DISTRIBUTION AND MOVEMENTS OF BARREN-GROUND CARIBOU FROM THE KAMINURIAK POPULATION DURING CALVING AND POSTCALVING PERIODS 1970

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Abstract: The distribution and movements of the Kaminuriak population of barren-ground caribou (Rangifer tarandus groenlandicus) were investigated between June 1 and July 29, 1970. The Kaminuriak caribou calved in June on the open tundra in central Keewatin, Northwest Territories. In 1970 most of them calved between latitudes 63°00' and 63°40' and longitudes 93°20' and 95°00'. The peak of calving took place between June 4 and 10. Large postcalving groups of several thousand caribou had formed by June 12. One area north of Parker Lake (63°38'N, 95°12°W) and one area north of MacQuoid Lake (63°33'N, 94°36'W) were occupied by most of the maternal cows and their newborn calves from June 15 until June 28. The postcalving migratory period began on June 28: with caribou moving south-southwest, south, and south-southeast for about 375 Km (235 miles) to the McConnell River drainage about July 28. The migrating caribou occurred in three distinct aggregations. Any disruption of caribou movements could be detrimental to cow and calf survival because of unknown and new dangers along new routes. Caribou return annually to the same areas for calving. Migratory barren-ground caribou may be endangered by changes in the landscape which accompany economic development of natural resources on their ranges. The greatest current threat to their

social behaviour and annual movement patterns is the construction of pipelines for transporting petroleum. Little is known of the external stimuli and social forces which influence caribou migrations and affinities for specific areas such as calving grounds, or of how these forces might be altered by environmental disturbances. Further behavioural studies are necessary to resolve such problems.

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INTRODUCTION

The Kaminuriak population of barren-ground caribou ranges over northern Manitoba, northeastern Saskatchewan, and the southeastern District of Keewatin, Northwest Territories - an area of approximately 282,000 sq km (109,000 sq. miles). The parturient females of the Kaminuriak population have shown a strong affinity for their calving ground and postcalving areas in the eastcentral district of Keewatin, Northwest Territories (Loughrey 1956, Malfair 1963, Miller and Broughton 1972, and Parker 1972).

Regardless of where Kaminuriak caribou wintered between 1966-1968 they returned to their same calving ground (Parker, 1972). In 1970, 24 Kaminuriak caribou equipped with radio transmitters on their winter range all returned to the traditional calving area (Miller et al., In press): further suggesting a strong affinity by parturient females for their calving ground.

The results of the Canadian Wildlife Service's 3-year (1966-68) intensive study of the Kaminuriak caribou suggested that the principal limiting factor at that time was the low rate of annual increment, due to a high loss in the calf crops during the first month of life. The fidelity of female caribou within this population to calving and postcalving areas could make them vulnerable to adverse effects of man-made disturbance on the survival of calves.

The proposed construction of gas and oil pipelines on or near the calving and summering ranges of the Kaminuriak caribou poses an obvious problem for consideration. Therefore, information on the distribution and movements of the reproductive segment of the Kaminuriak population during the calving and postcalving periods will be needed as a basis for sound advice on the matter.

STUDY AREA

Geographically, the summer area (Fig. 1) is divided into the coastal plain extending inland about 140 km (85 miles) from the west side of Hudson Bay and the interior plateau west of the lowlands grading into the hill and mountain region (Robinson, 1968). The lowlands are characterized by numerous elongated drumlins and eskers. Drainage is poor, and many streams meander from one depression to the next. Often long narrow lakes have formed where rock ridges or moraines block their outlets (Robinson, 1968). The interior plateau is generally under 150 m (500 ft.) elevation, but rock outcrops are more common than on the lowlands. It is also characterized by drumlins, eskers, and numerous lakes (Robinson 1968).

The geology of the summer area has been described by Wright (1955). On the calving ground Pleistocene features indicate that the glacial ice movement was in a

