Beverly and Kaminuriak Caribou Monitoring and Land Use Controls, 1978.

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ABSTRACT

In April 1978, a court injunction and a new policy announcement of the Department of Indian Affairs and Northern Development resulted in temporary changes to controls on land use activities in the Baker Lake area, N.W.T. Special zones and restrictions were applied at certain times to protect the Beverly and Kaminuriak populations of barren-ground caribou (**Rangifer tarandus groenlandicus**). A monitoring program was conducted from April to late August, 1978, to record caribou movements and to determine the effectiveness of these special zones and restrictions. Distribution and movement data were obtained by aerial reconnaissance and systematic survey. The scientific literature was reviewed to summarize tundra range use by the two populations and relevant disturbance studies.

Approximately half of the area where Beverly caribou calved in 1978 was outside of the pertinent area of restricted land use activity. During July, Beverly cows and calves were in the Thelon Game Sanctuary west of the pertinent area of restrictions. The majority of Kaminuriak cows and calves occupied the appropriate areas until 2 weeks before the termination of restrictions. At that time approximately half of the cows and calves moved elsewhere.

A disadvantage of 1978 controls is that restricted areas can not be released for land use activity in advance of the termination date even though no substantial number of caribou remain in the areas or are expected to return. The scientific literature suggests the need to exclude land use activities from traditional calving and post-calving areas, or any area used for calving, during sensitive times. There is no suggestion that exclusion from other areas is necessary as long as aircraft activity involving numerous passes at low altitude near caribou can be avoided.

Except for aircraft disturbance, mineral exploration activity is considered to be of less concern than long term development. Neither the 1978 controls nor proposed Land Management Zones of the Minister, DIAND, address the issue of long term development. Recommendations are given for more flexible controls on exploration activity. In addition, it is recommended that development of site specific land use activities (e.g. mines) be allowed within traditional calving and post-calving areas subject to stringent regulations to ensure the accessibility and quality of these areas as key pieces of caribou habitat.

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1. INTRODUCTION

The effects of mineral exploration and industrial development on barren-ground caribou ***(Rangifer tarandus groenlandicus)*** have concerned residents of Baker Lake, N.W.T., for the past decade. These concerns were repeatedly expressed to the Department of Indian Affairs and Northern Development (DIAND). On 25 March 1977, the Minister, DIAND, established a temporary freeze on the issuance of land use permits in a 78,000 km^2 (30,000 mi^2) area around Baker Lake (Interdisciplinary Systems Ltd. 1978). The suspension was implemented by Order-in-Council PC 1977-1153 and was later extended to 24 April 1978. It provided for investigations on the effect of exploration activities on wildlife and the importance of hunting and trapping to local native people. Interdisciplinary Systems Ltd. of Winnipeg conducted a study and produced a report in February 1978. The IDS report evaluated the importance of renewable resource harvest to the community and through resident interviews and literature review it identified critical areas for harvested populations and recommended industrial controls.

On 17 April 1978, the Hamlet of Baker Lake ***et al.*** filed a "Statement of Claim" against the Department of Indian Affairs and Northern Development. On 24 April 1978, Justice Patrick Mahoney ordered an interim injunction on the issuance of prospecting permits and land use permits in the "Baker Lake Area" (Figure 1) unless such permits are subject to restrictions stated in the order. The restrictions are based upon recommendations of the IDS report.

On 27 April 1978, the Minister, DIAND, announced a new policy of special land management zones and conditions to protect the Beverly, and Kaminuriak caribou herds in future. The policy announcement also called for caribou monitoring program to ensure the effectiveness of these zones. The restrictions were applied immediately for 1978 by special terms and conditions placed in new land use permits. The affected areas were defined by the Caribou Protection Map 1978 (Figure 1) certified by the Engineer, DIAND, on 30 April 1978. The map was compiled by DIAND in consultation with the Canadian Wildlife Service, the Northwest Territories Fish and Wildlife Service and representatives from the Hamlet of Baker Lake (in Ottawa). It expanded upon terms of the injunction to include caribou critical areas outside of the study area of the IDS report. The restrictions prohibited activity associated with new land use permits in the following critical areas and times:

(a) The "Area of Spring Migration" until 10 days after the pregnant cows have passed;

(b) the "Primary Calving Areas" between 15 May and 30 June;

(c) the "Primary Post Calving Areas" from 30 June to 31 July, and;

(d) within 3 miles (4.8 km) of any "Major Crossing Site" year round.

The 1978 Caribou Monitoring Program was conducted by the Government of the Northwest Territories Wildlife Service. The main objectives were outlined in a letter of agreement between DIAND and the N.W.T. Wildlife Service dated 29 June 1978. These were:

"1. a) to monitor and map the movements and activities of the Beverly and Kaminuriak caribou herds during spring migration, the calving period and post-calving period (through approximately August 31),

b) to determine caribou usage of water crossing sites in 1978, make a special study of the Kazan River crossing, and develop specific criteria for identification of "critical" water crossing sites,

c) to evaluate "1978 Caribou Protection Map" boundaries of calving and post-calving in relation to actual positions of animals and identify specific habitats of importance within these areas,

d) to note and map human activities near caribou and advise Land Use Inspectors of any anticipated problems,

e) to make observations on the behavioral response of caribou to human activities, including activities related to mining exploration where encountered during monitoring surveys, and

f) to advise Land Use Inspectors or other DIAND personnel on caribou related matters as needed"

"4. GNWT shall participate in workshop in November to evaluate 1978 Land Use Controls and to make recommendations for subsequent controls."

The author arrived in Baker Lake on 9 June 1978 and thence coordinated and participated in the monitoring program. This report presents field results for the period March to mid-August 1978 and evaluates the 1978 controls on the basis of field results and the scientific literature. Recommendations are given for future controls on exploration activity and long term development. Future research requirements are also discussed.

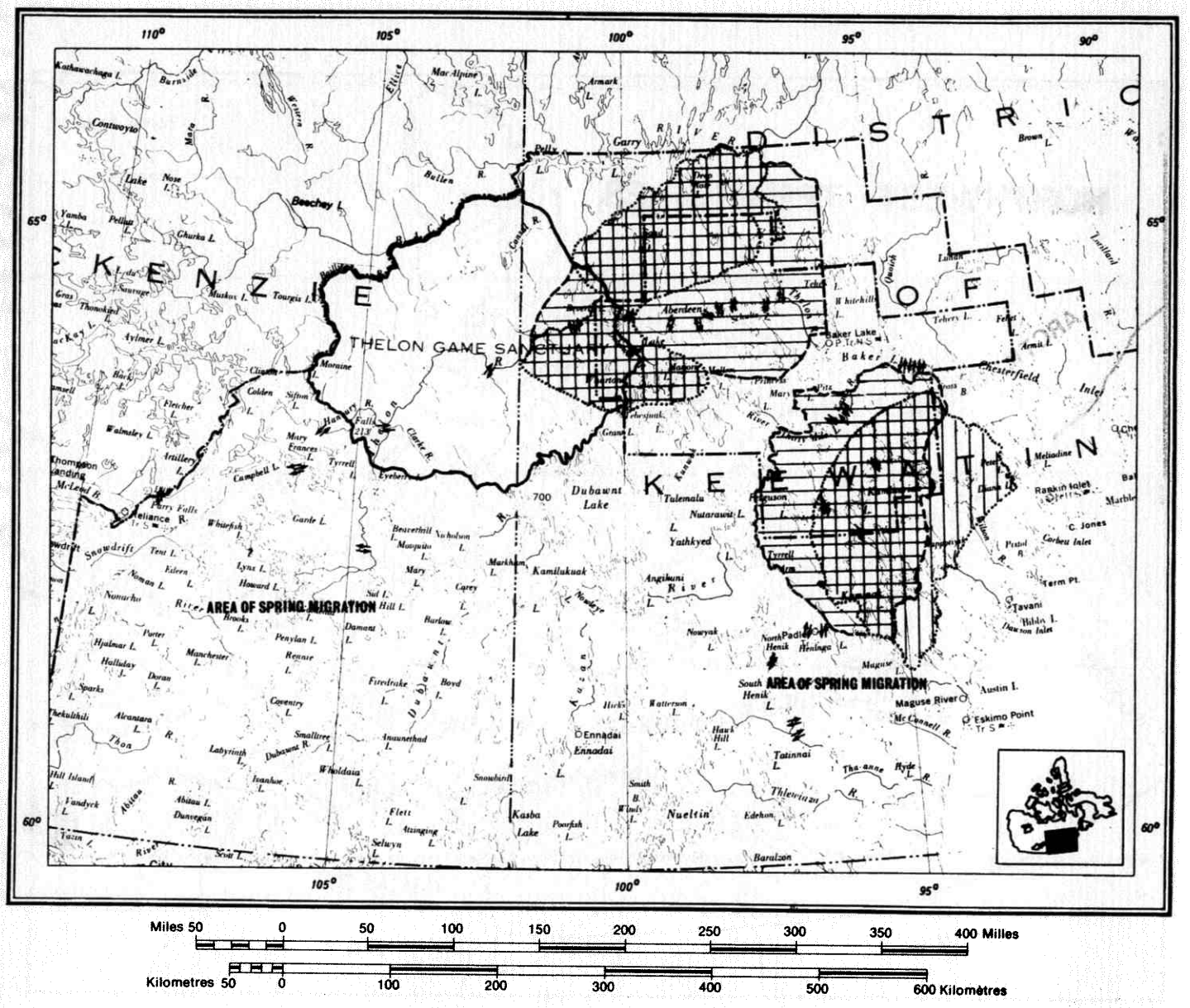


Figure 1: **Caribou Protection Map 1978 (copied with permission from original, Department of Indian Affairs and Northern Development).**

Legend

Limit of the Caribou Protection Map 1978.

Boundary of the Baker Lake Study Area (Interdisciplinary Systems Ltd. 1978)

Primary Calving Area.

Primary Post Calving Area.

Major Crossing Site.

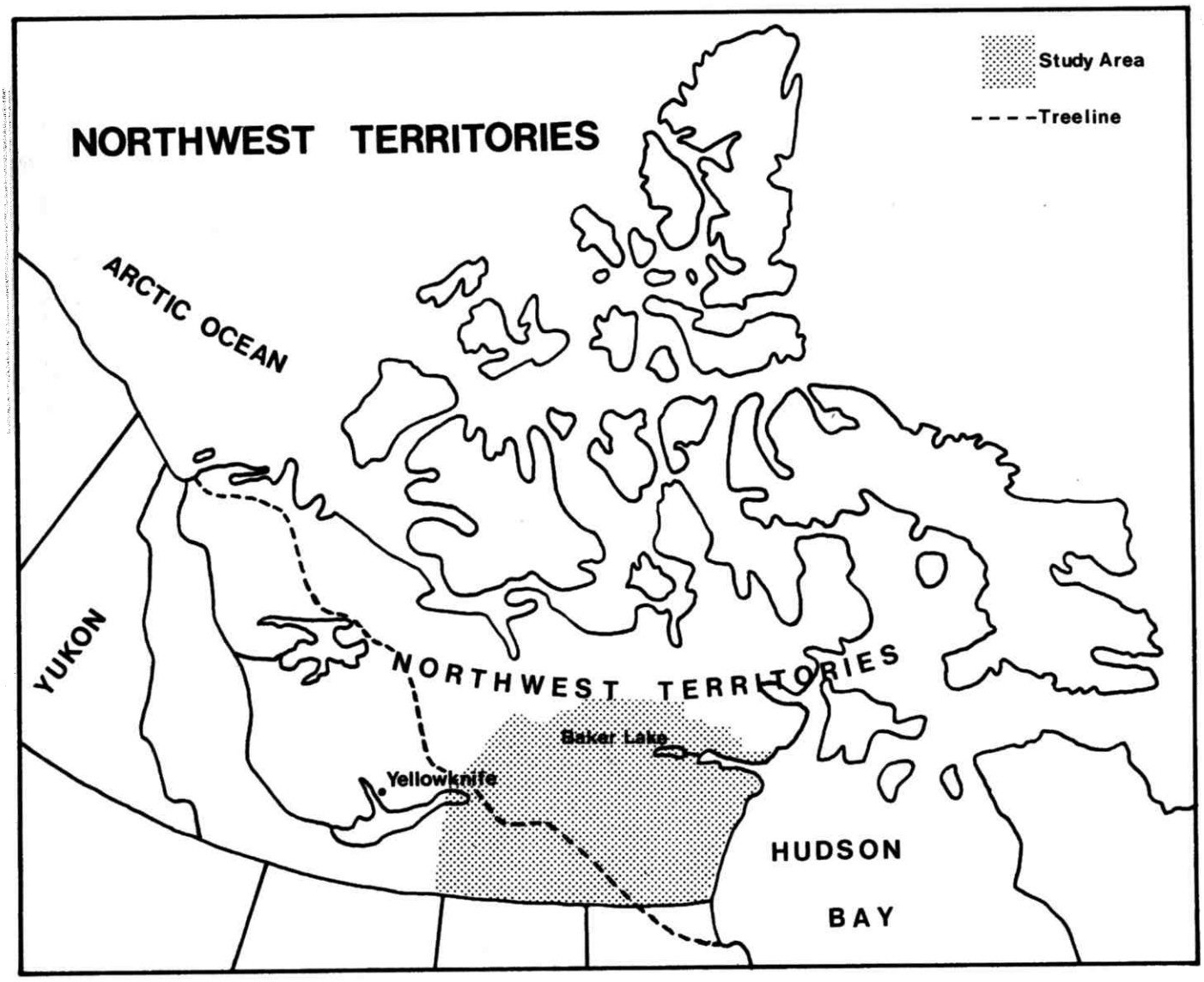


Figure 2: **The Study Area.**

2. THE STUDY AREA

The study area extended from Hudson Bay west to Great Slave Lake and from 60° latitude north to the Back River in the west and the limit of the Caribou Protection Map 1978 in the east (Figure 2). Its total area exceeds 550,000 km^2 (215,000 mi^2) and it includes portions of Manitoba, Saskatchewan and the Districts of Mackenzie and Keewatin, N.W.T. The summer ranges of the Beverly and Kaminuriak populations of barren-ground caribou approximate the tundra portion of the study area. The climate and vegetation of the study area are described in Parker (1972) and Kelsall (1968).

3. METHODS AND MATERIALS

3.1 Aerial Survey

3.1.1 Effort.

Table 1 presents the total approximate effort expended in monitoring movements of the Beverly and Kaminuriak caribou herds from March to late August 1978. Although the 1978 Caribou Monitoring Program did not commence until late May, additional data were acquired through the coordinated efforts of several agencies and programs. An approximate total of 66,380 km (41,440 mi) was flown during 395 hours of survey. Of this, approximately 245 hours were flown in association with the Monitoring Program. During spring and the month of August the Beverly caribou movements were recorded by R. Decker, N.W.T. Wildlife Service in conjunction with the Arctic Land Use Research wildlife mapping project. The Beverly caribou calving distribution was determined by a N.W.T. Wildlife Service calving ground census; part of a continuing caribou management program. S. Kearney, Manitoba Department of Renewable Resources and Transportation Services, conducted flights during August in the southeastern Keewatin. The Department of Indian Affairs and Northern Development collected caribou and human activity data on all flights associated with land use inspection.

Table 1: The approximate effort expended in monitoring movements of the Beverly and Kaminuriak Caribou herds, March to late August 1978.

	Beverly			Kaminuriak			Total		
	Distance Flown			Distance Flown			Distance Flown		
Program	km	(mi)	Hours	km	(mi)	Hours	km	(mi)	Hours
A.L.U.R.	13670	(8500)	80	2030	1260	9	15700	(9760)	89
NWTWS Census	7950	(4970)	47	–	–	-	7950	(4970)	47
NWTWS Enforcement	620	(390)	5	–	–	-	620	(390)	5
Manitoba RRTS	–	–	-	1890	(1180)	9	1890	(1180)	9
1978 Caribou Monitoring Program	16340	(10210)	90	23890	(14930)	155	40220	(25140)	245
				GRAND TOTAL			66380	(41440)	395

During late winter and spring three flights were conducted on the Beverly herd at one month intervals while flights on the Kaminuriak herd did not commence until 19 May. During June through early August each herd was intensively surveyed every 2 to 2½ weeks in addition to irregular flights. The survey routes are not presented here due to their large number but are kept on file in offices of the N.W.T. Wildlife Service, Yellowknife, N.W.T.

3.1.2 Reconnaissance and Distribution Mapping.

The monitoring program concentrated on mapping the movements of cows and calves and only investigated the distribution of males and non-breeding caribou as time and circumstances permitted. In addition intensive surveys plus irregular flights

were made to collect negative data to verify positive results. The aircraft most commonly utilized were Cessna 337's, Dehavilland Beavers and a Bell 206A helicopter.

Most monitoring flights were conducted at 1,000 feet above ground level (AGL) in order to avoid disturbance of caribou and occasionally we flew portions of a survey at 2,000 feet AGL. Sometimes it was necessary to fly at 500 feet AGL to determine whether caribou were cows and calves or males and non-breeders. Reconnaissance flights were irregular in nature when areas of suspected activity were to be investigated. Systematic reconnaissance surveys were conducted when searching for dispersed aggregations of caribou or when collecting negative data. The latter flights were flown along predetermined transects at 19 km (12 mi) or 26 km (16 mi) intervals.

Once a distribution of caribou was encountered the extent and nature of the distribution was usually determined by flying a more intensive systematic survey. A series of transect lines was established over the caribou at 10 km (6 mi), 16 km (10 mi), or 19 km (12 mi) intervals. More effort was allocated to obvious strata of higher density. Transects were flown well beyond the area of distribution to verify the boundaries and the survey was usually completed in 1 or 2 days. On all systematic surveys the aircraft flew along transects at either 500 or 1,000 feet AGL at 100 to 140 mph. Two observers each observed a strip of either 0.5 km (0.308 mi) or 1 km (0.616 mi) on either side of the aircraft depending on its altitude. Two pieces of black tape were placed on each wing strut to delineate the transect width. When either observer saw caribou he recorded the following data on a tape recorder: the number of non-calves and whether they were on or off transect; their classification as cows, others, or unknown; and the number or estimated percentage of calves with the group. All unidentified caribou in groups containing calves were classified as cows. The location of each sighting was plotted on 1:250,000 scale maps by either a navigator or the pilot depending upon whether a third observer was available to act as navigator.

In most cases recorded data were not used to calculate density estimates directly. Different observers were often used, some of whom had not received any special training in aerial survey procedure. Therefore the data were used to delineate the boundaries of high and low density distributions and to calculate the percentage of caribou in each area. During June, when cows and calves had not yet mixed with other herd elements, these percentages were applied to current population estimates for caribou on the calving grounds to produce estimated density figures. Calving ground census data were provided by the N.W.T. Wilflife Service (D. Heard pers. comm.). Where recorded data were used directly to calculate density estimates a 20% correction factor was added to the number of caribou seen after the techniques of other authors (Hawkins and Calef 1977, Parker 1972, Thomas 1969). During July, systematic surveys were still used but dense post-calving aggregations were estimated visually by the author from 1,000 feet AGL. Some aggregations were photographed with a 35 mm camera and these were later used to check visual estimates.

Flight report forms (Appendix 1) were completed for each monitoring flight. These were made available to DIAND officials in Baker Lake along with 1:1,000,000 scale maps showing flight lines, caribou locations and movements, and human activities. Copies of all original flight report forms and maps are kept on file in offices of the N.W.T. Wildlife Service, Yellowknife, N.W.T.

3.2 Community Involvement

During the 1978 Caribou Monitoring Program a concerted effort was made to establish good liaison with the Baker Lake Hunters and Trappers Association, the Hamlet Council and the community of Baker Lake. Meetings were held with each of these groups in conjunction with the Department of Indian Affairs and Northern Development to explain the 1978 controls and the purpose of the Caribou Monitoring Program. In addition, an office was maintained in the Iglu Hotel lobby to facilitate communication.

Six Inuit residents of Baker Lake were employed for varying periods of time during the program as field assistants. These were Samson Arnauyok, Barney Kudyaaq, James Ukpagaq, Jacob Atkitok, Basil Kayaveenik and David Peryouar.

3.3 Water Crossings

3.3.1 Major Crossings in 1978.

A number of major water crossings were designated by the Caribou Protection Map 1978 (Figure 1). The movements of Beverly and Kaminuriak caribou were monitored by aerial survey to determine crossing activity at these and other locations. Pairs of Inuit assistants were placed at locations on two rivers where substantial caribou activity was expected. From 29 June through 8 July Samson Arnauyok and James Ukpagaq counted and recorded Beverly caribou crossing the Thelon River just east of Lookout Point (central Thelon Game Sanctuary, Figure 1). They recorded the date, the number of caribou observed, their classification as bulls, cows, calves, others or unknown, their direction of travel, and whether or not they crossed the river. They also took some 35 mm photographs of caribou crossing the river.

Similarly, two pairs of assistants monitored Kaminuriak caribou activity along the lower Kazan River near Kazan Falls from 23 July through 1 August. Samson Arnauyok, Jacob Atkitok, Basil Kayaveenik and David Peryouar were placed along the river after a large aggregtion of males and non-breeding caribou had been observed at the east end of Thirty Mile Lake south of the river (Figure 8).

3.3.2 Special Study of the Kazan River Crossings.

A special study of major water crossings on the lower Kazan River (Figure 1), designated by the Caribou Protection Map 1978, was undertaken on 9 and 17 August 1978. The pattern of caribou trails along the river was mapped from a helicopter on 1:250,000 scale maps. The number and convergence of trails, and the overt effects of vegetation on their observability, were considered in evaluating the trail pattern. Several landings were made to examine the approximate age of trails and their characteristics. The scientific literature was later reviewed to summarize documented records of utilization.

3.4 Caribou and Land Use Activity Interactions

In addition to recording human activities on flight report forms, caribou and human activity interactions were documented on a caribou behavioural response form (Appendix 2). This form was not intended to provide adequate data for scientific evaluation since many records were obtained second hand. However, it did serve to document interactions known to have occurred during the 1978 Caribou Monitoring Program. An official N.W.T. Wildlife Service form for scientific purposes was not developed due to time constraints in mobilizing a monitoring program on short notice.

3.5 Evaluation of 1978 Controls

In order to properly evaluate land use controls for 1978 and the Caribou Protection Map 1978, the scientific literature was reviewed to summarize documented records of spring migration routes, calving areas, post-calving movements, and tundra-wintering areas for the Kaminuriak and Beverly herds. These data were then incorporated with present results to provide an overview of documented tundra range use.

