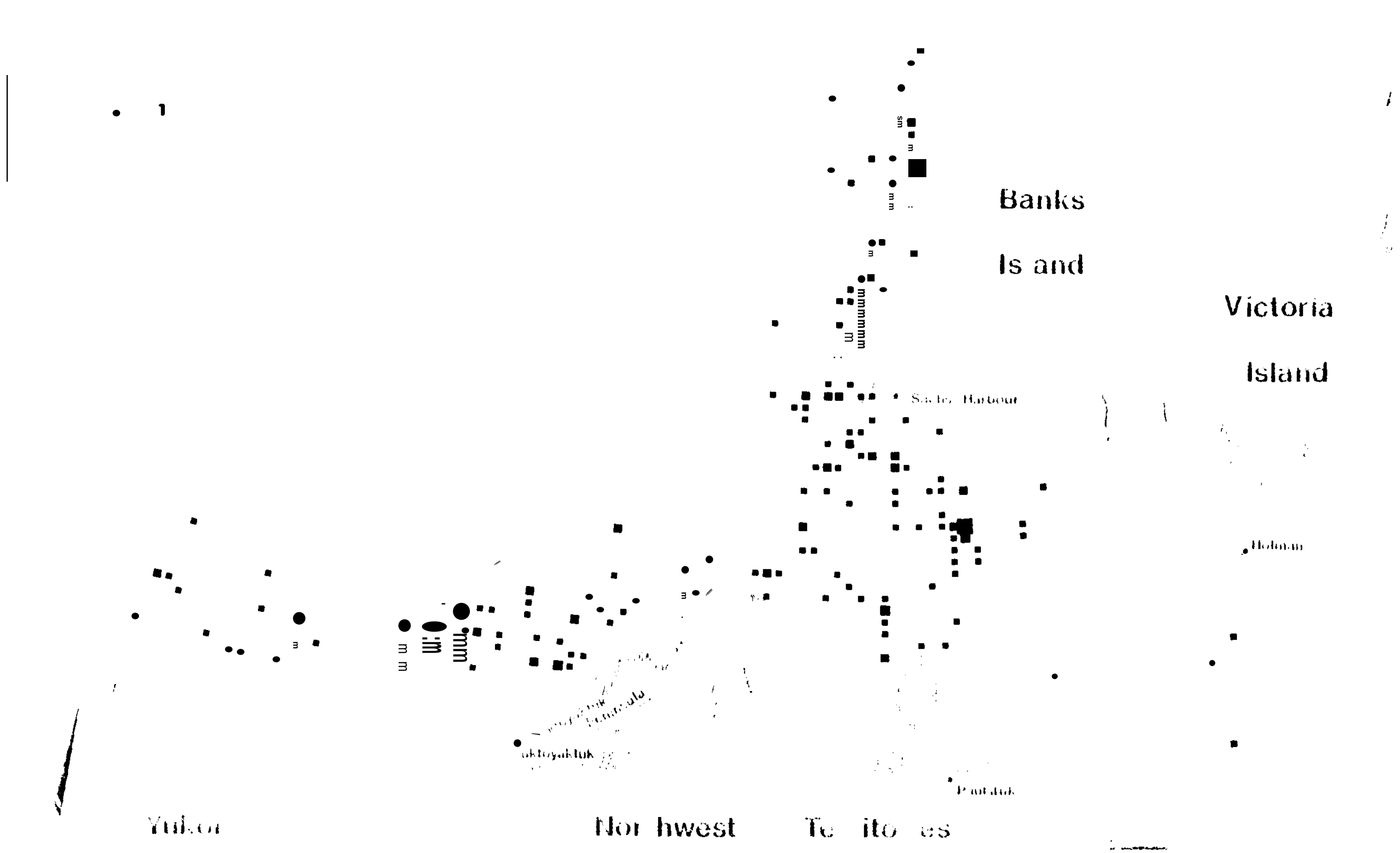

Figure 10. Locations at which adult male polar bears were captured, recaptured, or resighted from mid March to the end of May, 1971-79.

In contrast to adult males, adult females with cubs of the year showed a distinct preference for Type 1 over Types 3 and 4. Two hypotheses may explain this. First, when the cubs are small, the female keeps them away from areas where they might become chilled by having to swim across open water. Although open water may be important initially, its significance probably decreases rapidly as the cubs grow and we favor the second hypothesis, that females with cubs of the year select Type 1 in order to avoid interacting with other bears, particularly adult males, which may prey upon their cubs. The importance of adult males in reducing the survival of young has not been quantified in polar bears but Kemp (1970) has clearly demonstrated it in black bears (*Ursus americanus*).

There were no significant differences in the distribution of adult females with yearlings and those with 2-year-old cubs. Figure 11 illustrates the general overlap in their distribution. There was also no significant difference in the proportions of either of these groups in Type 1 versus Types 3 and 4 pooled, but their apparent preferences between Types 3 and 4 were different. Females with yearlings showed a strong preference for Type 4 over Type 3 but females with 2-year-old cubs appeared to show a preference for Type 3, although the Chi-square value was not quite significant.

Subadult females showed a significant preference for Type 1 over Types 3 and 4 but showed no difference between Types 3 and 4. In contrast, subadult males showed a significant, preference for Types 3 and 4 over Type 1 and a slight, though not significant preference for Type 3 over Type 4. In Figure 12, their distributions show general overlap in Types 3 and 4. However, the large proportion of subadult females in