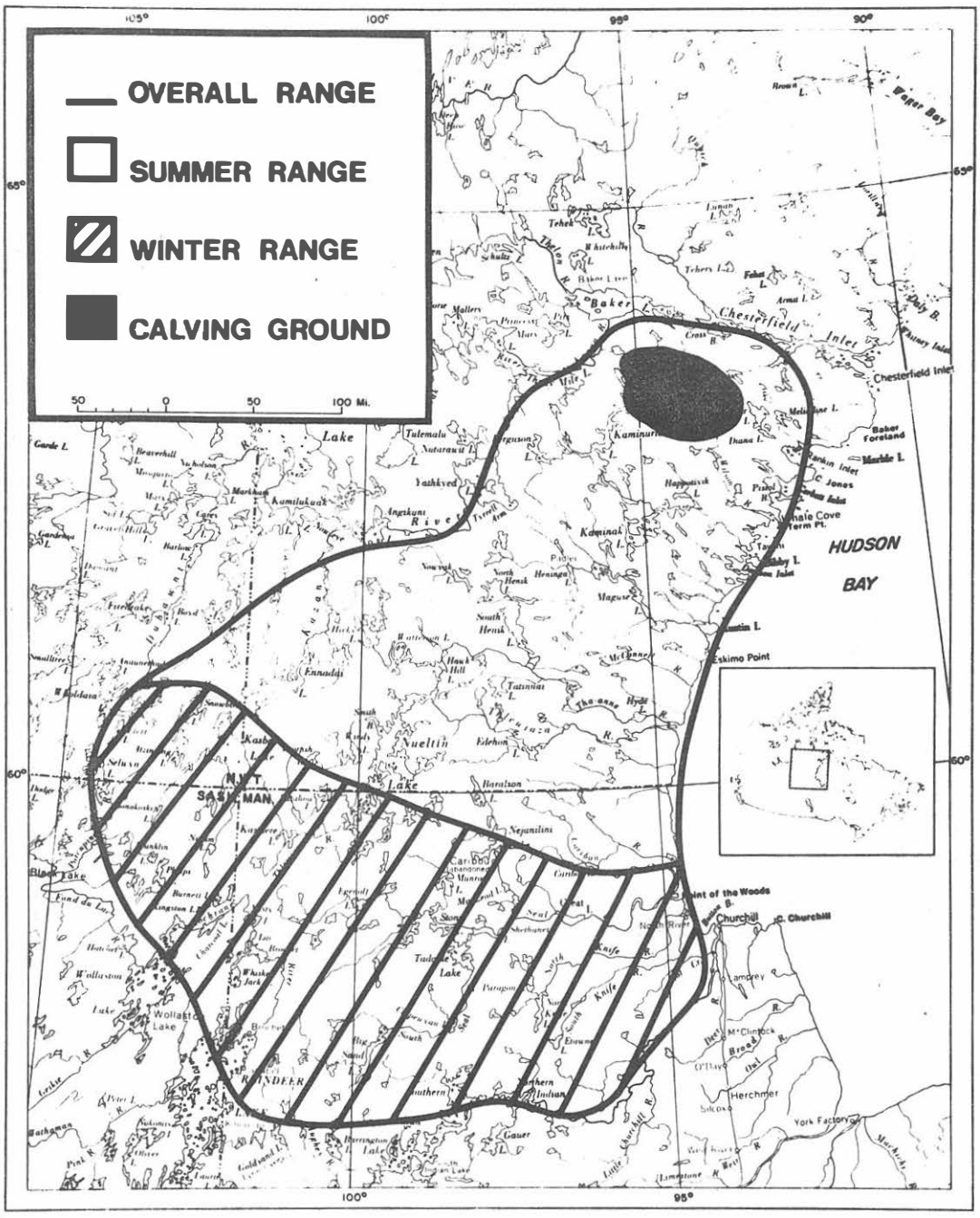

Fig. 1. - Summer and winter ranges (1966-1968) and calving ground (1970) of barren-ground caribou of the Kaminuriak population.

southeasterly direction (Wright, 1955). This resulted in the formation of most drumlins, drumlinoid ridges, and furrows with their primary axes oriented in a northwest-southeast direction. Most of the calving ground is underlain by granite, granodiorite and allied rocks with many bands of partly assimilated schist, gneiss, and amphibolite. The camp site at "Calf" Lake was set on a rather unusual mantle of diorite and gabbro with some syenitic intrusive rocks and minor amounts of serpentinite. Relatively dry, higher sites north of "Calf", McQuoid, and Parker lakes were dominated by outcroppings, of intermediate to basic volcanic rocks which included much schistose greywacke (Lower Thelon River belt) and undifferentiated basic intrusives.

Floristically, the summer range is divided into the Tundra and Forest-Tundra by Rowe (1959). The Forest-Tundra section is referred to generally as the taiga (Kelsall, 1968). The term tundra is synonymous with barren-ground. The forested portion of the study area is sparsely vegetated by dwarfed members of the open boreal forest; black spruce (Picea mariana), tamarack (Larix laricina), birches (Betula spp.) willows (Salix spp.) occur in varying frequencies, sometimes dominating local sites. On the tundra, vegetation is scanty on the drier

sites which support Empetrum nigrum, Vaccinium vitis-idaea, V. uliginosum, Ledum sp., mosses and lichens. The vegetation is relatively lush on the poorly drained sedge (Carex) meadows and tussock muskegs which are dominated by species of Carex, Eriophorum and mosses intermixed with Betula glandulosa, Salix spp., Ledum decumbens and L. groenlandicum. Much of the land mass, ranging up to 25 percent and even 50 percent, is covered by water.

Climate on the study area is characterized by cool wet springs and relatively dry moderate summers. The area has a mean annual maximum temperature of 27°C (80°F) (Kendrew and Currie, 1955). Mean annual precipitation for the summer range is 15 to 30 cm (6 to 12 inches) (Kelsall, 1968) and maximum precipitation occurs in July and August (Kendrew and Currie, 1955).

METHODS

Barren-ground caribou were live-captured in tangle nets in northern Manitoba in April 1970 (Miller et al., 1971). Groups of animals were located on frozen lakes by aerial reconnaissance and nets were set on their back trails in the adjacent forest. The caribou were then herded into the nets by taxiing aircraft. Eighty caribou were captured in 7 days: 27 were equipped with radio

transmitters.