3.6 Habitats of Importance within Calving and Post-Calving Areas

The delineation of specific habitats of importance within the Caribou Protection Map 1978 boundaries of Primary Calving and Post-Calving Areas was originally listed as an objective of the 1978 Caribou Monitoring Program. This requires detailed scientific research and investigation by a botanist in consultation with a caribou biologist. It requires experimental design planning and time to mobilize a field program. These requirements were beyond the capabilities of the 1978 Caribou Monitoring Program but habitat investigation in calving and post-calving areas is identified as a future research need.

4. RESULTS

4.1 Movements of the Beverly Caribou Herd 1978

Figure 3 shows spring migration routes of the Beverly caribou herd to the area used for calving in 1978 (R. Decker pers. comm., D. Heard pers. comm.) Caribou distribution south of 60° latitute was not investigated. During March cows were widely distributed from the Talston River and Nonacho Lake east to Snowbird Lake. The majority of cows occupied the area between Sparks Lake and Scott Lake to the southeast. On 23 March the majority of mature bulls were observed to occupy a smaller area south of Sparks Lake (R. Decker pers. comm.). Other mature bulls were scattered east to the Selwyn Lake area. On 25 March Decker (pers. comm.) observed approximately 60,000 to 90,000 caribou aggregated in a small area halfway between Small Tree Lake and Ivanhoe Lakes. Cows, calves and immatures of both sexes were present.

By late April spring migration had begun. The majority of cows followed the inverted "v" routes shown in Figure 3. The rest moved north on a broad front represented by the "+" route. On 27 April Decker (pers. comm.) observed approximately 80,000 to 100,000 caribou aggregated in a north-south stratum immediately west of Sid Lake. Again the aggregation consisted of all herd elements except mature bulls. The majority of these caribou had moved up the west side of Small Tree Lake and north over the ice of Damant Lake. The average rate of movement during this interval was approximately 6 km (4 mi) per day. Some of these caribou had come from northeastern Saskatchewan up the east side of the population's March distribution. They followed a fairly narrow path north between Snowbird and Wholdaia Lakes, thence north-northeast to join the main migration route south of Sid Lake. The mature bulls had also begun to move north over a wide front from the Talston River in the west to Wholdaia Lake in the east.

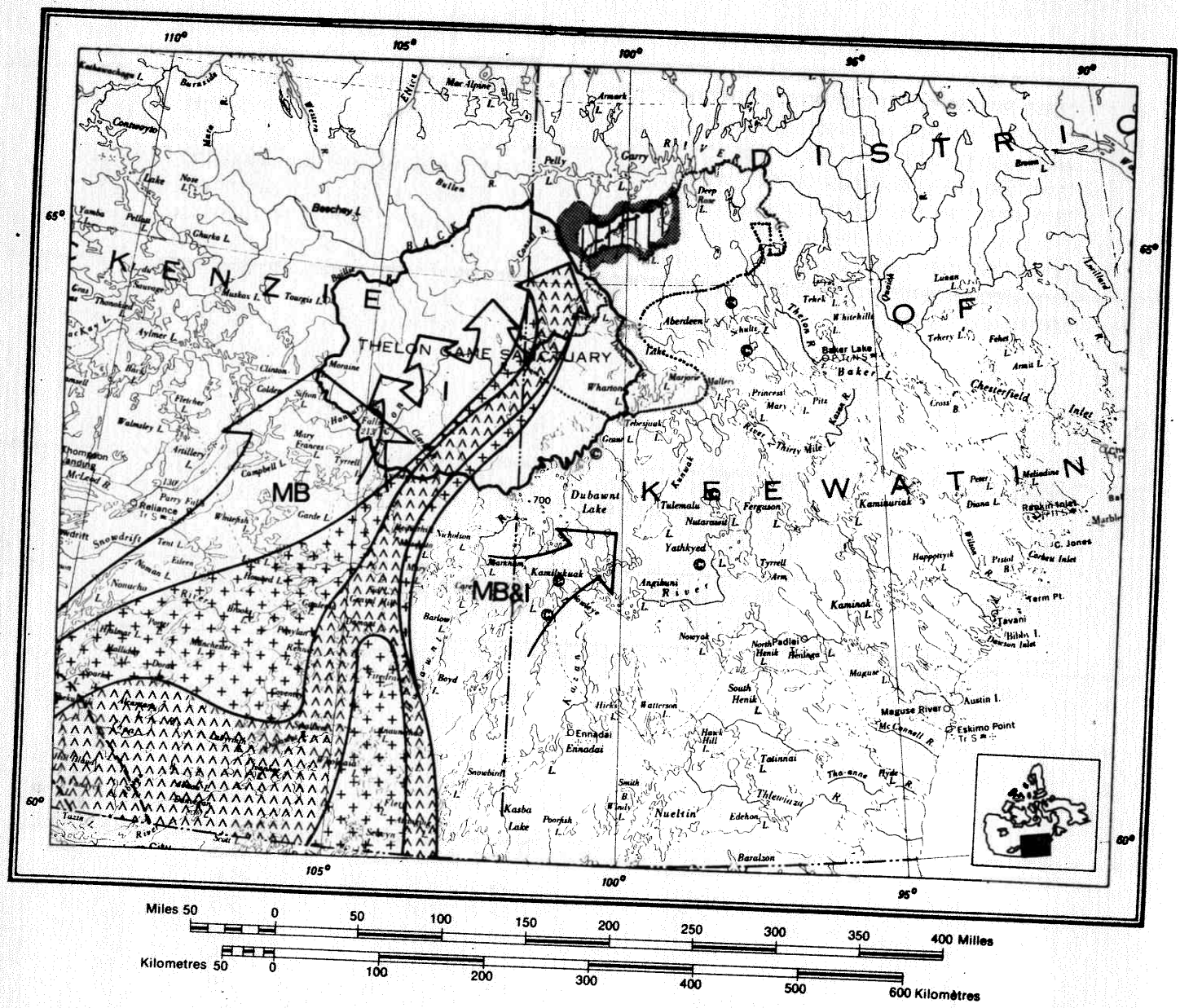


Figure 3: **Spring migration routes of Beverly caribou for 1978 and the calving area on 11 June 1978.**

Legend

Calving area, 11 June 1978, with most cows in the central area.

Cow migration from March wintering areas. Most followed the central route.

Migration of immatures and non-breeding cows.

MB

Migration of most mature bulls.

MB & I

Migration of some mature bulls and immatures.

March distribution of most mature bulls.

Boundary of the Primary Calving Area, Caribou Protection Map 1978.

© Land use camp present on or before 11 June 1978.

During the month of May the mature cows pulled ahead of other caribou and their migrational path narrowed considerably. From Beaverhill Lake the vanguard of cows swung northeast on the tundra to cross the frozen Thelon River at the east end of Ursus Islands (west of Beverly Lake) between 15 and 20 May. Travel conditions were still good as the snow and ice had not deteriorated. The average rate of travel from Sid Lake to Ursus Islands was approximately 16 km (10 mi) per day. Thawing temperatures did not become prevalent until 12 June (Table 2). This is approximately 2 weeks later than average (Table 3). The late thaw appeared to facilitate travel for cows and may have been a factor in the use of an area for calving slightly north of those documented previously (Kelsall 1960, McEwan 1959, 1960, 1962, Rippen 1971, Moshenko 1974).

Table 2: Daily temperatures for the month of June 1978, Baker Lake, N.W.T. (Atmospheric Environment Service, Baker Lake, N.W.T.).

Date	Max. Temp. °C (M.)	Min. Temp. °C (m)	Mean Temp. °C [(M + m)/2]
June 1	1.0	-5.0	-2.0
2	-0.6	-6.7	-3.7
3	1.6	-4.5	-2.9
4	-2.0	-6.6	-4.3
5	-3.2	-7.5	-5.4
6	-2.1	-6.7	-4.4
7	-4.4	-8.4	-6.4
8	-4.2	-9.4	-6.8
9	-2.0	-11.2	-6.6
10	-1.9	-4.7	-3.3
11	-0.2	-4.4	-2.3
12	4.2	0.7	2.5
13	4.2	-1.2	1.5
14	4.9	0.0	2.5
15	7.0	0.5	3.8
16	4.5	0.8	2.7
17	2.0	-0.7	0.7
18	3.7	0.0	1.9
19	3.8	-1.2	1.3
20	5.0	-0.2	2.4
21	6.0	0.2	3.1
22	3.5	0.2	1.9
23	9.7	-1.2	4.3
24	9.9	2.2	6.1
25	7.8	1.2	7.5
26	2.7	0.4	1.6
27	5.9	0.9	3.4
28	9.5	0.5	5.0
29	11.7	-0.6	5.6
30	12.2	0.9	6.6

The N.W.T. Wildlife Service, informed DIAND at this time that the Beverly cow migration had progressed beyond the southern boundary of the Thelon Game Sanctuary. Consequently, on 26 May, the Caribou Protection Map 1978 was amended by DIAND deleting that portion of the Area of Spring Migration south of the Sanctuary.

By 4 June the cow migration had ceased and an area of approximately 6,000 km^2 (2,350 mi^2) was occupied between Sand and Garry Lakes. From 4 to 9 June reconnaissance flights were made by the N.W.T. Wildlife Service to delineate the boundary of calving cows and their density strata. A census followed on 10 and 11 June and 51,000 caribou 1 year of age or older (hereafter referred to as "non-calves") were estimated to be present (D. Heard pers. comm.). A central high density stratum contained an estimated 15.4 non-calves/km^2 (39.3/mi^2) (Figure 3). A peripheral low density stratum contained an estimated 2.9 non-calves/km^2 (7.4/mi^2).

Table 3: Daily temperatures for the period 20 May to 15 June averaged over 10 years from 1968 to 1977, Baker Lake, N.W.T. (modified data, Atmospheric Environment Service, Toronto, Ontario).

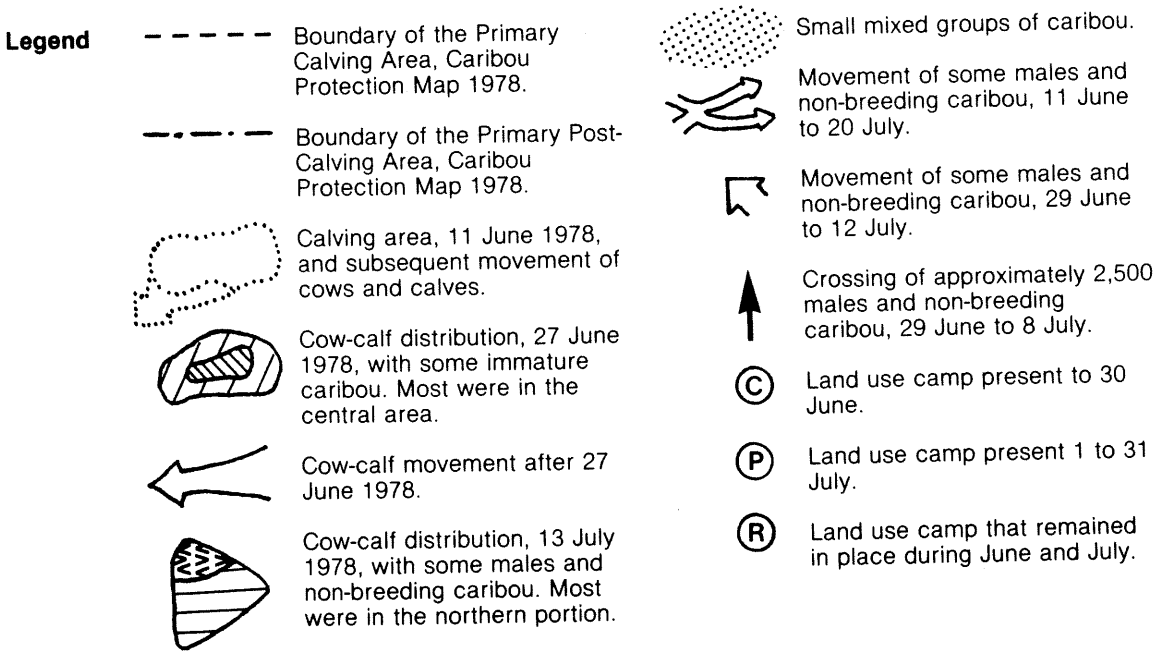
Date	Average Daily Max. Temp. °C (M)	Average Daily Min. Temp. °C (m)	Average Daily Mean Temp. °C [(M + m)/2)
May 20	-2.6	-8.6	-5.6
21	-1.7	-7.7	-4.8
22	-1.2	-6.8	-4.6
23	0.0	-5.8	-3.1
24	1.7	-4.1	-1.3
25	3.0	-3.7	-0.3
26	2.2	-5.1	-0.3
27	1.6	-3.4	-0.9
28	1.6	-3.9	-1.4
29	3.1	-2.9	-0.5
30	3.4	-2.9	-0.3
31	3.3	-2.8	-1.7
June 1	3.7	-3.1	-0.3
2	2.8	-3.0	0.0
3	4.0	-1.9	1.2
4	4.0	-1.5	1.3
5	5.3	-0.9	2.3
6	3.4	-2.1	0.7
7	4.1	-2.2	1.1
8	5.3	-1.8	1.8
9	6.7	-0.9	3.0
10	7.9	-0.4	3.9
11	6.2	-0.2	3.2
12	7.5	-0.1	3.8
13	8.1	0.7	4.6
14	8.8	0.8	4.8
15	9.7	2.3	5.4

Approximately half of the area used for calving was outside of the Primary Calving Area of the Caribou Protection Map 1978 and not within the Thelon Game Sanctuary (Figure 3). Many yearlings were scattered to the south-southwest at this time and other immature caribou had dispersed from the path of cow migration along both sides of the Thelon River from the Hanbury River to Beverly Lake. The majority of mature bulls occupied the region between Artillery Lake and the Thelon River as far north as Moraine Lake. Other groups of males and non-breeding caribou were scattered throughout the area of spring migration to the south. Some of these were moving northeast through the Kamilukuak and Nowleye Lakes area.

By 11 June small post-calving aggregations of cows and calves had started to form on the calving ground. Snow cover at this time was approximately 80%. By 15 June it had decreased to 50%. During this period the only major source of food was terricolous lichens (***Alectoria*** spp.) on exposed ridge tops and knolls. All depressions were still covered with deep snow. These conditions may have induced the immediate movement to the south-southwest that followed calving. By 27 June loose aggregations of cows and calves were northwest of Beverly Lake (Figure 4). Between 15 and 27 June the average rate of travel had been approximately 11 km/day (7 mi/day). Transects flown over the area of cow-calf distribution indicated a minimum of 49.3 non-calves/km^2 (126.3/mi^2) to occupy the central high density stratum while a minimum of 1.8 non-calves/km^2 (4.5/mi^2) occupied the peripheral area. The central stratum contained 91.4% of all caribou observed in the distribution. Density figures are minimal because the cow-calf groups had begun to mix with immature caribou on their back trail.

By 27 June, the cow-calf distribution was west of the Primary Calving Area of the Caribou Protection Map 1978 but within the Thelon Game Sanctuary. By 1 July it was west of the Primary Post-Calving Area. Some males and non-breeding caribou were scattered to the south of the cow-calf distribution while most were still dispersed between Artillery and Dubawnt Lakes (R. Decker pers. comm.). The movement of caribou through the Kamilukuak and Nowleye Lakes area observed in early June had increased considerably by 27 June. A rough estimate of 2,000 to 4,000 males and non-breeding animals were advancing north towards Wharton Lake between Dubawnt Lake and the Kunwak River.

Figure 4: Post-calving movements and distribution of Beverly caribou from 11 June to 13 July 1978.



110°
105°
100°
95°
65°
60°
THELON GAME SANCTUARY
Scattered MB&I
Beechey L
Tourgis L.
Pelly L.
Garry L.
Deep Rose L.
Aberdeen
Schultz L.
Beverly L.
Wharton L.
Marjorie L.
Princess Mary L.
Thirty Mile L.
Baker Lake
Whitehills L.
Dubawnt Lake
Tulemalu
Nutarawit L.
Yathkyed
Ferguson L.
Angikuni L.
Kaminak
Tyrrell Arm
Nowyak L.
North Henik L.
Padlei
South Henik L.
Ennadai
Ennadai
Hicks L.
Watterson L.
Hawk Hill L.
Tatinnai L.
Nueltin Lake
Edehon L.
Baralzon L.
Kasba Lake
Poorfish L.
Snowbird L.
Markham L.
Kamilukuak
Carey L.
Boyd L.
Firedrake L.
Barlow L.
Damant L.
Sid L.
Gravel Hill L.
Mary L.
Beaverhill L.
Nicholson L.
Garde L.
Campbell L.
Tyrrell L.
Eyeberry L.
Mary Frances L.
Clarke R.
Hanbury R.
Falls 213
Sifton L.
Colden L.
Clinton-Colden L.
Moraine L.
Aylmer L.
Muskox L.
Ghurka L.
Nose L.
Bullen R.
MacAlpine L.
Armark L.
Burnside
Mara R.
Western R.
Ellice
Back L.
Fletcher L.
Walmsley L.
Artillery L.
Parry Falls
Reliance
Whitefish L.
Tent L.
Eileen L.
Noman L.
Nonacho
Lynx L.
Howard L.
Gardenia L.
Brooks L.
Penylan L.
Porter L.
Hjalmar L.
Rennie L.
Manchester L.
Halliday L.
Doran L.
Coventry L.
Alcantara L.
Smalltree L.
Anaunethad L.
Labyrinth L.
Wholdaia L.
Ivanhoe L.
Abitau L.
Dunvegan L.
Flett L.
Atzinging L.
Selwyn L.
Scott L.
Dodge L.
Uranium City
Eldorado
Fond du Lac
Stony Rapids
Black Lake
N.W.T.
Sask.
Man.
700
Miles 50 0 50 100 150 200 250 300 350 400 Milles
Kilometres 50 0 100 200 300 400 500 600 Kilomètres

After the survey of 25 to 27 June I anticipated that the cows and calves would cross the Thelon River near Lookout Point. Two assistants, Samson Arnauyok and James Ukpagaq, were placed about 6 km (4 mi) downstream from the point to monitor crossing activity. However, the cows and calves did not continue to the southwest but turned and moved west-northwest towards the Baillie River. By this time mean daily temperatures had increased considerably (Table 2) and snow cover was reduced to 5 to 10%. Vegetation in the sedge meadows was growing and the Thelon River was free of ice although Beverly Lake was not. From 29 June to 8 July the field party at Lookout Point observed approximately 2,500 males and non-breeding caribou cross the Thelon River heading north within a 10 km (6 mi) stretch of river (Figure 4). At the same time caribou that had moved north past Wharton Lake were observed by the author on 8 July to be scattered throughout the area south of Ursus Islands, Beverly Lake and the west end of Aberdeen Lake. Most had presumably crossed the Dubawnt River at various locations and were drifting northwest. These males and non-breeding animals either crossed the Thelon River in widespread fashion from Lookout Point to Beverly Lake or turned southwest.

Systematic reconnaissance surveys were conducted on 25 June and 14 July in the Primary Post-Calving Area of the Caribou Protection Map 1978 north of the lower Thelon River. These and other flights south of the Thelon indicate that as of 14 July very few caribou remained in the Primary Post-Calving Area. Some small groups of stragglers are believed to have drifted east and were probably those observed by biologists monitoring caribou activity for Urangesellschaft Ltd. south of Schultz Lake and between Schultz and Deep Rose Lakes (R. Harland pers. comm.), and for Uranerz Ltd. at Amer Lake (R. Stemp pers. comm.). Personnel at the Shell Resources Ltd. camp on the northeastern corner of Dubawnt Lake reported that caribou ceased to move north past their camp by approximately 20 July (A. Grant pers. comm.).

From 27 June to 13 July the vanguard of caribou continued to travel at an average rate of approximately 11 km/day (7 mi/day). By 13 July the cows and calves were situated in a triangular area centered on the Baillie River. The majority of animals were concentrated in the area southeast of Beechey Lake along the Back River (Figure 4). Some males and non-breeding animals had joined the cows and calves and all aggregations were quite loose. An approximate visual estimate of 39,000 caribou, 1 year of age or older, occupied the northern part of the distribution. Approximately 11,000 of these were on the north side of the Back River. On this occasion it was necessary to fly at 2,000 feet AGL to avoid disturbing the large aggregations. Consequently, transects were not flown over the high density areas. The visual estimate of 39,000, however, yields an approximate density of 46 non-calves/km^2 (118/mi^2). The low density area to the south contained a matrix of scattered small groups with many dense aggregations of 100 to 5,000 non-calves dispersed throughout. Transects flown over this area produced an estimated matrix density of 4 non-calves/km^2 (10/mi^2). Behind the main herd mixed group of 1 to 70 stragglers (non-calves) were distributed between the Back and Thelon Rivers (Figure 4). Their density was low but was not quantified. In addition other caribou, especially mature bulls, were probably still scattered between Artillery and Dubawnt Lakes.