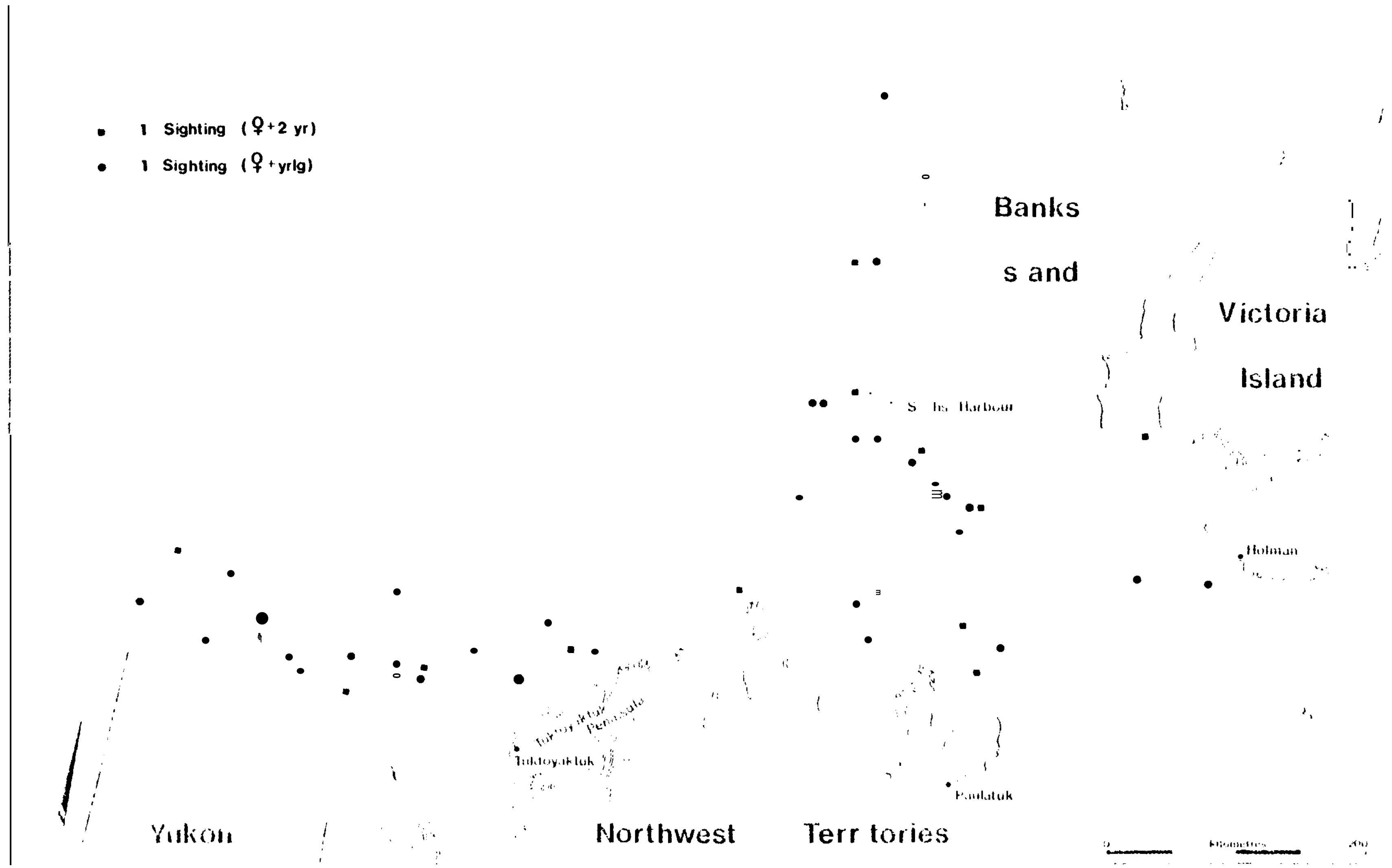

Figure 11. Locations at which adult female polar bears accompanied by yearling or 2-year-old cubs were captured, recaptured or resighted from mid March to the end of May, 1971-79.

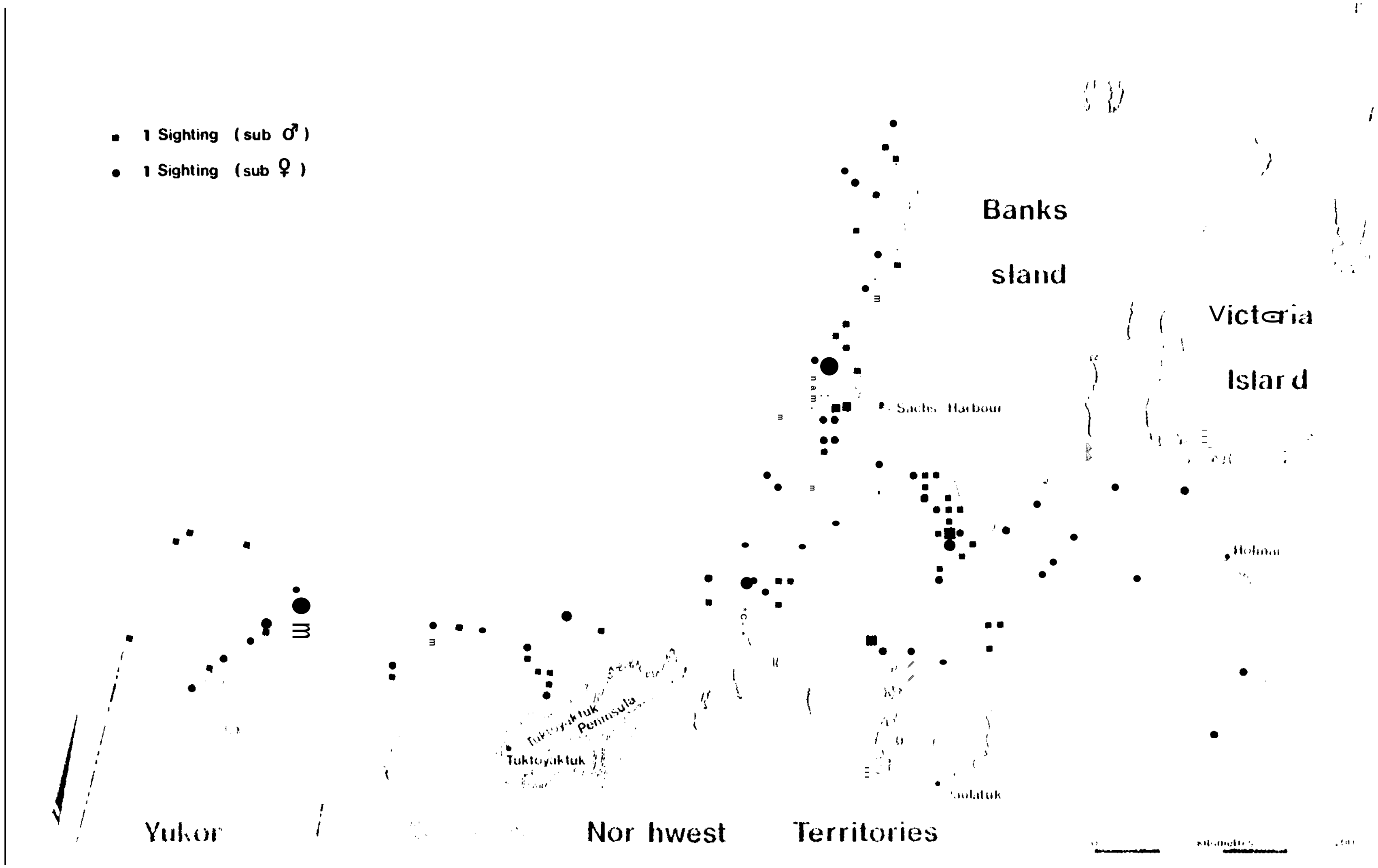

Figure 2. Locations at which subadult male and female polar bears were captured, recaptured or resighted from mid March to the end of May, 1971-79.