A total of 437 hrs. was flown during June and July 1970: 248 hrs. in the Hiller 12E helicopter, 174 hrs. in a Cessna 180, and 15 hrs. in an Islander. From the total flying time, 126 hrs. (29 percent) were expended in establishing gas caches, relocating camps, moving personnel, and obtaining supplies. Seventy-one percent (311 hrs.) of the total flying was devoted to search and survey work. Most of the flying was done about 150 to 300 m (500 to 1,000 ft.). Extensive searches for postcalving aggregations of caribou were made throughout June and July. The searches were non-random procedures. We returned as often as possible to the areas where caribou had been located and followed their fresh trails to their new locations when possible.

A delineation of the calving area was performed on June 9 (Fig. 2). The transect lines used on June 9 were the eastwest military grid lines, spaced 10.06 km (6.25 miles) apart. The survey was flown at an altitude of about 200 m (600 ft.). A systematic survey of caribou numbers on the calving ground was carried out on June 10 and 11. The area occupied by the parturient females was divided into 137 squares, each 23.5-sq-km (9-sq-mi) in area (4.8 x 4.8 km or 3 mi x 3 mi). For the survey, 34

of the squares were chosen at random by drawing numbers from a hat for a coverage of 24.8 percent of the calving ground (Miller and Broughton 1972: Appendix II). All the female caribou $\geq$ 2 years were counted within the boundaries surveyed. Parker's (1970) method of counting the caribou within a 0.4-km (1/4-mi) wide strip on each side of the aircraft was used. The windows and wing struts were marked so that each observer could project an angle of 72^{o} to the ground from an altitude of 150 m (500 ft). Six flight passes were required to survey each square. On June 18 through 21 an extensive survey was flown in an Islander aircraft to determine if there were any isolated concentrations of female caribou that we had not previously detected on the calving ground. The flights were made at approximately 150 m (500 ft) elevation.

RESULTS AND DISCUSSION

Pre-calving

The caribou that were in the Egenolf Lake area during April 1970 apparently resumed a northeast migration shortly after April 15, when a definite warming trend occurred on their transitional wintering range. The killing of radio-collared animals Nos. 4 and 13 by Eskimos at the south end of Maguse Lake during the second week of May suggests that the caribou from Egenolf Lake travelled to Maguse

Lake in less than three week's time. The Egenolf movement then apparently turned northward and moved to the area around Calf Lake, dispersed, and remained there throughout the calving period.

Personnel from Arctic Lodge (61°39'N, 97°23'W) which is located on the east side of the caribou water crossing between North and South Henik lakes reported several hundred caribou moving through the area in mid-May. Isolated reports by pilots indicated that the Nueltin Lake movement, or at least part of it, turned northeast on the east side of Nueltin Lake and passed between North and South Henik lakes. Some of those caribou possibly moved around the north end of North Henik Lake. They then migrated along the east side of Kaminuriak Lake, past Banks Lake to the area around MacQuoid Lake. Information from the calving period suggests that these animals remained mostly to the west of Calf Lake, calving in the area east and south of MacQuoid Lake and along the north end of Banks Lake.

By late May, caribou from the two movements were distributed east-west from Gibson Lake to MacQuoid Lake and north-south between Brown Lake and Banks Lake. Many groups of subadults and juvenile caribou were observed south of the area where parturient cows concentrated between base camp (63°28'N, 93°35'W) and MacQuoid Lake.

Reports from Frank Bailey, N.W.T. Regional Game Management Officer, indicate that the caribou wintering on the coastal area between Rankin Inlet and Eskimo Point moved northward in late April approximately two to three weeks before the caribou wintering on the taiga had reached Maguse Lake. Reports from Ellis Land, N.W.T. Game Management Officer, Baker Lake, stated that the coastal caribou had moved north across the calving ground, then west across MacQuoid Lake to Parker Lake, and from Parker Lake southeast to Banks Lake, stopping at the east side of Banks Lake. The movements of those caribou were similar to those recorded in 1968 by Parker (1972). However, it appears that they did not make their last northwest swing as they did in 1968, but stayed in the area of Banks and Parker lakes.

Calving Period

When we arrived on the calving ground on June 1, several cows with newborn calves were observed. By June 4 approximately 10 per cent (n=1,805) had calves and on June 8, 55 per cent (n=2,117) were with newborn calves. Eighty per cent of the cows (n=1,148) segregated on June 12 and 13 were with newborn young.

Caribou were forming postcalving groups by June 11 (Fig. 2). On June 12, the animals with calves on the west