All evidence indicates that the cows and calves did not continue to the north after 13 July (G. Calef, pers. comm., R. Decker pers. comm., Alex Hall pers. comm.). Instead they presumably reversed direction and moved south-southeast. Most caribou crossed the Hanbury and Thelon Rivers from Lac du Bois on the Hanbury to a location 16 km (10 mi) upstream from Hornby Point on the Thelon (R. Decker pers. comm.). Alex Hall (pers. comm.) observed large numbers of caribou travelling south along the east side of the Hanbury River below Dickson Canyon on 21 July. This herd contained 25-30% bulls. By early August the herd had fragmented and mixed groups

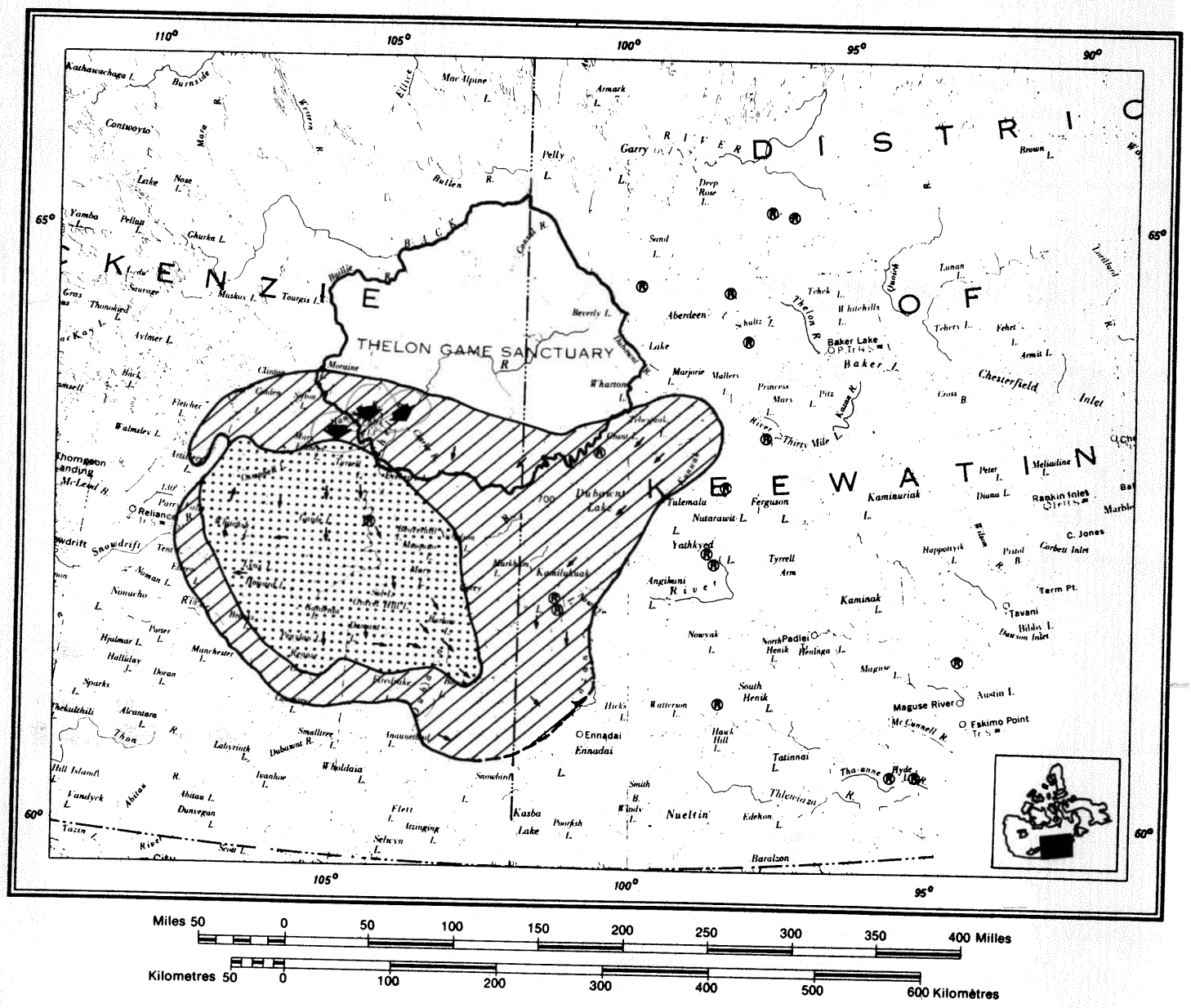


Figure 5: Movements and distribution of Beverly caribou during early August 1978.

Legend

- Crossing of Beverly caribou on the Hanbury and Thelon Rivers, 20 to 22 July 1978.
- Early August distribution of most Beverly caribou.
- Low density distribution of Beveraly caribou in early August.
- Observed caribou movements.
- (R) Land use camp present in early August.

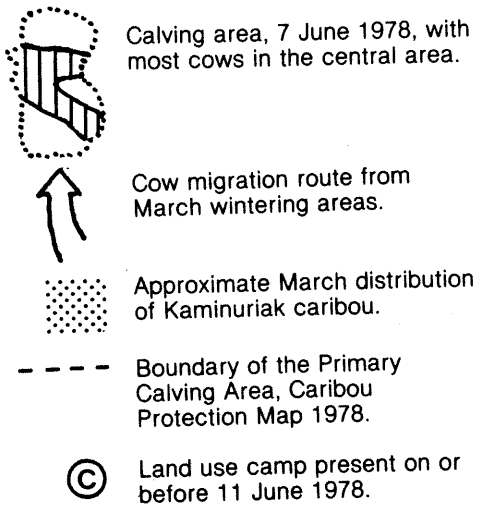
of caribou were widely dispersed from Artillery Lake in the west to Tulemalu Lake in the east (Figure 5). The majority of animals occupied a crude ellipse from Artillery Lake southeast to Boyd Lake and from the Clarke River southwest to Rennie Lake. All of these caribou were drifting in a southeasterly direction and by late August had extended their distribution to Nueltin Lake (R. Decker pers. comm.). By 13 August small groups of males and non-breeding caribou were observed to be drifting southwest in the area of Kamilukuak and Nowleye Lakes. These were probably stragglers that had not continued to follow the June movement up the east side of Dubawnt Lake. By late August it is probable that the low density distribution of caribou in this northeastern quarter had receded considerably.

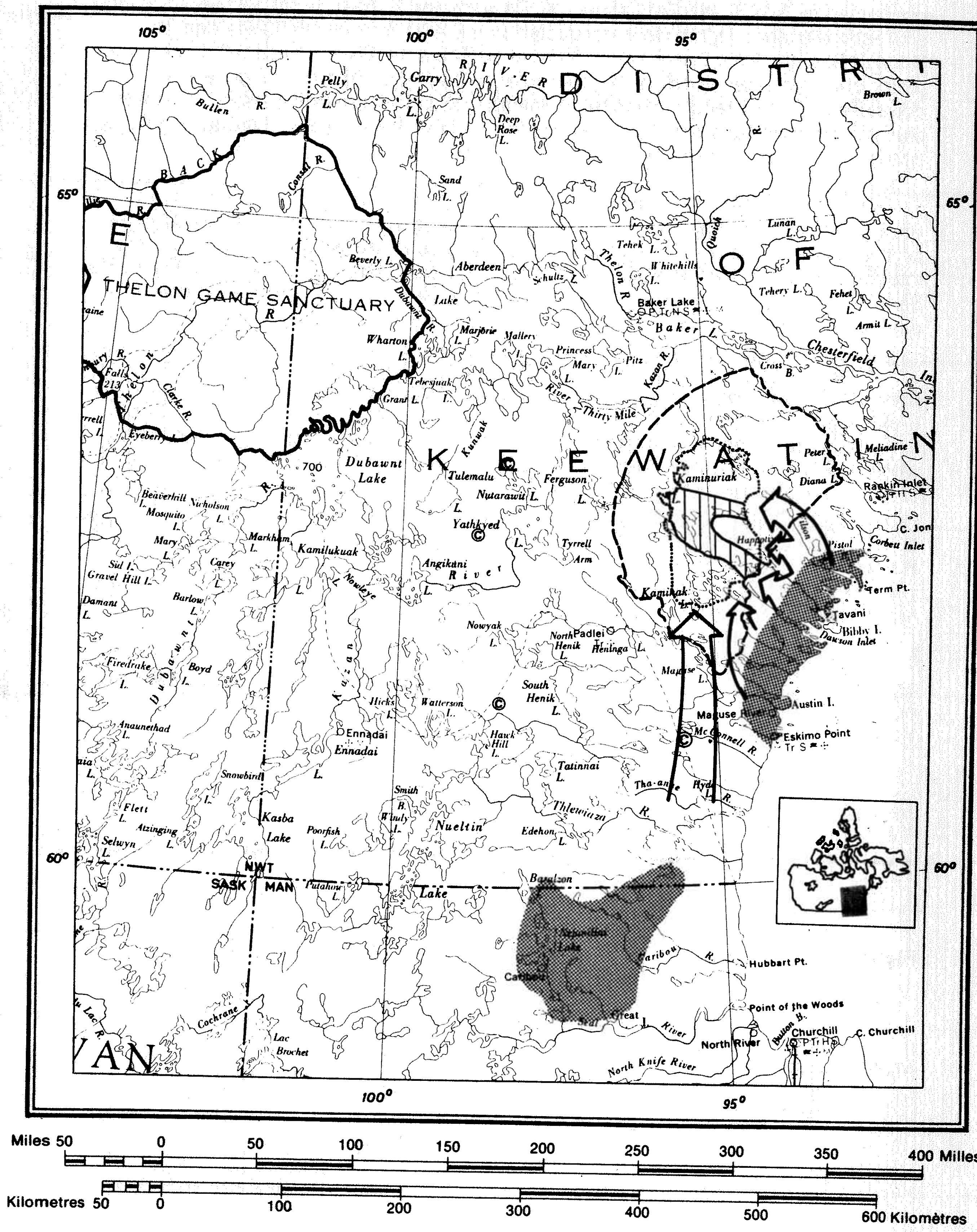
4.2 Movements of the Kaminuriak Caribou Herd 1978

Figure 6 shows the spring migration routes of Kaminuriak cows to the area used for calving in 1978. Aerial monitoring of their movements by the N.W.T. Wildlife Service did not commence until 19 May. The Manitoba Department of Renewable Resources and Transportation Services (RRTS) conducted several survey flights in northern Manitoba from 30 November 1977 to April 1978. The approximate February distribution of Kaminuriak caribou in Manitoba was north of the Seal River from Nejanilini Lake east to Great Island and the Caribou River (S. Kearney pers. comm.) (Figure 6). The caribou that moved into this area had exceeded 6,000 in number on 1 December 1977. No caribou were observed between Nejanilini Lake and Missaw Lake in Saskatchewan during the entire winter. By 13 March the caribou still occupied the area around Nejanilini Lake but appeared to be moving up the east side of Baralzon Lake. Survey flights in April indicated that the caribou had moved north out of the province (S. Kearney pers. comm.).

On the tundra large numbers of caribou (in excess of 10,000) wintered along the Hudson Bay coast between Eskimo Point and Whale Cove (E. Fast pers. comm.). The Manitoba RRTS reconnaissance flights of 30 November and 1 December 1977, indicated that the caribou distribution between Eskimo Point and the Manitoba border was probably continuous (S. Kearney pers. comm.). However, by the second week of March this distribution may have been broken in the area of the Tha-anne River (E. Fast pers. comm.).

Figure 6: **Spring migration routes of Kaminuriak cows for 1978 and the calving area on 7 June 1978.**

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DISTRICT OF KEEWATIN
THELON GAME SANCTUARY
Bullen R.
Pelly L.
Garry L.
Deep Rose L.
Back R.
Consul R.
Sand L.
Beverly L.
Aberdeen Lake
Schultz L.
Thelon R.
Whitehills L.
Tehek L.
Quoich R.
Lunan L.
Baker Lake
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Tehery L.
Fehet L.
Armit L.
Chesterfield Inlet
Cross B.
Dubawnt R.
Wharton L.
Marjorie L.
Mallery L.
Princess Mary L.
Pitz L.
Kazan R.
Tebesjuak L.
Grant L.
Thirty Mile L.
Clarke R.
Eyeberry L.
Falls 213
Kunwak
Dubawnt Lake
700
Tulemalu L.
Nutarawit L.
Ferguson L.
Kaminuriak
Peter L.
Diana L.
Meliadine L.
Rankin Inlet
C. Jones
Corbett Inlet
Pistol
Beaverhill L.
Nicholson L.
Mosquito L.
Mary L.
Markham L.
Kamilukuak L.
Yathkyed
Angikuni L.
River
Tyrrell Arm
Sid L.
Gravel Hill L.
Carey L.
Barlow L.
Damant L.
Nowleye
Kamilak L.
Term Pt.
Tavani
Bibby I.
Dawson Inlet
Nowyak L.
North Henik L.
Padlei
Heninga L.
Firedrake L.
Boyd L.
Kazan
Hicks L.
Watterson L.
South Henik L.
Maguse L.
Maguse River
Austin I.
Eskimo Point
McConnell R.
Anaunethad L.
Ennadai
Ennadai L.
Hawk Hill L.
Snowbird L.
Tatinnai L.
Tha-anne R.
Hyde L.
Flett L.
Atzinging L.
Selwyn L.
Kasba Lake
Poorfish L.
Smith B.
Windy L.
Nueltin
Edehon L.
Thlewiaza R.
NWT
SASK
MAN
Putahow L.
Lake
Baralzon
Nejanilini Lake
Caribou
Caribou R.
Hubbart Pt.
Point of the Woods
Button B.
Great Seal River
North River
Churchill
C. Churchill
Cochrane R.
Lac Brochet
North Knife River
Miles 50 0 50 100 150 200 250 300 350 400 Milles
Kilometres 50 0 100 200 300 400 500 600 Kilomètres

During May and June most monitoring flights on the Kaminuriak population were conducted by N.W.T. Wildlife Officers K. Davidge and E. Fast. From 19 May to 5 June six reconnaissance flights were conducted in the area from Henik Lakes east to Hudson Bay and from Baker Lake south to the Tha-anne River. These delineated the major cow migration routes to the calving area (Figure 6). The routes generally comprised a widespread movement to Kaminuriak Lake from the Hudson Bay coast plus a movement from the south through the Maguse Lake area (E. Davidge pers. comm., E. Fast pers. comm.).

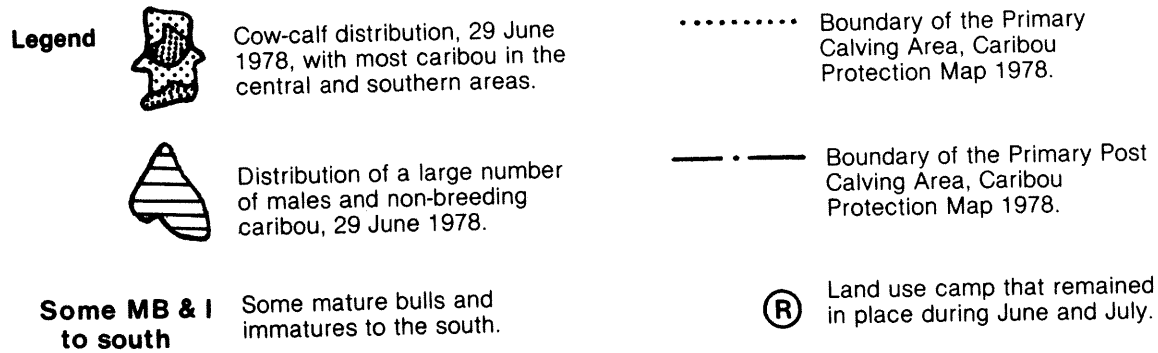
On 26 May DIAND amended the Caribou Protection Map 1978 by deleting the Area of Spring Migration east of 96° west longitude and south of the IDS Study Area on the advice of the N.W.T. Wildlife Service. By 3 June the pregnant cows were well into the Primary Calving Area of the Caribou Protection Map 1978. The N.W.T. Wildlife Service subsequently informed DIAND that the remaining Area of Spring Migration east and south of the Primary Calving Area could also be released.

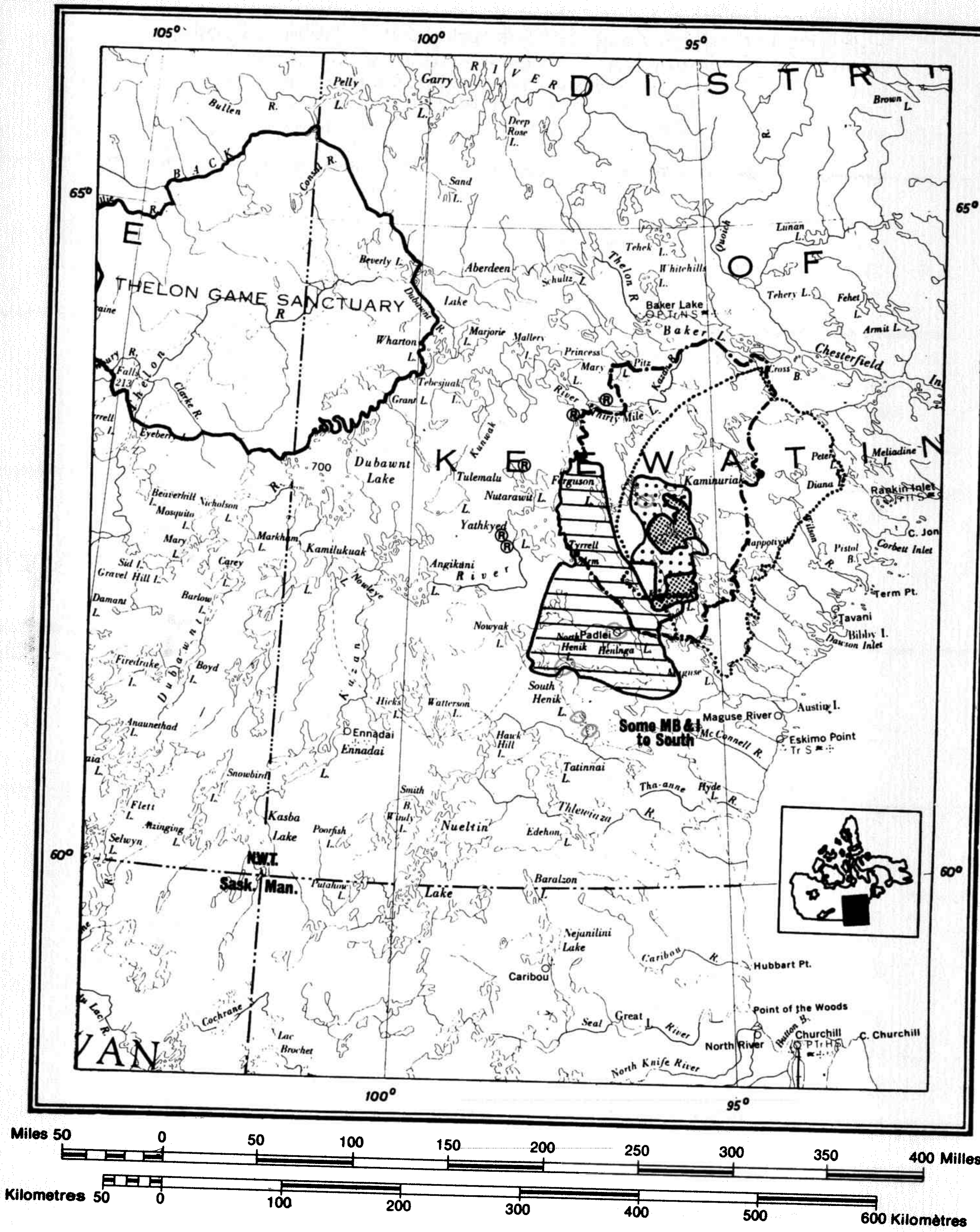
Monitoring flights from 3 to 7 June delineated the area used for calving by Kaminuriak cows (Figure 6). This area comprised approximately 8,200 km^2 (3,200 mi^2). It extended from the north end of Kaminuriak Lake south to Kaminak Lake and from Happotiyik Lake west to Kaminuriak Lake. The area of calving was therefore located within the Primary Calving Area of the Caribou Protection Map 1978. Seventy percent of all caribou present in the area of calving occupied a central high density stratum extending southeast to Quartzite Lake (E. Fast pers. comm.). Based upon the 1977 census results of 16,000 caribou over 1 year of age present on the calving ground (D. Heard pers. comm.) the estimated density in the central stratum was 4.1 non-calves/km^2 (10.5/mi^2). The peripheral low density stratum contained approximately 0.9 non-calves/km^2 (2.3/mi^2).

Snow cover in the area of calving exceeded 90% during the period 3 to 7 June and was reduced to 35 to 60% by 20 June. Kaminuriak cows did not migrate to the northern section of their traditional calving area, as did Beverly cows, despite good travelling conditions.

After calving, the cows and calves did not move north or northwest as they had been observed to do in previous years (Fischer *et al.* 1977, Miller and Broughton 1974, Parker 1972), possibly due to the late thaw. Instead, by 28 June the cows and calves had shifted their distribution to the southwest. Post-calving aggregations were

Figure 7: Post-calving distribution of Kaminuriak caribou on 29 June 1978.