Amundsen Gulf, where Types 1 and 2 prevail, differs markedly from the distribution of the males. These habitat preferences are difficult to interpret with certainty but we speculate that it may reflect the females' learned avoidance of adult males, while the males may be beginning to show the distribution pattern they will exhibit as adults.

4.4 Variations in habitat preference between years

Our data are not adequate to detect changes in distribution or habitat preferences between years, if they occur, with one exception. Between 1974 and 1975, the numbers of ringed seals dropped by 50% and their productivity by about 90% (Stirling et al., 1977). Thus, the availability of seals and their newborn pups in Type 1 habitat was reduced markedly. Only in that year were more females with cubs of the year found in Types 3 and 4 than in Type 1. From 1971 through 1979, 28 such family groups were sighted in Type 1, of which only one occurred in 1975. Conversely, of 15 females with cubs of the year sighted in Types 3 and 4 from 1971-79, seven were sighted in 1975. On the west coast of Banks Island, the most productive area for polar bear cubs, 0.73 and 0.52 tracks of females with cubs of the year were sighted per 100 km of Type 1 surveyed in 1973 and 1974 respectively. In 1975, that figure fell to 0.15. In 1976 and 1977, the value increased again to 1.04 and 1.21 respectively as productivity of the seal population began to increase in Type 1 again (Smith and Stirling, 978). Clearly, the scarcity of seals in Type 1 was a sufficient stimulus to cause females with cubs of the year and probably other females as well to move further offshore to hunt in Types 3 and 4.

This apparent shift in the distribution of polar bears during this period of natural environmental stress serves to underscore the overall importance of Types 3 and 4 for survival.

4.5 Utilization of habitat by subarea

Table 5 summarizes the number of tracks and polar bears sighted per 100 km of each habitat type surveyed from 1971 through 1979 in each of the subareas defined in Section 3.6. Only Types 1, 3 and 4 are sufficiently important to merit consideration here.

The lowest numbers of tracks/100 km in Type 1 occurs in Subareas 1, 2 and 3. This, may be partly because the water is so shallow for several kilometres offshore, especially along the Tuktoyaktuk Peninsula. In an aerial survey in the Western Arctic, ringed seals preferred water deeper than 25 m (Stirling et al., 1977 and 1981). Much of the water under Type 1 in Subareas 2 and 3 especially is less than 10 m deep. If those areas have fewer ringed seals, the density of polar bears would be lower as well.

The Type 1 in Subareas 4 and 5 is mostly located over water in excess of 75 m. Although the numbers of bears sighted/100 km in Subareas 4 and 5 were similar to Subareas 2 and 3, the numbers of tracks were about double. The anomaly is Subarea 6 where the water is well over 50 m in most areas, even along the southeast coast of Banks Island, and seal productivity is high (Smith and Stirling, 1975). Consequently, we would have predicted a higher density of bears and tracks than we recorded. Even though tracking is particularly difficult in Subareas 5

Table 5. Number of tracks and bears sighted per 100 km surveyed of each habitat type in each subarea fran mid March to the end of May, 1971-79.

	Type 1					Type 2				
Subarea	# km travelled	# bears seen	# tracks seen	# bears 100 km	# tracks 100 km	# km travelled	# bears seen	# tracks seen	# bears 100 km	# tracks 100 km
1	1351	1	24	0.07	1 ●B	52		1		192
2	3912	13	55	0933	1.41	145				
3	877	4	25	0.46	2.85					
4	1211	3	78	0.25	6.44	601		43		7.15
5	3326	14	150	0.42	4.51	1090	1	13	0.09	1.19
6	5451	20	178	0.37	3.27	2267	3	22	0.13	097
7	2392	29	175	1.21	7.32	312		25		8.01
8	5173	73	319	1.41	6.17	45		3		6.67

	Type 3					Type 4				
Subarea	# km travelled	# bears seen	# trades seen	# tears 100 km	# tracks 100 km	# km travelled	# tears seen	# trades seen	# bears 100 km	# tracks 100 km
1	288	9	33	3.13	11.46	5147	54	507	1.05	985
2	1373	14	100	1.02	7.28	5701	67	679	1.18	11.91
3	1739	39	313	2.24	18.03	3337	41	673	1.23	20.17
4	219	8	34	3.65	15.53	3234	36	269	1.11	8.32
5	40	-	10		25.00	390	3	13	037	333
6	65					582	1	40	0.17	6.87
7	3992	127	454	3.18	11.37	5635	49	714	0.87	12.67
8	5948	99	691	1.66	11.62	4275	63	614	1.47	14.36

Table 5. Continued.

	Type 5					Type 6				
Subarea	# km travelled	# bears seen	# tracks seen	# bears 100 km	# tracks 100 km	# km travelled	# bears seem	# tracks seen	# bears 100 km	# tracka 100 km
1	90	2		2022	-	198		3		1.52
2	337		40		11.87	24				
3	209		2		0.96	15		3		20.00
4	27		6		22.22					
5	5									
6	24		2		8033	78		3		385
7	44	2	13	4.55	29.55	333	3	29	oa8	8.55
8	801	7	51	0.87	6.37	445	6	32	1035	7.19

	Type 7				
subarea	# km travelled	# bears seen	# tracks seen	# bears 100 km	# tracks 100 km
1	-				
2	788				
3	100				
4	87		3		3.45
5	283		1		0.35
6	197		5		2.54
7	-				
8	71		7		9.86

and 6, we have surveyed more Type 1 in Subarea 6 (5,451 km) than anywhere else in the study area and can only conclude it is not high density polar bear habitat.

The greatest numbers of polar bears and tracks seen in Type 1 were in Subareas 7 and 8. There is a productive band of Type 1 habitat over water depths of 25 m or more along the west coast of Banks Island and we have always found polar bears to be abundant there.