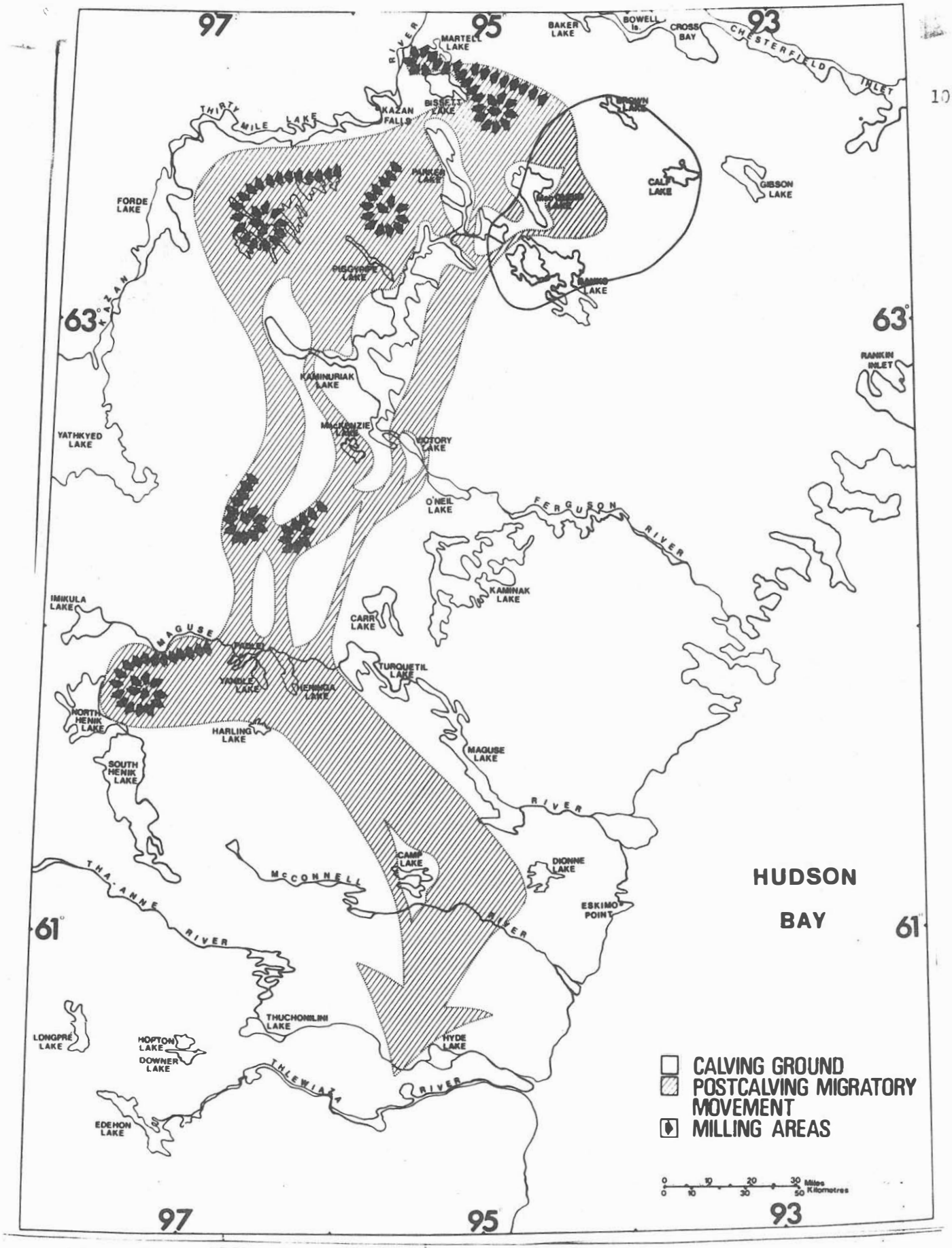

Fig. 2. - Distribution and movements of barren-ground caribou of the Kaminuriak polulation, June and July 1970.

side of Calf Lake were "staging" in the area at the northeast end of MacQuoid Lake. About 12,000 caribou were concentrated on several square miles about 24 km (15 miles) east of MacQuoid Lake at 63°30'N, 94°10'W. These animals were beginning a slow northwest movement to north of MacQuoid Lake. Several hundred caribou from the east side of Calf Lake were moving across the north end of Calf Lake on June 13 while the animals that had staged on June 12 near MacQuoid Lake had moved northwest and west in the direction of Parker and Bissett Lakes. By June 14 the caribou from the east side of Calf Lake were concentrated about 16 km (10 miles) north of the caribou in the western movement. The animals from the eastern movement then moved in the same northwest direction as the caribou in the western movement. The western movement entered the area north of Parker Lake, while the animals from the eastern movement concentrated in the area north of MacQuoid Lake. These two general areas were occupied by the caribou until approximately June 27, 1970. There was much local movement and fragmentation of large concentrations and regrouping for a 10 - to 12-day period.

The coastal caribou moved out of the area of Banks Lake on June 15 to the east side of MacQuoid Lake. From there they moved northeast to the narrows on the west side of Cross Bay. Eskimos at Baker Lake reported that many

caribou crossed the narrows to Bowell Islands and continued on the north side of Chesterfield Inlet. The crossing of Chesterfield Inlet was never substantiated. Information from Transair pilots suggests that most if not all of these animals continued eastward below Cross Bay to an area just west of Rankin Inlet. A concentration of approximately 10,000 caribou (estimate is questionable) was reported west of Rankin Inlet during the second week of July, 1970. Reports from the parish priest at Rankin Inlet stated that some of the animals in the movement were collared. Unfortunately, our resources did not allow us to investigate the coastal movement. The movement along the coast was probably composed of animals that had wintered on the coast the previous winter. There is a possibility, however, that the movement had been supplemented by animals that traditionally moved to the coastal areas during mid-summer. Tagging returns from Little Duck Lake, Manitoba, (Miller and Robertson, 1967) support that possibility.