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DISTRICT OF KEEWATIN
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Beverly L.
Aberdeen Lake
Schultz L.
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Tehek L.
Whitehills L.
Quoich R.
Lunan L.
Tehery L.
Fehet L.
Armit L.
Baker Lake
Baker L.
Chesterfield Inlet
Cross B.
Wharton L.
Marjorie L.
Mallery L.
Princess Mary L.
Pitz L.
Kazan R.
Thirty Mile L.
Tebesjuak L.
Grant L.
Clarke R.
Eyeberry L.
Falls 213
Dubawnt Lake
700
Kunwak
Tulemalu L.
Nutarawit L.
Ferguson L.
Kaminuriak
Peter L.
Meliadine L.
Diana L.
Rankin Inlet
Yathkyed L.
Tyrrell
Angikuni L.
Kamilukuak L.
Markham L.
Beaverhill L.
Nicholson L.
Mosquito L.
Mary L.
Carey L.
Sid L.
Gravel Hill L.
Barlow L.
Damant L.
Nowleye L.
Firedrake L.
Boyd L.
Dubawnt R.
Nowyak L.
North Henik
Padlei
Heninga L.
Maguse L.
Pistol B.
Wilson R.
Corbett Inlet
Term Pt.
Tavani
Bibby I.
Dawson Inlet
South Henik L.
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Snowbird L.
Hawk Hill L.
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Maguse River
McConnell R.
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Hyde L.
Thlewiaza R.
Flett L.
Kasba Lake
Poorfish L.
Smith B.
Windy L.
Nueltin Lake
Edehon L.
Selwyn L.
N.W.T.
Sask.
Man.
Baralzon L.
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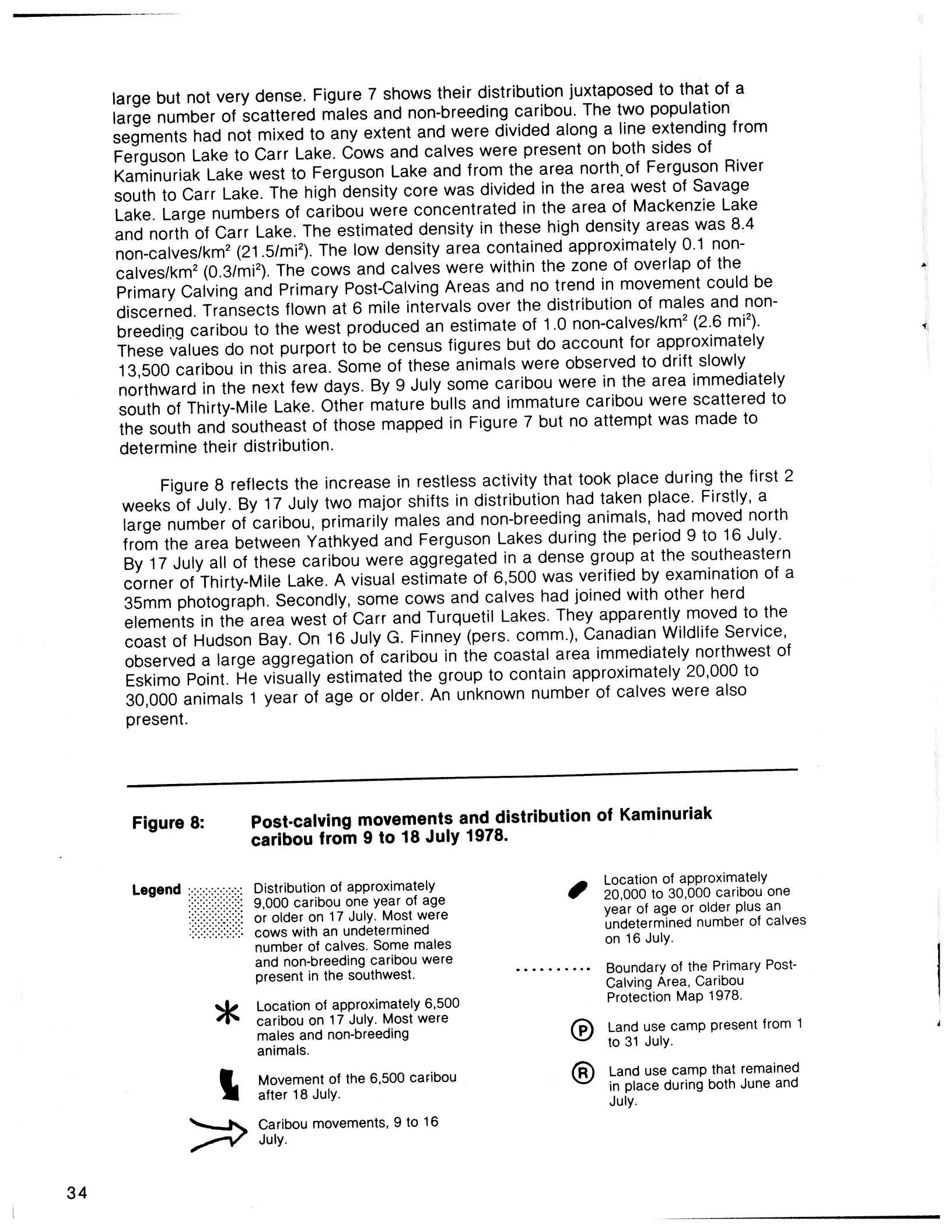
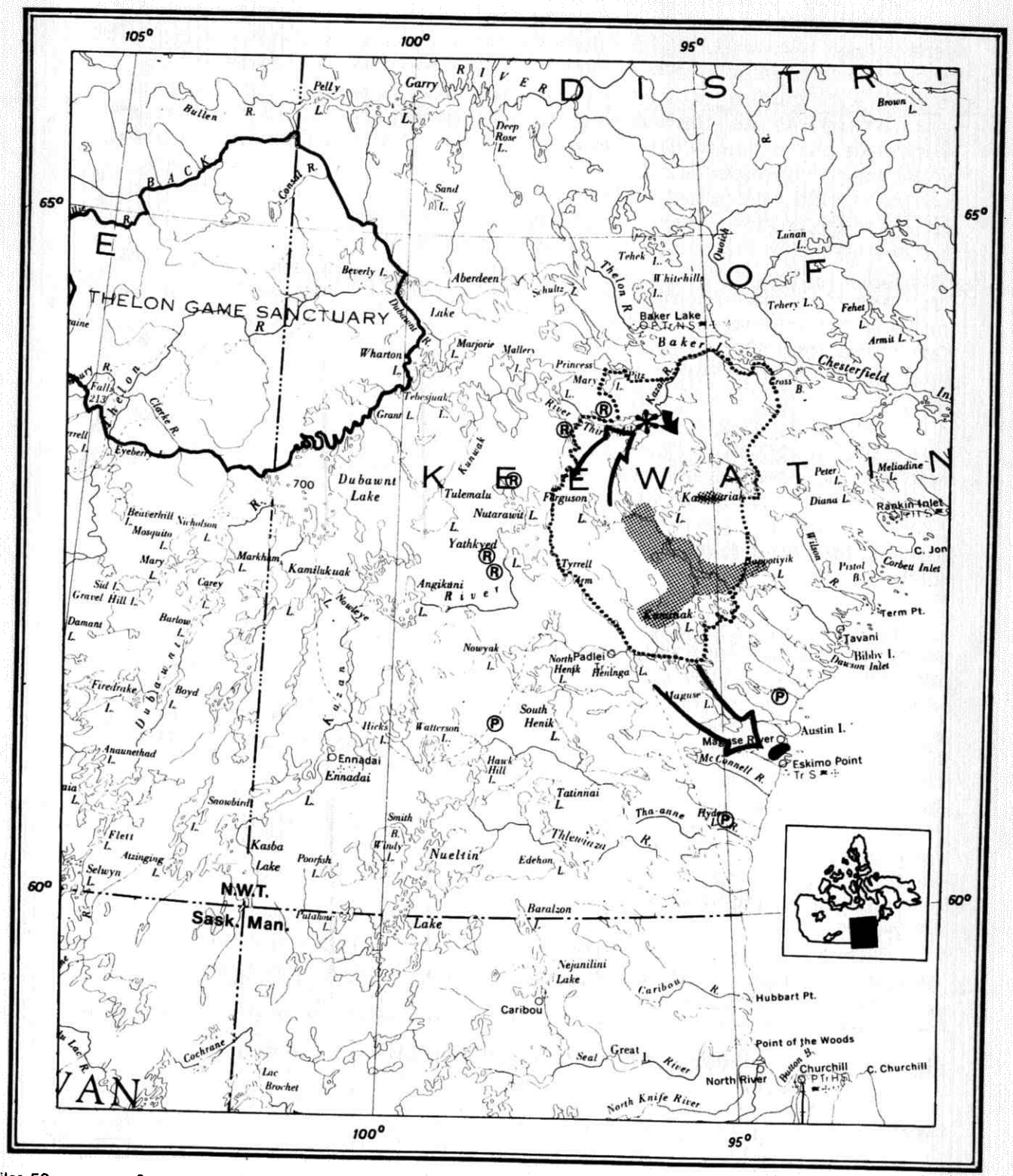
Point of the Woods
Button B.
Churchill
C. Churchill
North River
North Knife River
Miles 50 0 50 100 150 200 250 300 350 400 Milles
Kilometres 50 0 100 200 300 400 500 600 Kilomètres

large but not very dense. Figure 7 shows their distribution juxtaposed to that of a large number of scattered males and non-breeding caribou. The two population segments had not mixed to any extent and were divided along a line extending from Ferguson Lake to Carr Lake. Cows and calves were present on both sides of Kaminuriak Lake west to Ferguson Lake and from the area north of Ferguson River south to Carr Lake. The high density core was divided in the area west of Savage Lake. Large numbers of caribou were concentrated in the area of Mackenzie Lake and north of Carr Lake. The estimated density in these high density areas was 8.4 non-calves/km^2 (21.5/mi^2). The low density area contained approximately 0.1 non-calves/km^2 (0.3/mi^2). The cows and calves were within the zone of overlap of the Primary Calving and Primary Post-Calving Areas and no trend in movement could be discerned. Transects flown at 6 mile intervals over the distribution of males and non-breeding caribou to the west produced an estimate of 1.0 non-calves/km^2 (2.6 mi^2). These values do not purport to be census figures but do account for approximately 13,500 caribou in this area. Some of these animals were observed to drift slowly northward in the next few days. By 9 July some caribou were in the area immediately south of Thirty-Mile Lake. Other mature bulls and immature caribou were scattered to the south and southeast of those mapped in Figure 7 but no attempt was made to determine their distribution.

Figure 8 reflects the increase in restless activity that took place during the first 2 weeks of July. By 17 July two major shifts in distribution had taken place. Firstly, a large number of caribou, primarily males and non-breeding animals, had moved north from the area between Yathkyed and Ferguson Lakes during the period 9 to 16 July. By 17 July all of these caribou were aggregated in a dense group at the southeastern corner of Thirty-Mile Lake. A visual estimate of 6,500 was verified by examination of a 35mm photograph. Secondly, some cows and calves had joined with other herd elements in the area west of Carr and Turquetil Lakes. They apparently moved to the coast of Hudson Bay. On 16 July G. Finney (pers. comm.), Canadian Wildlife Service, observed a large aggregation of caribou in the coastal area immediately northwest of Eskimo Point. He visually estimated the group to contain approximately 20,000 to 30,000 animals 1 year of age or older. An unknown number of calves were also present.

Figure 8: Post-calving movements and distribution of Kaminuriak caribou from 9 to 18 July 1978.

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N.W.T.
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Back R.
Dubawnt R.
Kazan R.
Angikuni River
Great Seal River
North Knife River
Miles 50 0 50 100 150 200 250 300 350 400 Miles
Kilometres 50 0 100 200 300 400 500 600 Kilometres

On 17 July I observed approximately 7,500 cows, with their calves, to still occupy the area between Kaminuriak and Kaminak Lakes (Figure 8). These cows were at least 144 km (90 mi) from the aggregation sighted near Eskimo Point the day before and were probably different animals. A few small groups included in this estimate were situated just east of Kaminuriak Lake. The caribou distribution was very clumped with post-calving aggregations containing up to 3,000 animals over 1 year of age plus undetermined numbers of calves.[1] In addition, three aggregations containing approximately 1,500 caribou (excluding calves) of mixed sex and age categories were located just northwest of Carr Lake. I was not able to continue aerial surveys to the southeast on 17 July due to bad weather. However, the data indicate that at least half of the cow population still remained within the Primary Post-Calving Area of the Caribou Protection Map 1978. The other half had probably moved to Eskimo Point with large numbers of males and non-breeding caribou. Reconnaissance transects had been flown over the entire Primary Post-Calving Area and west of the Kazan River from 15 to 17 July. These revealed no substantial numbers of caribou in the areas northeast of Parker Lake and west or southwest of Mackenzie Lake.

In the week following 17 July the males and non-breeding caribou at Thirty-Mile Lake travelled northeast towards Bisset Lake. They apparently turned west in the vicinity of the latter and followed the eastern shore of Kazan River upstream to Kazan Falls. Fresh trails in this area indicated that they continued upstream for another 6 km (4 mi) and then travelled in a southeasterly direction. All available evidence indicates that these caribou did not cross the lower Kazan River in any substantial numbers.

From 23 July to 1 August two pair of Inuit assistants monitored caribou activity on the lower Kazan River. Basil Kayaveenik and David Peryouar were located approximately 8 km (5 mi) upstream from Kazan Falls on the eastern side of the river while Samson Arnauyok and Jacob Atkitok were camped an additional 5.5 km (3.4 mi) further upstream on the southern side. They monitored activity along a 16 km (10 mi) stretch of river. During this period they observed a total of approximately 1,250 caribou using the area on the southern and eastern side of the river; some of which may have been seen more than once. No caribou were observed crossing and only 28 cows with 11 calves were seen. The majority of activity took place on 23 July when two different groups of 600 and 250 caribou were sighted. These two groups were travelling east. Then on 1 August approximately 350 males and non-breeding caribou were sighted travelling north.

Between 17 July and early August Kaminuriak cows and calves continued to mix with other elements of the herd. Aggregations fragmented and dispersed over a large area. The caribou near Eskimo Point apparently started to disperse immediately after

Figure 9: Distribution of Kaminuriak caribou from 2 to 15 August 1978.

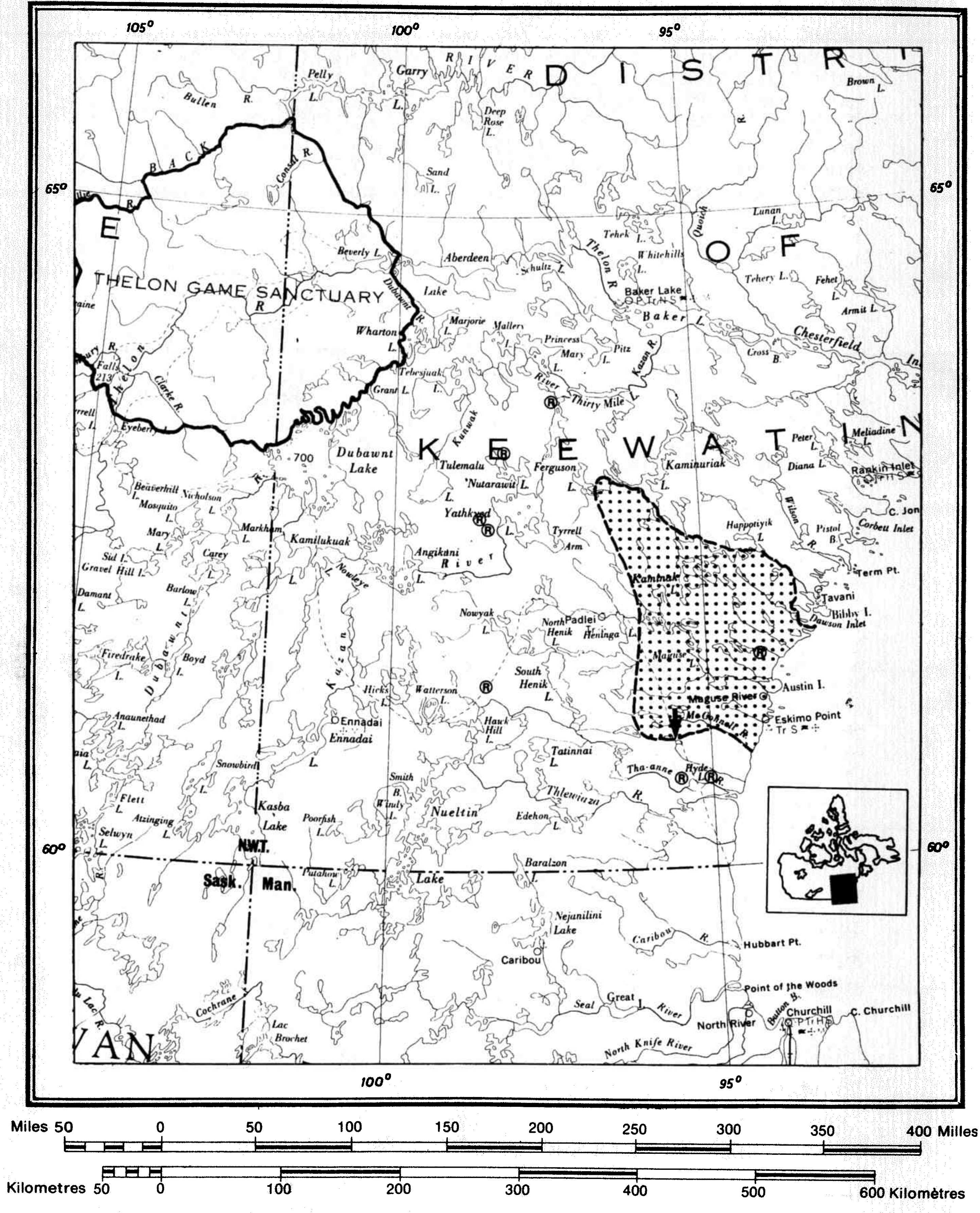
Legend

Distribution of Kaminuriak caribou, 2 to 15 August.

Movement of approximately 7,000 to 8,000 caribou across the McConnel River on 15 August.

Ⓡ Land use camp present 2 to 15 August.

[1] On 16 July, in clear calm weather, it was necessary to fly at 600 m (2,000 feet) AGL to avoid causing caribou in some of these aggregations to canter.



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DISTRICT OF KEEWATIN
THELON GAME SANCTUARY
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Tehek L.
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Seal R.
Great Island
Button B.
Churchill
C. Churchill
North River
Lac Brochet
North Knife River
Miles 50 0 50 100 150 200 250 300 350 400 Milles
Kilometres 50 0 100 200 300 400 500 600 Kilomètres

16 July. By 25 July the largest group in that vicinity comprised approximately 5,000 to 6,000 (J. Umpherson pers. comm.). These were situated along the northern side of the mouth of Maguse River. Reconnaissance transects were flown from 2 to 5 August and on 9 and 15 August, at 16 and 19 km (10 and 12 mi) intervals, from Baker Lake south to the Tha-anne River and from Heninga and Ferguson Lakes east to the coast. The Manitoba Department of Renewable Resources and Transportation Services also flew three flights on 13 and 14 August from Ennadai Lake east to the coast and as far north as Hicks and Ray Lakes (S. Kearney pers. comm.). Flights were not conducted in the area between Henik Lakes and Yathkyed Lake but personnel at the Henik Lake Lodge were later interviewed. They reported that few caribou were sighted in their vicinity during early August (R. Decker pers. comm.). The following pattern of caribou distribution therefore emerges.

An approximate limit of distribution in early August extended from the Hudson Bay coast inland along the Ferguson River to Ferguson Lake, thence south to Ray Lake and east to the coast (Figure 9). No evidence of substantial numbers of caribou was observed outside of this area. Caribou were scattered in clumped distribution with major concentrations known to exist in the region of Mackenzie Lake (south of Kaminuriak Lake), Carr Lake (west of Kaminak Lake), Maguse River and Ray Lake. No evidence of overt migrational activity was observed until 15 August when approximately 7,000 to 8,000 caribou were sighted crossing the McConnell River 34 km (21 mi) due east of Ray Lake.[1] This herd contained various sex and age classes and was moving south. Three days later they passed by a Geological Survey of Canada camp just northwest of Hyde Lake (J. Pin pers. comm.).

4.3 Water Crossings in 1978

4.3.1 Beverly Population.

All lakes and rivers were still ice-bound during spring migration. The route taken by Beverly cows crossed the frozen Thelon River at the east end of Ursus Islands (Figure 3). This was just west of the major water crossing west of Beverly Lake designated by the Caribou Protection Map 1978. The migration of other herd elements occurred on a broad front and ice-crossings were widely dispersed (R. Decker pers. comm.).

During the summer four major water crossings designated by the Caribou Protection Map 1978 were probably used by substantial numbers of Beverly caribou (Figure 1). These were:

1) Lookout Point on the Thelon River, late June and early July;
2) the Thelon River west of Beverly Lake, late June and early July;
3) the Hanbury River at Lac du Bois, 20 to 22 July;
4) the junction of the Thelon and Hanbury Rivers, 20 to 22 July.

In addition to these, substantial crossing activity in the following areas was observed and/or deduced from recorded movements (Figures 4 and 5):

1) undetermined locations along the Baillie River, early July;
2) the Back River east of Beechey Lake, early to mid-July;
3) the lower Dubawnt River between Dubawnt and Beverly Lakes, June and early July;

[1] On this date, in clear calm weather, it was necessary to fly at 600 m (2,000 feet) AGL to avoid causing caribou in some of these aggregations to canter.

4) the Thelon River between Lookout Point and Beverly Lake, late June to mid-July;
5) the Hanbury and Thelon Rivers between Lac du Bois and a location 16 km (10 mi) upstream from Hornby Point on the Thelon River, 20 to 22 July.

4.3.2 Kaminuriak Population.

Evidence of substantial crossing activity by Kaminuriak caribou was acquired for only one major crossing site designated by the Caribou Protection Map 1978 during the monitoring program. It is situated on the Ferguson River between Kaminuriak Lake and the first unnamed lake to the west (Figure 1). Caribou were often moving across the Ferguson River in this general area through late June and July. Ground surveillance was not conducted and it is not known if crossings were concentrated or dispersed. Other designated crossings near Padlei and at the south end of Kaminuriak Lake may have been used but insufficient evidence is available to comment on them.

All evidence acquired on caribou activity along the Kazan River, from Angikuni Lake to Baker Lake, indicates that no substantial numbers of caribou had crossed by the end of field work on 23 August. A few isolated groups of 2 to 30 Kaminuriak caribou were observed on the west side of the Kazan River during the summer. Most of these were immediately west of Forde Lake and north of Thirty-Mile Lake. They had presumably crossed at widely scattered locations.

Two crossings of major rivers occurred at locations other than the major crossing sites designated by the Caribou Protection Map 1978. Firstly, numerous caribou crossed the Maguse River during late July and early August between Maguse Lake and the coast. Secondly, I observed approximately 7,000 to 8,000 caribou crossing the McConnell River heading south on 15 August (Figure 9) about 30 km (20 mi) east of Ray Lake. All crossing activity took place within a 13 km (8 mi) stretch of river.

4.3.3 The Lower Kazan River Crossings.

Four major crossings sights were designated by the Caribou Protection Map 1978 on the lower Kazan River between Thirty-Mile Lake and Baker Lake. A special study of these was conducted on 9 and 17 August after Inuit monitors had observed caribou activity in the area from 23 July to 1 August. The pattern of old caribou trails was easily observed from a helicopter and was plotted on 1:250,000 scale topographical maps. Vegetation cover appeared to be relatively uniform so that no major bias affecting trail visibility was apparent.

Figure 10 shows the pattern of trails on the lower Kazan River. Orientation of the trails and their convergence at certain locations indicate past crossing activity to be concentrated in 13 places. Inukshuks are located at three of these places and stone rings are located at one. A fourth Inukshuk is located further downstream but trail systems do not clearly indicate major crossing activity to have occurred at this point. Crossings were located at narrows and peninsulas, or across islands. With the exception of Kazan Falls, the riverbanks have a gentle slope and rock or gravel shores. Kazan Falls is not precipitous but is a narrow gorge 1 km (½ mi) long with extremely fast and turbulent water. No evidence of a crossing at this gorge was observed as was indicated on the Caribou Protection Map 1978.

There is very little information in the scientific literature concerning use of the Kazan crossing. Banfield (1954) refers to the importance of the water crossing as a spearing point for Inuit hunters. Hugh Ungungai (pers. comm.), Assistant Wildlife Officer, Baker Lake, recorded evidence of a large herd crossing in mid-July 1964. He observed a large herd east of the river mouth on 16 July 1964 and later saw large amounts of hair and tracks on both sides of the Kazan crossing. Caribou were not observed to cross the river in large numbers in the late 1960's (Parker 1972) and in 1970 (Miller and Broughton 1974) but continued to use the area adjacent to the eastern shore of the river and south of Baker Lake during the post-calving period.