As discussed earlier, Type 1 is of particular importance to females with cubs of the year and this partially accounts for why so many bears and their tracks were seen per 100 km habitat surveyed in Zones 7 and 8. Figure 13 shows the location of maternity dens recorded by Harington (1964) and during "the course of our study. Sightings in April of females with cubs of the year were also plotted because they indicate the proximity of maternity denning areas. It is clear from this figure that more maternity denning occurs along the western and southern coasts of Banks Island than in all the rest of the Western Arctic.

Apparently, maternity denning along the mainland coast occurs infrequently since only three dens have been reported by Inuit hunters in the last 10 years and only one was found during this study. Lentfer (1972) reported finding dens along the Alaskan coast but the number was insignificant when compared to the large size of the population of polar bears on the sea ice north of Alaska. Subsequently, Lentfer (1975) confirmed that some maternity denning occurs in the multi-year pack ice of the Beaufort Sea but as yet there is no information on its extent.

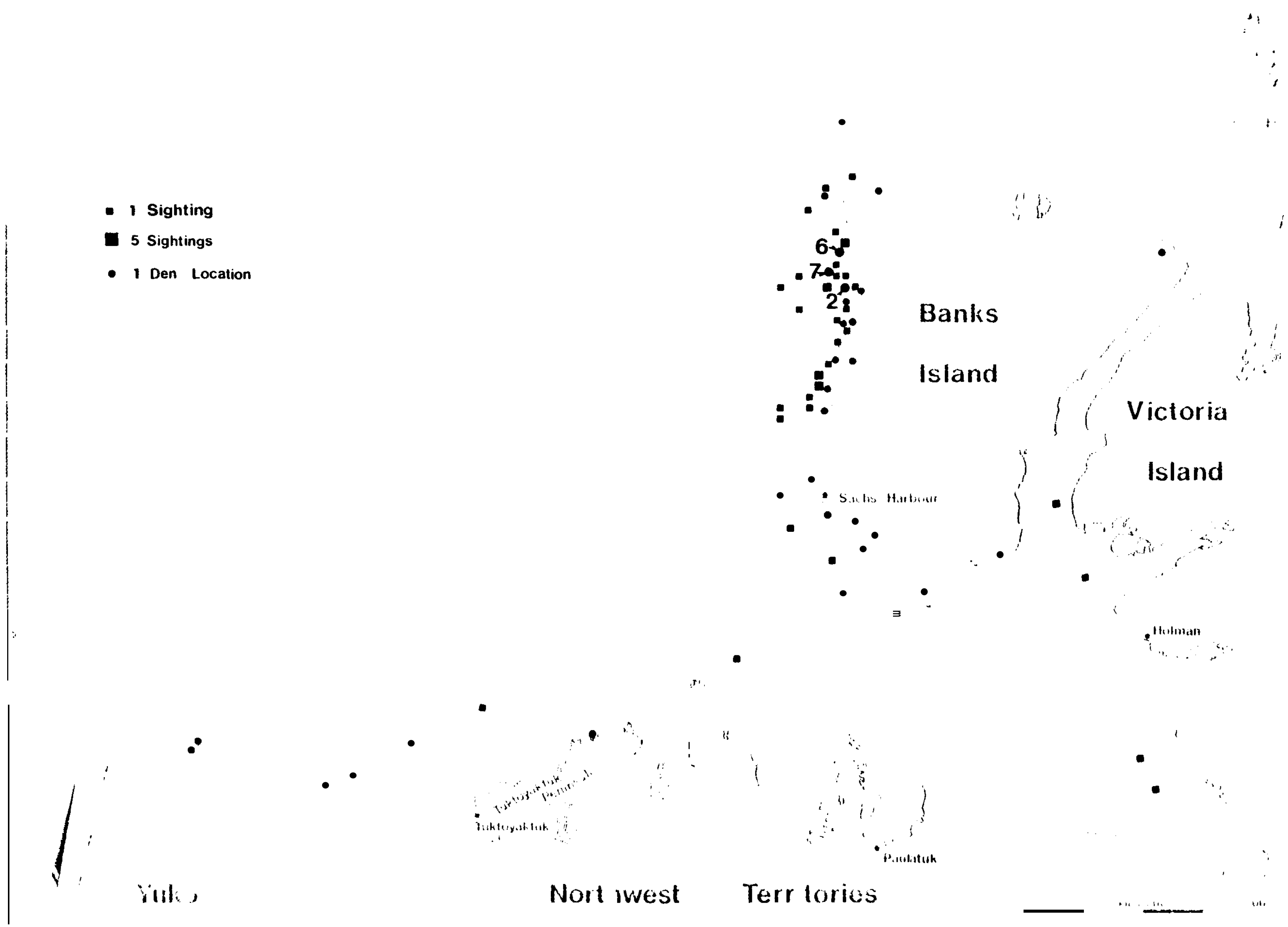

Figure 3. Locations of maternity dens and of captures, recaptures or resightings of adult female polar bears accompanied by cubs of the year from mid March to the end of May, 1971-79.

It seems surprising that more maternity denning does not occur along the mainland coast. Suitable snowbanks are abundant close to where the females can hunt seals after leaving the den in the spring. However, the mainland coast area has been inhabited by whalers and Inuit supplied with firearms for over 80 years. It seems likely that many adult female polar bears which utilized the mainland coast for denning were shot. If, like most mammals, they have a high degree of fidelity to parturition sites, some of the total adult female population may have returned to the mainland coast to dig maternity dens each year and were eventually eliminated when the use of firearms became widespread. Continued hunting and extensive traveling along the coast would deter re-establishment of denning in this area by new adult females. This conclusion is supported by Leffingwell's (1919) report that, "'The natives in the vicinity [Canning River] shot perhaps a dozen [polar tears] each year, mostly females that were giving birth to young in snow caves under high banks of the land." Lentfer (pers. comm.) has found few dens in that area in recent years.

In summary, the most important Type 1 in the study area occurs in Subareas 7 and 8. The next most important Subarea for Type 1, in terms of its seal production at least if not in bears, is Subarea 6.

From Table 4, the highest densities of polar bears and their tracks in Types 3 and 4 were in Subareas 3, 8, 4, and 7. Even though, as discussed before, seals are probably more abundant and accessible to polar bears in Types 3 and 4, it is the amount of each habitat type present in each subarea that is most important. For example, Types 3 and 4 are usually distributed in a fairly narrow band parallel to the coast in

Subareas 1 and 2 and to an even more limited degree in Subareas 5 and 6 in most years. In comparison, Types 3 and 4 are much more extensively distributed in Subareas 3, 4, 7 and 8 because of the way in which the leads and recurring polynyas form (Lindsay, 1975 and 1977; Smith and Rigby, 1981). Subareas 3, 4 and 7 also overlap most of the area known as the Cape Bathurst polynya which has been known as a rich feeding area for marine birds and mammals for almost a century (Stirling, 1980). Consequently, it is not surprising to find it is important for polar bears as well.