As we flew westward over the high country between Parker and MacQuoid lakes on June 17 we found many concentrations of cows, young animals, and newborn calves, ranging in size from several to about 150. We then entered a void at the northwest end of MacQuoid Lake for about 5 km (3 miles) of lowland. When we reached the western edge of the high ground north of MacQuoid Lake we encountered the main

concentration of maternal cows and newborn calves. The distribution of those animals was most interesting. They were restricted to the sites above 130 km (400 feet) elevation and had sought out high ground on which they could rest and forage in a relatively dry situation. Caribou were distributed over nearly all of the 32 km (20 miles) of crescent-shaped area of high ground which varies in width from about 8 km to 1.6 km (5 miles to 1 mile) along the crescent. Caribou were even on the "fingers" of high ground that ran out from the main curvature of the crescent and on a few high isolated peaks above the 130 m (400 ft) contour of surrounding country. These caribou had apparently stopped moving during the adverse weather of June 16 when 2.18 cm (0.85 inches) of rainfall occurred and evening temperatures dropped below freezing. We estimated that on the crescent of high ground north of MacQuoid Lake there were between 12,000 and 15,000 cows and newborn calves distributed in a non-random grouping over much of the high ground. An earlier flight on June 15 across the middle of MacQuoid Lake and to the south of MacQuoid Lake yielded many groups of yearlings, juveniles, subadults, and the occasional maternal cow with newborn calf in groupings from several animals to approximately 75. The peripheral groupings that were found around the loose

concentration of maternal cows and newborn calves on that date, closely resembled the peripheral groupings found around the tight postcalving groups from the end of June well into July.

It appears that the large postcalving groups function as loosely knit entities and that the cohesive bonds of the smaller, stronger, social units within the postcalving groups have already formed or are in the process of being established. The yearlings and other non-breeding animals are all subordinate to the core of maternal cows. Newborn calves share the social position of their maternal cows during the postcalving period.

On June 20 between the weather station at MacQuoid Lake and the weather station at Parker Lake we encountered many peripheral groups of yearlings, juveniles, and assumed non-breeding cows ranging from several to 27. Some groups were composed mainly of yearling animals, and others were mixed with yearlings, juveniles, subadults, and a few adult cows with newborn calves. Some of the peripheral groups extended to the northwest of Parker Lake. The main concentration of maternal cows and newborn calves were still on the high ground north of Parker and MacQuoid lakes. An impressive behavioural trait of the yearling groups was that they often ran with the helicopter in the direction

that the helicopter travelled rather than away from the helicopter as it passed by. The groups were often seen still "chasing" the helicopter after it passed 0.8 km to 1.6 km (1/2 to 1 mile) beyond them.

The caribou had moved off to the high ground north of MacQuoid Lake to the sedge meadows to the north on June 21. The caribou on the high ground to the north of Parker Lake had also moved off to the sedge meadows between MacQuoid and Parker lakes. It is most likely that the movement was in response to the rapid new growth that the sedges had made in the past 36 hours and the drying out of the lichens on the higher sites. On June 22, the large postcalving groups were still foraging on the sedge meadows north of MacQuoid Lake and between MacQuoid and Parker lakes. The animals on the northeast end of Parker Lake had moved onto the sedge meadows and were travelling in a general northwest direction between Parker and Bissett lakes. The wettest areas in the sedge meadows had turned green and many animals were observed foraging while standing in the water. Juveniles, subadults, and cows that had either not produced or had lost their calves were in small peripheral groups scattered over the sedge meadows and often several miles from the large postcalving groups. The caribou spent the next two days meandering over the sedge meadows. On June

25, large postcalving groups of caribou were moving into the corridor between Bissett and Parker lakes. There was one large movement of about 1,200 caribou on the southeast end of Bissett Lake, but no animals had reached the east bank of the Kazan River. The more easterly movements of several thousand caribou had also resumed a northwest course. The animals drifted and shifted directions throughout June 26 and 27.

Many of the cows that lost their calves probably left the large postcalving groups and joined the peripheral groups, thereby masking the effect of the calf losses during the first two weeks after the peak of calving. That would explain the apparent existence of 70 to 80 per cent newborn calves in the postcalving groups. Behaviourally, the departure of the calfless cows from the postcalving groups may represent a loss of their social position in their group. They may become subordinate to all cows that were still with calves. The maternal cows may become so antagonistic that many of the calfless cows would form their own sub-groups or join the non-breeding segment of the postcalving movements.

Some of the cows that were giving birth or about to give birth on July 4 were leaving the large postcalving groups and remaining somewhat isolated.

Sometimes several parturient cows were seen close together. Three cows, two having just given birth and one about to give birth, were within 30 m to 65 m (100 to 200 feet) of each other.

Postcalving Migratory Period.