Crossing activity in the past has probably been associated with post-calving movements. If a decrease in crossing activity has occurred since the mid-1960's it may be related to the decline of the Kaminuriak herd (Heard in prep.). Any future population growth, therefore, would presumably result in increased crossing activity. The physical impediments of Thirty-Mile Lake and Baker Lake do not allow for easy movement of caribou around disturbances should the latter preclude use of the traditional crossings. A portion of their range might then be cut off.

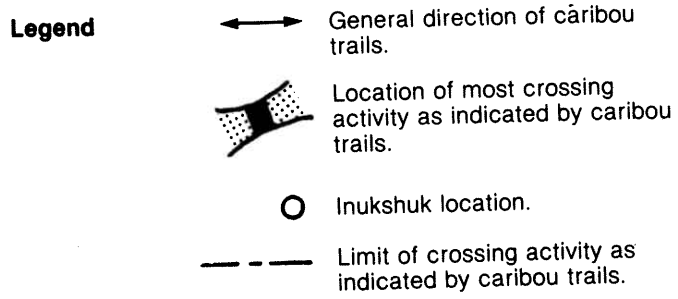
4.4 Caribou and Land Use Activity Interactions

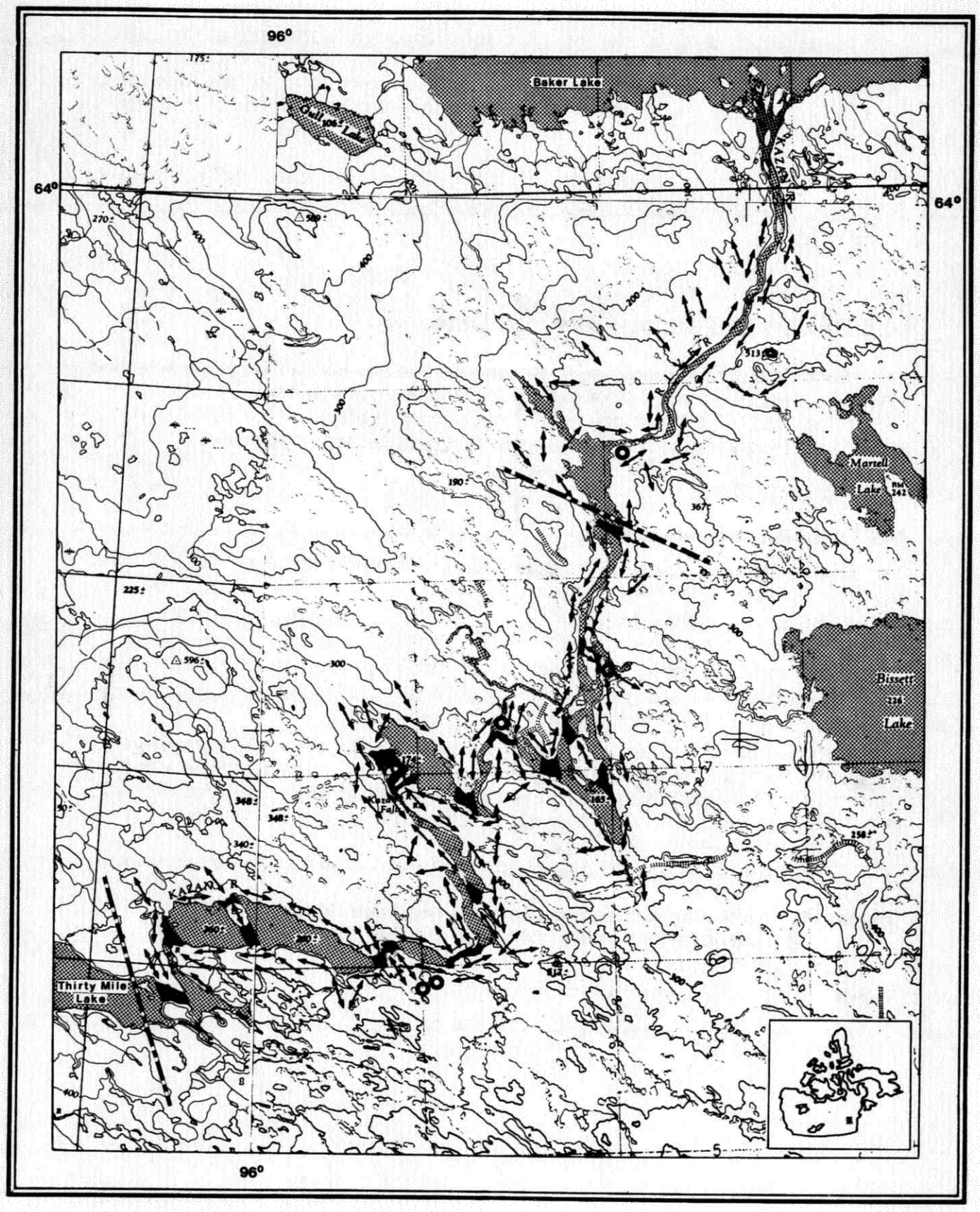
Thirty eight caribou and land use activity interactions were documented for the Beverly and Kaminuriak caribou herds during the spring and summer of 1978. Of these, 20 involved caribou and aircraft while 18 involved caribou and ground activities. Monitoring personnel were present at one of these interactions.

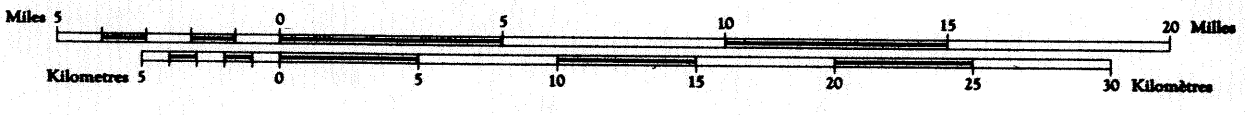
No interactions involving large numbers of cows with calves were documented during the period 15 May to 15 June. This was mainly due to the exclusion of most land use activities from caribou areas by the 1978 controls. Several dozen caribou of mixed sex and age classes were reported near a camp and diamond drill at Ray Lake during late May. Camp personnel reported that no adverse reactions took place.

Spring migration of large numbers of males and non-breeding caribou did occur near mineral exploration camps at Dubawnt Lake from 23 June to 19 July and at Nowleye Lake from 24 May to 5 June. Camp personnel reported these animals to pass by in groups of 6 to 30 about ¼ mile from camp and as close as 200 to 300 yards. Camp activity apparently did not deter migration.

Figure 10: Caribou trails and crossing sites in the lower Kazan River area.




96°
64°
Baker Lake
Duck Lake
KAZAN R.
Martell Lake
Bissett Lake
Thirty Mile Lake
Kazan Falls
64°
96°


Miles 5 0 5 10 15 20 Miles
Kilometres 5 0 5 10 15 20 25 30 Kilomètres

Large groups of mixed sex and age classes occurred near camps at Beaverhill Lake from 23 August to 18 September and at Maguse River from 15 July to 15 August. Groups of 10 to 2,000 were reported as often being ¼ to ½ mile from camp and as close as 200 feet. Camp presence apparently did not deter use of the areas by caribou.

The 20 caribou and aircraft interactions usually involved small numbers of males and non-breeding animals. No incidents of serious aircraft disturbance were documented.

4.5 Review of Past and Present Data.

Records of tundra range use by Kaminuriak and Beverly caribou in the scientific literature were reviewed in order to evaluate land use controls and the Caribou Protection Map 1978. These data are incorporated with results of the 1978 Caribou Monitoring Program to provide a current summary of available information.

4.5.1 Beverly Herd.

4.5.1.1 Spring Migration Routes.

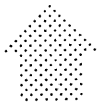
Spring migration routes of the Beverly caribou herd are documented for 9 years over the period 1948 to 1978 inclusive (Figure 11):

1948	Banfield	(1954)	1960	McEwan	(1960)
1949	Banfield	(1954)	1962	McEwan	(1962)
1957	Kelsall	(1960)	1967	Thomas	(1969)
1958	Kelsall	(1960)	1978	this report.	
1959	McEwan	(1959)			

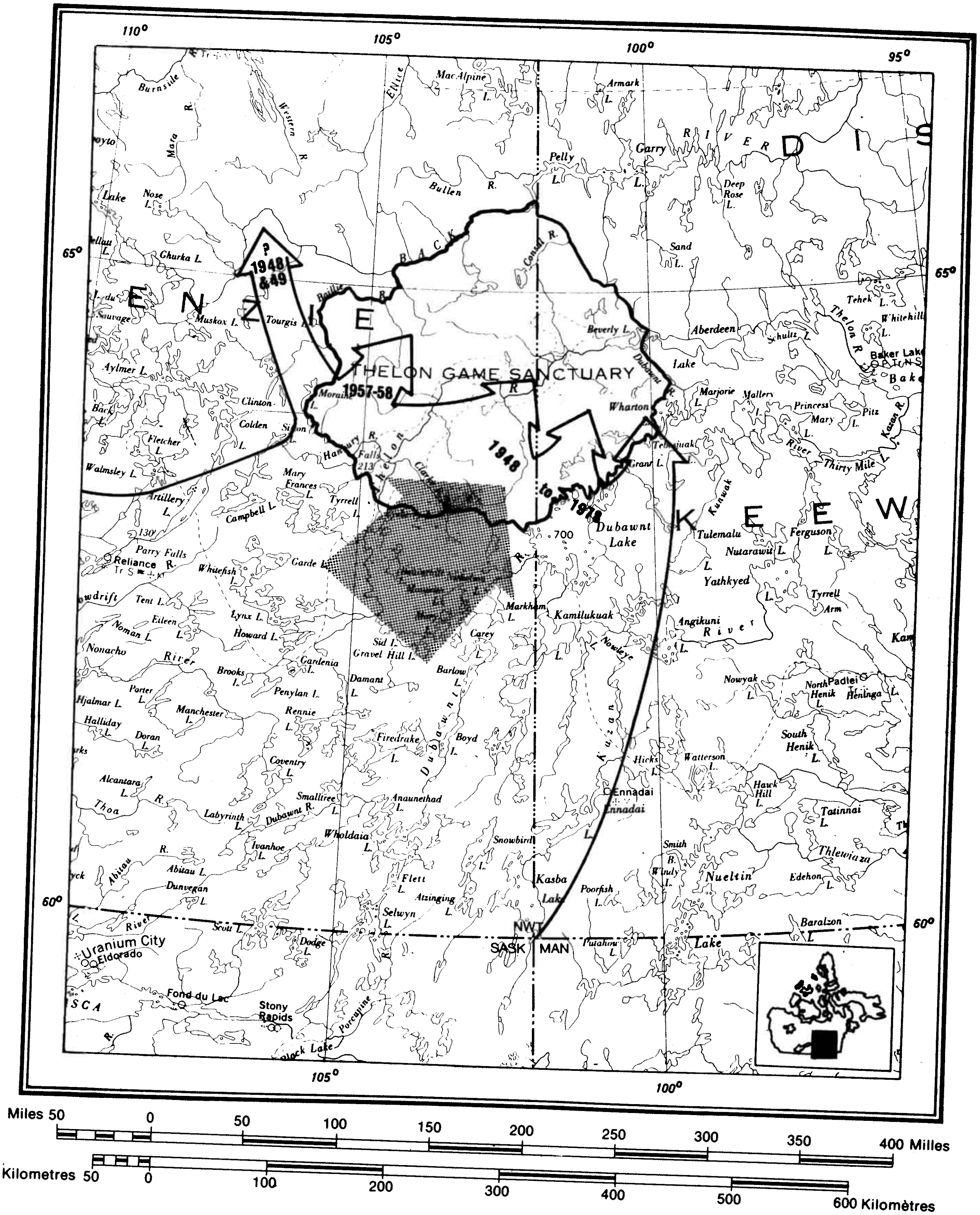
The documented routes vary and Figure 11 shows the total area used in these years. Generally the routes lie within a wedge from Artillery Lake to Ennadai Lake with the apex pointing towards Beverly Lake. Except for Banfield's (1954) report for 1948 and 1949 the major migration movement has usually traversed the area between Mosquito and Beaverhill Lakes.

Figure 11: Total area of spring migration documented for all Beverly caribou for 9 years from 1948 to 1978.

Legend



Area traversed by most migrations.


THELON GAME SANCTUARY
1948 &49
1957-58
1948 to 1978
Uranium City
Eldorado
Fond du Lac
Stony Rapids
Reliance
Dubawnt Lake
Kasba Lake
Ennadai
Baker Lake
NWT
SASK
MAN
Miles 50 0 50 100 150 200 250 300 350 400 Milles
Kilometres 50 0 100 200 300 400 500 600 Kilomètres

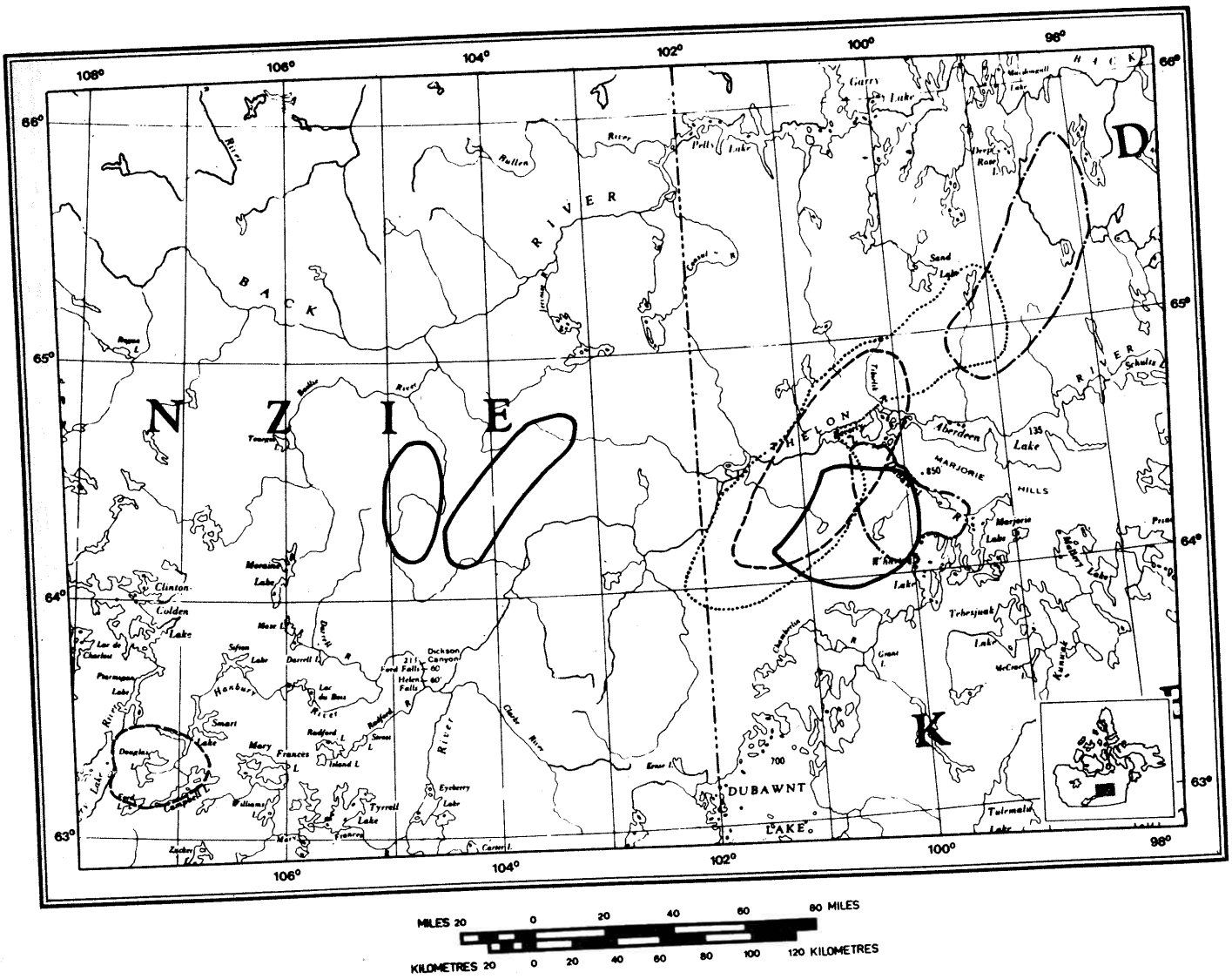


Figure 12: **The calving areas of Beverly caribou from 1957 to 1960.**

Legend

——— 1957

– – – – – – 1958

..... 1959

—·—·— 1960

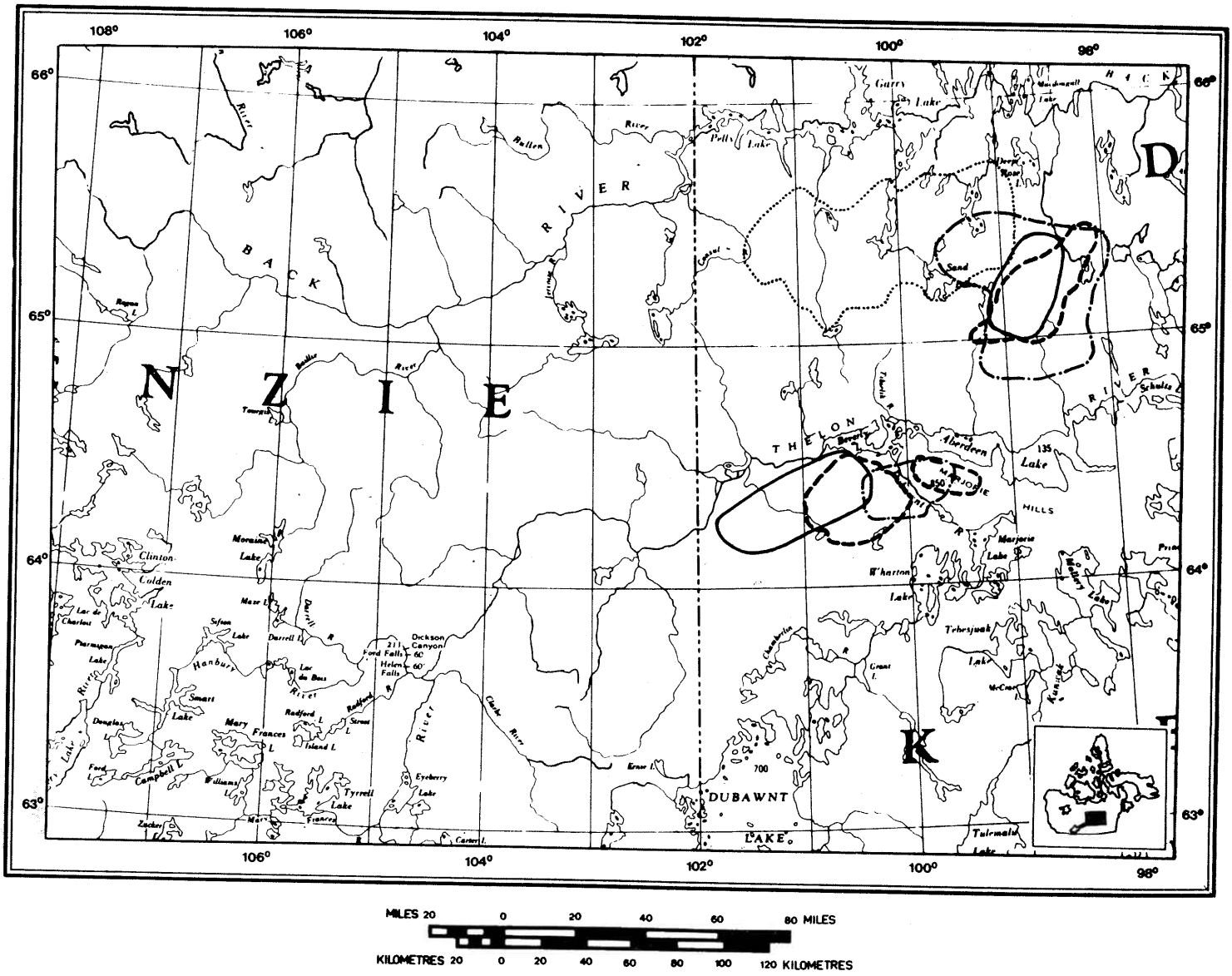


Figure 13: **The calving areas of Beverly caribou for 4 years from 1962 to 1978.**

Legend

———— 1962

- - - - - - - 1971

—·—·— 1974

..... 1978

4.5.1.2 Calving Areas

The traditional calving area of the Beverly caribou herd is north and south of Beverly Lake on the lower Thelon River (Figures 12 and 13). The areas used for calving were documented for 8 years over the period 1957 to 1978 inclusive:

1957	Kelsall	(1960)	1962	McEwan	(1962)
1958	Kelsall	(1960)	1971	Rippen	(1971)
1959	McEwan	(1959)	1974	Moshenko	(1974)
1960	McEwan	(1960)	1978	this report.	

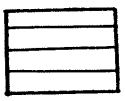
Data for 1974 (Moshenko 1974) shows the majority of cows calving north of Beverly Lake and in 1978 most cows calved further north-west than in previous years (D. Heard pers. comm.). No data are available for intervening years. However, this may not represent a trend away from the southern calving ground. In 1957 and 1958 a few thousand cows calved west of the main herd (Kelsall 1960), but in both of these cases Kelsall (1968) feels that "the animals were almost certainly diverted, or retarded, during spring migration by unusual snow conditions."

4.5.1.3 Post-Calving Movements.

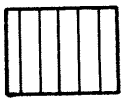
Documented information on post-calving movements of the Beverly caribou herd is available for 10 years during the period 1948 to 1978 inclusive (Figure 14). Movements east and north-east of the calving grounds to the area of Schultz Lake occurred in 1948 and 1949 (Banfield 1954), 1957 and 1958 (Kelsall 1960) and 1960 (McEwan 1960). Usually the caribou returned west and went southwest past Beverly Lake. Since 1960 all major documented post-calving movements have remained west of 98° 30' longitude. During 1962 (McEwan 1962) and 1978 movements occurred north of Beverly and Aberdeen Lakes and then southwest and west respectively. During 1959 (McEwan 1959), 1973 (Hawkins 1973) and 1977 (D. Heard pers. comm.) movements were recorded in the area of Beverly Lake, and north of Beverly and Aberdeen Lakes, but the data are insufficient to delineate the total pattern.