4.6 Fidelity of polar bears to the study area

Data on the fidelity of polar bears to the study area were obtained from the mark and recapture studies and from the return of tags from bears killed by Inuk hunters. From October 1970 through May 1979, 605 individual polar bears were captured in the study area. Ninety-one recaptures and 113 resightings were made of these bears and 75 were reported killed by hunters. Additional tagged bears were killed but we did not receive any data.

Figures 14, 15 and 16 show the recorded movements of polar bears tagged on the west coast of Banks Island, in Amundsen Gulf and along the mainland coast from the Alaska border to Cape Parry respectively between mid March and the end of May of any year and recaptured in the same season one or more years later. Figure 17 illustrates the recorded movements of tagged polar bears between Alaska and Canada.

Although we do not analyse the movement data in detail, several conclusions relevant to this report may be drawn from Figures 14 to 17.

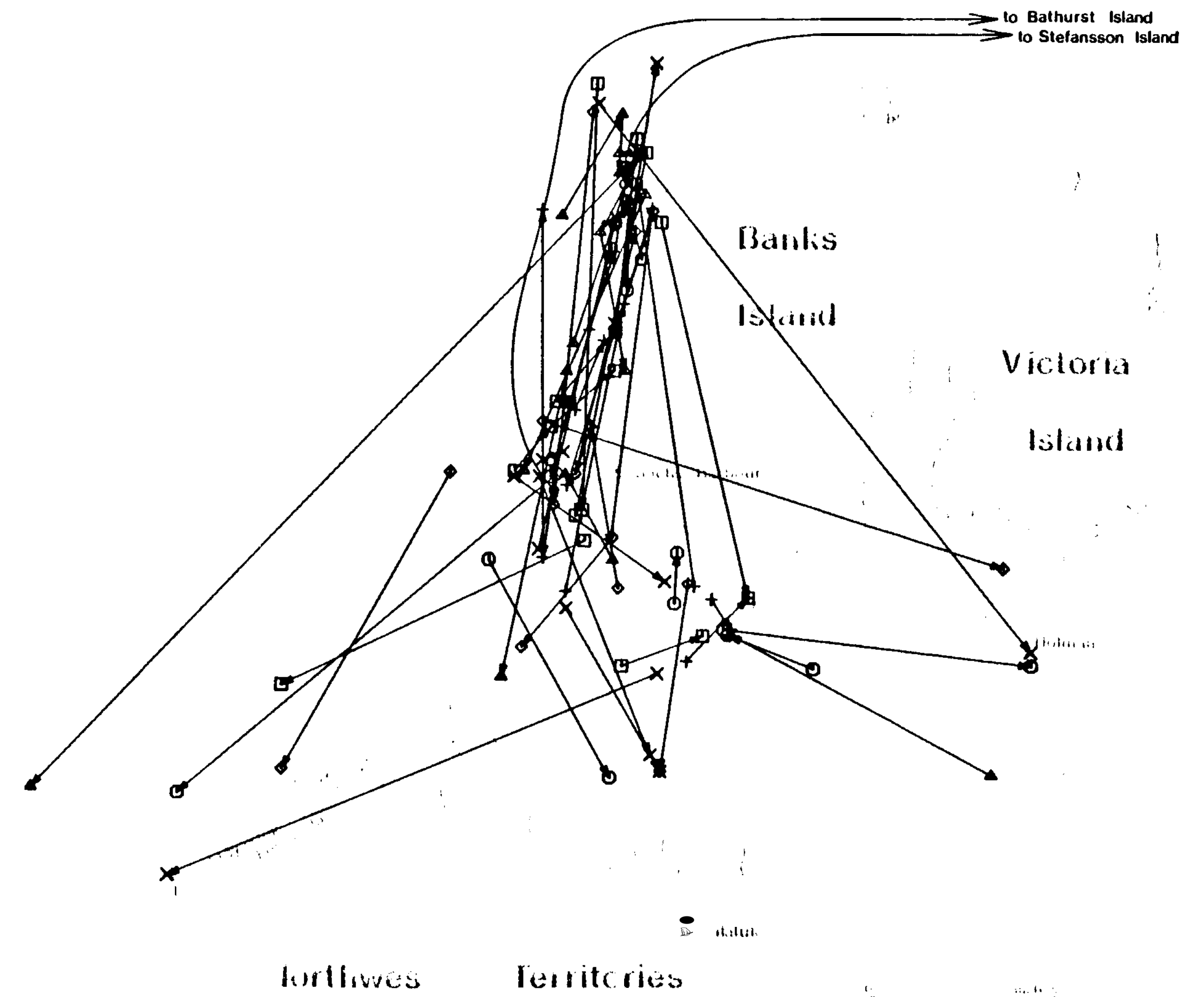

Figure 14. Recorded movements of polar bears tagged on the west coast of Banks Island between mid March and the end of May and recaptured or shot one or more years later.