The postcalving migratory period began June 28 with the general southwest movement of caribou around Parker Lake (Fig. 2). The caribou divided into three groups. One group moved almost due west to the south shore of the Kazan River almost 10 km (6 miles) upstream from the Kazan Falls. Those caribou passed parallel to the river on the south side, until they reached the southwest end of Thirty-mile Lake. From there they turned in a more southerly direction to the area around the east side of Forde Lake. They then turned back into the large area which is surrounded by Thirty-mile Lake on the north, Forde Lake on the west, and a system of unnamed lakes that run from east of the south end of Forde Lake northeast to the east end of Thirty-mile Lake. The area was centered at approximately 53°25'N, 96°45'W. The second movement from the Parker Lake area went west of the north end of Parker Lake and took a sharp southerly course to the east of the first movement. The second group then concentrated in the area west of Parker Lake and at the north

end of Kaminuriak Lake. The area was bordered on the south by Piggypipe Lake and on the west by the system of unnamed lakes as described for the eastern boundary of the first (western) movement. The third group from the Parker Lake area moved down the east side of Parker Lake and crossed the narrows at the south end of Parker Lake.

There was a fourth more easterly movement from north of MacQuoid Lake which moved westward to the area just east of Bissett Lake. Some of those animals then moved to the west side of Bissett Lake by travelling between Martell and Bissett lakes. None of the caribou was observed to have reached the east shore of the Kazan River north of the Kazan Falls. The most westerly segment of the movement at the south end of Martell Lake came within 10 km (6 miles) of the Kazan River. Those groups returned on a more northerly course to an area above the west end of MacQuoid Lake. They then travelled southeast approximately halfway down the east side of MacQuoid Lake. A segment of the movement, however, turned at the north end of MacQuoid Lake and came around the west side of MacQuoid Lake and continued down the west side to the east side of Parker Lake and then down the east side of Kaminuriak Lake. Meanwhile, the movement to the east side of MacQuoid Lake continued on a more easterly route inland along the east side of Banks Lake, then to the east shore of Kaminuriak

Lake. The caribou on the east side of Kaminuriak Lake then continued along the east shore until they reached the Ferguson River at the south end of Kaminuriak Lake. At that point the movement again divided into two segments. Most of the caribou crossed the Ferguson River at the rapids at Victory and MacKenzie lakes. They then traversed the isthmus between MacKenzie and Victory lakes to the bottom of MacKenzie Lake, and then west to the bottom of the unnamed lake approximately 13 km (8 miles) west-southwest of MacKenzie Lake at 62°32'N, 95°57'W. The other segment of the movement had continued on the east side of Victory Lake until it reached the narrows on the Ferguson River between Victory and O'Neill lakes. At that point it crossed the Ferguson River and set a course due west and merged with the animals which had left them at the south end of Kaminuriak Lake. All of these animals were in the same general area westsouthwest of MacKenzie lake on July 12 when the period of rainy weather and high winds began.

On July 16 when we were able to resume aerial searching we found that the caribou from the eastern movement had left their area, again dividing into two segments. The minor segment moved due south along the 95°57'W meridian, while most of the caribou moved southeast, merging with the large western movement at 62°17'N, 96°23'W approximately 15 miles northeast of Padlei.

The animals from the western movement that had been under surveillance on July 12 were located on July 16 at approximately 63°33'N, 95°55'W, having dispersed during the period of bad weather. The movement had fragmented into many small social sub-units that foraged and moved about the countryside. There was then a general southward drift on a rather wide front. It appeared that the large postcalving movement must have split up, but most of the animals were moving southwest around the bottom of a lake where we had established a gas cache at 62°17'N, 96°17'W. They then swung northwest for about 32 km (20 miles) and met the large postcalving movement that was coming down through the central portion of the area. The central movement had been travelling south to southwest for the previous five days, and during the period of bad weather they had milled about in the area 19 km (12 miles) northwest of the gas-cache.

Meanwhile, caribou from the more easterly movement had merged with animals from the central movement, and had moved to within 64 km (40 miles) of the northeast end of North Henik Lake. There had also been considerable fragmentation of the central movement in the area of the gas-cache during the period of bad weather. Many small groups of 50 to 200 animals were observed streaming back

into the central area seemingly for a restaging before the movement continued on the trails of the caribou that had already moved to the southwest.

Unfortunately, we are unable to evaluate the degree of fragmentation which occurred during the July 12 - 15 period of bad weather. It is likely, however, that this fragmentation represents the breakdown of the larger postcalving movements, that in themselves are relatively rather weak social units, into smaller sub-units which are the more persistent or binding social groups. The core of these sub-units is most likely composed of the remnants of previous winter bands. Even though marked caribou from the Egenolf and Nueltin movements were observed in each other's company, fragmentation of the large aggregations results in those animals always separating and travelling with different smaller groups. This suggests that those caribou share a common tie to the population or movement, but maintain a stronger bond of socialization with the basic social unit - the band. The aggregation of these bands during seasonal movements could be considered superbands. There is probably an interchange of animals between bands within superbands, the basic core of the band being maintained by a maternal line.

Table 1. Postcalving groups of 200 or more caribou observed between July 18 and 25, 1970, District of Keewatin, N.W.T.