Figure 14: Post-calving areas used by Beverly caribou (to approximately 31 July) over 10 years in which movements were documented from 1948 to 1978.

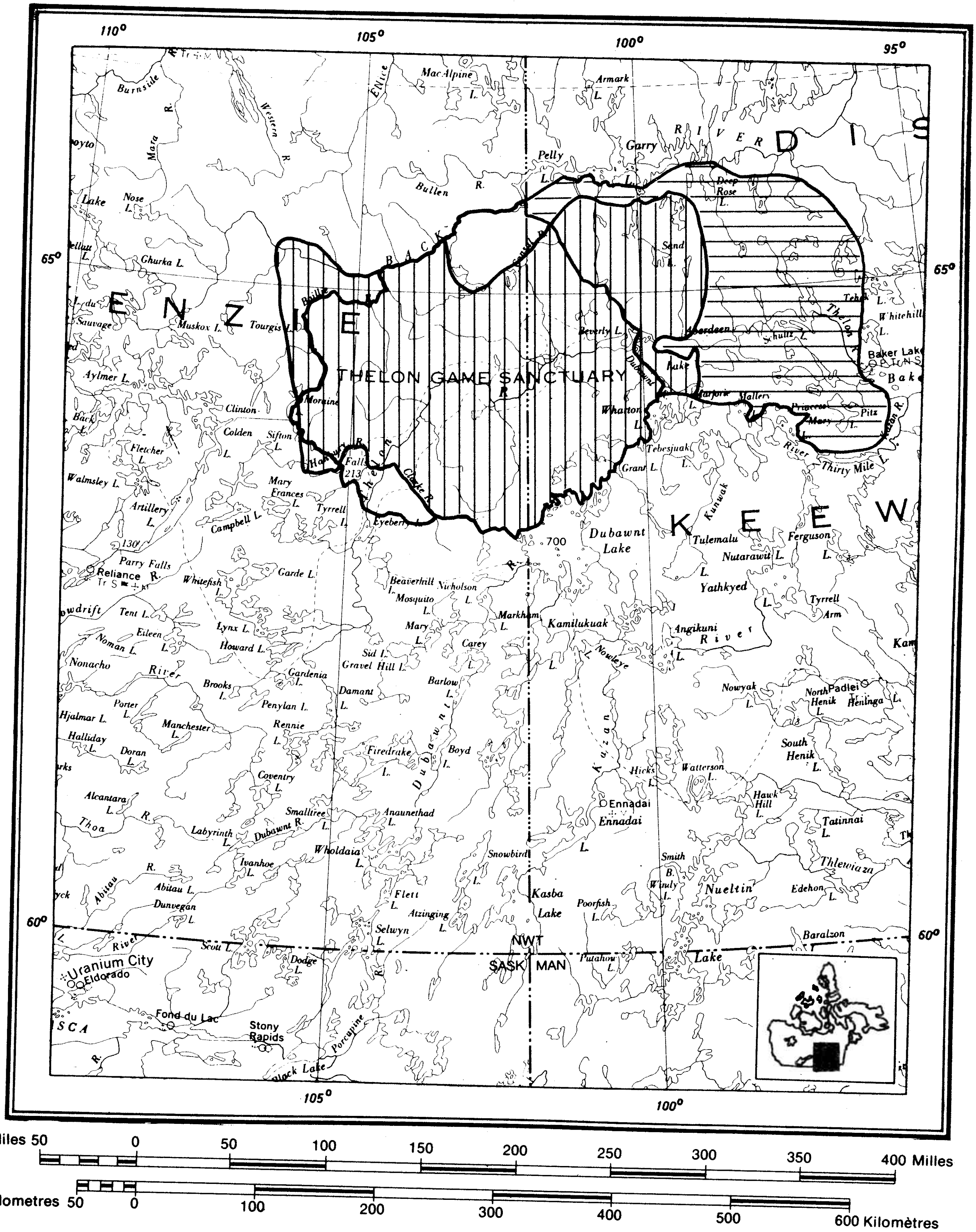
Legend



Post-calving area used over 5 years from 1948 to 1960.



Post-calving area used over 10 years from 1948 to 1978.



110°
105°
100°
95°
65°
60°
THELON GAME SANCTUARY
Burnside
Mara R.
Western R.
Ellice
MacAlpine L.
Armark L.
Garry
Pelly L.
Bullen R.
Deep Rose L.
Sand L.
Nose L.
Ghurka L.
Muskox L.
Tourgis L.
Beverly L.
Aberdeen
Schultz L.
Thelon
Tehek L.
Whitehill L.
Baker Lake
Dubawnt
Lake
Marjorie
Mallery
Princess Mary
Pitz
Kazan R.
Wharton
Aylmer L.
Clinton
Colden L.
Sifton L.
Moraine
Fletcher L.
Falls 213
Clarke R.
Hanbury R.
Walmsley L.
Artillery L.
Mary Frances L.
Tyrrell L.
Campbell L.
Eyeberry L.
Tebesjuak L.
Grant L.
Thirty Mile L.
Kunwak
Dubawnt Lake
700
Tulemalu
Nutarawit L.
Ferguson L.
Yathkyed
Tyrrell Arm
Parry Falls
Reliance
Whitefish L.
Garde L.
Beaverhill L.
Nicholson L.
Mosquito L.
Markham L.
Kamilukuak
Angikuni
River
Tent L.
Eileen L.
Noman L.
Lynx L.
Howard L.
Mary L.
Carey L.
Nonacho
River
Sid L.
Gravel Hill L.
Nowleye
Gardenia
Brooks L.
Barlow L.
Damant L.
Nowyak L.
North Henik L.
Padlei
Heninga L.
Porter L.
Hjalmar L.
Penylan L.
Manchester L.
Rennie L.
Halliday L.
Doran L.
Firedrake L.
Boyd L.
Kazan
South Henik L.
Hicks
Watterson L.
Coventry L.
Alcantara L.
Hawk Hill L.
Ennadai
Ennadai L.
Thoa
Smalltree L.
Anaunethad L.
Tatinnai L.
Labyrinth L.
Dubawnt R.
Wholdaia L.
Snowbird L.
Ivanhoe L.
Smith B.
Thlewiaza
Abitau L.
Kasba Lake
Windy L.
Nueltin
Edehon L.
Dunvegan L.
Flett L.
Atzinging L.
Poorfish L.
Selwyn L.
Baralzon
Lake
Scott L.
NWT
SASK
MAN
Putahow L.
Uranium City
Eldorado
Dodge L.
Fond du Lac
Stony Rapids
Porcupine
Black Lake
Miles 50 0 50 100 150 200 250 300 350 400 Milles
Kilometres 50 0 100 200 300 400 500 600 Kilomètres

4.5.2 Kaminuriak Herd.

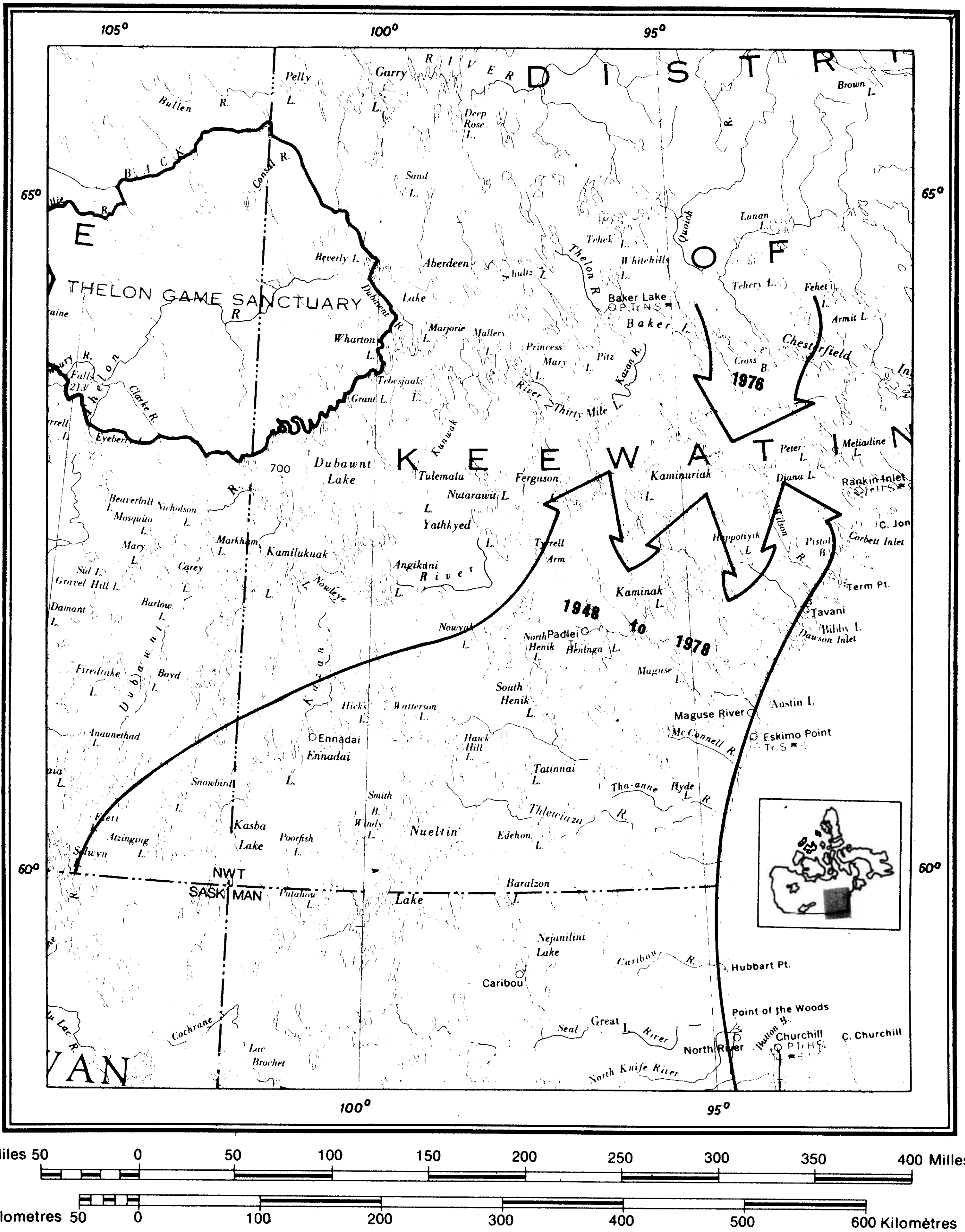
4.5.2.1 Spring Migration Routes.

Spring migration routes of the Kaminuriak herd are documented for 8 years over the period 1948 to 1978 inclusive (Figure 15):

1948 and 1949	Banfield	(1954)	1968 and 1969	Parker	(1972)
1959	McEwan	(1959)	1976	Ficher *et al.*	(1977)
1960	McEwan	(1960)	1978	this report.	

The routes vary from year to year but generally they lie within a wedge between Ennadia Lake and the Hudson Bay coast with the apex pointing towards Kaminuriak Lake. In 1975/76 a large portion of the herd apparently wintered north of Baker Lake. The distribution of these caribou was determined in March 1976 by Fischer *et al.* (1977) who also recorded evidence of their migration south to Kaminuriak Lake prior to calving.

Figure 15: Total area of spring migration documented for all Kaminuriak caribou for 8 years from 1948 to 1978.


DISTRICT OF KEEWATIN
THELON GAME SANCTUARY
1976
1948 to 1978
Baker Lake
Chesterfield Inlet
Rankin Inlet
Eskimo Point
Churchill
Caribou
NWT
SASK MAN
Nueltin Lake
Dubawnt Lake
Kaminak L.
Yathkyed L.
Ennadai
Padlei
Maguse River
Hubbart Pt.
Point of the Woods
North River
C. Churchill
Tavani
Term Pt.
105°
100°
95°
65°
60°
Miles 50 0 50 100 150 200 250 300 350 400 Milles
Kilometres 50 0 100 200 300 400 500 600 Kilomètres

4.5.2.2 Calving Areas.

The traditional calving grounds of the Kaminuriak herd are situated in the MacQuoid and Kaminuriak Lakes area south of Baker Lake and Chesterfield Inlet (Figures 16 and 17). The areas used for calving were documented for 12 years over the period 1963 to 1978 inclusive:

1963	Malfair	(1963)
1966 to 1968	Parker	(1972)
1970	Miller and Broughton	(1974)
1971	Land and Bowden	(1971)
1972	Bowden and Timmerman	(1972)
1973	Land and Hawkins	(1973)
1974	Hawkins and Howard	(1974)
1976	Hawkins and Calef	(1977)
1977	Heard	(pers. comm.)
1978	this report	

Figure 16: The calving areas of Kaminuriak caribou for 6 years from 1963 to 1971.

Legend

- 1963
- 1966
- 1967
- 1968
- 1970
- 1971

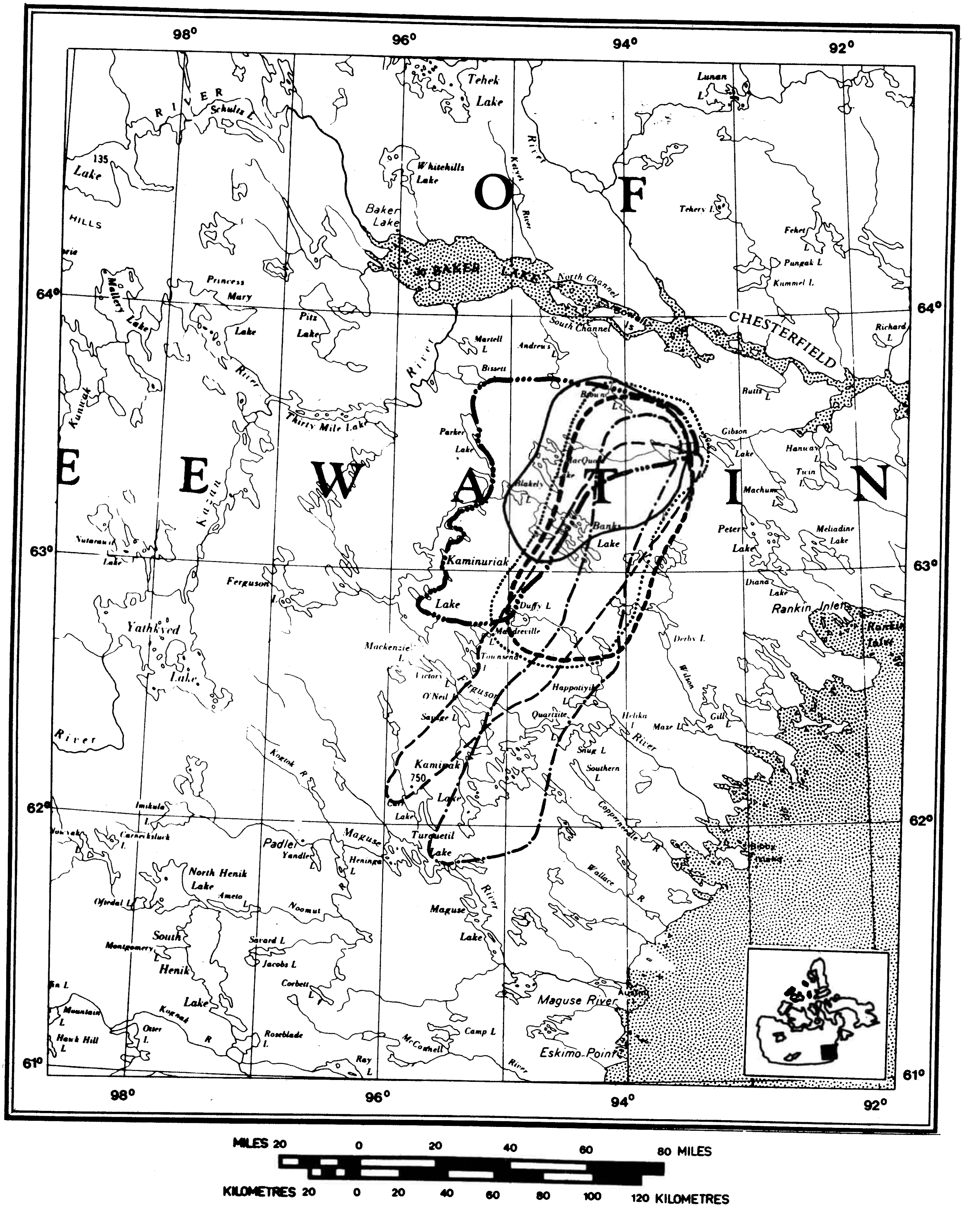
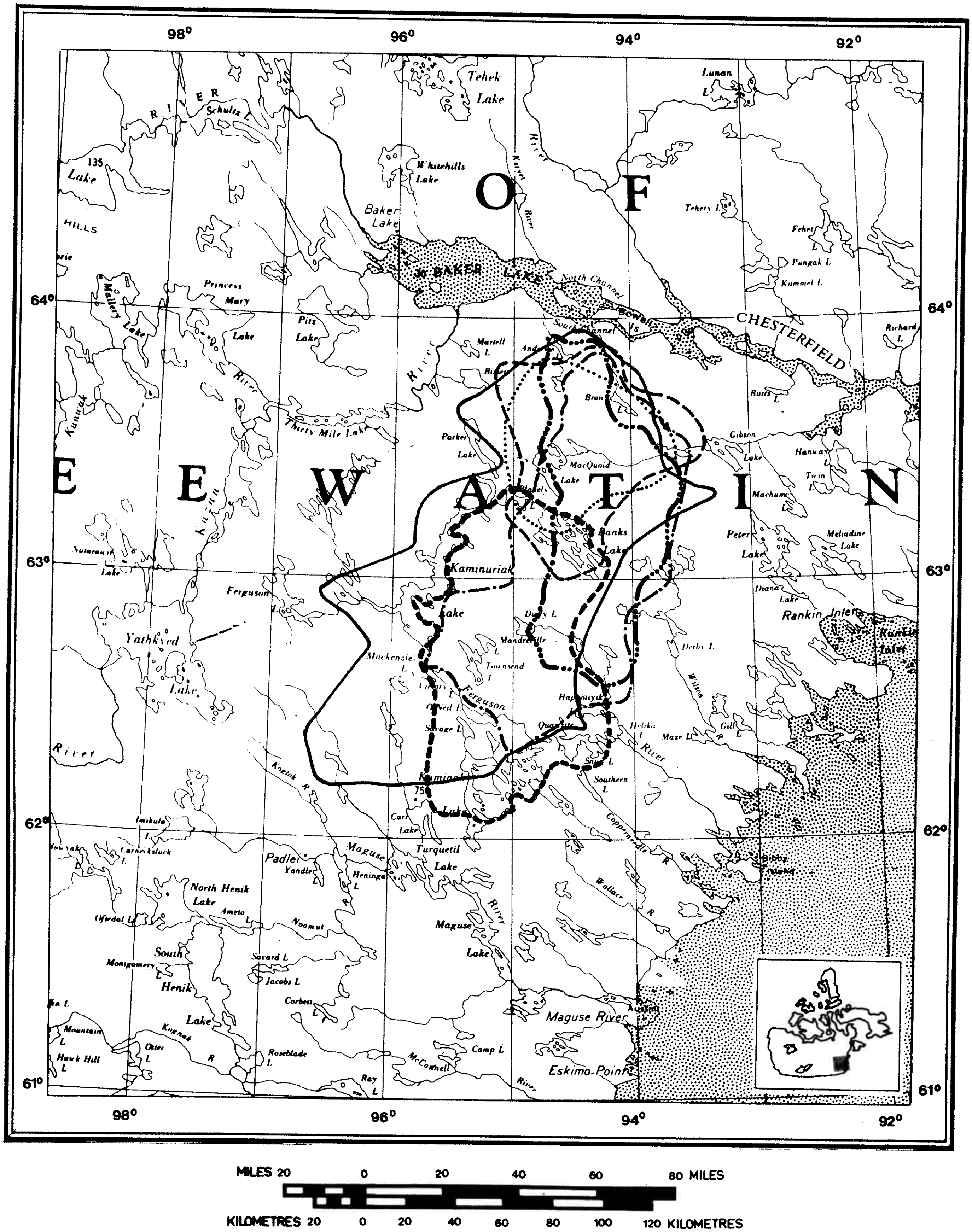

98°
96°
94°
92°
64°
63°
62°
61°
Tehek Lake
Lunan L
Schultz L
RIVER
135
Lake
HILLS
Whitehills Lake
Baker Lake
BAKER LAKE
OF
Tehery L
Fehet L
Pungak L
Kummel L
North Channel
South Channel
Bowell Is
CHESTERFIELD
Richard L
Princess Mary Lake
Mallery Lake
Pitz Lake
Martell L
Andrew's L
Bissett
River
Thirty Mile Lake
Kunwak
Parker Lake
Brown L
MacQuoid Lake
Blakely L
Banks Lake
Gibson Lake
Hanway L
Twin L
Machum L
E E W A T I N
Kazan
Peter Lake
Meliadine Lake
Kaminuriak Lake
Ferguson L
Duffy L
Mandreville L
Townsend L
Diana Lake
Rankin Inlet
Yathkyed Lake
Mackenzie L
Victory L
O'Neil L
Savage L
Ferguson R
Derby L
Wilson R
Happotiyik L
Quartzite L
Helika L
Maze L
Gill L
River
Kaminak Lake
750
Kognak R
Snug L
Southern L
River
Carl Lake
Imikula L
Carneikshuck L
Padlei
Yandle L
Maguse
Heninga L
Turquetil Lake
Coppermeadle R
Wallace R
North Henik Lake
Ameto L
Oftedal L
Noomut
River
Maguse Lake
South Henik Lake
Montgomery L
Savard L
Jacobs L
Corbett L
Maguse River
Mountain L
Hawk Hill L
Otter L
Kognak R
Roseblade L
Camp L
McConnell
Eskimo Point
Ray L
River
MILES 20 0 20 40 60 80 MILES
KILOMETRES 20 0 20 40 60 80 100 120 KILOMETRES

Figure 17: **The calving areas of Kaminuriak caribou for 6 years from 1972 to 1978.**