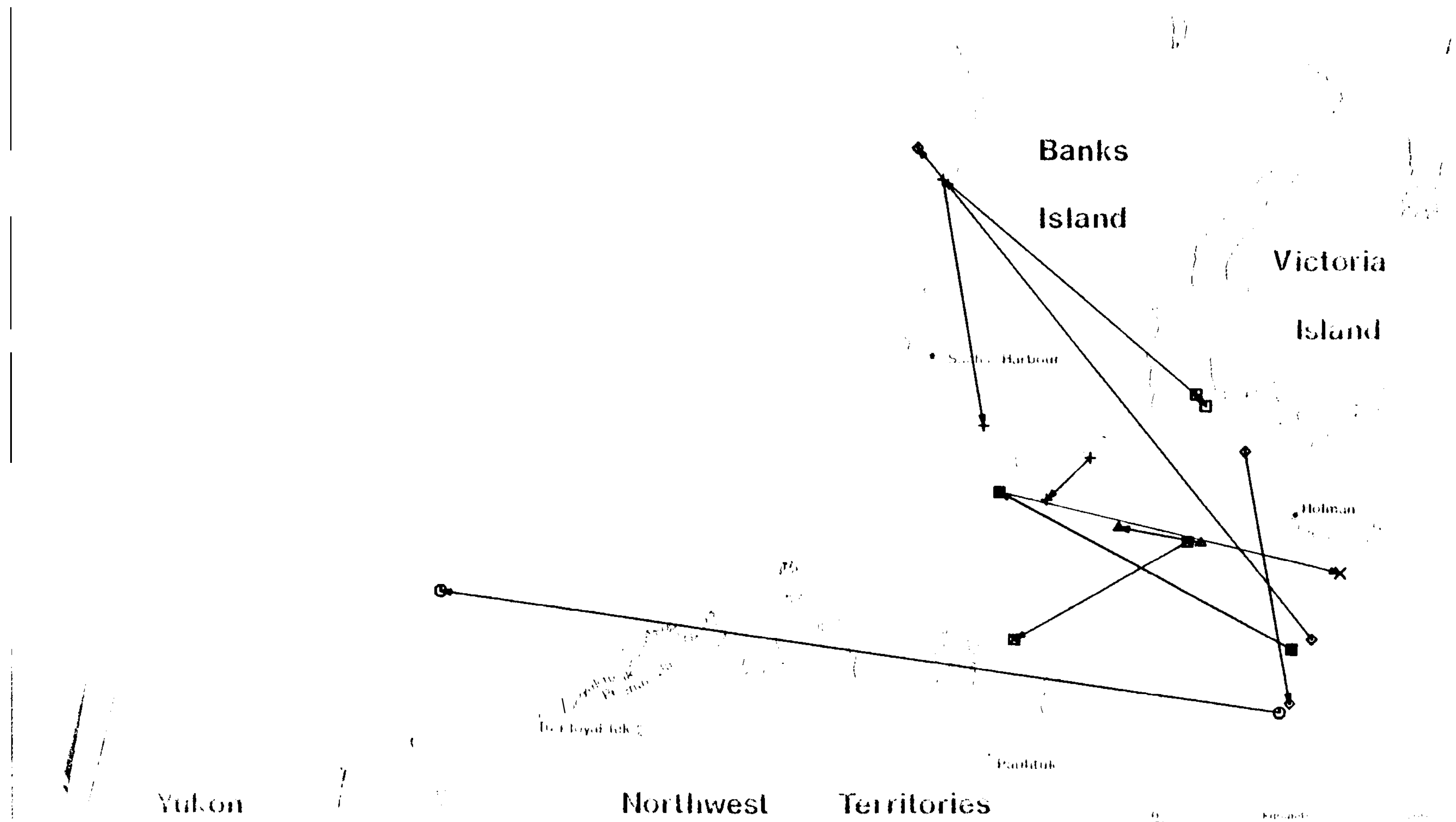

Figure 15. Recorded movements of polar bears tagged in Amundsen Gulf between mid March and the end of May and recaptured or shot one or more years later.

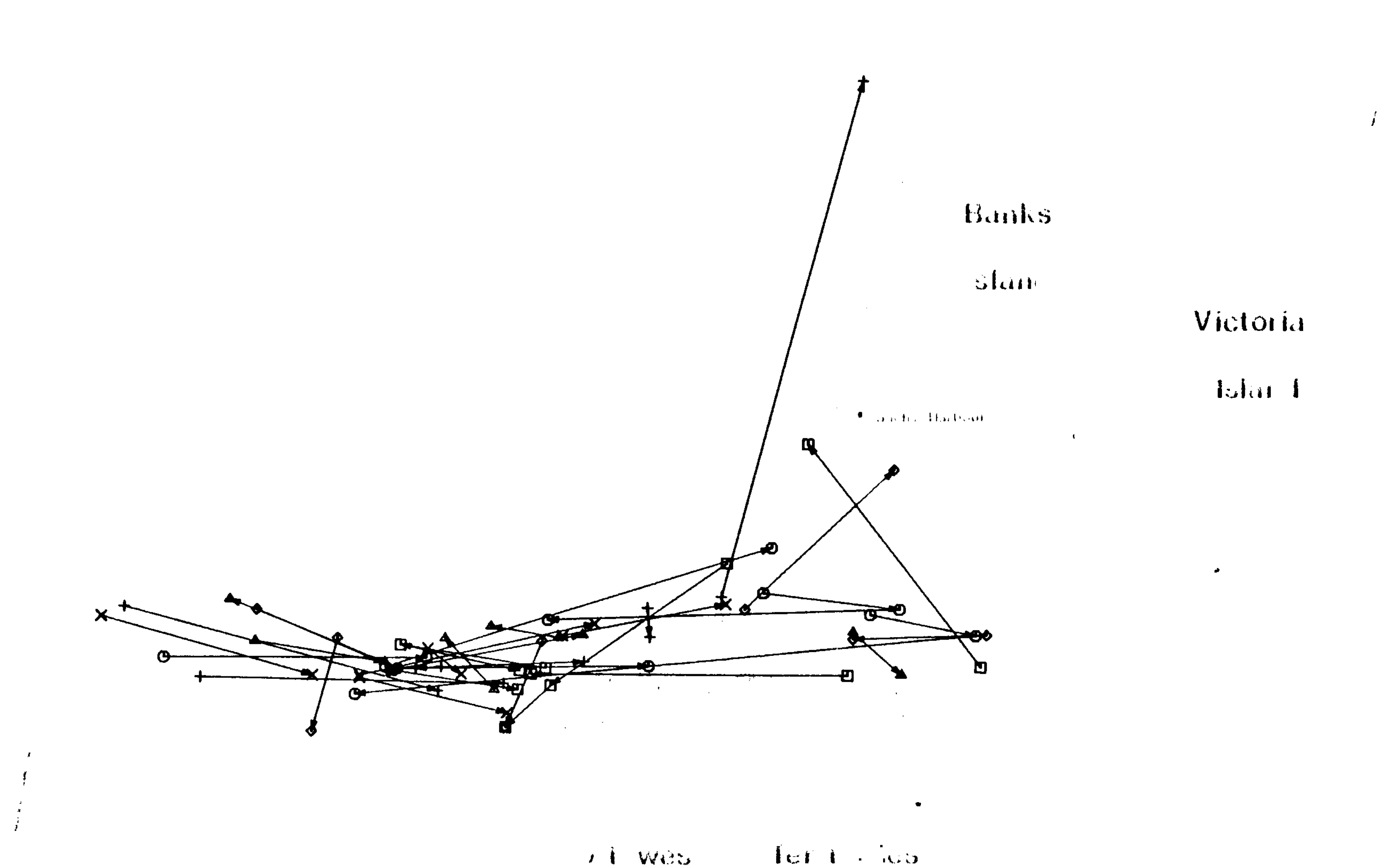

Figure 16. Recorded movements of polar bears tagged on the mainland coast from the Alaskan border to Cape Parry between mid March and the end of May and recaptured or shot one or more years later.