Date	Location (lat.-long.)[1]	Size of Group (c.a.)
18 July	6154-9730	1,000
	6153-9737	2,000
	6152-9730	2,500
	6150-9725	250
	6148-9718	300
	6147-9720	1,500
20 July	6157-9643	1,000
	6156-9642	500
	6144-9736	750
	6143-9728	1,000
	6142-9726	1,200
	6141-9726	800
21 July	6157-9644	800
	6155-9639[2]	400[2]
	6145-9645[2]	2,000[2]
	6145-9645[2]	2,000[2]
	6144-9633	2,000
	6139-9550	3,000
22 July	6145-9628	250
	6145-9631	200
	6144-9630	200
	6134-9540	500
	6133-9530	1,500
	6131-9521	250

Table 1 continued

Date	Location (lat.-long.)[1]	Size of Group (c.a.)
23 July	6148-9654	750
	6147-9657	2,000
	6146-9646	2,000
	6145-9634	750
	6144-9618	1,000
	6144-9550	200
	6142-9553	2,000
	6142-9544	1,000
	6135-9538	500
24 July	6150-9638	200
	6147-9653	1,200
	6143-9630	200
	6140-9625	350
	6140-9622	500
	6133-9520	200
	6128-9532	350
	6126-9532	4,000
	6126-9514	500
	6125-9518	1,000
	6125-9514	500
25 July	6135-9617	8,000[3]

[1]Latitude north - longitude west, e.g. 6154-9730 equals 61°54'N, 97°30'W.

[2]Two separate groups of 2,000 each.

[3]Total composed of several postcalving groups.

Between July 18 and 25 the caribou were scattered in many small groups and several large groups over a vast tract of land south of 62°00'N, and east of 97°40'W. The caribou observed in groups of 200 or more during that period are listed in Table 1.

By July 19 two groups of about 800 and 1,200 caribou had arrived on the high ground north of the water crossing between North and South Henik lakes (61°42'N, 97°26'W). They represented the most westerly movement of caribou south of 62°00'N. They remained for three days on the high ground, seemingly, hesitant to cross or undecided about crossing. Human activities at Arctic Lodge, especially noises from the generator and heavy equipment on the airstrip could have deterred them from crossing. I believe that no caribou crossed between North and South Henik lakes or across the south end of South Henik Lake during July 1970. On July 21 both groups of caribou moved from the southeast shore of North Henik Lake. They travelled due east, where they joined the main migration that had passed between Yandle and Harling lakes. The general movement was then southeast to the east side of Maguse Lake where most caribou arrived by July 25.

On July 21 a group of 400 caribou was observed as it passed east to west between the old Hudson Bay post buildings on the north shore of Padlei Lake (61°55'N, 96°39'W).

Another 800 caribou were about 10 km (6 miles) west of the Padlei group also moving to the west along the north bank of the Maguse River. I believe that the caribou in the two groups were from the most easterly movement that had started south on the 95°57'W meridian, coming southeast to the west of Carr and Turquetil lakes, then turning west along the north side of the Maguse River. Some caribou from the movement crossed the Maguse River between Turquetil and Heninga lakes and drifted south on a 32 km-wide (20-mile) front. The rest of the movement continued along the Maguse River to about 40 km (25 miles) west of the old Padlei settlement. They then crossed the Maguse River on the main migrational path of the central and western movements. These caribou were among the last to move south of 61°30'N during the last week of July.

On July 26 the caribou were travelling in a southeast direction along the west side of Maguse Lake. Some caribou had reached the south end of Maguse Lake and had travelled eastward to Dionne Lake. Other caribou had continued southeast to the west of Dionne and had turned southwest at the bottom of Dionne toward the McConnell River. It appeared that many of the caribou to the north of Camp Lake passed along the east side of Camp Lake into the area which was in line with the animals travelling southwest

to the north shore of the McConnell River. Several thousand animals were sighted moving southeast at 61°08'N, 95°21'W. Fresh trails indicated that caribou had crossed McConnell River at 61°06'N, 95°17'W, moving southeast and southwest, with other caribou moving east along the river.

By July 28 it appeared that the main impetus of the mid-summer migration was either waning or entering a temporary lull. Signs indicated that there had been a heavy migration of caribou through the area 61°00'N, 94° 56'W moving south. In the area of 61°02'N, 95°08'W there were several hundred caribou just foraging without any apparent migratory movement. The trails continued south-southeast, and there were about 1,000 caribou in the area of 61°02'N, 95°12'W. They were scattered in small groups of from a few cows and calves to 30 cows, juveniles, and calves. West of 61°02'N, 95°22'W the caribou were moving in a more southwesterly direction. The animals were segregated into groups of cows, juveniles, and calves, and solitary bulls or groups of up to five bulls. Along the McConnell River at 61°05'N, 95°40'W and along the lake just to the west, several hundred caribou were moving west in small groups. Those groups were observed as far west as 61°08'N, 95°57'W, where the bulls seemed to be in much greater number than in the groups observed to the east.

On July 29 about three hundred caribou were observed at 60°45'N, 95°40'W, moving southwesterly. Another four hundred animals were located at 60°40'N, 95°20'W also moving in the southwesterly direction. At 60°52'N, 95°02'W, a movement of approximately one thousand cows, calves, and bulls were sighted travelling southward. The migration appeared to have lost much of its momentum.