Legend

- 1972
- 1973
- 1974
- 1976
- 1977
- 1978


98°
96°
94°
92°
64°
63°
62°
61°
O F
E E W A T I N
Tehek Lake
Lunan L
Whitehills Lake
Baker Lake
BAKER LAKE
North Channel
South Channel
Bowell Is
CHESTERFIELD
Schultz L
RIVER
Lake
HILLS
Princess Mary Lake
Pitz Lake
Mallery Lake
Kunwak
Thirty Mile Lake
Kazan
Kazan River
Tehery L
Fehet L
Pungak L
Kummel L
Richard L
Martell L
Parker Lake
Brown
MacQuoid Lake
Banks Lake
Kaminuriak
Lake
Gibson Lake
Butts L
Hanway L
Machum
Peter Lake
Meliadine Lake
Diana Lake
Rankin Inlet
Rankin Inlet
Ferguson L
Yathkyed Lake
Mackenzie L
Dufy L
Mandreville L
Townsend L
Ferguson
Quartzite
Kaminak
Lake
Carr Lake
Turquetil Lake
Derby L
Wilson
Maze L
Gill L
River
Southern L
Coppernedle R
Bibby Island
Wallace R
Kognok R
Maguse
Padlei
Yandle
Heninga L
North Henik Lake
Ameto L
Ofterdal L
Noomut
Maguse Lake
South Henik Lake
Montgomery L
Savard L
Jacobs L
Corbett L
Maguse River
Eskimo Point
Mountain L
Hawk Hill L
Otter L
Roseblade L
McConnell
Camp L
Ray L
River
MILES 20 0 20 40 60 80 MILES
KILOMETRES 20 0 20 40 60 80 100 120 KILOMETRES

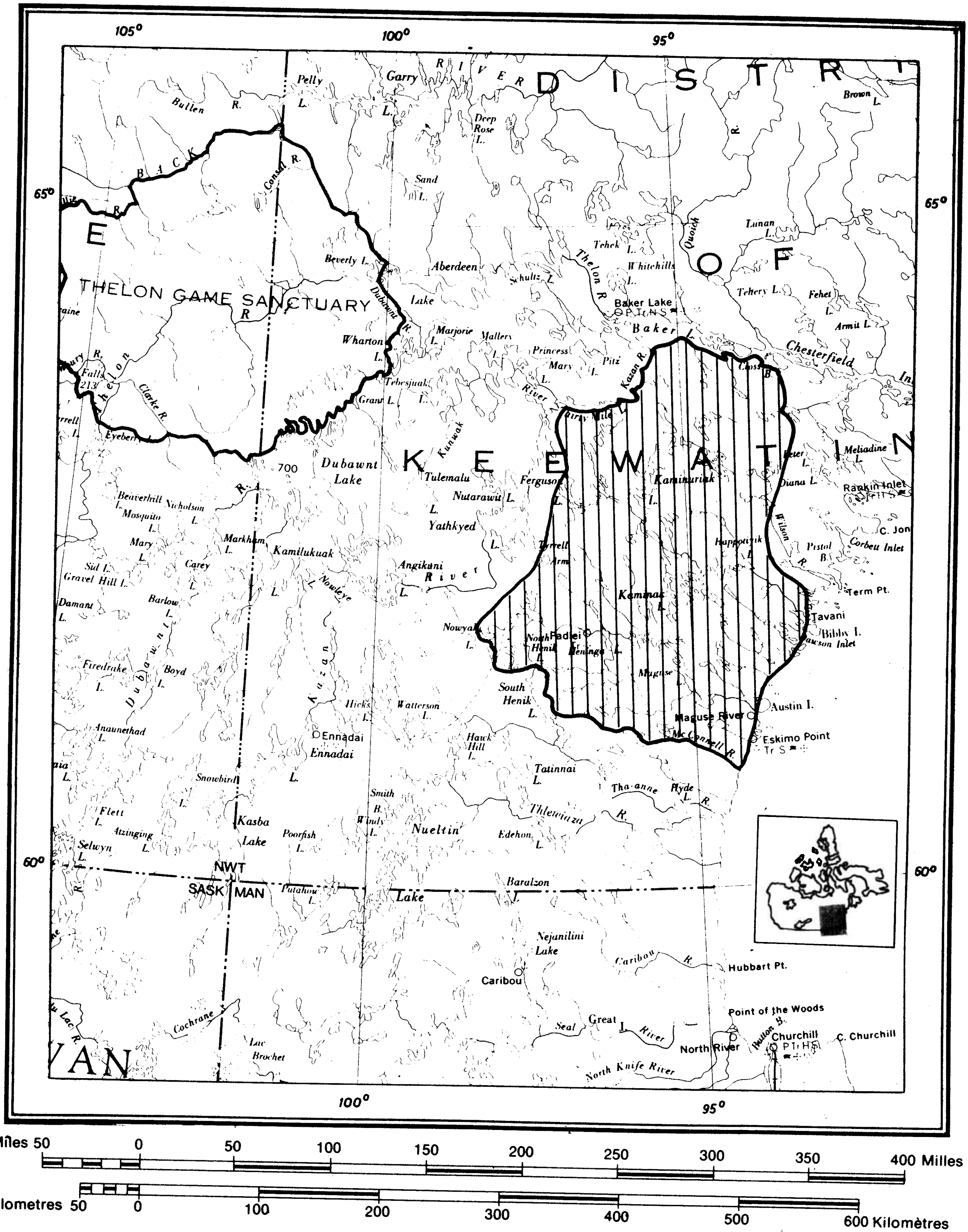
4.5.2.3 Post-Calving Movements.

The scientific literature contains documented information on the post-calving movements of the Kaminuriak caribou herd for 9 years during the period 1948 to 1978 inclusive (Figure 18):

1948 and 1949	Banfield	(1954)
1966 to 1969	Parker	(1972)
1970	Miller and Broughton	(1974)
1976	Fischer *et al.*	(1977)
1978	this report.	

The area south of Baker Lake and east of the lower Kazan River has been used consistently by large numbers of cows and calves in 6 of 7 years for which there is detailed information from 1966 to 1978 (Fischer *et al.* 1977, Miller and Broughton 1974, Parker 1972). In 1 of 7 years (1978) most cows and calves did not move north after calving but approximately 6,500 males and non-breeding caribou used the area between Bissett Lake and the lower Kazan River.

Figure 18: Post-calving area used by Kaminuriak caribou (to approximately 31 July) over 8 years in which movements were documented from 1948 to 1978.


105°
100°
95°
65°
60°
DISTRICT
E
THELON GAME SANCTUARY
OF
KEEWATIN
Pelly L.
Garry L.
RIVER
Deep Rose L.
Brown L.
Bullen R.
BACK R.
Consul R.
Sand L.
Lunan L.
Quoich
Tehek L.
Whitehills L.
Beverly L.
Aberdeen
Schultz L.
Thelon R.
Baker Lake
Baker L.
Tehery L.
Fehet L.
Armit L.
Chesterfield
Dubawnt R.
Lake
Wharton L.
Marjorie L.
Mallery L.
Princess Mary L.
Pitz L.
Kazan R.
Falls
Clarke R.
Tebesjuak L.
Grant L.
Kunwak
Eyeberry L.
Meliadine L.
700
Dubawnt Lake
Tulemalu
Nutarawit L.
Ferguson
Kaminuriak
Peter L.
Diana L.
Rankin Inlet
Beaverhill L.
Nicholson L.
Mosquito L.
Mary L.
Yathkyed L.
Wilson R.
C. Jones
Corbett Inlet
Markham L.
Kamilukuak
Angikuni
River
Tyrrell Arm
Pistol B.
Sid L.
Gravel Hill L.
Carey L.
Nowleye L.
Term Pt.
Daman L.
Barlow L.
Kaminak L.
Tavani
Nowyak L.
North Henik
Padlei
Bibby I.
Dawson Inlet
Firedrake L.
Boyd L.
Dubawnt
Kazan
South Henik L.
Austin I.
Hicks L.
Watterson L.
Maguse River
Anaunethad L.
Ennadai
Ennadai L.
Hawk Hill L.
McConnell R.
Eskimo Point
Tatinnai L.
Tha-anne
Hyde L.
Snowbird L.
Smith B.
Windy L.
Flett L.
Kasba Lake
Poorfish L.
Nueltin
Thlewiaza R.
Edehon L.
Atzinging L.
Selwyn L.
NWT
SASK
MAN
Putahow L.
Lake
Baralzon L.
Nejanilini Lake
Caribou R.
Hubbart Pt.
Caribou
Point of the Woods
Cochrane
Great
Seal
River
Churchill
C. Churchill
Lac Brochet
North River
North Knife River
VAN
Miles 50 0 50 100 150 200 250 300 350 400 Milles
Kilometres 50 0 100 200 300 400 500 600 Kilomètres

4.5.3 Tundra Wintering Areas.

Figure 19 shows the tundra wintering areas that have been documented in the scientific literature for the Beverly and Kaminuriak caribou herds. Kelsall (1968) points out that while frequently used tundra wintering areas exhibit the most favourable conditions for caribou winter survival, it is very difficult to survey these areas in winter. He feels that the "general extent of mapped tundra wintering areas is therefore decidedly minimal." The areas that are documented represent data for various years over the period 1940 to 1978 inclusive:

1940 to 1950	Banfield	(1954)
1954/55	Loughrey	(1955)
1959/60	McEwan	(1960)
February 1975	Robertson	(1975 and pers. comm.)
March 1976	Fischer ***et al.***	(1977)
1977/78	this report.	

Banfield's (1954) reference to use of the Garry Lake and lower Thelon River areas represents generalized use during the period 1940 to 1950.

4.5.4 Rutting Areas.

Caribou are in constant motion during the rut. The areas of rutting activity are usually situated near the treeline but vary from year to year (Kelsall 1968). The area of Edehon Lake and South Henik Lake has been important for the Kaminuriak herd (Parker 1972).

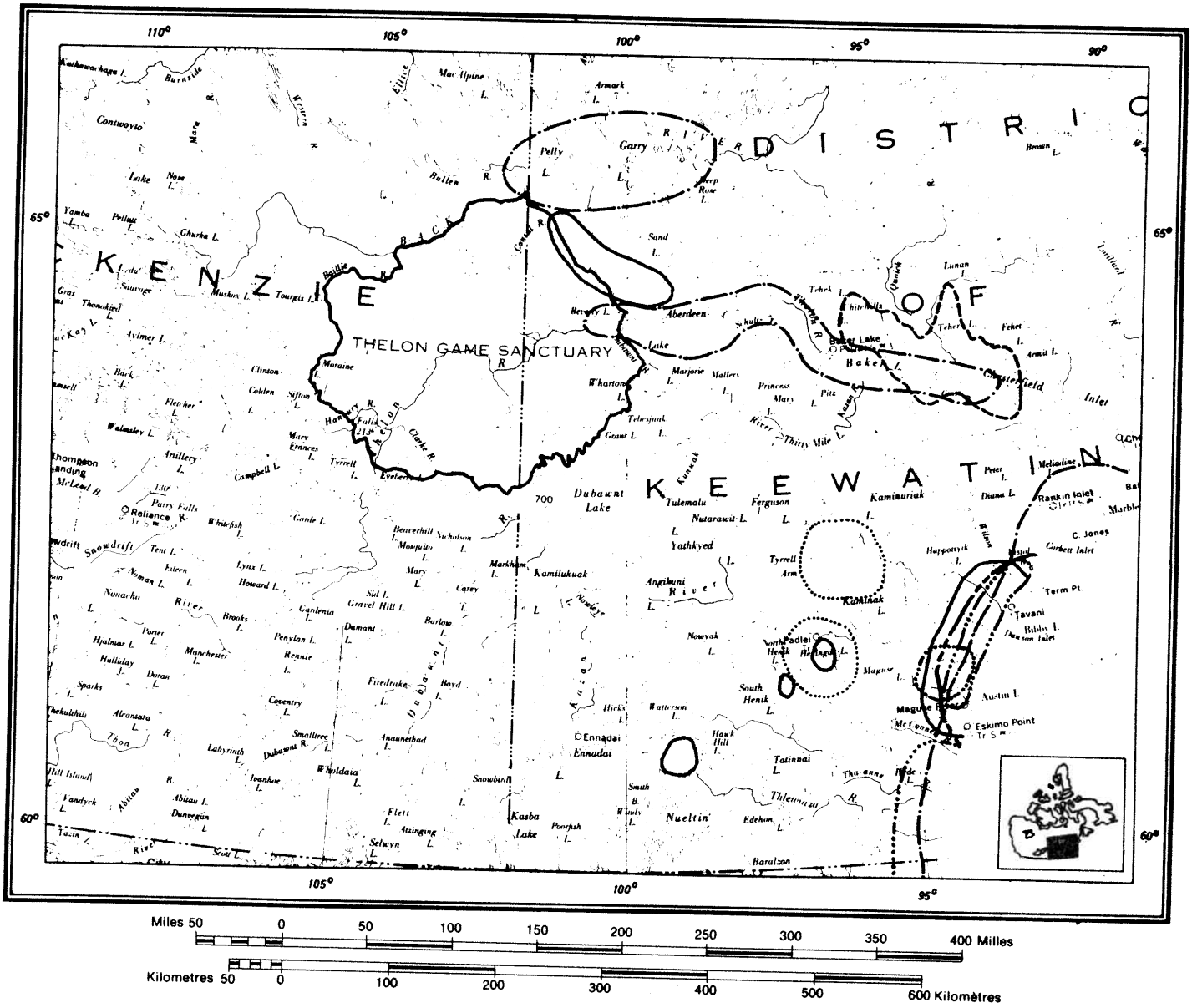


Figure 19: **Tundra wintering areas of Beverly and Kaminuriak caribou documented for various winters between 1940 and 1978.**

Legend

- 1940 - 1950
- 1954/55
- 1959/60
- 1966/67
- Feb. 1975
- Mar. 1976
- 1977/78

5. DISCUSSION

5.1 Predictability of the Use of Various Areas

5.1.1 Spring Migration Routes.

The Beverly herd usually exhibits a heavy migrational movement in the area of Mosquito and Beaverhill Lakes (Figure 11). There is only one record in the scientific literature of a spring migration of Beverly cows in the area between Dubawnt and Yathkyed Lakes. Banfield's 1954 report shows a spring migration through this area for the years 1948 and 1949. His information was based on personal observations, reports of police and wardens, questionnaires, and interviews with trappers. The importance of this route for cow migration appears to be dubious since it has not been reported by more definitive investigations since (R. Decker pers. comm., Kelsall 1960, McEwan 1959, 1960, 1962, Thomas 1969). However, males and non-breeding animals may have used it as they did in 1978. Documentation on the Kaminuriak herd shows a high degree of variability in spring migration routes (Banfield 1954, K. Davidge pers. comm., E. Fast pers. comm., Fischer ***et al.*** 1977, McEwan 1959, 1969, Parker 1972).

Our capability to predict specific routes in detail and in advance is low. However, it does not appear likely that a spring migration of cows will traverse the area between Dubawnt and Yathkyed Lakes in the foreseeable future.

5.1.2 Calving Areas.

A high degree of predictability is possible. The Kaminuriak herd has shown high fidelity to the area east and northeast of Kaminuriak Lake (Figures 16 and 17). The Beverly herd has used the area north and south of Beverly Lake in 7 of 8 years in which movements were documented (Figures 12 and 13). In 1 of 8 years (1978) all cows calved between Beverly and Garry Lakes.

The consistent use of traditional calving grounds by barren-ground caribou has been documented in the literature (Bergerud 1974, Kelsall 1968, Lent 1966, Skoog 1968) and by this study. The probability of continued use of the Beverly and Kaminuriak calving grounds for the majority of years in the foreseeable future is high. However, unusual spring snow conditions could occasionally result in some caribou calving elsewhere, as was the case in 1957 and 1958 with the Beverly herd (Kelsall 1968).

5.1.3 Post-Calving Areas.

The scientific literature shows that from 1948 to 1960 inclusive Beverly caribou often used the area to the east and northeast of the calving grounds after calving (Banfield 1954, Kelsall 1960, McEwan 1960). Since then all major documented movements show caribou to have remained west of 98° 30' longitude (Hawkins 1973, D. Heard pers. comm., McEwan 1962) (Figure 14). The Kaminuriak herd has utilized the calving grounds and the area south of Beverly Lake in 7 of 7 years for which there is detailed information (Fischer ***et al.*** 1977, Miller and Broughton 1974, Parker 1972).

The probability of future post-calving activity in the traditional calving areas and the area south of Baker Lake and east of the Kazan River is high. The use of other areas is not highly predictable and can be expected to vary from year to year.

5.2 Sensitive Areas and Times

The scientific literature contains many examples which indicate that caribou migrations are not deterred by buildings and human activity (Harper 1955, Banfield 1954, Jakimchuk ***et al.*** (1974) or by roads (Bergerud 1974, Skoog 1956, Surrendi and DeBock 1976) and railroads (Banfield 1954, Dugmore 1913, Klein 1971), as long as there are no physical or psychological impediments to prevent caribou from moving around or over obstructions. In the case of roads and railroads the impediment they represent depends on the amount of traffic and the nature of the profile, ditches, snowbanks or associated snowdrifts (Bergerud 1974, Klein 1971, Surrendi and DeBock 1976, Villmo 1975). In fact, winter mortality of free-ranging reindeer is a serious problem on roads and railroads in Scandinavia. In areas of deep snow the reindeer are reluctant to leave the snow-free routes and are killed by vehicles and trains (Espmark 1966, Klein 1971, Villmo 1975). Other factors can be important besides transportation facilities. Klein (1971) and Villmo (1975) refer to the psychological barrier that may be created by the "hum" of electric power lines and other effects of hydroelectric development in Scandinavia.

These references are generally qualitative in nature. Although they indicate that the effects of such facilities on caribou may be mitigated there are few quantitative studies to indicate the detailed design and operation controls required. Some information is available on the effects of natural gas compressor station noise (McCourt ***et al.*** (1974) and the Trans-Alaska oil pipeline (Cameron and Whitten 1978, Child 1974 and 1975, Roby 1978) but further research is required into problems of development endemic to the Northwest Territories.

Aircraft disturbances or other human activities that cause a substantial delay or deviation in migration and/or a substantial increase in energy expenditure and physiological stress could have detrimental effects (Calef 1974, Dauphiné 1976, Geist 1971, Zhigunov 1968 ***in*** Thomson 1972). Several studies of the effect of aircraft disturbance are reported in the literature (Calef ***et al.*** 1976, Klein 1973, McCourt ***et al.*** 1974, McCourt and Horstman 1974, Miller and Gunn 1977, Surrendi and DeBock 1976). These generally concede that, for light aircraft, a minimum altitude of 300 m (1,000 feet) AGL is sufficient to avoid causing most of the caribou to run. Only one study (McCourt ***et al.*** 1974) investigated the effect of aircraft disturbance at altitudes greater than 300 m (1,000 feet) AGL and the sample size was small. No studies have been conducted on disturbance by large aircraft (eg. DC-3, Boeing 737, Hercules). There is evidence that caribou are more sensitive to aircraft disturbance when negotiating or preparing to negotiate water crossings than when engaged in other activities (Calef ***et al.*** 1976, Surrendi and DeBock 1976). Other authors did not collect data on the differential reactivity of caribou at water crossings. There is also evidence that caribou sensitivity to aircraft is high during the calving period (Calef ***et al.*** 1976, Surrendi and DeBock 1976). McCourt and Horstman (1974) found that caribou were most sensitive during post-calving while McCourt ***et al.*** (1974) and Klein (1973) did not present separate data for the calving period.

The scientific literature suggests the need to protect caribou from excessive human disturbance during the calving and post-calving periods (Calef 1974, Calef ***et al.*** 1976, Dauphiné 1976, DeVos 1960, Geist 1971, Kelsall 1968, Lent 1964, Miller and Broughton 1974, Miller and Gunn 1977, Surrendi and DeBock 1976, Thomson 1972, Zhigunov 1968 ***in*** Thomson 1972). Human activities in calving and post-calving areas can be more serious than those encountered elsewhere because:

a) Caribou sensitivity to disturbance is high during the calving period (Bergerud 1974, Calef ***et al.*** 1976, Lent 1964, Surrendi and DeBock 1976, Thomson 1971 ***in*** Thomson 1972),

b) The cows are at the nadir of their annual physiological cycle and all caribou are on a critical energy budget (Dauphiné 1976),

c) A direct or indirect reduction in recruitment is more likely to take place as a result of disturbance to cows and calves through premature travel, disruption of the cow-calf bond, separation of cows and calves, or trampling (Bergerud 1974, Calef 1974, Geist 1971, Lent 1966, Surrendi and DeBock 1976, Zhigunov 1968 ***in*** Thomson 1972).

On this same theme Kelsall (1968:290) states:

"Limited reserve areas might be valuable to protect caribou during calving. The protection traditionally afforded caribou by the isolation and ruggedness of the calving areas has been reduced by the airplane. Disturbance of calving caribou by aircraft and aircraft-transported parties might cause heavy mortality among young calves. Any tendency to visit calving areas during June by native hunters or tourists should be discouraged or banned.

Extreme harassment by parties equipped with aircraft might be detrimental to the well-being of caribou herds at other seasons as well. Seasonal or geographic restrictions on aircraft, except those flying at high altitudes (e.g. above 1,000 feet), could alleviate any such difficulties."

At the proceedings of the Mackenzie Valley Pipeline Inquiry (1975/76 Summary Vol 2:110-117) Bergerud, Lent and Calef reiterated the importance of the calving and post-calving periods as sensitive intervals in the annual cycle of caribou life history. They indicated the calving grounds to be key pieces of habitat. Bergerud stated that should "man's activities force them (the caribou cows) elsewhere, the second choice may not be good enough for survival."