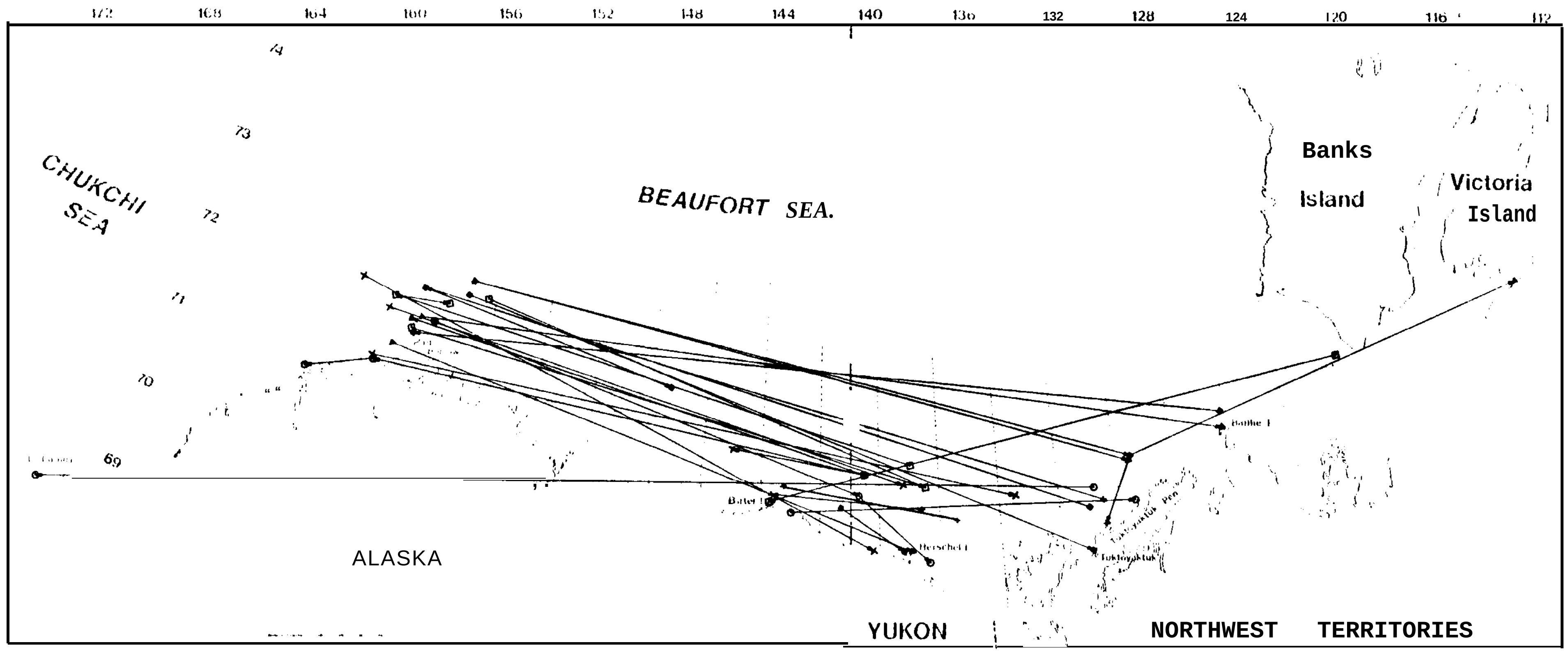

Figure 17. Recorded movements of tagged polar bears between Alaska and Canada.

Polar bears within the study area show high fidelity to specific locations during the spring. Many bears were recaptured within a few kilometres of where they were first captured. For management purposes, all the polar bears within the study area are considered as one population. However, from Figures 14 to 17, there are clearly two components to the population which, in the spring, show fidelity to either the west coast of Banks Island or the mainland coast. In general, the polar bears in Amundsen Gulf showed more affinity to the west coast of Banks Island than to the mainland coast.

Exchange between the Western Canadian Arctic and Alaska was restricted to bears caught along the mainland coast (Fig. 17). No polar bears were recorded moving between Banks Island and the Point Barrow area of Alaska.

4.7 Seasonal movements

From freeze-up in the fall to break-up in the late spring, polar bears are distributed over the ice of the southeastern Beaufort Sea and Amundsen Gulf (Figs. 10-13). As break-up proceeds, the first area in which extensive open water develops is the Cape Bathurst polynya (Lindsay, 1975 and 1977; Smith and Rigby, 1981). The open water then extends east into Amundsen Gulf, north along the west coast of Banks Island and west along the mainland coast. The bears appear to move ahead of the advancing floe edge. Bears from Amundsen Gulf and Banks Island move north along the west coast of Banks Island. Bears on the mainland coast move west along the coast as break-up proceeds. Both groups probably migrate north as far as necessary to remain with the edge of the permanent ice pack.