Where the caribou travelled after August 1 is quite questionable, but unless they turned in a westerly direction, they would have bypassed the South Henik Lake crossing altogether. They may have continued in a general south-westerly direction and then turned inland along the Tha-anne River which would take them either to the western side of Longpré Lake or in a more southerly direction to the northeastern side of Edehon Lake. If the Tha-anne River turned them to the west they would have traversed the ground north of Thuchonilini Lake then turned south along the eastern side of Hopton Lake and the east side of Downer Lake to the north shore of the Thlewiaza River. If they then turned to the southwest they would have reached the northern shore of Edehon Lake. At that point they could have passed southeast across the Thlewiaza River and then south to the area of Boundary Lake or inland towards Caribou Lake or back to Edehon Lake. There is a possibility, however, that they continued along the coastal area and were not

turned by the Tha-anne or the Thlewiaza rivers. If they crossed both of these rivers, they could have continued either further south along the coast and inland, or inland and along the south shore of the Thlewiaza River to the more western summering areas. Further speculation is not justified. The animals started their southward movement two weeks earlier in 1970 than in 1968, and may or may not have terminated their midsummer southward movement earlier. All of this would have some bearing on where the terminus took place.

Radio-Tracking

Radioed caribou were observed to travel 0-55 km/24 hr (n=24) at a maximal rate of 8.7 km/hr for 3 hr during the premigratory period and 2-64 km/24 hr (n=39 caribou days) at a maximal rate of 16 km/hr for 2 hr during the migratory period. Totals of 25 per cent, and 40 per cent of the radioed caribou seen twice within 24 hr periods during the premigratory and migratory periods respectively were travelling at average rates in excess of 1 km/hr. Overall average rates, however, are misleading because of the individual variations in daily activities. One radioed caribou travelled 103 km (65 miles) in 41 hr (aver. 2.5 km/hr). The 12 radioed caribou, each of which was detected 10 or more times, travelled minimal distances during 7 weeks that ranged from 286 km (178 mi) to 597 km (371 mi) and averaged 447 km (278 mi).

The distribution, movements, and social cohesion of the Kaminuriak caribou as determined by radio tracking on the calving and postcalving areas is given in Miller et al., (1972).

DISCUSSION and CONCLUSIONS

Baskin (1970:33) stated that it is doubtful that the structuring of herds within populations of reindeer is the result of adaptation to the environment. He believes that reindeer migrate along migratory paths that are familiar to the herds and that experience plays an important role in all migratory movements. The role of leadership and the need for only the relatively few reindeer that are leaders to know travel routes have been discussed by Naumov and Baskin (1969) and Baskin (1970:64-75).

Disruption of behavioural patterns could cause serious physiological changes and upset a species' relationship to its environment. Zhigunov (1961) reviewed by Geist (1971), reported many detrimental effects to reindeer caused by harassment and disturbances. The best example of the value of socialization to the genus Rangifer is the following reported by Espmark (1970). In recent years, Swedish reindeer ranchers have moved their reindeer from the summer to the winter ranges by truck, instead of walking them. This has resulted in abnormal numbers of reindeer staying on the

winter range and not migrating in the spring. Espmark (1970) believes that as a result of the unnatural movements, the reindeer found themselves in social chaos. Klein (1970) has summarized the influence of man-made obstructions and disturbances on reindeer in Scandinavia. The effect of barrier fences on the movement of caribou during spring migration in northern Manitoba has been described by Miller et al. (1972).

Caribou return annually to the same areas for calving. Selective forces favour pregnant caribou reaching their calving area before parturition. If parturient cows do not reach their calving areas, or if they are disturbed while on their calving ground they may suffer psychological stress. This stress may result in a greater rate of desertion of young at birth, especially if the animals continue to move about rapidly. It may also weaken the bond between cow and calf, and thus subsequently contribute to greater loss of calves. Furthermore, if the Kaminuriak caribou are forced to calve south of their traditional calving ground, they would be within the heartland of denning wolves on the west side of Hudson Bay. This could lead to a much greater loss of calves to wolves at a time when usually only non-breeding wolves prey on newborn caribou (Miller and Broughton, 1972).

The migrating caribou occurred in three distinct aggregations, each of which included many small cohesive groups. The migrational paths of caribou are traditional, and apparently learned by the animals when they associate with older members of their populations. For their well-being; animals require a high degree of familiarity with their surroundings. Caribou are most vulnerable to unknown and new dangers. Any disruption of caribou movements could be detrimental to cow and calf survival because of increased dangers along new routes.

Statistical analyses of the data from radioed caribou (Miller et al.,1972) demonstrated the following: (1) certain animals were usually seen on the same day, (2) certain animals were usually in the same groups, and (3) animals returned to the same groups after being separated for hours or days. The non-random association of the radioed caribou is believed to be a result of social cohesion. Those conclusions are consistent with the supposition put forth by Miller (1970), that currently, one of the primary functions of postcalving migratory movements among caribou of the Kaminuriak population is social: to create a favourable situation for reforming of previous groups with minimal social strife.

Migratory barren-ground caribou could be endangered by changing land practices which accompany economic development of natural resources on their ranges. Depending on

their location and design, the construction of pipelines for transporting petroleum could upset annual movement patterns and social behaviour. Little is known of the external stimuli and social forces which influence caribou migrations and affinities for specific areas such as calving grounds, or how those forces might be altered by environmental disturbances. Further behavioural studies are necessary to resolve such problems.

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