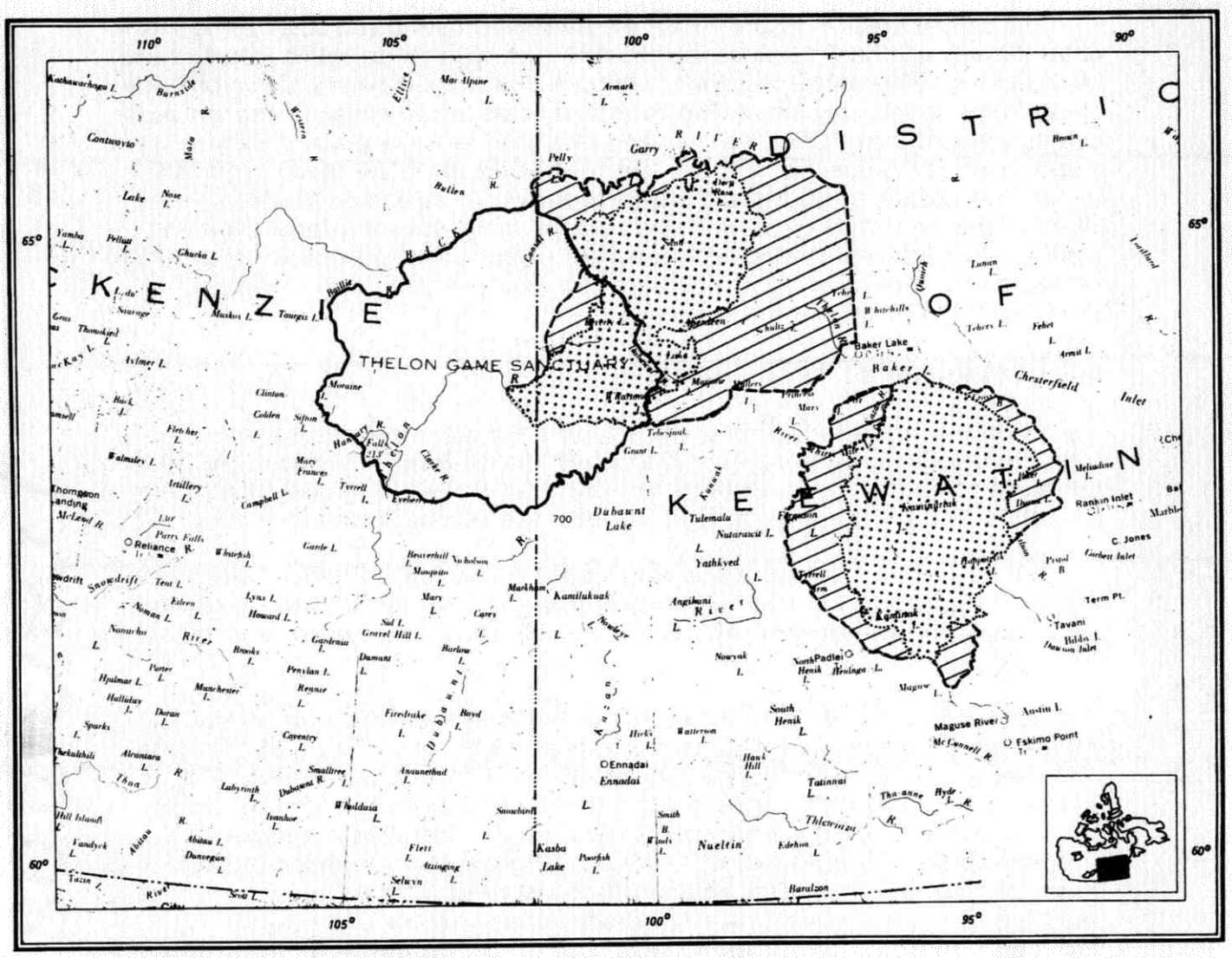


Figure 20: Traditional and potential calving and post-calving areas for the Beverly and Kaminuriak caribou herds based upon the scientific literature and results of the 1978 Caribou Monitoring Program.

Legend

Traditional calving and post-calving area.

Potential calving and post-calving area.

The traditional calving grounds of the Kaminuriak herd and the north calving grounds of the Beverly herd have already been designated as I.B.P. Ecological Sites by Nettleship and Smith (1975) but do not have any protected status at present.

The central areas in Figure 20 are the traditional calving and post-calving areas of the Beverly and Kaminuriak caribou herds based upon the scientific literature and results of the 1978 caribou monitoring program. These areas have a high probability of use in the foreseeable future. The peripheral areas are potential calving and post-calving areas. Occasional variation in the areas used for calving would likely result in a shift to either the potential areas or towards treeline along the spring migration routes. The location of calving in the latter areas would depend on several unpredictable factors. Consequently, the potential areas are not extended towards treeline. The traditional calving and post-calving areas comprise approximately 17,770 km^2 (6,940 mi^2) outside of the Thelon Game Sanctuary for the Beverly herd and 28,160 km^2 (11,000 mi^2) for the Kaminuriak herd.

5.3 Evaluation of 1978 Controls

In 1978 approximately 50% of the area where the Beverly herd calved was outside of the Primary Calving Area (Caribou Protection Map 1978) and not within the Thelon Game Sanctuary. Post-calving movements of Beverly cows and calves were west of the Primary Post-Calving Area but within the Thelon Sanctuary.

The majority of Kaminuriak cows and calves occupied the Primary Calving and Primary Post-Calving Areas during the appropriate periods until 16 July. By this date some cows and calves had moved outside of the Primary Post-Calving Area to Eskimo Point.

Observations of the 1978 Caribou Monitoring Program and studies on aircraft disturbance in the scientific literature (Calef ***et al.*** 1976, Jakimchuk ***et al.*** 1974, Klein 1973, McCourt ***et al.*** 1974, McCourt and Horstman 1974, Miller and Gunn 1977, Surrendi and DeBock 1976) indicate that a minimum altitude of 300 m (1,000 feet) AGL is sufficient to avoid causing most caribou to run. Therefore, the present recommended minimum altitude of 1,000 feet AGL over Spring Migration Areas and groups of caribou is considered appropriate. Observations of the monitoring program also show that on calm, sunny days cows and calves in dense post-calving aggregations will sometimes canter in response to light aircraft flying at 300 to 600 m (1,000 to 2,000 feet) AGL. However, there is no scientific evidence which indicates that a minimum altitude of 600 m (2,000 feet) AGL is necessary for light aircraft. No studies have been conducted on disturbance by large aircraft but these are usually flying above 600 m (2,000 feet) AGL. Consequently, the recommended restriction of 2,000 feet AGL over Primary Calving and Primary Post-Calving Areas is not considered to be justified. This issue can be clarified by future research. In practice, weather conditions often do not permit light aircraft (on VFR flights) to fly above 1,000 feet AGL.

No controls apply to non-land use activities. This is not considered to be serious except for possible aircraft harassment of caribou.

At present, Land Use Inspectors are supposed to have authority to stop only aircraft activity associated with a land use permit if caribou are in the immediate area. The legal status of this power is apparently dubious. The term "caribou" in this regard is not defined.

Disturbance of caribou as they approach water crossings should be avoided since caribou have been shown to be more sensitive to disturbance when preparing to negotiate a crossing (Calef ***et al.*** 1976, Surrendi and DeBock 1976). For this reason the 3 mile (4.8 km) restricted area around water crossings is biologically sound. The designated water crossings (Caribou Protection Map 1978) in the area of Kazan Falls are generally correct in their placement except for minor inaccuracies. Reference to Figure 10 will reveal the latter. At the present time there is no available information which disputes the placement of other designated water crossings. Each of these will have to be examined in the field and with reference to the literature to determine the validity of their present status.

A disadvantage of 1978 controls is that restricted areas can not be released for land use activity in advance of the termination date even though no substantial numbers of caribou remain in the areas or are expected to return.

The scientific evidence indicates that during migration caribou will go around or over obstacles as long as there are no physical or psychological impediments to prevent them from doing so (Banfield 1954, Bergerud 1974, Dugmore 1913, Harper 1955, Klein 1971, Jakimchuk ***et al.*** 1974, Skoog 1956, Surrendi and DeBock 1976, Villmo 1975). During calving and post-calving, disturbance is more serious (Calef 1974, Calef ***et al.*** 1976, Dauphiné 1976, Geist 1971, Kelsall 1968, Surrendi and DeBock 1976, Zhigunov 1968 ***in*** Thomson 1972). Land use activities (e.g. mineral exploration camps) should therefore not be permitted in traditional calving and post-calving areas (Figure 20) during sensitive times, or wherever caribou may calve.

In other areas land use activities should be regulated on the basis of caribou presence. Land use camps should not be excluded as long as aircraft activity involving radiometric survey or the relocation of drills, fuel caches and camps is terminated near substantial numbers of caribou. These involve numerous passes at low altitude and can cause strong reactions by caribou (Calef ***et al.*** 1976, Surrendi and DeBock 1976, Miller and Gunn 1977). However, flights necessary for the daily movement of ground crews and for camp maintenance could continue at altitudes above 300 m (1,000 feet) AGL. Ground surveys by people on foot could also continue.

Neither the 1978 controls nor the proposed Land Management Zones of the Minister, D.I.A.N.D., address the issue of long term developments and their effects on caribou. The construction of mines, airstrips, roads and related infrastructure should be planned to avoid conflicts with caribou.

5.4 Major Concerns relating to Long Term Development

1) Traditional Calving and Post-Calving Areas (Figure 20):
   a) Aircraft and noise disturbances during caribou occupancy,
   b) The development of transportation or energy corridors that might act as physical or psychological barriers to caribou movement, particularly of young calves,
   c) Release of gaseous emissions harmful to lichens and other vegetation (Richardson ***et al.*** 1975, Villmo 1975).

2) Anywhere:
   a) Reclamation of sites, especially open pit mines, to a state compatible with use of the area by caribou,
   b) Hunting from development sites or access routes,

c) The development of transportation or energy corridors that might act as physical or psychologcal barriers to caribou migration,

d) Displacement of caribou from essential tundra wintering areas, could jeopardize their survival and/or reproduction,

e) Disturbance of caribou during the rut that could de-stabilize the synchrony of rut (Dauphine and McClure 1974, Jakimchuk 1974).

6. RECOMMENDATIONS

6.1 Recommendations Concerning Exploration

6.1.1 Recommendations Based on Adequate Research Data.

a) Controls should require land use activities to move out of Traditional Calving and Post-Calving Areas (Figure 20) during the period 15 May to 31 July or until no "substantial number" of caribou is expected to use or return to the Area before 31 July, whichever comes first. The release of restrictions should apply to parts of a Traditional Area when it is expected that no "substantial number" of caribou will use or return to that portion before 31 July. A definition of a "substantial number" of caribou is given below.

b) Pilots should maintain an altitude of not less than 1,000 feet (300 m) AGL over Traditional Calving and Post-Calving Areas (Figure 20) between 15 May and 31 July or until the release of restrictions.

c) Pilots should maintain a minimum altitude of 1,000 feet (300 m) AGL over portions of the Potential Calving and Post-Calving Areas, Areas of Spring Migration, or any other areas designated by the monitoring biologist where calving takes place.

d) At all other times pilots should maintain a minimum altitude of 1,000 feet (300 m) AGL near groups of caribou.

e) The lower Kazan River water crossings should continue to be designated as major crossing sites with minor changes in the position of crossings to reflect the evidence acquired during the 1978 monitoring program (Figure 10).

f) Land Use Inspectors should have legal authority to restrict aircraft activity in the area of a "substantial number" of caribou, as defined below.

g) The monitoring program should be continued and a biologist should be employed to coordinate the program and advise the Land Use Inspectors.

6.1.2. Interim Recommendations with Further Research Required.

a) Until further clarification by future research data the term "substantial number" of caribou should be defined as follows:

1,000 or more caribou of any age or sex occupying an area of 500 sq. km. (195 sq. mi.) or less. When a population comprises less than 20,000 caribou then a figure of 5% of the population size should apply.

b) If calving by a "substantial number" of caribou occurs within a Potential Calving and Post-Calving Area (Figure 20) or an Area of Spring Migration (see 6.1.2 d) then land use activities should cease in the affected portion until 30 June. However, if calving does not occur within these areas the scientific evidence does not indicate that land use activities should be excluded. Restrictions on aircraft activity near "substantial numbers" of caribou would suffice *if* the enforcement of restrictions is considered to be practical by D.I.A.N.D. The types of aircraft activity that must be restricted involve multiple passes at low altitude near caribou (e.g. radiometric survey; slinging fuel or equipment by helicopter). If the effective control of aircraft activity is considered impossible then land use activities should be excluded.

c) If calving by a "substantial number" of caribou occurs outside of Traditional Calving and Post-Calving, Potential Calving and Post-Calving, or Spring Migration Areas, then land use activities should cease in the affected area until 30 June.

d) If D.I.A.N.D. determines that practical enforcement of aircraft restrictions discussed in 6.1.2 b necessitates the exclusion of land use activities from Areas of Spring Migration then the time period and boundaries relating to these areas should be amended as follows:

   (i) The time period should extend from 20 April until the majority of migrating cows have passed,

   (ii) The Beverly herd Area of Spring Migration should extend south of the Traditional Calving and Post-Calving Area (Figure 20) and the Hanbury River to latitude 62° 00' and from Artillery Lake east to Dubawnt Lake and the Dubawnt River,

   (iii) The Kaminuriak herd Area of Spring Migration should extend south and east of the Traditional Calving and Post-Calving Area (Figure 20) to the Hudson Bay coast and the Tha-anne River and west to Yathkyed, Nowyak and Hicks Lakes.

e) The present policy on designated water crossings should be maintained subject to changes required by future research data.

6.1.3 Research Requirements.

a) Investigation of the effect of disturbance factors on caribou at various times of the exploration season is required. The relationship between response level and group composition, size and activity should be clarified. The disturbance factors to be investigated are aircraft activity from 500 to 2,000 feet (150 to 600 m) AGL, blasting, diamond drill operation, and camp activity.

b) Investigation of designated water crossings as indicated on the Caribou Protection Map 1978, except for the lower Kazan River crossing, is still required to verify the importance and location of the crossings. The criteria by which important crossings can be identified are:

   (i) Mapping of caribou trail systems on 1:250,000 scale maps. Analysis of these trails should consider the number, age, and convergence of trails to identify crossing sites used in the past. The distribution and uniformity of vegetation types must be examined to determine the effects on trail formation and visibility,

   (ii) The literature should be examined to review documented records of utilization,

(iii) The number and nature of physical barriers and alternative routes of movement must also be considered.

c) Investigation of the Traditional Calving and Post-Calving Areas (Figure 20) is required to clarify the environmental factors that result in their traditional use. If specific habitats of importance can be identified within these areas they should be described and delineated.

6.2 Recommendations Concerning Long Term Development

6.2.1 Area A — Traditional Calving and Post-Calving Areas.

The development of site-specific land use activities (e.g. mines) may be allowed within the Traditional Calving and Post-Calving Areas (Figure 20). However, the importance of these areas necessitates stringent regulations to ensure that no activities or changes to the environment will endanger the accessibility or quality of the areas as key pieces of caribou habitat.

6.2.1.1 Recommendations based on Adequate Research Data.

a) Pilots should maintain an altitude of not less than 1,000 feet (300 m) AGL over Area A between 15 May and 31 July, or until release of restrictions as outlined in 6.1.1. a, except for landings, takeoffs and emergencies.

b) At all other times pilots should maintain a minimum altitude of 1,000 feet (300 m) AGL near groups of caribou.

c) Pilots should avoid unnecessarily long and low approaches to, or departures from, an airstrip from 15 May to 31 July or until release of restrictions.

d) Maintenance overhauls and/or scheduled activity slowdown should be timed to coincide with peak calving activity from 1 to 20 June.

e) Gaseous emissions that damage lichens and other vegetation should be controlled. In particular, sulphur dioxide concentrations should not exceed the levels recommended by Richardson *et al.* (1975).

f) Open pit mines should be fenced.

g) Habitat should be restored after the termination of activities (especially open pit mines) to a state compatible with use of the area by caribou.

6.2.1.2 Interim Recommendations with Further Research Required.

a) Exploration activity may continue under restrictions recommended in the previous section of this report.

b) Aircraft activity should be restricted to that necessary for camp maintenance when a "substantial number" of caribou (as defined earlier) are within 32 km (20 mi.) of the development between 15 May and 31 July.

c) Surface blasting and heavy equipment activity should cease when a "substantial number" of caribou (as defined earlier) are within 8 km (5 mi.) of the development.

d) No all-weather transportation or energy corridors above ground should be permitted.

e) Snowbanks or high profile stretches of winter road should be levelled prior to spring thaw if the N.W.T. Wildlife Service considers that they may inhibit movement of caribou during calving.

f) DIAND's policy on the exclusion of developments at water crossings should be continued.

g) Temporary restrictions on winter road traffic should be imposed if a "substantial number" of caribou may be displaced from essential tundra wintering habitat. This judgement would have to be made by a monitoring biologist. Convoy traffic, as often used on winter roads, would minimize conflicts.

h) The Land Use Inspector should have the legal authority to impose the above temporary restrictions.

i) No hunting from development sites or associated transportations corridors (N.W.T. Wildlife Ordinance).

6.2.2 Area B — Potential Calving and Post-Calving Areas.

6.2.2.1 Recommendations based on Adequate Research Data.

a) Pilots should maintain an altitude of not less than 1,000 feet (300 m) AGL over portions of Area B designated by the monitoring biologist when calving by a "substantial number" of caribou takes place in Area B.

b) At all other pilots should maintain a minimum altitude of 1,000 feet (300 m) AGL near groups of caribou.

c) Open pit mines must be fenced.

d) Habitat should be restored after termination of activities (especially open pit mines) to a state compatible with use of the area by caribou.

6.2.2.2 Interim Recommendations with Further Research Required.

a) Exploration activity may continue under restrictions recommended in a previous section of this report.

b) Aircraft activity should be restricted to that necessary for camp maintenance when a "substantial number" of caribou are within 16 km (10 mi.) of the development between 15 May and 31 July.

c) Restrictions on surface blasting or heavy equipment activity are not considered to be necessary at localized developments.

d) All weather transportation or energy corridors should be allowed subject to environmental review with special regard to the effects on caribou.

e) DIAND's policy on the exclusion of developments at water crossings should be continued.

f) Temporary restrictions on traffic should be imposed along winter or all-weather roads if a "substantial number" of caribou may be displaced from essential tundra wintering habitat. This judgement would have to be made by a monitoring biologist. Convoy traffic, as often used on winter roads, would minimize conflicts.

g) The Land Use Inspector should have the legal authority to impose the above temporary restrictions.

h) No hunting from development sites or associated transportation corridors (N.W.T. Wildlife Ordinance).

6.2.3 Other Areas.

6.2.3.1 Recommendations based on Adequate Research Data.

a) Pilots should maintain an altitude of not less than 1,000 feet (300 m) AGL over areas and at times designated by the monitoring biologist where calving by a "substantial number" of caribou takes place.

b) At all times of the year pilots should maintain a minimum altitude of 1,000 feet (300 m) AGL near groups of caribou.

c) The construction and placement of any transportation or energy corridors in caribou habitat should be subject to environmental review with special regard to the effects on caribou.

6.2.3.2 Interim Recommendations with Further Research Required.

a) Temporary restrictions on traffic should be imposed along winter or all-weather roads if a "substantial number" of caribou may be displaced from essential tundra wintering habitat or if rutting or migration activity may be disturbed. This judgement would have to be made by a monitoring biologist. Convoy traffic, as often used on winter roads, would minimize conflicts.

b) DIAND's policy on the exclusion of developments at water crossings should be continued.

c) The Land Use Inspector should have the legal authority to impose the above temporary restrictions.

d) No hunting from development sites or associated transportation corridors (N.W.T. Wildlife Ordinance).

6.2.4 Research Requirements.

Investigation of the effect of disturbance factors associated with long term development on caribou is required. The relationship between response level and such factors as group composition, size, activity and season should also be examined. The disturbance factors of importance are: airport activity, including 737 and Hercules class aircraft operation; surface blasting and heavy equipment operation; presence of a winter road on a calving ground that is slow to thaw; all-weather roads; powerlines; etc. Investigations should concentrate on the effects on caribou in Calving, Post-Calving, and Spring Migration Areas.

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APPENDIX I

FLIGHT REPORT FORM - D.I.A.N.D.

☐ Kaminuriak ☐ Beverly Date:_____

Aircraft_____ Pilot_____IFR Yes/No

Redar Altimeter_____ GNS_____Weather:Cloud_____

Wind: Speed/Direction _____Temperature_____Visibility_____

% Snow Cover_____Lakes/Rivers Frozen_____

Comments_____

_____

_____

Survey Type:_____

1. Reconaissance_____ 2. Transects (line, strip width)_____
   Other_____

Altitude(s)_____Air Speed_____

Duties of observers(Names)

1. Navigate_____
2. Write Obs._____
3. Tape Obs._____4. Observe Only_____
5. Photograph_____

Distance Flown_____Hours Flown_____

Location(s): Maps Used NTS 1:250,000_____

_____

1:1,000,000 submitted_____

Vegetation types: trees, treeless tundra, shrubby tundra, dwarf shrub (< 50 cm) tundra_____

Number and Type of data sheets attached:_____

_____

Proposed next aerial survey and/or ground observations_____

_____

_____

FLIGHT REPORT FORM

Comments on survey and caribou activity_____

_____

_____

_____

_____

_____

_____

_____

Water Crossings noted_____

_____

Human Activities Noted_____

_____

Aerial/ on ground_____

_____

Submitted By_____ _____

Signature (s) Date

APPENDIX II

May 24, 1978

Memo To: DINA Baker Lakers and others (Laporte, Parks, Umpherson)

From : K. L. MacInnes

Re: Caribou Behavioural Responses

The following is a preliminary guide to organizing observations of disturbance (natural or human related) to caribou which I have prepared using reports and papers as a guide (Miller and Gunn, Calef etal). I expect FWS to compile their own official form. In the meantime, you might try recording any caribou-human interactions which you encounter. NOTE: WANT UNBIASED RESULTS OF ENCOUNTERS. RECORD CHANGE OR NO CHANGE. BE CRITICAL. COMMENT ON LIMITATIONS.

Date_____

Observers_____

_____

BACKGROUND:

1. Human or other activity (e.g. wolves)

Location:NTS_____ Weather_____ Time_____

Duration:_____ Terrain/Vegetation_____

Describe activity:(people, aircraft, equipment)_____

_____

_____

Location of Observer(s):_____

2. Caribou

Time: Precalving_____ Calving_____ Post Calving_____

Group Size: Count_____,Estimate_____

Age/Sex Composition: Unknown_____ with Calves_____ without calves_____

Other_____

Distance from disturbance - Vertical_____ Horizontal_____

Recorded For: Majority of group_____ Strongest response by some_____

Response:Approach_____ Closest Contact_____ Departure_____

Undisturbed_____ During disturbance_____ post disturbance_____

Animal Activity
a) lying/bedded
b) foraging
c) travelling
d) standing

Behavioural Response
1. none visible-continued resting, feeding or moving in same direction
2. alert to disturbance but no appreciable change
3. lying animal stands
4. slow movement away
5. running(trotting) How far? How long?
6. panic-out of control, stumbling, colliding, running into obstacles
7. Other - calves separated from mothers

Comments:_____

_____

_____

_____