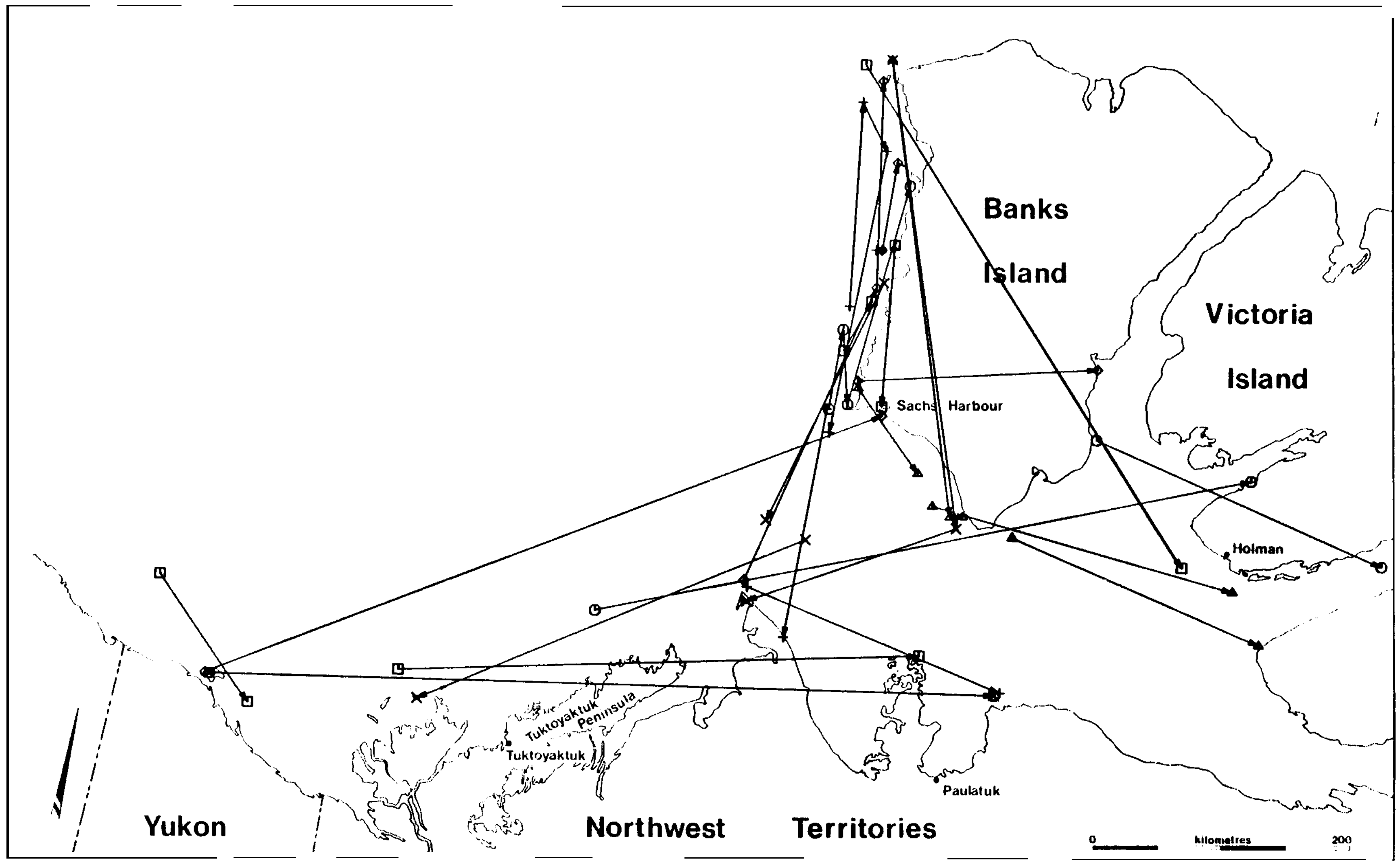

Figure 18. Recorded movements of polar bears tagged between December and May and recaptured or shot between July and November, or vice versa.

Some of our observations demonstrate the close and sensitive relationship between movements of polar bears and seasonal changes in ice conditions. In October 1973, there was a rare period of six consecutive days of good weather immediately after the annual ice first froze between the southern edge of the pack ice and the mainland. During that period, field work was conducted in the eastern Beaufort Sea from Norway Island to 145 km south of Sachs Harbour. The direction of travel was determined for 51 sets of polar bear tracks (family groups were considered as one unit because each adult female presumably determines the direction of travel of her cubs). Eighty-six percent (44 of 51) of these tracks were headed south (Stirling, 1974b). The motivation to move south was apparently so strong that many of the bears were many kilometres out onto young ice that was barely thick enough to support them.

Lentfer (1972) reported that in Alaska polar bears are much more abundant during years in which the permanent pack ice is blown south to the mainland coast. Similarly, at Herschel Island in 1970 and 1975, when heavy pack ice moved south in early October and remained there, numerous polar bear sightings were reported. However, should the ice suddenly be blown offshore from the mainland by southeast winds after freeze-up, the bears move back cut with it rather than remain on the coast. For example, Stirling (1974b) reported that sometime between 8 and 15 October 1971, young ice united the pack ice with the Yukon coast. In the week or so that followed, 10 polar bears were sighted at Herschel Island. A survey after two days of southeast winds had blown the young ice offshore showed that the polar bears were absent, having departed with the ice as rapidly as they had arrived, clearly demonstrating their close relationship with it.

Presumably they do this in order to continue to hunt seals since they probably do little hunting in the open water and ringed seals rarely haul out on land. Some bears occasionally spend the summer on land on the south end of Banks Island (Manning and McPherson, 1958; this study), but this probably occurs more by accident than design. Overall, polar bear movements during break-up appear to be facultative and probably vary considerably between years. For example, in 1974 when break-up was much later than usual and considerably less extensive, sightings of polar bears at Baillie Islands and along the mainland coast during the summer were common.

Beginning in October and November, depending on freeze-up, polar bears migrate south. This movement was first documented by Stefansson (1921) but a substantial fall migration of bears south along the west coast of Banks Island has been well known to the Inuit of that region for many years. The continuum formed by the annual ice between the multi-year pack ice and the land first appears along the west coast of Banks Island and along the mainland coast in the vicinity of Herschel Island. The ice then continues to freeze south and east toward the Cape Bathurst polynya, and the polar bears move to exploit newly created areas of Types 3 and 4 as discussed above.

Figure 18 shows movements made by polar bears caught between December and May and recaptured or shot between July and November, or vice versa. It confirms that polar bears migrate seasonally between the west coast of Banks Island and the Cape Bathurst polynya or Amundsen Gulf and, that bears off the mainland tend to move east or west along the coast.

The data on seasonal movements and fidelity are important in terms of evaluating possible environmental impacts from offshore exploration and development. Since most exploratory drilling and production is taking place along the mainland coast (Subarea 2), it is likely that any detrimental influences will affect mainly the portion of the population that occurs there. However, there may be an impact on polar bears in Alaska because there is some exchange. If oil from a spill or a blowout contaminates the Types 3 and 4 along the shear zone parallel to the mainland, the Alaskan portion of this shared population may be impacted since the current runs from east to west. The polar bears off the west coast of Banks Island and in Amundsen Gulf will probably be much less affected by activities offshore from the Tuktoyaktuk Peninsula unless shipping takes place through the Cape Bathurst polynya area and Amundsen Gulf on route to the Northwest Passage. Then, ship or noise disturbance and oil spills could affect the polar bears and seals of Amundsen Gulf and the west coast of Banks Island.

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